United States
Department of
Agriculture

Forest
Service

[Month] 2006

Environmental Assessment

Tee Timber Sale

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

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

For Information Contact: Bruce Holmson, Tee Interdisciplinary Team Leader
2445 Highway 141, Trout Lake, WA 98650
(509) 395-3390
bholmson@fs.fed.us

Table of Contents

SUMMARY

The Gifford Pinchot National Forest proposes to commercially thin approximately 1,065 acres of timber stands on the Mount St. Helens National Volcanic Monument (outside of the legislated Monument) in Washington State. The project area is located in T. 4N, R. 5E, within the East Fork Lewis River watershed. The purpose of this action is to restore and improve/accelerate timber growth and yield of even-aged, stagnated stands that were naturally regenerated following the Yacolt fires in 1902 and to manage the lands 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.

The proposed action would thin stands within Riparian Reserves. There is a need to restore late-successional components within Riparian Reserves. The proposed action would accelerate the growth of the young trees by releasing 67 acres of currently overtopped by dense hardwood stands and by increasing overall species diversity by underplanting with a mix of shade-tolerant species. The proposed action will yield approximately 10.5 million board feet (MMBF) of commercial timber for sale.

Following internal and public scoping, the Forest Service identified two potentially significant issues:

- The effect of this action, considered along with past, present and foreseeable future actions within this watershed would result in cumulative watershed effects that could retard or prevent attainment of Aquatic Conservation Strategy standards at 5th field watershed scale (East Fork Lewis River).
- Sediment generation and damage to thin, erosive soils from ground-based logging systems (tractor or skyline yarding) and road-related actions.

In consideration of these issues, the Forest Service evaluated the following alternatives to the proposed action (Alternative A):

- Alternative B: Address potential cumulative effects
- Alternative C: Emphasize helicopter logging

Alternative D 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 will decide which alternative (including the No Action alternative) best meets the overall purpose of and need for action or whether there will be any significant effects to the human environment which would call for the preparation of an Environmental Impact Statement.

CHAPTER 1. PURPOSE OF AND NEED FOR ACTION

Background

The proposed action is a commercial thinning of overstocked stands located in T. 4N, R. 5E, W.M., within the East Fork Lewis River 5th field watershed, Skamania County, Washington. The planning area occupies the Upper East Fork Lewis River 6th field watershed and the northern portion of the Copper Creek 6th field watershed (Figure 1.1).

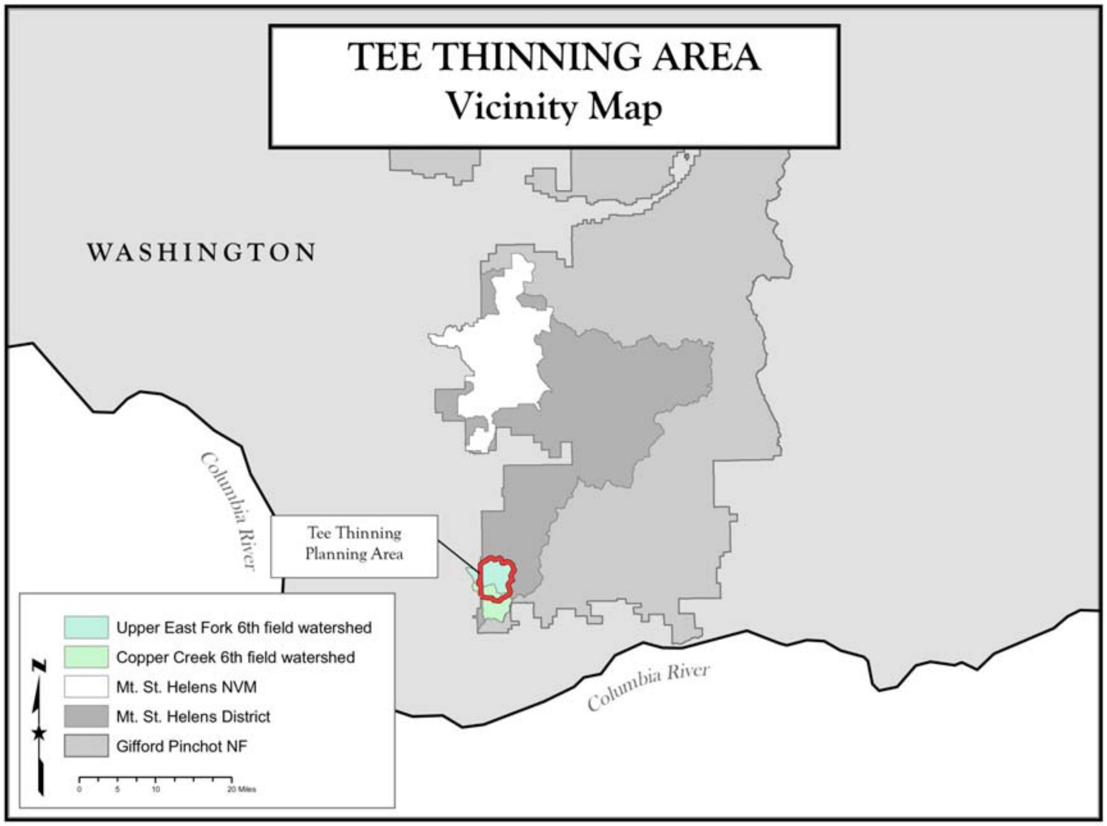

Figure 1.1. Tee Timber Sale planning area vicinity map.

Portions of the East Fork of the Lewis River watershed were subjected to several large-scale stand replacement fires, notably the Yacolt Fire in 1902. An estimated at 238,900 acres of state, private and federal lands were burned during this fire and re-burnt several times, the largest being the Rock Creek Fire in 1927 which burned 48,000 acres and the Dole Fire of 1929 which covered 227,500 acres. Some of these fires burned beyond the boundaries of the original 1902 burn.

These large, hot stand-replacement fires have resulted in the formation of large, fairly homogenous stands over most of the watershed. The watershed presently consists of approximately four percent late-successional habitat (stands in the "large tree" structure stages), compared to an historical range of 35 to 45 percent. The late-successional 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.

The timber stands resulting from these fires were primarily naturally regenerated and contain a high density of trees and hardwoods that are currently experiencing inter-tree competition for light, water, and nutrients. If not managed, these conditions will retard growth and delay the attainment of large diameter trees (a key characteristic of the riparian desired future condition) and restoration of 15 percent late-successional habitat within the watershed. Thinning can more rapidly attain large diameter individual trees than would otherwise be possible in young, dense forest stands.

Timber stands within Riparian Reserves consist exclusively of Douglas-fir and a hardwood component. Besides the dense, stagnated stand condition, some of these Riparian Reserves lack sufficient snags and coarse woody debris to meet current Forest Plan standards and guidelines. Thinning within the Riparian Reserves would accelerate the development of late-successional stand characteristics, provide a source for down-wood within stands and coarse wood for improvement of stream habitat conditions.

Purpose of and Need for Action

The purpose of this action is to restore and accelerate the timber growth and yield of even-aged, stagnated stands within these fire-regenerated stands.

This action is needed to accelerate the development of late-successional characteristics, increase the percentage of late-successional habitat within the East Fork Lewis River 5th field watershed, and for the continued production and utilization of forest resources within the matrix allocation. Stands within the Upper East Fork Lewis River and a portion of the Copper Creek sub-watersheds were identified as being overstocked and would respond favorably to thinning.

Management Direction

This action responds to the goals and objectives outlined in the *Gifford Pinchot National Forest Land and Resource Management Plan* (LRMP, USDA 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, USDA and USDI 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 14,300 acre planning area[1] for Tee Timber Sale consists of the Upper East Fork Lewis River 6th field watershed and a portion of the Copper Creek 6th field watershed that excludes the Silver

[1] The planning area may differ from the resource analysis area. The planning area is defined as the area in which all of the actions will take place and in which most of the direct impacts will occur. A particular resource analysis may analyze direct, indirect and cumulative impacts at a different scale. If different than

Star Scenic Special Area (Administratively Withdrawn). The East Fork Lewis River 5th field watershed has been designated a Tier 1 Key Watershed under the Northwest Forest Plan. Key watersheds are a system of large refugia comprising watersheds that are crucial to at-risk, anadromous fish stocks. The East Fork Lewis River (upstream of McKinley Creek) and several tributaries within the planning area (Slide Creek, Snass Creek, Copper Creek, McKinley Creek, Little Creek, Green Fork, Bolin Creek) support anadromous and resident fish populations. Elevation within the Tee planning area ranges are from 1,160 to 3,480 feet.

The Tee Timber Sale project incorporates recommendations for vegetation management from the *East Fork Lewis River Watershed Analysis* (Watershed Analysis, USDA 2002(a)). The Watershed Analysis includes a recommendation for thinning certain upland stands in subwatersheds with greater than 35 percent of stands with closed sapling/pole or closed small tree stand structure and in subwatersheds where vegetation removal has increased peak flows more than five percent (Watershed Analysis, pages VI-6 – VI-8). Selected stands meeting this description within the Upper East Fork and Copper Creek subwatersheds were designated as the Tee Timber Sale project. The Watershed Analysis also recommends overstory release or thinning in Riparian Reserves to accelerate growth of conifers and interplanting to enhance species diversity (Watershed Analysis, page VI-10).

Road-related recommendations from the Watershed Analysis include decommissioning, weatherization, and removal of barriers to fish passage. Specific roads are identified in the *Upper East Fork Lewis River Water Quality Restoration Plan* (WQRP, USDA 2002(c)) and the *Gifford Pinchot National Forest Roads Analysis* (USDA 2002(b)).

All of the proposed Tee Timber Sale units are located within lands designated as matrix in of the Northwest Forest Plan and within the General Forest, Deer and Elk Winter Range, or Scenic River management areas 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.

Thinning, conifer release, and planting of shade tolerant species (western redcedar, western hemlock, and grand fir) 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 these stands is to encourage the growth of larger conifers, increase species diversity, and augment course wood in streams.

the planning area, the analysis scale is described by resource topic in Chapter 2, the Environmental Consequences section of this document.

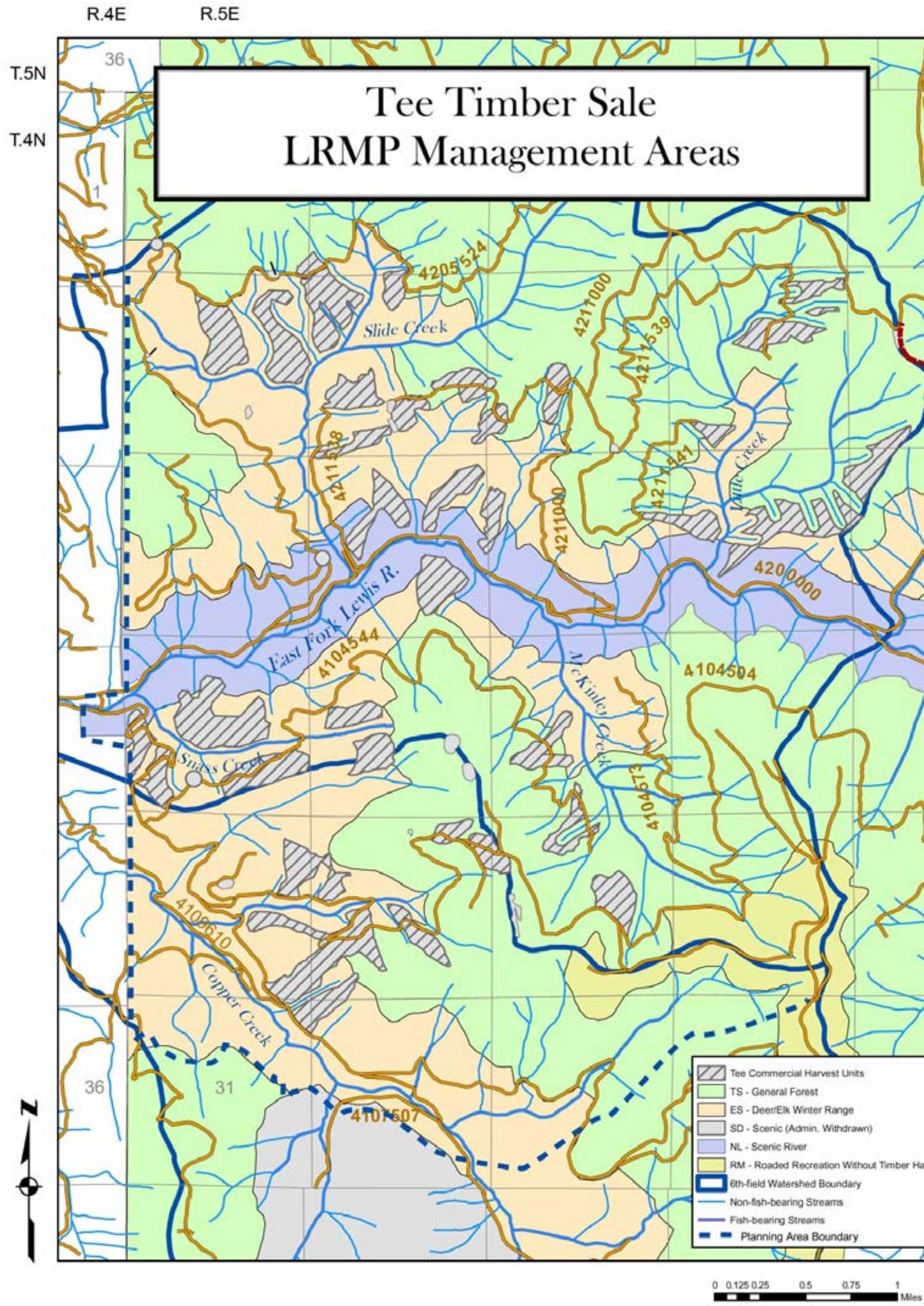

Figure 1.2. Gifford Pinchot National Forest LRMP management areas within the Tee Timber Sale planning area.

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 5th field watersheds comprised of 15 percent or less of late-successional forest to retain late-successional patches.

Approximately 49 percent (7,100 acres) within the planning area are 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 35 percent (5,100 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 5th 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).

A Scenic River (NL prescription) corridor along the East Fork of the Lewis River runs through the middle of the planning area and occupies approximately ten percent (1,400 acres) of the area. Within the Scenic River management area, timber harvest may be visible. Timber harvest will be scheduled consistent with the assigned VQO in the NL prescription. The VQO for this prescription is Retention and the ROS is Roaded Natural (LRMP, Amendment 11, page 6-38).

A small portion (approximately 800 acres) of a larger Roaded Recreation Without Timber Harvest management area (RM prescription) lies within the southeast edge of the planning area and within 0.10 mile of the nearest harvest unit. This is allocated as an Administratively Withdrawn Area in the Northwest Forest Plan. Scheduled timber harvest is not permitted within this management area, however management activities are evident, though not conspicuous. The VQO for the RM prescription is Partial Retention and the ROS is Roaded Natural (LRMP, Amendment 11, page 4-14).

Proposed Action

To meet the purpose and need, the Forest Service proposes to commercially thin approximately 998 upland acres and approximately 67 riparian acres within the Tee Timber Sale planning area. In addition, an approximately 12 year old planted stand of approximately 15 acres will be pre-commercially thinned. The proposed action will yield approximately 10.5 million board feet

(MMBF) of commercial timber for sale from both upland and riparian harvest. Harvested trees would be logged using helicopter, skyline, or tractor yarding systems. The following connected actions would be needed: construct approximately 1.9 miles of temporary roads, reconstruct approximately 9 miles of existing roads, and construct 14 helicopter landings occupying a total of approximately 14 acres. Other actions that are proposed following harvest include treating approximately 58 acres of slash using grapple-pile, treating approximately 34 acres of slash treatment using hand-pile methods, and underplanting approximately 67 acres of thinned riparian area. Finally, the temporary roads would be closed, ripped, and re-seeded.

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

Decision Framework

The responsible official (Mount St. Helens Monument Manager) will review the proposed action and the other alternatives 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 the interdisciplinary team and from comments received from the public, other agencies, and tribes in response to this analysis.

The final decision will be to either:

- select one of the alternatives 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 April, 2005. A description of the proposal was sent to a mailing list of 30 individuals, organizations, agencies, and tribes for comment during scoping which was initiated on November 21, 2005.

During the initial scoping period, the Forest Service received two 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 will be addressed in this analysis.

Issues

The Forest Service separated the issues into two groups: significant issues and other issues. Significant issues were defined as those impacts that would directly or indirectly be caused by implementing the proposed action, could not completely be mitigated through the application of standards and guidelines from the LRMP or specific mitigation measures, and would drive the development of another alternative. Other issues were identified as those that are directly or indirectly caused by implementing the proposed action and could be mitigated by specific actions or design criteria.

Some issues were suggested but were dropped from further study because they were: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence.

Significant Issues

Two significant issues resulted from the review of public comments and interdisciplinary team consideration of the proposed action.

Cumulative Watershed Effects

This issue can best be summarized as the potential for watershed effects from this action as well as those from past, ongoing and foreseeable future actions and the existing watershed condition in the East Fork Lewis River 5^{th} field watershed to cumulatively prevent or retard attainment of Aquatic Conservation Strategy objectives at the 5^{th} field watershed scale.

Soil condition, aquatic and riparian habitats, water quality, and peak streamflows within the East Fork Lewis River watershed have been affected by past wildfire, mining, logging, road construction, quarrying and stream cleanouts. The proposed action would thin forest stands, construct temporary roads, reconstruct existing roads and construct helicopter landings to facilitate removal of the cut trees. Combined with past actions and ongoing actions on adjacent State and private lands, these activities could contribute to higher risk of sediment introduction to the East Fork Lewis River, increases in peak flows, and reduced levels of organic contributions to the soils. Additional degradation of the watershed could mean that these actions could cumulatively prevent or retard attainment of Aquatic Conservation Strategy objectives at the 5^{th} field watershed scale.

The scale, intensity, and rate of recurrence of wildfires in the early 1900's stripped much of the organic matter from the watershed, and damaged soils throughout large portions of the drainage. The loss of vegetative cover and damage done to the soils caused increased surface soil erosion and loss of topsoil. Today, many of the most impacted areas continue to have poor soil structure and little development of an organic soil horizon. Mining activities along with road construction and logging that has occurred since the fires have contributed to continued introduction of fine sediment to the East Fork Lewis River and tributaries.

Loss of forest cover that resulted from the wildfires of the early 1900's likely caused increases in the frequency and magnitude of peak streamflows occurring in response to rain-on-snow conditions. This effect has persisted due to the poor revegetation of some of the more damaged portions of the watershed, and logging which has removed forest canopy from those areas that were effectively reforested. The East Fork Lewis watershed analysis indicated that peak flow increases were greatest in the Slide Creek, McKinley Creek, and Copper Creek sub-watersheds within the Upper East Fork Lewis drainage (USDA 2002(c)).

An alternative will be developed to address this issue by reducing the acres of thinning, retaining higher amounts of canopy cover in thinned areas, less road construction, less road reconstruction, and road decommissioning consistent with watershed analysis recommendations.

Analysis Indicators:

- peak flows (percent area proposed for thinning)
- sediment production
- road density

Sediment generation and damage to thin, erosive soils

Ground-based logging systems (tractor or skyline yarding) and road-related actions have the potential to generate sediment which could reach streams and adversely affect water quality, listed fish species and their habitat. Heavy equipment operations, resulting in compaction or displacement of already thin soils, increase the potential for loss of soil productivity.

Soil displacement occurs from ground-based systems and road actions, such as road construction, reconstruction, and hauling. The terrain within the planning area is generally steep. About 78 percent of the planning area consisting of slopes greater than 30 percent which increases the potential for displaced upland soils to reach streams.

This condition is exacerbated by relatively high winter precipitation amounts that contribute to soil transport and also increase susceptibility to soil compaction from heavy equipment or log yarding operations.

Analysis indicators:

- acres of ground-based logging
- miles of road reconstruction
- miles of temporary road construction
- miles of road needed for log hauling

Other Issues

The following issues were identified though internal and public scoping. These issues may be addressed through project design criteria or mitigation.

Down Logs

Some Riparian Reserves are currently deficient in large down logs according to Forest Plan standards. The current recruitment potential of large wood from the riparian areas into the stream system is a concern due to past fires, subsequent salvage logging practices, and existing road systems. Due to stand age and the size of trees, these conditions would not be changed in the short-term without intervention.

Habitat for Sensitive Species

Habitat for Sensitive species is limited in the planning area. In addition to buffering known sites, habitats that may serve as refugia even though Sensitive species are not present.

High Water Temperatures

High water temperatures during summer months represent the most important water quality concern in the upper East Fork Lewis River. The Washington State Department of Ecology temperature standard is 16°C; excursions beyond 16°C are considered “water temperature exceedances.” Because the East Fork Lewis River exceeds WDOE water quality standards, the river was listed in the Washington 1998 §303(d) list (WAC 173-201-080).

Presence of Historic Sites

This area is dotted with evidence of early mining. Historic sites are present or may be located in the preparation for the timber sale. If not protected, logging or slash treatment actions could destroy these sites.

Economic Feasibility of Helicopter Logging

A large portion of this sale is proposed to be logged using helicopters due to limited access to proposed units by forest roads, the condition of existing roads, and the steep, potentially erosive soils. Economic feasibility of the timber sale could be an issue given the large sale area, relatively low volume, and the costs associated with helicopter logging.

Tail #173

A portion of Trail #173 is located within the route of a proposed temporary road. Road construction could disrupt trail use.

Silver Star Scenic Special Interest Area

The Silver Star Scenic Special Interest Area is located within the Copper Creek 6^{th} field watershed. The Desired Future Condition of this Management Area provides that the features remain substantially undisturbed and the visual evidence of management activities is subordinate to the special features. The VQO is Retention and the ROS is Semi-primitive Non-Motorized. This area could be adversely impacted by timber harvest and associated actions.

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This chapter describes and compares the alternatives considered for the Tee Timber Sale project. It includes a description and map of each alternative considered.

Alternatives

Alternative A – The Proposed Action

The proposed action would commercially thin approximately 998 upland acres and approximately 67 riparian acres within the Tee Timber Sale planning area using helicopter, skyline, or tractor logging systems, as indicated in Table 2.1 and Figure 2.1. The proposed action would yield approximately 10.5 million board feet (MMBF) of commercial timber for sale. The proposed action would make use of four helicopter landings that were constructed for the 2005 Divot Timber Sale. The proposed action also includes planting thinned riparian areas, slash treatment, and removal of temporary roads following post-sale activities (slash treatment and planting). Refer to Table 2.1 for a description by unit. In addition, a 15-acre plantation of 12 year old conifers will be pre-commercially thinned.

The connected actions to construct approximately 1.9 miles of temporary roads (Table 2.2), reconstruct approximately 9.1 miles of existing roads, and construct 14 helicopter landings occupying a total of approximately 14 acres would also be implemented. The proposed action also includes associated actions of planting thinned riparian areas, slash treatment, and removal of temporary roads following post-sale activities (slash treatment and planting). Refer to Table 2.1 for a description by unit.

Applicable design features from Appendix A would also be followed for the implementation of Alternative A.

Table 2.1. Detail of Alternative A – Proposed Action: commercial thinning prescription, logging system and slash treatment prescription by unit.

Unit #	Total Acres	Upland Acres Thinned	Post-thinning Canopy Cover (%)	Riparian Acres Thinned	Post-Thinning Canopy Cover (%)	Logging System	Slash Treatment
1	32	32	40	0	N/A	Skyline	HP 75' along FR 4104 (2.0 ac). MP landings (0.3 ac).
2	20	20	40	0	N/A	Helicopter	Lop/Scatter
4	28	28	40	0	N/A	Helicopter	Lop/Scatter
5	11	11	40	N/A	N/A	Tractor	MP 10 ac.
6	23	20	40	3	40	Helicopter	Lop/Scatter
7	10	10	40	0	N/A	Helicopter	Lop/Scatter

Unit #	Total Acres	Upland Acres Thinned	Post-thinning Canopy Cover (%)	Riparian Acres Thinned	Post-Thinning Canopy Cover (%)	Logging System	Slash Treatment
8	57	57	40	0	N/A	Helicopter	Lop/Scatter
9	32	32	40	0	N/A	Helicopter	Lop/Scatter
10	3	3	40	0	N/A	Helicopter	Lop/Scatter
11	14	14	40	0	N/A	Helicopter	Lop/Scatter
16	38	38	40	0	N/A	Helicopter	Lop/Scatter
18	22	17	40	5	50	Helicopter	HP 75' on both sides of FR 4104 (1.5 ac). MP landings (0.2 ac).
19	32	24	40	8	40	Skyline/ Helicopter	HP 75' on east side of FR 4104 (2.75 ac). MP landings (0.4 ac).
20	28	28	40	N/A	N/A	Helicopter	Lop/Scatter
21	16	16	40	0	N/A	Helicopter	Lop/Scatter
22	16	16	40	N/A	N/A	Tractor	MP 9 ac.
23/24	14	14	40	N/A	N/A	Helicopter	HP 75' on both sides of FR 4211-538 (1.5 ac).
25	35	35	40	0	N/A	Helicopter	Lop/Scatter
26	48	43	40	5	40	Skyline	HP 75' along FR 4205-523 (1.5 ac).
27	7	6	40	1	50	Helicopter	HP 75' along FR 4211-538 (1 ac.)
28	51	37	40	14	50	Helicopter	Lop/Scatter
29	41	41	40	0	N/A	Tractor	HP both sides of FR 4205 (5 ac). MP 30 ac.
30	25	25	40	0	N/A	Helicopter	Lop/Scatter
31	56	49	40	7	50	Helicopter	Lop/Scatter
32	27	24	40	3	50	Helicopter	HP 75' on north side of FR 41 (1.25 ac).
35	14	12	40	2	50	Skyline	Lop/Scatter
36/42	23	22	40	1	50	Skyline	HP 12 ac. MP landings
37/38/ 39	20	16	40	4	50	Tractor	MP 7 ac.
40	19	19	50	N/A	N/A	Tractor	HP 75' on both sides of the FR 4104 (3.0 ac). MP landings (0.3 ac).
43	20	20	40	0	N/A	Helicopter	HP 50' in spots along the TR173 (1.0 ac). MP landings (0.3 ac).

Unit #	Total Acres	Upland Acres Thinned	Post-thinning Canopy Cover (%)	Riparian Acres Thinned	Post-Thinning Canopy Cover (%)	Logging System	Slash Treatment
44	77	63	40	14	50	Tractor	HP 50' in spots along the TR173 (1.0 ac). MP landings (0.3 ac).
45	40	40	40	0	N/A	Helicopter	Lop/Scatter
46	39	39	40	N/A	N/A	Helicopter	Lop/Scatter
47	49	49	40	0	N/A	Skyline/ Helicopter	Lop/Scatter
48	28	28	40	0	N/A	Helicopter	Lop/Scatter
49	18	18	40	0	N/A	Helicopter	Lop/Scatter
50	32	32	40	0	N/A	Helicopter	Lop/Scatter
Total	**1,065 ac.**	**998 ac.**		**67 ac.**		**--**	**21.5 ac. HP 70.9 ac. MP**

Legend:

HP = Handpile
MP = Machine Pile w/ grapple piler

Fifteen acres of pre-commercial thinning would also occur under this alternative (Unit 41). Slash treatment would be lop and scatter.

Table 2.2. Alternative A – Proposed Action: temporary road construction.

Unit	Approx. Length (feet)
26	2,000
44	1,680
47	4,200
Helicopter landings F and G	2,400
Total	**10,280 feet**

Table 2.3. Alternative A – Proposed Action: helicopter landing sites to be constructed.

Helicopter Site #	Location	Size	Slash Treatment
A	FR 4205524 (North of Unit 47)	1 acre	MP
B	Un-named spur rd off the FR 4205 (SW ¼ of the SE ¼ of Section 7)	1 acre	MP
C	End of the FR 4211538.	1 acre	MP
D	FR 4205 (0.3 mile south of FR 4205524 jct)	1 acre	MP
E	FR 4211541/FR 4211539-jct.	1 acre	MP
F	Temp. road off FR 53 (SE ¼ of the NW ¼ of Section 11)	1 acre	MP
G	Temp. road off the FR 53 (SE ¼ of the SW ¼ of Section 11)	1 acre	MP
H	Temp. road off the end of FR 4104602	1 acre	MP
I	Temp. road off the end of FR4104602	1 acre	MP
J	West of Unit 5	1 acre	MP
K	FR 4104 (switchback NE ¼ of the SW ¼ Sec. 29)	1 acre	MP
L	FR 4104571 (SW ¼ of the NE ¼ Sec. 30)	1 acre	MP
M	Un-named spur into Unit 41 (NW ¼ of the SW ¼ Section 28)	1 acre	MP
N	FR 4104 within Unit 18	1 acre	MP
Total		**14 acres**	**14 acres**

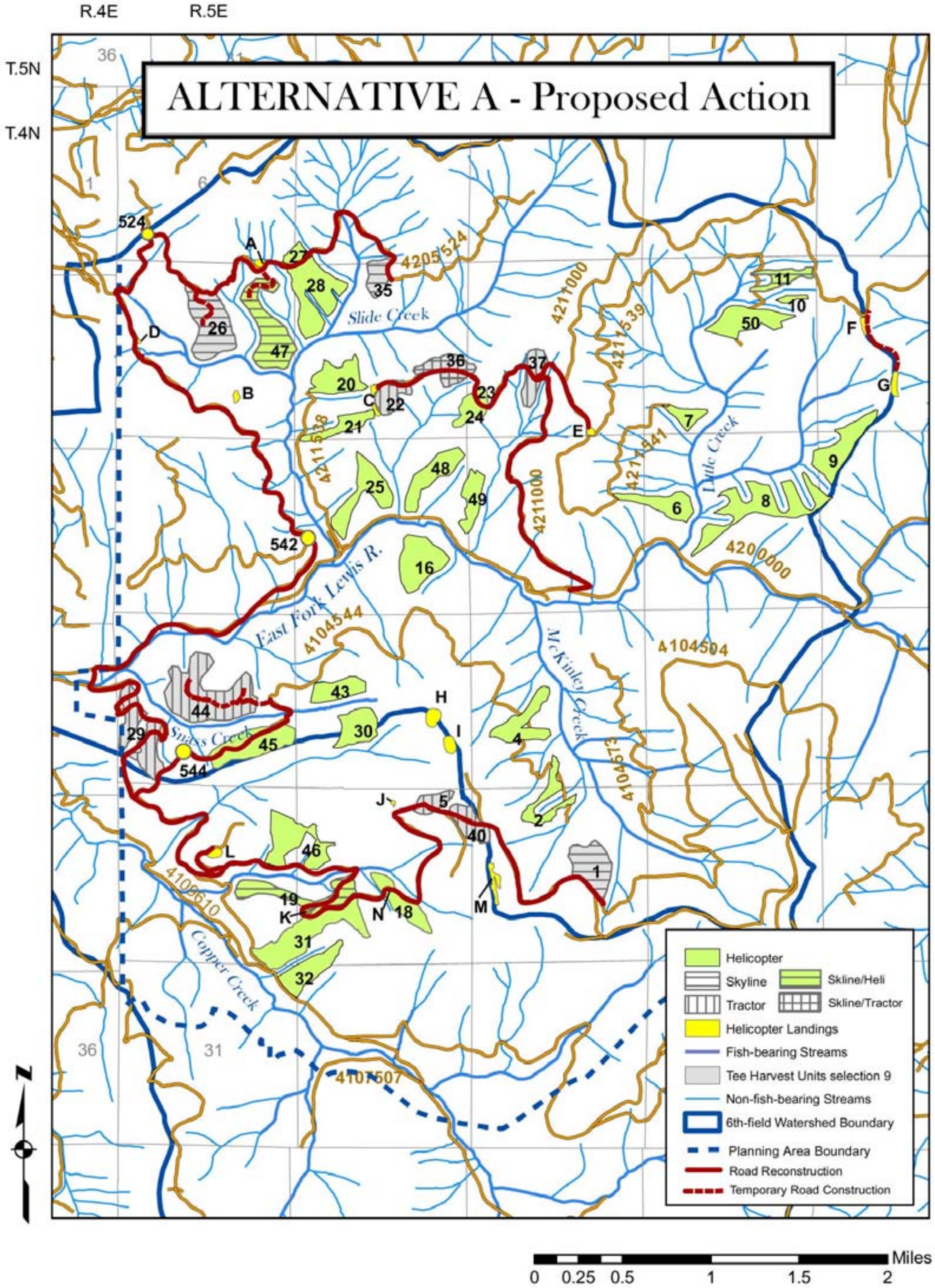

Figure 2.1. Alternative A – Proposed Action: map.

Alternative B – Address Cumulative Effects

Alternative B was designed to address cumulative watershed affects by reducing the total number of acres subject to commercial thinning; eliminating thinning treatments from riparian areas, reducing temporary road and landing construction, and decommissioning roads identified in the *East Fork Lewis River Watershed Analysis* (USDA 2002(a)) and the *East Fork Lewis River Water Quality Restoration Plan* (USDA 2002(c)).

Specific actions under this alternative would be to commercially thin approximately 886 upland acres to yield approximately 8.9 MMBF of timber for sale using helicopter, skyline, or tractor logging systems (refer to Table 2.4 and Figure 2.2); pre-commercially thin 15 acres of a 12 year old plantation; decommission approximately 8.5 miles of roads no longer needed for national forest management.

This alternative includes the following connected actions: construct 13 helicopter landings which would occupy approximately 13 acres, reconstruct approximately 9.1 miles of roads.

Applicable design features from Appendix A would also be followed for the implementation of Alternative B.

Differences from the Proposed Action:

Alternative B would reduce thinning by approximately 179 acres.

Approximately 67 acres of riparian areas and associated reforestation enhancement planting would not be thinned or planted.

Units 6, 8, and 25 would not be thinned.

There would be no temporary road construction.

Units 26, 44, and 47 (approximately 174 acres) would be changed from skyline (Unit 26) or tractor (Unit 44) or skyline/helicopter (Unit 47) to helicopter logging system and slash treatment changed from machine piling to hand-piling or lop and scatter.

Units 11, 18, and 31 (approximately 92 acres) changed from helicopter to skyline/helicopter logging system.

Unit 36/42 (approximately 23 acres) changed from tractor to tractor/skyline logging system.

Delete helicopter landing “G”.

Moves helicopter landing “F” to the junction of FR 53 and FR 42.

Add approximately 8.5 miles of road decommissioning:

FR 4107507 – 1.1 miles

FR 4104573 – 1.9 miles

FR 4211539 – 3.7 miles

FR 4211541 – 1.8 miles

Remove culverts on FR 4207 – 1.2 miles (already partially decommissioned)

Table 2.4. Detail of Alternative B: commercial thinning prescription, logging system and slash treatment prescription by unit.

Unit #	Acres Thinned	Post-thinning Canopy Cover (%)	Logging System	Slash Treatment
1	32	40	Skyline	HP 75' along FR 4104 (2.0 ac). MP landings (0.3 ac).
2	20	40	Helicopter	Lop/Scatter
4	28	40	Helicopter	Lop/Scatter
5	11	40	Tractor	MP 10 ac.
7	10	40	Helicopter	Lop/Scatter
9	32	40	Helicopter	Lop/Scatter
10	3	40	Helicopter	Lop/Scatter
11	14	40	Skyline/ Helicopter	Lop/Scatter
16	38	40	Helicopter	Lop/Scatter
18	17	40	Skyline/ Helicopter	HP 75' on both sides of FR 4104 (1.5 ac). MP landings (0.2 ac).
19	24	40	Skyline/ Helicopter	HP 75' on east side of FR 4104 (2.75 ac). MP landings (0.4 ac).
20	28	40	Helicopter	Lop/Scatter
21	16	40	Helicopter	Lop/Scatter
22	16	40	Tractor	MP 9 ac.
23/24	14	40	Helicopter	HP 75' on both sides of FR 4211-538 (1.5 ac).
26	43	40	Helicopter	HP 75' along FR 4205-523 (1.5 ac).
27	6	40	Helicopter	HP 75' along FR 4211-538 (1 ac.)
28	37	40	Helicopter	Lop/Scatter
29	41	40	Tractor	HP both sides of FR 4205 (5 ac). MP 30 ac.
30	25	40	Helicopter	Lop/Scatter
31	49	40	Skyline/ Helicopter	Lop/Scatter
32	24	40	Helicopter	HP 75' on north side of FR 41 (1.25 ac).
35	12	40	Skyline	Lop/Scatter
36/42	22	40	Tractor/ Skyline	HP 12 ac. MP landings
37/38/ 39	16	40	Tractor	MP 7 ac.
40	19	50	Tractor	HP 75' on both sides of the FR 4104 (3.0 ac). MP landings (0.3 ac).
43	20	40	Helicopter	HP 50' in spots along the TR173 (1.0 ac). MP landings (0.3 ac).

Unit #	Acres Thinned	Post-thinning Canopy Cover (%)	Logging System	Slash Treatment
44	63	40	Helicopter	HP 50' in spots along the TR173 (1.0 ac). MP landings (0.3 ac).
45	40	40	Tractor/ Skyline	Lop/Scatter
46	39	40	Helicopter	Lop/Scatter
47	49	40	Helicopter	Lop/Scatter
48	28	40	Helicopter	Lop/Scatter
49	18	40	Helicopter	Lop/Scatter
50	32	40	Helicopter	Lop/Scatter
Total	**886 ac.**		**--**	**21.5 ac. HP** **70.9 ac. MP**

Legend:

HP = Handpile
MP = Machine Pile w/ grapple piler

Fifteen acres of pre-commercial thinning would also occur under this alternative (Unit 41). Slash treatment would be lop and scatter.

Table 2.5. Alternative B: helicopter landing sites to be constructed.

Helicopter Site #	Location	Size	Slash Treatment
A	FR 4205524 (North of Unit 47)	1 acre	MP
B	Un-named spur rd off the FR 4205 (SW ¼ of the SE ¼ of Section 7)	1 acre	MP
C	End of the FR 4211538.	1 acre	MP
D	FR 4205 (0.3 mile south of FR 4205524 jct)	1 acre	MP
E	FR 4211541/FR 4211539-jct.	1 acre	MP
F	Temp. road off FR 53 (SE ¼ of the NW ¼ of Section 11)	1 acre	MP
H	Temp. road off the end of FR 4104602	1 acre	MP
I	Temp. road off the end of FR4104602	1 acre	MP
J	West of Unit 5	1 acre	MP
K	FR 4104 (switchback NE ¼ of the SW ¼ Sec. 29)	1 acre	MP
L	FR 4104571 (SW ¼ of the NE ¼ Sec. 30)	1 acre	MP
M	Un-named spur into Unit 41 (NW ¼ of the SW ¼ Section 28)	1 acre	MP
N	FR 4104 within Unit 18	1 acre	MP
Total		**14 acres**	**14 acres**

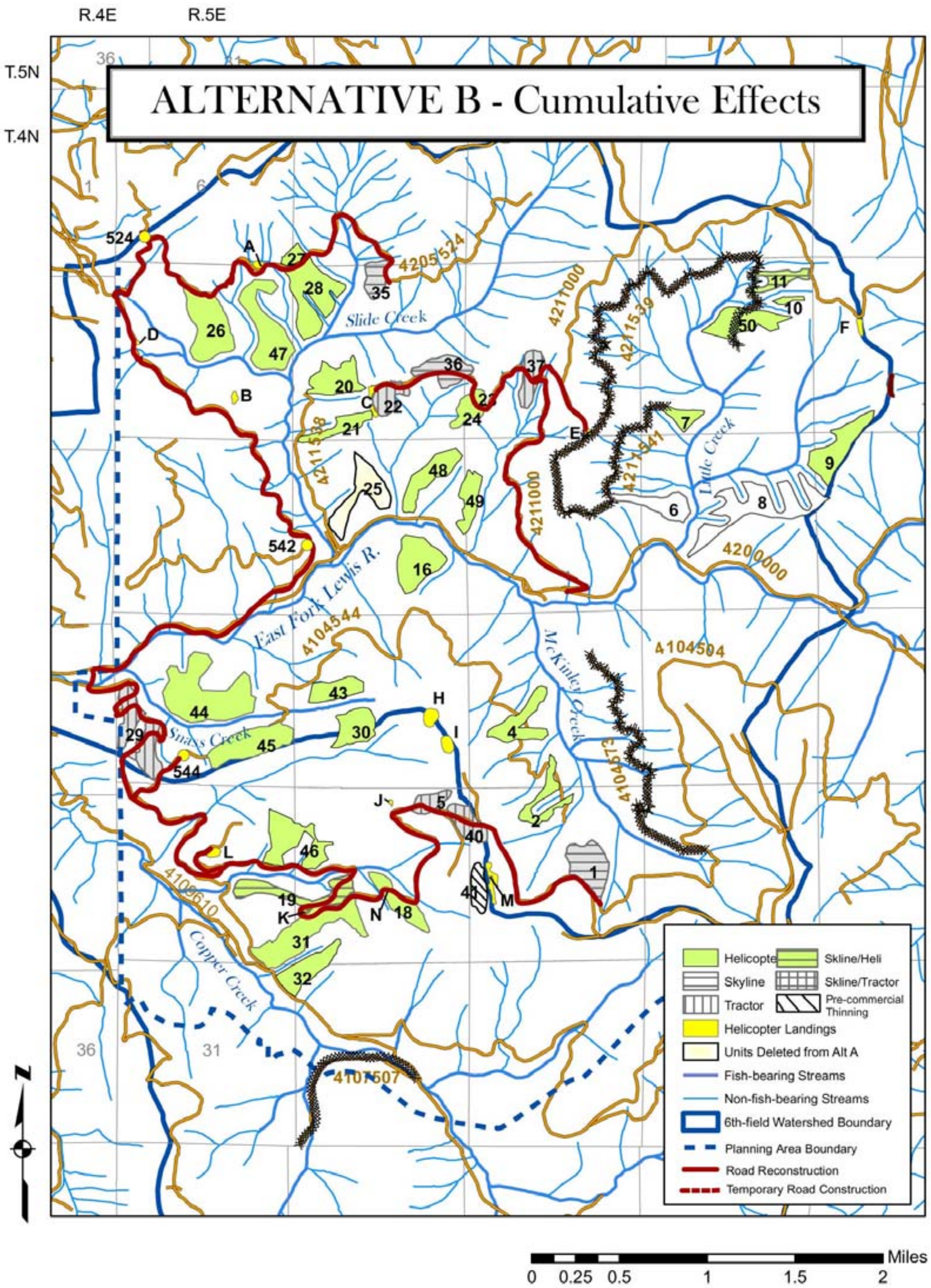

Figure 2.2. Alternative B: map.

Alternative C – Emphasize Helicopter Logging

Alternative C responds to the issue of the potential for sediment generation from road activities and hauling by reducing the need for reconstruction and maintenance of roads intended for hauling logs. This would be achieved by emphasizing helicopter logging systems over ground-based systems (skyline or tractor yarding) and concentrating road reconstruction and heavy maintenance activities along fewer roads. In addition, emphasizing helicopter logging instead of ground-based systems would reduce the need for temporary road construction and system road reconstruction.

Specific actions under this alternative would be to commercially thin approximately 998 upland acres and 67 riparian acres to yield approximately 10.5 MMBF of timber for sale using helicopter, skyline, or tractor logging systems and treat slash by machine piling, hand piling, or lop and scatter (refer to Table 2.6 and Figure 2.3); pre-commercially thin and underplant 15 acres of a 12 year old plantation.

This alternative includes the following connected actions: construct approximately 0.5 miles of temporary road, construct 12 helicopter landings which would occupy approximately 12 acres, reconstruct approximately 4.2 miles of roads.

Applicable design features from Appendix A would also be followed for the implementation of Alternative C.

Differences from the Proposed Action:

Alternative C would replace approximately 311 acres of ground-based logging systems with helicopter logging in Units 1, 19 (portion), 22, 26, 35, 36/42, 37/38/39, 44, 47 (portion).

Reduce slash treatment by machine piling by 14.6 acres.

Reduce temporary road construction by approximately 1.4 miles.

Reduce the number of helicopter landings from 14 to 12 and the number of acres of landing construction by approximately 1 acre.

The need for road reconstruction, heavy maintenance and log hauling along FR 4211 would be eliminated.

Table 2.6. Detail of Alternative C: commercial thinning prescription, logging system and slash treatment prescription by unit.

Unit #	Total Acres	Upland Acres Thinned	Post-thinning Canopy Cover (%)	Riparian Acres Thinned	Post-Thinning Canopy Cover (%)	Logging System	Slash Treatment
1	32	32	40	0	N/A	Helicopter	HP 75' along FR 4104 (2.0 ac).
2	20	20	40	0	N/A	Helicopter	Lop/Scatter
4	28	28	40	0	N/A	Helicopter	Lop/Scatter
5	11	11	40	N/A	N/A	Tractor	MP 10 ac.
6	23	20	40	3	40	Helicopter	Lop/Scatter
7	10	10	40	0	N/A	Helicopter	Lop/Scatter
8	57	57	40	0	N/A	Helicopter	Lop/Scatter
9	32	32	40	0	N/A	Helicopter	Lop/Scatter
10	3	3	40	0	N/A	Helicopter	Lop/Scatter
11	14	14	40	0	N/A	Helicopter	Lop/Scatter
16	38	38	40	0	N/A	Helicopter	Lop/Scatter
18	22	17	40	5	50	Helicopter	HP 75' on both sides of FR 4104 (1.5 ac). MP landings (0.2 ac).
19	32	24	40	8	40	Helicopter	HP 75' on east side of FR 4104 (2.75 ac).
20	28	28	40	N/A	N/A	Helicopter	Lop/Scatter
21	16	16	40	0	N/A	Helicopter	Lop/Scatter
22	16	16	40	N/A	N/A	Helicopter	MP 9 ac.
23/24	14	14	40	N/A	N/A	Helicopter	HP 75' on both sides of FR 4211-538 (1.5 ac).
25	35	35	40	0	N/A	Helicopter	Lop/Scatter
26	48	43	40	5	40	Helicopter	HP 75' along FR 4205-523 (1.5 ac).
27	7	6	40	1	50	Helicopter	HP 75' along FR 4211-538 (1 ac.)
28	51	37	40	14	50	Helicopter	Lop/Scatter
29	41	41	40	0	N/A	Tractor	HP both sides of FR 4205 (5 ac). MP 30 ac.
30	25	25	40	0	N/A	Helicopter	Lop/Scatter
31	56	49	40	7	50	Helicopter	Lop/Scatter
32	27	24	40	3	50	Helicopter	HP 75' on north side of FR 41 (1.25 ac).
35	14	12	40	2	50	Helicopter	Lop/Scatter

Unit #	Total Acres	Upland Acres Thinned	Post-thinning Canopy Cover (%)	Riparian Acres Thinned	Post-Thinning Canopy Cover (%)	Logging System	Slash Treatment
36/42	23	22	40	1	50	Helicopter	HP 12 ac.
37/38/39	20	16	40	4	50	Helicopter	MP 7 ac.
40	19	19	50	N/A	N/A	Tractor	HP 75' on both sides of the FR 4104 (3.0 ac). MP landings (0.3 ac).
43	20	20	40	0	N/A	Helicopter	HP 50' in spots along the TR173 (1.0 ac).
44	77	63	40	14	50	Helicopter	HP 50' in spots along the TR173 (1.0 ac).
45	40	40	40	0	N/A	Helicopter	Lop/Scatter
46	39	39	40	N/A	N/A	Helicopter	Lop/Scatter
47	49	49	40	0	N/A	Helicopter	Lop/Scatter
48	28	28	40	0	N/A	Helicopter	Lop/Scatter
49	18	18	40	0	N/A	Helicopter	Lop/Scatter
50	32	32	40	0	N/A	Helicopter	Lop/Scatter
Total	**1,065 ac.**	**998 ac.**		**67 ac.**		**--**	**33.5 ac. HP 56.3 ac. MP**

Legend:

HP = Handpile
MP = Machine Pile w/ grapple piler

Fifteen acres of pre-commercial thinning would also occur under this alternative (Unit 41). Slash treatment would be lop and scatter.

Table 2.7. Alternative C: temporary road construction.

Unit #	Approx. Length (feet)
Helicopter landings F and G	2,400
Total	**2,400 feet**

Table 2.8. Alternative C: helicopter landing sites to be constructed.

Helicopter Site #	Location	Size	Slash Treatment
A	FR 4205524 (North of Unit 47)	1 acre	MP
B	Un-named spur rd off the FR 4205 (SW ¼ of the SE ¼ of Section 7)	1 acre	MP
D	FR 4205 (0.3 mile south of FR 4205524 jct)	1 acre	MP
F	Temp. road off FR 53 (SE ¼ of the NW ¼ of Section 11)	1 acre	MP
G	Temp. road off the FR 53 (SE ¼ of the SW ¼ of Section 11)	1 acre	MP
H	Temp. road off the end of FR 4104602	1 acre	MP
I	Temp. road off the end of FR4104602	1 acre	MP
J	West of Unit 5	1 acre	MP
K	FR 4104 (switchback NE ¼ of the SW ¼ Sec. 29)	1 acre	MP
L	FR 4104571 (SW ¼ of the NE ¼ Sec. 30)	1 acre	MP
M	Un-named spur into Unit 41 (NW ¼ of the SW ¼ Section 28)	1 acre	MP
N	FR 4104 within Unit 18	1 acre	MP
Total		**12 acres**	**12 acres**

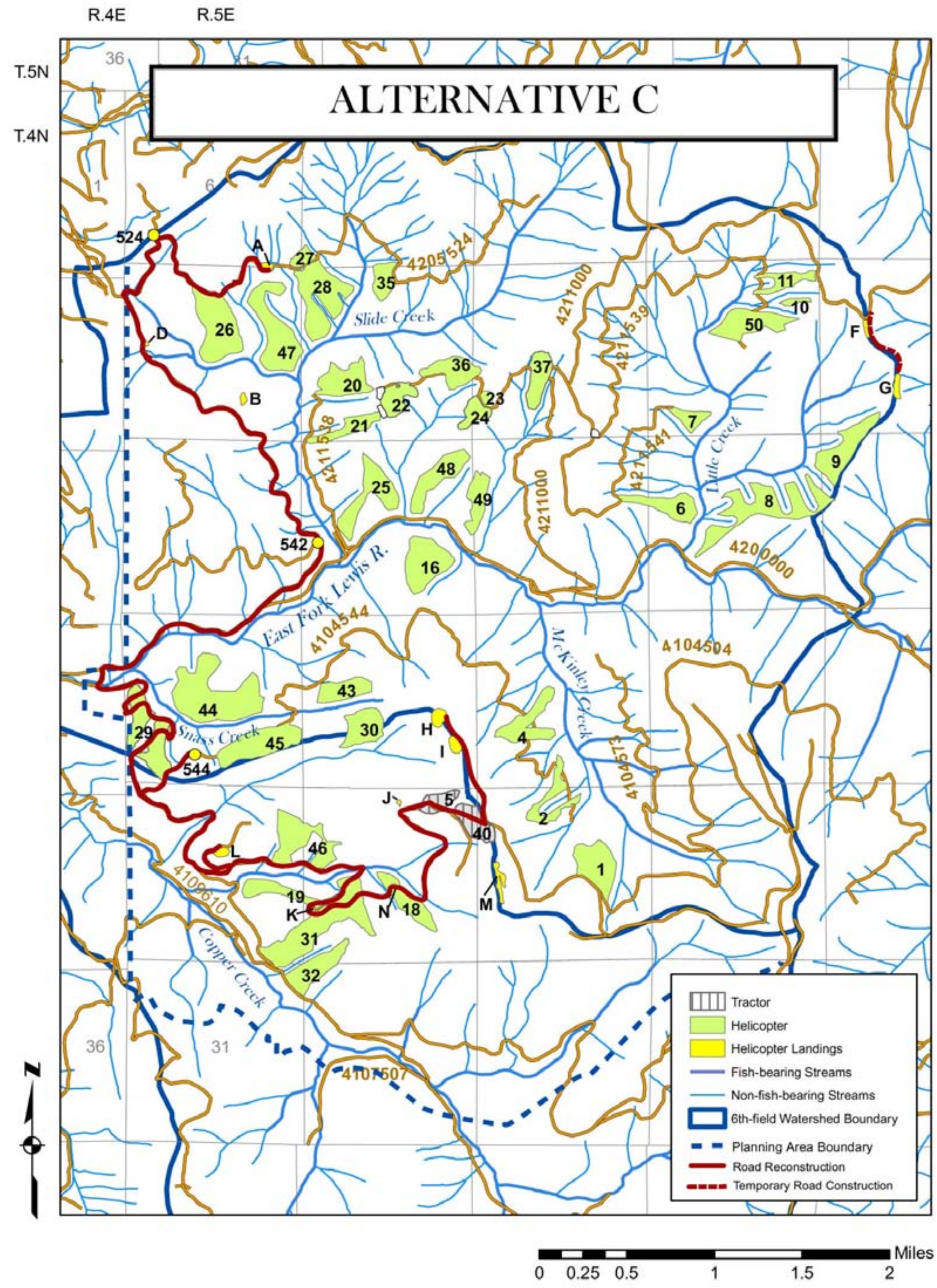

Figure 2.3. Alternative C: map.

Alternative D – No Action

Alternative D 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, construction of helicopter log landing sites; slash treatments, and/or road decommissioning activities.

Mitigation Prescribed for Action Alternatives

In response to public comments on the proposal, mitigation measures were developed to ease some of the potential impacts the various alternatives may cause. The mitigation measures may be applied to any of the action alternatives. Chapter 3 (Environmental Consequences) includes an analysis of effects by resource area that would be expected if mitigation measures were not applied.

Table 2.9. Mitigation measures by resource area. These measures apply to all action alternatives, unless otherwise specified.

Soils	
S.1	Areas where rutting exceeds 6 inches in depth for a length of ten feet or more will be prohibited from further ground-based equipment passes to prevent detrimental rutting of the soil.
S.2	Temporary roads and landings will be subsoiled to a depth of 20 inches. Subsoiling and grass seeding must be done immediately following logging and create an uneven, rough surface without furrows. Proposed alternative methods to subsoiling must be approved by a qualified specialist in consultation with the sale administrator and documented.
S.3	Vehicular access to areas that have previously been subsoiled and/or seeded will be prohibited to prevent these areas from being re-compacted and to allow vegetation to develop.
S.4	Burning will be limited to periods when soil and duff moisture is sufficient to prevent consumption of more than ten percent of the duff layer.
S.5	If partial suspension logging systems gouge the surface greater than 12 inches deep for a length of 10 feet or more, rehabilitate with cross drains (if ground is sloping) and erosion seeding or pile slash over them.
S.6	Available logging debris and slash would be scattered onto the subsoiled roads and landings to maintain organic matter levels.
S.7	Machine piling of slash would be accomplished with as light a track machine as is practicable, equipped with a swivel grapple. Piling would begin at the end of the unit furthermost from the access road and work its way back, operating on top of the slash. Activity slash would not be piled within the units. Slash piles would be placed in designated landing locations.
S.8	Subsequent to burning machine piled slash, soil under piles greater than 100 square feet would be seeded, but not fertilized.
S.9	Where designated by the timber sale contract administrator, impacted areas of skyline yarding would be waterbarred, seeded and fertilized.

Hydrology	
H.1	No equipment will be allowed in Riparian Reserves. The objective of this measure is to minimize disturbance of ground cover, soils and vegetation within Riparian Reserves. This measure applies to all units.
H.2	To minimize the amount of sediment delivered to streams along the haul route and from reconstructed and obliterated roads, dispose of soils 100 feet from any perennial or intermittent stream at a location approved by the Sale Administrator. In addition, place sediment barriers (straw bales, slash filter windrow and/or sediment fence) in ditchlines along the haul route or in areas where the ground is disturbed and sediment has the potential for delivery to streams. Sediment filters should be left in place where possible to naturally degrade. If non-biodegradable filters are used, precautions should be followed to minimize transport of trapped sediment material during removal, including the following: a) work during the dry season, and/or b) relocate captured sediment to a stable location.
H.3	All road maintenance and reconstruction activities, and all timber hauling would occur in the June through September period to minimize sediment production and delivery to the aquatic system. This applies to all roads in the project area. The September 30 end date for haul may be waived if conditions are good and haul-related sediment production is not increased as a result of fall precipitation levels. Conditions typically meriting a waiver include: 1) daily precipitation levels remaining below the average daily maximum precipitation for the June through September period (1.05 inches as measured at the Carson National Fish Hatchery); and 2) two-week cumulative total precipitation of less than the average maximum two-week precipitation levels during the June through September period.
H.4	Prior to any expected seasonal period of precipitation and runoff, and after sale activities are complete, cross drains and grade breaks would be installed in all temporary roads, skid trails, landings and skyline corridors.
Botany	
B.1	When culvert replacement sites are identified during 2006, botanical surveys of these sites will be conducted. If sites for *Corydalis aquae-gelidae* or any other Sensitive or Survey and Manage species requiring management of known sites are located during these surveys, additional project design criteria designed to ensure site persistence and viability will be incorporated into the project.
Invasive Weeds	
I.1	To prevent the introduction of noxious weeds into the project area, all heavy equipment, or other off- road equipment used in the project is to be cleaned to remove soil, seeds, vegetative matter or other debris that could contain seeds. Cleaning should be done before entering National Forest Lands, and when equipment moves from or between project sites or areas known to be infested into other areas, infested or otherwise.
I.2	Use weed-free straw and mulch for all projects, conducted or authorized by the Forest Service, on National Forest System Lands. If State certified straw and/or mulch is not available, individual Forests should require sources certified to be weed free using the North American Weed Fee Forage Program standards or a similar certification process. Mulch species shall preferably be from native seed sources.
I.3	Inspect active gravel, fill, sand stockpiles, quarry sites, and borrow material for invasive plants before use and transport. Treat or require treatment of infested sources before any use of pit material. Use only gravel, fill, sand, and rock that is judged to be weed free by District or Forest weed specialists.

Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in Table 2.10 is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives. Table 2.11 provides a comparison of the analysis indicators for the significant issues (refer to Chapter 1, page 4).

Table 2.10. Comparison of actions proposed for all alternatives .

Activities	Alternative A (Proposed Action)	Alternative B (Cumulative Effects)	Alternative C (Helicopter Logging Emphasis)	Alternative D (No Action)
CT Thin-uplands	998 acres	886 acres	998 acres	0
PCT Thin-uplands	15 acres	15 acres	15 acres	
Thin - riparian	67 acres	0	67 acres	0
Plant riparian	67 acres	0	67 acres	0
Temp. Roads	10,280 feet	0	2,400 feet	0
Helicopter Log	714	697	994	0
Skyline Log	167	86	0	0
Tractor Log	184	103	71	0
Construct Heli-landings	14 acres	13 acres	12 acres	0
Utilize 2005 Divot Heli-landings	4 acres	4 acres	4 acres	0
Grapple Pile Slash	71.9 acres	70.3 acres	68.3 acres	0
Handpile Slash	33.5 acres	33.5 acres	33.5 acres	0
Decommission Roads	0 miles	8.5 miles	0	0

Table 2.11. Comparison of analysis indicators for significant issues by alternative.

	Alternative A	Alternative B	Alternative C	Alternative D
Issue: Cumulative watershed effects				
peak flows (% area to be thinned): Copper Creek U. East Fork	 2 8	 2 7	 2 8	 0 0
sediment production (tons/ac.) dry season haul year around haul	 1,500 3,000 – 3,500	 1,500 3,000 – 3,500	 1,000 2,000 – 2,500	 500 500
road density (mi/sq.mi): Copper Creek U. East Fork	 2.4 3.4	 2.3 2.9	 2.4 3.4	 2.4 3.4
Issue: Sediment generation and damage to thin, erosive soils				

	Alternative A	Alternative B	Alternative C	Alternative D
acres of ground-based logging	351	189	71	0
miles of road reconstruction	9.1	9.1	4.2	0
miles of temporary road construction	1.9	0	0.5	0
miles of road needed for log hauling	38	38	30	0

CHAPTER 3. ENVIRONMENTAL CONSEQUENCES

This chapter describes the current environment in the project area. It also displays potential effects (direct/indirect, beneficial/adverse, long-term/short-term, and cumulative) on resources that could occur if the alternatives proposed 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 various 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 ID Team between 2004 and 2006, data from silvicultural examinations, as well as information provided by resource specialists and the public. The application of all design features from Appendix A as well as legally-required, terms and conditions of Biological Opinions, standards and guidelines, and Best Management Practices is integral to the assessment of impacts. Effects of the alternatives with and without mitigation measures have been analyzed, as indicated.

The actions considered by the cumulative effects analysis are listed in Table 3.1, unless otherwise described in the cumulative effects sections of the resource analyses.

Table 3.4. Actions considered in 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– 1960s
Reforestation efforts following catastrophic fires	Hillslope terracing to provide planting opportunities	1902 – 1955
Present and/or Ongoing		
National Forest System roads	Construction and use of system roads on lands within the listed Sub-Basins.	Ongoing
Divot Timber Sale	0.6 miles of temporary road and 2.2 acres of landing construction	Ongoing
Forest Trails	Management of forest trails including erosion work, route signing, and maintenance.	Ongoing
Future		
Increased amounts of recreational forest visitors	The use of existing and the creation of new dispersed camping sites along the East Fork Lewis River, the Green Fork and Copper Creek also continue to increase (USDA 2002(c)).	Ongoing
Silvicultural Treatments	Intermediate stand entry and subsequent rotational thinning in matrix.	10 – 15 years
Other Silvicultural Treatments	Stand treatments adjacent to private lands that minimize the potential for fire to reach adjacent private lands.	None planned, only recommended

Action	Description	Date
		(USDA 2002(c))
Road and quarry decommission	Removing roads from the transportation system and returning to stable configuration, including Roads to Trails. Rehabilitating rock quarries could include stabilizing soil to reduce surface erosion, replacing topsoil, and seeding to encourage re-establishment of native species.	None planned, only recommended (USDA 2002(c))

Some of the cumulative effects have been previously discussed in the Forest Plan EIS (USDA 1990). These disclosures of potential effects have been reviewed during the site-specific analysis performed for this project and are consistent with the site-specific effects. The following are incorporated by reference:

Cumulative Effects of: Reference

- Air Quality pages IV-8 to IV-9
- Water pages IV-15 to IV-33
- Soil pages IV-37 to IV-42
- Vegetation pages IV-43 to IV-52
- Old Growth pages IV-53 to IV-58
- Wildlife and Fish pages IV-59 to IV-81
- Cultural and Historic Resources pages IV-82 to IV-88
- Roadless Areas pages IV-106 to IV-110
- Recreation and Visual Resources pages IV-92 to IV-105
- Social & Economic pages IV-128 to IV-132

The effects analysis for the significant issues spans several resource areas. Table 2.11 provides a summary for comparison purposes.

Soils

Geomorphic Background

The Upper East Fork of the Lewis River is a geologically unique area of the Gifford Pinchot National Forest due to the amount of mineralization that has occurred in the Silver Star area. Geologically this area has been intruded by a pluton (an igneous intrusion that solidified slowly, causing minerals to form separately). This pluton dates back about 20 million years. The volcanism in this area also formed numerous pipes, or vertical conduits beneath volcanoes. These pipes are usually filled with volcanic breccia and fragments of older rock. As a zone of high permeability, it is commonly mineralized. The numerous mining claim holders in this area (over 300 valid claims) are primarily interested in copper, silver, zinc, lead, and molybdenum. Mining in the area can be traced back to the late 1800s.

Volcanism in the rest of the basin has formed numerous flows of andesite and pyroclastics, as it has in other areas of the forest. This material is more than 24 million years old. The pyroclastic material shows some weathering but has not produced the stability problems noted in other watersheds. Mass wasting potential for the Upper East Fork is low to moderate. Folding and faulting of this material along with glacial activity which is evident in the higher elevations has helped create the landforms seen today.

Soils in the area are thin and not very productive. This is presumably due in part to the loss of organic matter and soil erosion that occurred in response to the numerous fires that occurred in the drainage during the early 1900s. However, field observations have found that soils in unburned areas are also thin, suggesting that soils in the Upper East Fork Lewis River Watershed are naturally thin (USFS 2002(c)).

Current soils information for this project area was collected on a site-specific basis and documented in the *Soils Resource Report for the Tee Timber Sale* (Tee Timber Sale analysis file). Soils of the project area were mapped as part of the *Gifford Pinchot National Forest 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 consistent with timberland suitability classification (Forest Service Manual (FSM) 2415.2).

Approximately 60 percent of the soils affected in the project area are less than 3 feet deep, with a thin, gravelly, sandy loam layer over a thin layer of gravelly loam. Seventy-seven percent of the proposed units are on slopes greater than 30 percent. Coarse rock fragment percentages affect soil characteristics such as water holding capacity, productivity, fertility and stability.

Soil Productivity

Existing Condition

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.

Representative samples of each proposed unit were visited on the ground to evaluate compacted skid trails and landings. In the areas occupied by existing landings and skid trails the soils have been converted to an essentially non-productive condition in the long term (greater than fifty years). National Forest system roads were estimated using GIS analysis and include roads within and adjacent to each unit boundary. System roads currently occupy between 1.2 and 10 percent of the proposed units.

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 productivity has been reduced where ground-based skidding operations displaced organic surface layers or caused deep compaction. Most of the precipitation that falls on the compacted surfaces becomes surface runoff.

As summarized in Table 3.2, detrimental conditions are presently limited to less than 20% of the activity area, and so are within Forest Plan standards for soil quality.

Table 3.2. Approximate extent of detrimental soil conditions currently in Tee Timber Sale units and helicopter landings - existing condition.

Unit	Acres	System roads, (%)[2,3]	Skid roads and landings[4] (%)	Total detrimental soil conditions (%)
22	16	9.7%	3.9%	13.6%
29	41	9.0%	1.2%	10.3%
40	19	9.3%		9.3%
41	15		8.9%	8.9%
5	11	6.0%	2.3%	8.2%
27	7	5.5%	1.8%	7.3%
19	32	6.3%	0.8%	7.0%
37/38/39	20	5.2%	1.4%	6.7%
36/42	23	5.4%	1.1%	6.5%
11	14	4.6%	1.8%	6.3%
23/24	14	4.5%	1.8%	6.3%
35	14	3.8%	1.8%	5.5%
45	40	4.6%		4.6%
20	28	2.6%	1.8%	4.4%
18	22	4.1%		4.1%
2	20	3.9%		3.9%
1	32	3.3%		3.3%
50	32	3.0%		3.0%
31	56	2.2%	0.4%	2.7%
4	28	2.7%		2.7%
32	27	2.6%		2.6%
21	16	1.4%	0.8%	2.2%
6	23	0.8%	1.2%	2.0%
7	10	1.7%		1.7%
26	48	1.6%		1.6%
46	39	1.6%		1.6%
28	51	0.8%	0.2%	1.0%
43	20	0.8%		0.8%
25	35	0.6%		0.6%
44	77			0.0%
8	57			0.0%
47	49			0.0%
16	38			0.0%
9	32			0.0%
48	28			0.0%

[2] Assuming a 30 foot (9.1m) road width
[3] Where units share a system road, the acreage was divided between them.
[4] Assuming landings are a quarter acre (18m radius) and temp road are 20 foot (6.1m) wide

Unit	Acres	System roads, (%)[2,3]	Skid roads and landings[4] (%)	Total detrimental soil conditions (%)
30	25			0.0%
49	18			0.0%
10	3			0.0%

Direct and Indirect Effects of Alternative A, B, and C

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

Under all of the action alternatives, the standards and guidelines for soil productivity would be achieved in all activity areas.

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

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

Soil impacts would not exceed Forest Plan standards and guidelines of 20 percent of the project units, including existing skid trails. Locally concentrated losses in soil productivity would occur due to additional compaction and displacement. The extent of soil disturbance to areas previously undisturbed is expected to be less than 2.4 percent of any activity area with the prescribed logging system design (Table 3.3).

Units 5 and 40, proposed for tractor logging in all three action alternatives, would have a high potential for compaction on the gentle slopes where soil mapping unit 94 is delineated (Figure 3.1). If all ground based equipment trails are not subsoiled in these units, there would be potential for long term loss in soil productivity.

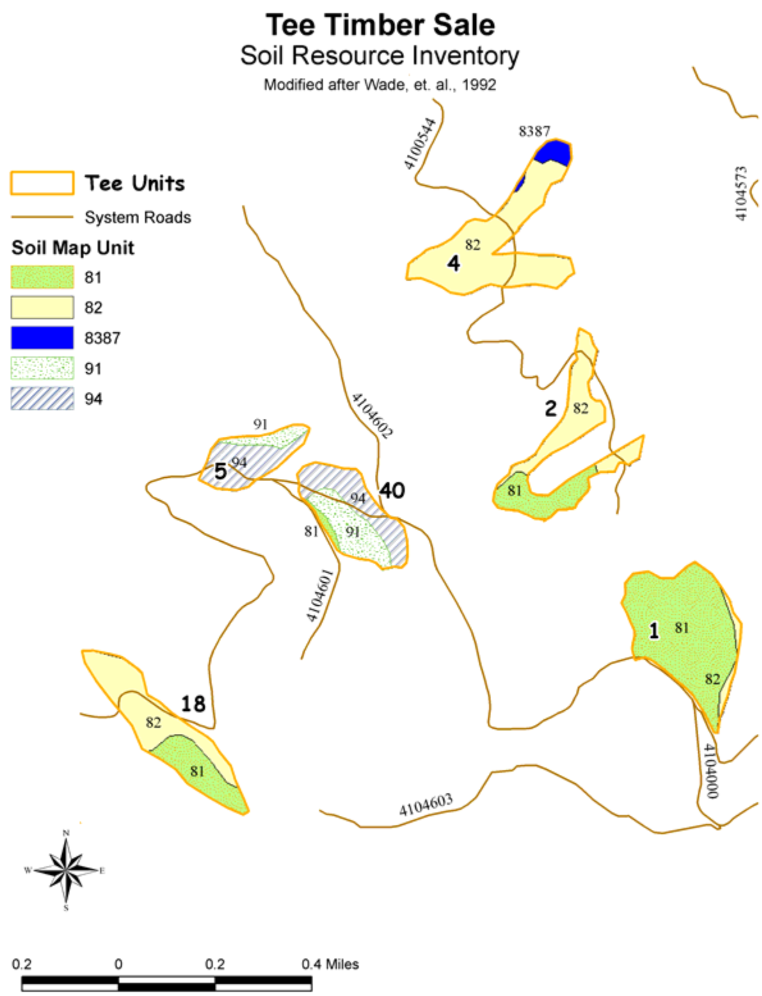

Figure 3.1. Soil Map of Tee Timber Sale Units 1, 2, 4, 5, 18 and 40 (southeast ¼ of project area).

Fuels Treatment

Localized severe burning in large slash piles may result in nutrient loss through volatilization and potentially from accelerated leaching. Local observations of large machine-piled slash piles have often shown signs of severe burning compared with smaller hand piles. Water-repellency would also be induced which may lead to increased erosion.

Slash burning would not be a concern because the extent of burning in the activity areas would be relatively small—less than 0.2 percent of each activity area (Harm, personal communication). The distribution of these piles would be spread out across the units, which further reduces the potential for negative impact. Limiting slash burning to periods of adequate soil moisture and re-seeding large (> 100 square feet) slash piled would further reduce the impact of slash burning to soils and the organic layer.

Severe burning is not analyzed as an effect on soils on landings because of the overriding impact of the landing construction and associated use. Therefore consideration or calculations of soil disturbance due to burning do not include piling or burning slash on landings.

Soil Compaction

The moderate risk of compaction rated by the soil mapping units would be limited by the pre-designating skid trails, restricting equipment operations to designated skid trails or slash beds. In addition, subsoiling following equipment operations 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 roads and landings would be restored to accelerate their recovery and reduce losses in soil productivity.

Road decommissioning proposed in Alternative B is taken into account because of the restoration of compacted soil conditions on the road surface, i.e. subsoiling and seeding.

Table 3.3. Prediction of remaining detrimental soil conditions due to proposed road and landing construction (refer to Soils Resource Report, Appendix B: Calculations and Assumptions).

	Alternative A	Alternative B	Alternative C	Alternative D
New construction, roads & landings (range of %, each unit)	Up to 2.2 %	0%	Up to 1.2%	0%
Fuels treatment – machine piling and burned area	Up to 0.2% (0.14 ac)	Up to 0.2% (0.14 ac)	Up to 0.2% (0.11 ac)	0%
Cumulative Disturbance before mitigation	36.9 acres total	32.5 acres total	33.1 acres total	0
Predicted compaction, post-mitigation	Same as existing condition, 31.7 acres total.	Net decrease of 1.7 acres of compacted soils after road decommissions, 29.4 acres total.	Same as existing condition, 31.7 acres total.	N/A

Up to approximately 2.4 percent of the activity areas would involve disturbance of fresh soils for Alternative A, 0.2 percent for Alternative B, and 1.2 percent for Alternative C. 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. Suboiling and reseeding would rehabilitate compaction from the construction and use of temporary roads in all proposed activities. Therefore, there would be no net loss in soil productivity 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 moderate in intensity, except for Unit 5 (Figure 3.1) located on soil mapping unit 94, where losses would be higher intensity. The losses would vary with time (Table 3.4). This could translate to similar effects on soil productivity, however the project design criteria for the action alternatives and application of mitigation measures as described in Table 2.9 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	Moderate to High	Relatively small
Long term, more than 50 years	Insignificant (not measurable) to Low	Relatively small

Conditions in disturbed areas would be 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 would not greatly deplete nutrients. Losses would tend to be associated only 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.

Tractor Logging

Unit 5 would machine pile 10 acres of slash. Slash would be placed on the ground for equipment to travel over. This would offset the risk of causing compaction by cushioning the weight of machinery as the slash is crushed. Assuming a grapple pile machine needs to travel throughout the unit where slash is on the ground, a large percentage of the activity area could be impacted. Monitoring of soils post treatment has shown little or no compaction after two to three passes of equipment over the same spot, especially when cushioned by slash.

Because ground based equipment would only work on previously disturbed roads and landings in Unit 40, no risk for further detrimental soil conditions would be expected.

Because of the soil type, the potential risk of soil compaction would be high causing a loss in soil productivity and exceeding the Forest Plan standards and guidelines for detrimental soil conditions of 20 percent of the activity area. However, the likelihood of exceeding the standards would be low if the design criteria for action alternatives and mitigation measures are followed to limit the risk.

Direct and Indirect Effects of Alternative A, B, and C

Alternatives A and C would result in similar amounts of soil disturbance, while Alternative C would result in less soil disturbance. Because of the road decommissioning, Alternative B would result in less detrimental soil conditions than any of the other Alternatives, including the No Action alternative. Although none of the three action alternatives would increase the amount of detrimental soil conditions already existing, they would all pose about the same amount of risk to the soils resource in each unit.

Direct and Indirect Effects of Alternative D

The No Action alternative would result in the same amount of detrimental soil conditions as Alternatives A and C.

Slope Stability

Existing Condition

Mass wasting in the Upper East Fork Lewis River Watershed is characterized by three main processes: shallow, rapid landslides, soil creep and slower shallow landslides, and very infrequent but chronic, deep-seated failures. Pacific Watershed Institute (PWI) conducted a landslide analysis in the Upper East Fork Lewis River Watershed (PWI 1998), the results of which are summarized below.

The PWI inventory reported 87 landslide and soil-creep/landslide sites, which were identified in the field and/or from aerial photographs (flight year 1958, 1959, 1975, 1995 and 1997). Eighty-three percent of the landslides in the upper East Fork drainage are debris avalanches or shallow, rapid landslides. Approximately 16 percent may be characterized as soil creep and slower shallow landslides. Only a small number (1%) were characterized as chronic, deep-seated failures that have occurred sporadically over the past century. A large landslide feature on the north side of the mainstem channel (RM 35) appears to have been active during and prior to the 1902 fires. It was reactivated during 1958 based on aerial photo interpretation. The landslide is bisected by Forest Road (FR) 42, and is deposited in the river as a debris fan that has been reworked by the river, and appears as a point bar.

The majority of landslides (59%) appeared to be activated (or reactivated) by stand management activities associated with timber harvest or salvage of fire-impacted stands. It is possible that fires, with subsequent destabilization by management activities, initially disturbed some percentage of these landslides. Recent failure activity detectable in aerial photos (bare erosion surfaces and debris tracks), and evidence of mechanical site disturbance (stumps embedded in failure plane, skid or yarding trails intersecting the failure, etc.) indicated landslides that were associated with management activities (PWI 1998).

Twenty-five percent of landslides were associated with road construction, side-cast failure, or collapse of the road prism; four percent were attributed to natural causes, and ten percent were of unknown origin. Most landslides occurred in steep terrain (>60%) slope, and with convergent topography. These areas were usually associated with hollows at stream headwalls, incised channels, and seepage swales.

Most landslide events appear to have coincided with management and salvage activities that occurred during the 1950s, with a smaller pulse sometime between 1975 and 1995. This information is limited to available aerial photo flight years 1958, 1959, 1975, 1995 and 1997. PWI (1998) surmised that most areas prone to fail have already done so with the exception of road-related failures that are expected to occur as unmaintained roads and roads built on side-cast continue to age beyond their design life.

Figure 3.2 displays unstable and potentially unstable as mapped in GIS, and known landslide locations that were identified in the PWI report. The Copper Creek subwatershed was not included in the landslide analysis, so the lack of any observed landslide scarps in that subwatershed should not be taken as an indication that no landslides have occurred there.

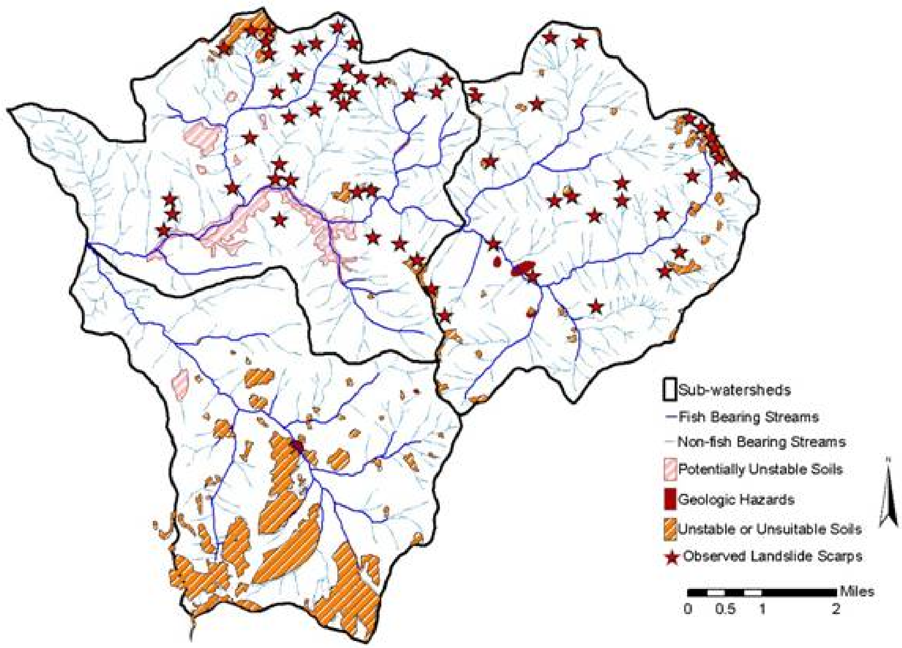

Figure 3.2. Potentially unstable soils, geologic hazards and historical landslide scarps in the Upper East Fork Lewis River Watershed. Landslide scarps are from PWI (1998), mapped potentially unstable soils, identified unstable soils and geologic hazards are mapped in the USFS GIS system. In this analysis area, slope stability is a concern where slopes are delineated as potentially unstable in the Soil Resource Inventory (Wade, *et al.* 1992).

Direct and Indirect Effects of Alternative A, B, and C

Soil mapping identifies potentially unstable slopes within Unit 4, which is mapped as soil mapping unit 8387 (corporate GIS layer) and in Unit 29. Field investigations only found this condition on north-northwest facing slopes in the area. The amount of soil mapping unit 8387 within Unit 4 represents about half of the 2.1 acres (as currently mapped in GIS). No road construction is planned on that portion of the unit.

The risk of increasing landslide frequency or magnitude in Units 4 and 29 would be relatively low due to the nature of the prescription and delineation of the unit boundaries.

In Unit 4, the silvicultural prescription calls for a relatively close spacing that would leave enough live tree roots to hold the soil in place. These factors should 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.

A qualified, experienced earth scientist identified unstable and potentially unstable land during field surveys within Unit 29. 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.

Unit 29 is delineated around an area with signs of soil mapping unit 89, which is a potentially unstable soil type. However, the soils have not been associated with landslides nearby, and the unit has been marked to avoid those features that would suggest potential instability. As currently delineated, the proposed activities within Unit 29 would be located on stable ground.

No road construction or timber harvest activities are planned in the areas described above in any of the alternatives—this includes areas in Units 4 and 29. There would be no change in the rate, size, or number of mass failure events due to the proposed actions.

Direct and Indirect Effects of Alternative D

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

Soil Organisms/Soil Biology

Existing Condition

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.

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.

Soil dwelling organisms are not specifically addressed by standards and guidelines at either Forest or Regional levels.

Direct and Indirect Effects of Alternative A, B, and C

Magnitude, duration and intensity of effects to soil dwelling organisms from fuels treatment are likely to be similar to that of soil quality effects listed for Soil Productivity (page 26). Knowledge of specific fungal, bacterial, and arthropod populations is not available for analysis in this project.

Logging and site preparation could affect the numbers of species and abundance of soil organisms. Within Unit 5, where the risk of soil compaction is high, there would be similar risks to soil organisms as those described for soil productivity. The mitigation measures for soil (Table 2.9) are designed to protect soil productivity would also protect soil organisms and their habitat.

Soil compaction, lack of vegetation, or lack of plant litter covering the soil surface would tend to reduce the number of soil arthropods (USDA 2002(d)). 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 and Lewandowski 2001, Chapter 2).

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

Limiting the degree and extent of the effects listed above would provide protection for the majority of the populations of soil organisms within the activity areas. These effects would be temporary and recover naturally after restoration efforts (subsoiling and seeding/planting). Magnitude, duration and intensity of effects to soil dwelling organisms would likely be to be similar to that of soil quality effects listed above (Table 3.3 and Table 3.4).

Long Term Effects- more than 50 years

Populations of soil dwelling organisms would have essentially recovered in fifty years. Restoration by subsoiling, fertilization and revegetation, which was intended to accelerate recovery of soil productivity, would improve conditions in disturbed areas. The organisms then could re-colonize the disturbed areas when conditions become favorable.

Cumulative Effects

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

Past, Present, and Proposed Actions

The proposed activities (with incorporated design features), in combination with past or reasonably forseeable future actions on nearby federal land and adjacent private land, would be not likely to increase the amount of detrimental soil conditions already existing. Soil disturbance from natural events and past management activity are summarized in the Existing Condition for Soil Productivity. Roads represent the greatest amount of detrimental permanent soil damage.

None of the Divot Timber Sale units (Table 3.1) coincide with units of the proposed action. Areas of previous harvest that do coincide with Tee harvest units would be expected to decrease detrimental soil conditions by restoring re-used skid trails and landings according to the design features of the action, which would result in improved soil productivity.

Relative to the other proposed actions in the Tee Timber Sale, Alternative B would cumulatively improve soil productivity at the watershed scale, mostly due to the restoration activity that reduces soil compaction in the process of road decommissioning. The combined effects of current disturbances and the proposed activities are addressed above.

Foreseeable Activities

Foreseeable activities in the project area includes 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 due to the restoration activity that reduces soil compaction in the process of road decommissioning. Other activities would neither increase nor significantly decrease soil productivity or populations of soil dwelling organisms.

The action alternatives combined with all past, present, and reasonably foreseeable management activities would affect soil productivity in the project area. Forest Service activities would meet standards and guidelines for maintaining soil productivity through proper implementation of project design features and mitigation measures during and following project activities.

Hydrology

The following is summarized from the Hydrology Report, Analytical Process, and the Fisheries Biological Assessment for Tee Timber Sale. These reports are available in the Tee Timber Sale project file.

Watershed Characterization

The Tee analysis area includes an area of National Forest lands and other ownership lands within the Upper East Fork Lewis River drainage and its tributaries. The "analysis area" for aquatic resources refers to the two 6th field subwatersheds in which project activities are focused—Upper East Fork Lewis River, and Copper Creek. Where necessary, information is also provided for the Headwaters East Fork Lewis subwatershed to better characterize the entire drainage. The analysis area covers 30,468 acres and ranges in elevation from 1,000 feet in the western downstream part of the watershed to 4,442 feet at the summit of Green Mountain.

Table 3.5. Analysis area subwatersheds

6th Field HUC Name (Number)	Acres
East Fork Lewis Headwaters (170800020501)	9,541
Upper East Fork Lewis (170800020502)	11,270
Copper Creek (170800020503)	9,657
Entire upper East Fork watershed	**30,468**

There are a total of approximately 288 miles of stream in the upper East Fork Lewis River watershed, including all Forest Service System lands within the three 6th-field sub-watersheds considered in this analysis. Eight miles of the East Fork Lewis River on national forest lands within the analysis area is considered Class I. This portion of the East Fork is considered Class I because it supports anadromous fish and supplies flow to domestic water uses downstream of Forest System Lands. There are no water withdrawals on National Forest; however, a well supplies water to the Forest Service housing unit at Sunset Falls. This segment of the river also provides the most important habitat for winter steelhead in the entire watershed (Washington State Conservation Commission 1999).

There are approximately 38 miles of Class II stream within the entire upper East Fork Lewis River watershed. These are stream reaches that support non-anadromous fish. Class II streams include the mainstem of Slide Creek, Snass Creek, Copper Creek, McKinley Creek, Little Creek, Green Fork, and the East Fork upstream of McKinley Creek. There are 12 miles of non-fish bearing perennial streams (Class 3) and 173 miles of intermittent (Class 4) streams within this area.

Water quality is generally good in the watershed, with the exception of water temperatures which have been found to exceed state water quality standards. As a result of temperature exceedances, the East Fork Lewis River was included on the 1998 303(d) list of streams not meeting state water quality standards. A Water Quality Restoration Plan and associated TMDL were completed for the East Fork Lewis watershed by the USFS and Dept of Ecology in 2002.

Results of the Pacific Watershed Institute landslide analysis (PWI 1998) indicated that the East Fork Lewis River watershed was sediment supply-limited due to various factors including depletion of sediment sources due to fire and subsequent salvage-related landslides, naturally thin soils, recent low landslide rates, and the observation that gravels are not plentiful naturally. The estimated sediment size fractions observed in landslides included cobbles and boulders (40%), silt and sand (35%), and very course gravel (25%).

Current stand conditions within the watershed are a result of a variety of disturbances. Fire has been the most significant and pervasive disturbance process in the watershed over the past century as described in previous sections.

Following the fires of the early 1900's, most areas were strategically planted to assure adequate reforestation of the area. Between 1902 and 1929, approximately 3500 acres were planted; from 1929 until present about 15,000 acres have been planted.

The result of these reforestation activities together with natural vegetation development is a watershed that has conifer dominated stands between 41 and 80 years of age (70%) with 30% of the stands greater than 80 years of age. Hardwood communities have developed significantly along streams and wet areas where they presently dominate over a highly scattered conifer component. The 41 to 80 year old age class represents approximately 45 to 50 percent of the forested landscape with younger age classes (1–40 years) representing about 20 percent and older age classes (81+ years) representing about 32 percent of the forested landscape located on national forest. Figure 3.3 provides a more specific breakdown of these age classes.

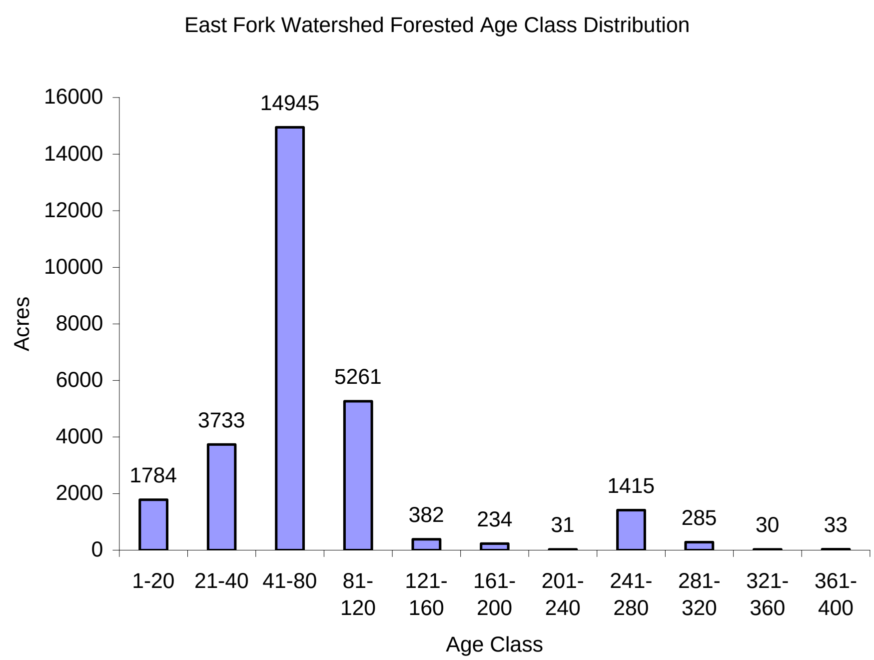

Figure 3.3. Upper East Fork Lewis River Watershed current age class distribution.

Stocking levels within the 10 to120 year-old forested stands are important in forested stand development. Densely stocked stands typically develop with a much smaller average tree diameter, shorter tree crowns and are less structurally stable than stands which are more open. Less dense stands or open stands typically will have longer crowns and therefore more and larger limbs, have larger diameters and be more structurally stable.

Stands within the East Fork Watershed have varying degrees of density. While young stand thinning has occurred in some of these stands, others have developed under relatively dense conditions with no artificial thinning and little natural thinning. Natural thinning is occurring in many ways. Disease or insects vectors have killed small numbers of trees and created small gaps that have allowed shade tolerant conifers or shrubs to enter the understory. In high-density forested stands, increased competition for light, water and nutrients cause intermediate and suppressed trees to decline and eventually die due to competition with adjacent dominant and co-dominant conifers. Other stands that were lightly stocked consist of widely spaced open grown conifers with shrub and hardwood growing in the understory. Conifers in these types of stands typically have longer crowns and larger limbs due to growth under open conditions.

Forest canopy cover densities vary throughout the watershed. In young stands, canopy cover can be as low as 10 percent; and in older stands can exceed 80 percent. Analysis of Current Vegetation Survey (CVS) Data shows an average canopy cover forested stands within the watershed of 60 percent with a range of 35 to 75 percent. This was for stands greater than 20 years of age (USFS 2002(c)).

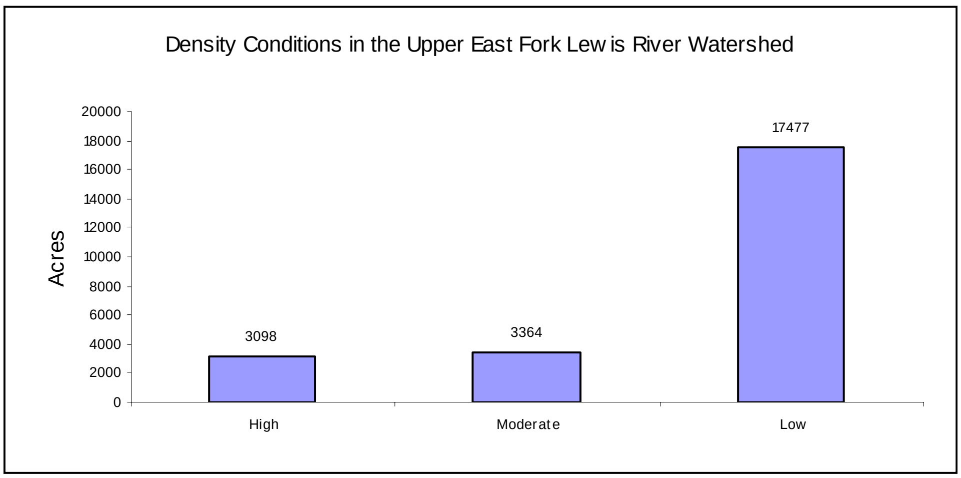

Figure 3.4. Acres of stands with high, moderate or low density within the Upper East Fork Lewis River Watershed.

Riparian Reserves

Existing Condition

Forest conditions within riparian areas change over time in response to development of the stands and disturbance processes including fire, flooding, mass wasting or insects and disease. Fire was probably the disturbance process that most commonly affected stand-level forest conditions including seral class in the East Fork Lewis River watershed. The proportion of riparian forests in late successional condition was thought to historically range from 50 to 85 percent in the Lewis River watershed, based on the Regional Ecosystems Assessment Process Report (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(c)). Currently, about four percent of the Upper East Fork of the Lewis River watershed stream riparian areas is in single and multi-layered large tree (late successional) stands.

The REAP report (1993) also estimated between four percent and 12 percent of the Lewis River watershed stream riparian areas were historically in early successional conditions. Currently nine percent of the stream riparian areas are in early successional stages (grass/forb/seedling), and 25 percent are in hardwoods.

Structure and composition of forest stands within Riparian Reserves of the analysis area have been strongly influenced by the fire history within the watershed. Approximately 3 percent of the Riparian Reserves are in late-successional structure stages, 27 percent are in hardwoods, and 70 percent are in early to mid-successional structure stages. Table 3.6 lists grouped structure stages within Riparian Reserves, by sub-watershed.

Table 3.5. Grouped riparian reserve vegetation structure stages in the Upper East Fork Lewis River Watershed. Percentages are based upon the amount of Riparian Reserve within each sub-watershed.

Riparian Structures	Headwaters East Fork	Upper East Fork Lewis *	Copper Creek*	Watershed Totals
Grass/Forb	100	10	20	130
Dry Meadow	12	0	67	79
Wet Meadow	22	0	0	22
Shrub/ Seedling	201	154	79	434
Open Sapling/ Pole	61	102	49	212
Closed Sapling/Pole	329	360	129	818
Open Small Tree/Light Forest	255	250	220	725
Closed Small Tree	669	738	469	1876
Large Tree Single Story	111	16	33	160
Large Tree MultiStory	22	0	3	25
Hardwoods	569	775	544	1,888
Non Forest (Rock)	24	56	213	293
Totals	**2,375**	**2,461**	**1,826**	**6,662**

*USFS lands only in these subwatersheds.

Aquatic Habitat Fragmentation

One of the key objectives of Riparian Reserves is to protect and provide connectivity of instream and riparian habitats. Roads and culverts not only have the potential to block upstream migration of resident and anadromous fish, but can also alter the flow pattern of large wood, organic material and gravels through the system. In addition, roads and culverts also have the potential to fragment aquatic habitat for aquatic organisms other than fish, including amphibians and invertebrates.

An inventory of culvert barriers was conducted in the anadromous fish bearing streams in the watershed during 2002. Two culverts inventoried in the basin were determined to be barriers to anadromous fish. There are also eight culverts in the Copper Creek sub-watershed that are considered to be barriers to resident fish, including cutthroat trout. Barriers to fish passage are discussed in more detail under the “Physical Barriers” section of the fisheries analysis.

Large Woody Debris

Another essential purpose of Riparian Reserves is to provide for long term supply of Large Woody Debris (LWD) to streams and aquatic environments. Large wood was removed from stream channels and adjacent riparian areas within the Upper East Fork Lewis River Watershed through successive salvage logging operations following fires, which began during the 1930s and occurred periodically for over three decades (USDA 1995). Large wood was also removed from stream channels during the early 1980s when all debris jams were mistakenly interpreted as fish migration barriers. In addition, a portion of the large wood has been transported out of the system through periodic high flow events such as the 1995/1996 floods. A small amount of large wood designed to enhance fish habitat was added to the East Fork in the Sunset Falls area and Slide Creek in the early 1980s. Boulders and wood were also placed in side channels along the Green Fork during this time period.

The current recruitment potential of large wood from the riparian areas into the stream system is a concern due to past fires, subsequent salvage logging practices, and existing road systems. As reported in the first iteration of the Upper East Fork Watershed Analysis (USDA 1995), 19 percent of the riparian areas have a “low” potential for current large wood recruitment, 68 percent have a “moderate” potential for current large wood recruitment, and 13 percent have a “high” potential for current large wood recruitment (USDA 1995).

Direct and Indirect Effects of Alternatives A and C

Approximately 67 acres of Riparian Reserves would be thinned under Alternatives A and C. Table 3.7 summarizes the Riparian Reserve widths, proposed treatments, and logging systems for units that include riparian thinning. Some proposed thinning units include more than one stream as noted in the table. Riparian Reserve widths and untreated buffer widths differ between streams as a result of site conditions.

Table 3.7. Riparian treatments under Alternatives A and C of the Tee Timber Sale.

Unit	Stream Class	Riparian Reserve Width	Untreated Buffer Width	Acres Riparian Reserve Thinned	Target Canopy Cover (%)	Logging System in Riparian Reserves
6	I	340	170	3	40	Helicopter
18	IV	170	50	(see below)	50	Skyline
18	II	340	170	5 (total)	50	Skyline
19	II	340	170	8	40	Helicopter
26	II	340	170	5	40	Helicopter
27	III/IV	170	100	1	50	Helicopter

Unit	Stream Class	Riparian Reserve Width	Untreated Buffer Width	Acres Riparian Reserve Thinned	Target Canopy Cover (%)	Logging System in Riparian Reserves
28	II	340	170	(see below)	50	Helicopter
28	III/IV	170	50	14 (total)	50	Helicopter
31	III/IV	170	100	7	50	Helicopter
32	III/IV	170	100	3	50	Helicopter
35	II	340	170	(see below)	50	Skyline
35	III/IV	170	100	2 (total)		Skyline
36/42	III/IV	170	100	1	50	Skyline
37	III/IV	170	170 (west strm)	0	50	n/a
37	III/IV	170	100 (east strm)	4	50	Skyline
44	II	340	100	14	50	Skyline
Total				**67**	**--**	

In general, thinning prescriptions within Riparian Reserves are expected to result in variable canopy densities. Nearest the stream, canopy cover will remain as it is currently because there would be no thinning. This untreated buffer ranges in size from 50 to 170 feet, depending on site conditions. Site conditions that influenced the width of untreated buffers include: existing stand density, tree sizes and species composition, slope of near-stream areas and size of the stream. These untreated buffers along all streams will protect the immediate area along streams from a number of potential effects including direct and indirect impacts to channel functions or instream habitat, water temperature, sediment filtering, nutrient and detritus inputs, soils and ground cover, and microclimate. Connectivity and habitat protection within these core areas of the Reserves will be maintained.

Thinning occurring outside of the untreated buffers but within 170 feet of any stream would be designed to result in canopy cover of 50 percent or more. Treated riparian areas between 170 and 340 feet from fishbearing streams would be thinned to a 40% canopy cover to maximize the increased growth benefits of thinning. Effects of the thinning would be greatest in the outer portions of Reserves where the most 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 Reserves. This 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 re-coalesce following thinning treatments the microclimate within the Reserves would begin to recover to pre-treatment levels. This is estimated to occur over a period of 5 to 10 years (pers comm. Bruce Holmson, Silviculturist, March 17, 2006). Over time, the 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 one to two inches in diameter as compared to trees in untreated stands (pers comm. Bruce Holmson March 17, 2006). The thinning treatments within riparian stands are also expected to increase structural and species diversity within these stands.

A total of 67 acres of Riparian Reserve are proposed for treatment under Alternatives A and C. This represents approximately 1.3 percent of the Riparian Reserves in the Upper East Fork Lewis River subwatershed, and 0.9 percent of the Riparian Reserves in the Copper Creek subwatershed.

Direct and Indirect Effects of Alternatives B and D

There are no riparian treatments proposed under Alternatives B and D. As such there would be no short term negative effects and no long term beneficial effects to Riparian Reserves under these alternatives. Riparian forests would continue to grow at rates following their current trajectory. Dense riparian forest stands would remain dense until some natural thinning process and/or differentiation of the stand occurs. The mix of species in riparian areas would slowly change as senescence occurs in existing hardwood stands and as other species slowly become established and develop.

Cumulative Effects of Alternatives A, B, C and D

There are no other known riparian treatments occurring in the East Fork Lewis subwatershed and no cumulative effects of this project to Riparian Reserves.

Road Density and Location

Existing Condition

There are a total of approximately 121 miles of road within the entire upper East Fork Lewis River watershed. Because roads can act to impede surface water infiltration, intercept subsurface flows, and provide a direct surface linkage for delivering water to stream channels, the road network can substantially increase the natural drainage density of a watershed. By changing hydrologic flow paths, roads can contribute to changes in the hydrologic performance of the watershed, and can be significant sources of fine sediment in streams draining heavily roaded watersheds. Table 3.8 summarizes the current road densities in the analysis area.

Table 3.8. Road density by sub-watershed, National Forest System Lands only.

Sub-watershed	Road Density National Forest
Headwaters East Fork	2.3 mi./sq. mi.
Upper East Fork Lewis	3.4 mi./sq. mi.
Copper Creek	2.4 mi./sq. mi.

The Upper East Fork Lewis subwatershed has the highest road densities within National Forest lands in the analysis area. Road densities on private forest lands are often higher than those found on the National Forest, so it is possible that the total road density in both the Copper Creek and Upper East Fork Lewis subwatersheds is somewhat higher than reported here because there are portions of those drainages that lie on private lands. Roads throughout the analysis area occupy a range of positions from following ridgelines to paralleling streams along valley bottoms, and crossing mid-slopes.

Table 3.9. Road summary by subwatershed in the Tee analysis area, National Forest lands.

Sub-watershed	Area (mi^2)	Road mileage	Road density (mi/mi^2)	Stream crossings
East Fork Lewis River Headwaters 170800020501	14.9	35.0	2.3	68
Upper East Fork Lewis River 170800020502	15.2	51.8	3.4	121
Copper Creek 170800020503	14.0	33.9	2.4	56
Entire upper East Fork Lewis River watershed	**44.1**	**120.7**	**2.7**	**245**

Direct and Indirect Effects Common to All Alteranatives

No new permanent road would be constructed under any of the alternatives. Alternatives A and C would construct temporary roads to access landing and thinning units, and Alternative B would decommission approximately 8.5 miles of road. Table 3.10 summarizes road treatments under all alternatives.

Table 3.10. Miles of road construction and decommissioning proposed under each alternative.

	Alt A	Alt B	Alt C	Alt D
New Road Construction (miles)	0	0	0	0
Temporary Road Construction (miles)	1.9	0	0.5	0
Road Decommission (miles)	0	8.5	0	0

Direct and Indirect Effects of Alternatives A and C

Road density and location would be unaffected by this project over the long term. The temporary roads constructed under these alternatives would be eliminated at the end of the project by scarification, waterbarring and revegetation. None of the temporary roads would cross surface streams, aquatic feature, or Riparian Reserves. All existing ("system") roads would remain in place.

Direct and Indirect Effects of Alternative B

Road density would be reduced by the decommissioning of approximately 7.1 miles of road in Upper East Fork Lewis River subwatershed, and 1.4 miles in the Copper Creek subwatershed. Road densities would change from 2.4 miles/square mile in the Copper Creek subwatershed to 2.3 miles/square mile, and from 3.4 miles/square mile in Upper East Fork subwatershed to 2.9 miles/square mile.

Direct and Indirect Effects of Alternative D

There would be no road construction or decommissioning under this alternative, and no change to road density or location.

Cumulative Effects of All Alternatives

There are no other known road construction or decommission activities in the analysis area, and no cumulative effects of this project on road density.

Increase in Drainage Network

Existing Condition

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 indicate increased peak flows (Wemple, *et al.* 1996). Table 3.11 displays road density and number of stream crossings within the Upper East Fork Lewis River Watershed.

Stream channel network extension estimates were based on a modification of methods described by Wemple *et al.* (1996). Table 3.11 lists estimated increases in the stream channel network that has occurred as a result of road building within each sub-watershed in the Upper East Fork Lewis River. 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. Drainage network increase based on culvert spacing, number of crossings and stream channel lengths. Numbers reflect National Forest System Lands only.

Table 3.11. Estimated drainage network increases within the Upper East Fork Lewis River Watershed.

Sub-watershed	Area (mi^2)	Drainage network length, miles		Drainage density, mi/mi^2		Percent change
		Streams (L_S)	Road-related extension (L_{RC})	Streams (D_d)	Total (D'_d)	
East Fork Lewis River Headwaters 170800020501	14.9	80.8	13.8	5.4	6.4	14.6
Upper East Fork Lewis River 170800020502	15.2	83.0	24.6	5.5	7.1	22.9
Copper Creek 170800020503	14.0	54.1	11.4	3.9	4.7	17.4
Total	**44.1**	**217.9**	**49.8**	**14.8**	**18.2**	**20.5**

Stream channel network extensions were highest in the Upper East Fork Lewis River sub-watershed with a 22.9 percent increase over the pre-management (and pre-road) drainage density condition. Most stream crossings occur in Little Creek, McKinley Creek, and Slide Creek (24, 23, and 30 crossings, respectively), where roads were extended sometime between 1959 and 1975. Stream channel network increases were 14.6 percent and 17.4 percent in the East Fork Lewis River Headwaters and Copper Creek, respectively. Most extensions in the East Fork Headwaters occurred within the Green Fork drainage.

Terracing that occurred following fires in the East Fork, Green Fork and Copper Creek headwaters represents another potential contribution to increases in the stream channel network. The objective of terracing was to provide planting opportunities during the extensive reforestation efforts following the fires that occurred during the early part of the 20th century. The effects of terracing on peak flows, stream channel network increases and soil productivity are unknown relative to the effects of intensive fires that occurred along ridgetops. However, evidence suggests that in some areas terracing has had a negative effect. Many terraced areas did not regenerate to trees and remain in a shrub successional stage. Additionally, Horton overland flow (HOF) has been observed along ridgetops (PWI, 1998), which occurs when precipitation rates exceed infiltration rates. Because HOF is not a common occurrence in undisturbed soils, this indicates the severity and persistence of past disturbances in these sensitive higher elevations of the watershed.

Direct and Indirect Effects of Alternatives A and C

Drainage networks would not be negatively affected by this project because no permanent roads would be constructed or decommissioned.

Approximately 1.9 miles of temporary road would be constructed under these alternatives. These roads would be located outside of Riparian Reserves, and as such are a minimum of 170 feet from any stream. Most of the temporary roads are on ridges or convex slopes, and as such would have very little accumulation of upslope drainage. Because these temporary roads do not cross streams and do not approach any stream closer than 170 feet, they are not likely to contribute to extension of the drainage network.

The probability of any portion of this project increasing the drainage network density in the watershed is so low as to be discountable. There would be no construction or decommissioning of any permanent roads. Any temporary roads constructed for logging this sale and that are not decommissioned prior to the wet season would be weatherproofed by construction of waterbars, crossdrains and grade breaks. This will ensure that surface waters do not concentrate on the road surface and contribute directly to increases in drainage network density.

Direct, Indirect and Cumulative Effects of Alternative B

Alternative B proposes to decommission 8.5 miles of road within the Tee planning area. The elimination of 8.5 miles of road would reduce or eliminate any drainage network extension that is currently caused by the roads that have been selected for decommissioning. Drainage networks in the East Fork Lewis River watershed have been extended throughout past decades by the construction of road systems that capture and route water through surface channels into natural streams. The decommissioning of roads under this project would reduce drainage densities in Copper Creek from 4.7 miles/square mile to 4.6, and in the Upper East Fork Lewis River subwatershed from 7.1 miles/square mile to 6.8.

Cumulative Effects of Alternatives A and C

These alternatives would not cumulatively affect drainage network density within the watershed.

Direct, Indirect and Cumulative Effects of Alternative D

No permanent or temporary road construction is proposed in Alternative D. This alternative would have no direct, indirect or cumulative effect on drainage networks.

Change in Peak/Base Flows

Existing Condition

According to streamflow records from the East Fork Lewis River near Heisson, WA gauging station, major flood events occurred on the East Fork Lewis River in 1931, 1934, 1972, 1978, 1986 and 1996. The February 8, 1996 flood was measured at 28,600 cubic feet per second (cfs) and was the largest flood on record at this station. This event along with most other large floods on the East Fork Lewis River had a strong component of rain-on-snow runoff contributing to the flood peak.

Annual peak flows on the East Fork Lewis River typically occur from November through March, with the highest of these typically occurring in response to heavy rains and rain-on-snow. Mean annual low flows occur in August, but the lowest flows of any given year can occur anywhere from July through September. The lowest flow on record at the Heisson gauging station occurred in September of 1967 at 30 cfs. Figure 3.5 summarizes monthly flow statistics from the Heisson stream gauge.

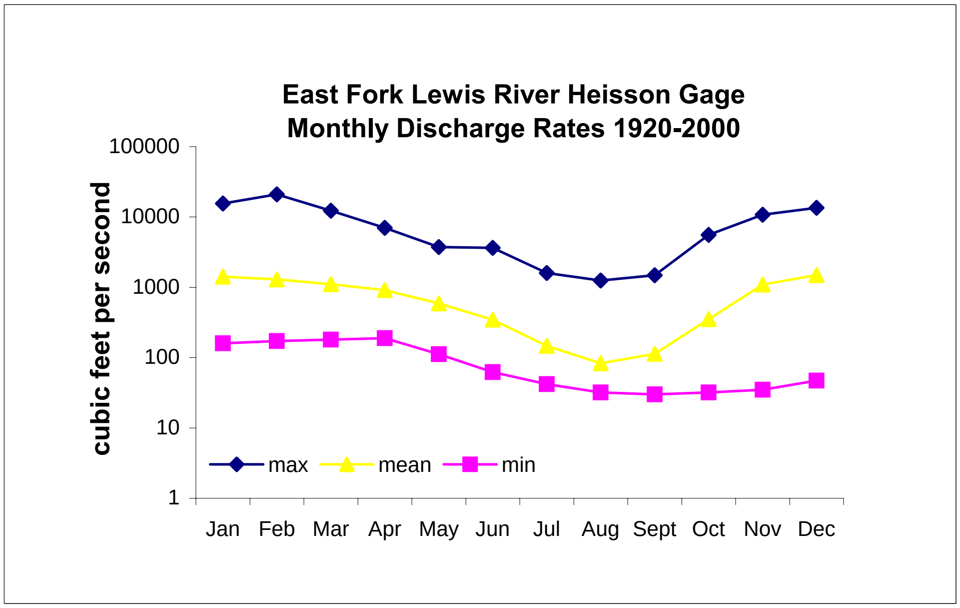

Figure 3.5. Maximum, minimum and mean daily discharge rates measured at the East Fork Lewis River USGS Heisson gauging station (no. 14222500).

Forest practices such as timber harvest and road construction can alter runoff processes by changing vegetation type and structure, and soil surface properties. Changes in processes such as evapotranspiration, soil infiltration rates and snow accumulation, distribution and melt rates have the potential to alter the frequency, timing and magnitude of peak flow events, which may result in direct impacts to aquatic and riparian environments adjacent to and downstream of the land use activity, on and off-forest.

A peak flow analysis was conducted by PWI (2002) using the State of Washington "Standard Methodology for Conducting Watershed Analysis" (1997), Hydrologic Change Module. The analysis predicts changes in discharge that may result from vegetation removal. GIS data were used for the analysis. Peak flows for individual drainages were modeled to isolate areas where changes in vegetation may contribute to cumulative effects associated with the amplification of peak flows (Table 3.12). The range in percentage values reflects the difference in potential discharge for an average or "normal" rain-on-snow event versus an unusual or "extreme" event.

Table 3.12. Potential peak flow increases due to current vegetation conditions and predicted rain-on snow runoff conditions during a 2 year, 24-hour runoff event. Discharges shown are for the outlets of the watershed and reflect the expected discharge from the entire drainage area upstream of the outlet point.

East Fork Lewis River Sub-watershed	Acres	Discharge, USGS[1] (cfs)	Peak Flow, Existing (cfs)	Peak Flow, Fully Forested (cfs)	Potential Peak Flow Increase
East Fork Headwaters upstream of Green Fork (170800020501)	4147	726	1338 – 1651	1285 – 1526	4.1 – 8.2%
Green Fork (170800020501)	3319	418	711 – 864	690 – 813	3.1 – 6.3%
East Fork Headwaters and Green Fork (170800020501)	9541	1056	2049 – 2514	1975 – 2339	3.7 – 7.5%
Upper EF tributaries Anaconda Snass McKinley Little (170800020502)	 1622 1243 1642 1723	 213 169 215 224	 322 – 409 267 – 323 321 – 399 314 – 381	 304 – 372 254 – 303 307 – 368 309 – 369	 5.9 – 9.9% 4.9 – 6.9% 4.3 – 8.5% 1.6 – 3.2%
Slide Creek	2807	344	573 – 720	546 – 657	5.1 – 9.6%

(170800020502)					
Upper East Fork and Headwaters (170800020501 and 170800020502)	20812	1995	4335 - 5341	4168 - 4964	4.0 - 7.6%
Copper Creek (170800020503)	9655	1017	2065 - 2617	1976 - 2415	4.5 - 8.4%
Upper East Fork and Headwaters, and Copper Creek (170800020501-03)	30467	2787	6401 - 7959	6143 - 7379	4.2 – 7.9%

[1]USGS discharge is based on USGS regression equations described in Sumioka et al (1998).
Values in parentheses reflect total drainage area including non-Forest Service lands.

The Washington State Forest Practices Board Hydrologic Change analysis assumes that the greatest likelihood of causing significant long-term cumulative effects on public resources is by altering forest hydrologic processes via the removal of vegetation, which influences winter snow accumulation and melt rates during rain-on-snow storm events.

Current watershed condition in terms of vegetation type and structure stage, and the physical characteristics of the watershed including elevation [relative to rain-on-snow (ROS) zone], area of catchment basin, historic trends and flood event frequency recorded in stream discharge records, and precipitation records are obtained from the Gifford Pinchot National Forest GIS database.

The model calculates snow accumulation as a function of elevation and forest cover, and snowmelt as a function of wind speed, temperature, elevation and forest cover. "Average" ROS conditions and "unusual" ROS conditions (deeper snowpack, warmer and windier conditions) are modeled. The water available for runoff (WAR) as a function of forest cover is calculated, which is the sum of additional water generated from snowmelt and baseline estimates of precipitation. Results are categorized according to storm intensity ("normal" or "extreme"), vegetative cover condition, and recurrence intervals (2 year, 10 year, 25 year, 50 year, 100 year). Vegetative cover conditions contain three categories including "fully forested" (hydrologically mature) "current condition" and "fully stocked with young forest" (hydrologically immature). Peak flows are calculated from the WAR values, predicting peak flow discharge by storm event frequency and watershed analysis unit.

East Fork Headwaters upstream of Green Fork (8.2%), McKinley Creek (8.5%), Slide Creek (9.6%) and Copper Creek (8.4%) had the highest maximum peak flow predictions. It is important to note that peak flow predictions are based on vegetation data available to the GIS database, which is limited to National Forest lands. The resulting values extrapolate vegetation data off-forest and onto the entire sub-watershed.

Direct and Indirect Effects of Alternatives A and C

General Effects

Thinning would occur inside and outside of Riparian Reserves in both the Copper Creek and Upper East Fork Lewis subwatersheds. Anadromous and resident fish are present in each of these subwatersheds, and in downstream reaches of the East Fork Lewis River and therefore would be exposed to any changes in peak or base flows caused by this project.

Vegetation manipulation can affect hydrologic processes at the stand scale, including changes in the interception of precipitation, changes in evapotranspiration, changes in snow accumulation, and changes in rates and timing of snowmelt. These hydrologic changes brought about by vegetation modification can affect the amount and timing of water that is available for runoff from a site, and thus can cumulatively affect streamflows. The degree to which these stand scale changes are manifested at the subwatershed scale in terms of changes in streamflow is dependent upon a number of factors related to both the extent and intensity of the forest manipulation, and characteristics of the site and subwatershed.

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 Tee planning area is in the elevation band that commonly experiences a mix of rain and snow through the course of the winter, or ROS 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. 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, particularly important during the summer months and at the onset of the fall and winter storm season. At the subwatershed scale, this stand-scale effect manifests in increased streamflow levels during the growing season, and increased peak flows during early season runoff events. In some cases, the initial increases in summer streamflow in the years after timber harvest can be followed by reduced low flow levels, as near stream areas become densely populated with hardwoods or phreatophytic vegetation (Hicks, *et al.* 1990).

The level of forest canopy removal that begins to materially 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.

Site-Specific Effects

Existing canopy cover in the upper East Fork Lewis River watershed including the Tee planning area averages 60 percent, and ranges from 35 to 75 percent in stands over 20 years old (USFS 2002(c)). Canopy cover has not been determined for all units included in the Tee 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 to 80 percent (author's personal observation). Thinning prescriptions under the proposed action call for leaving 40 percent canopy closure on all treated stands, except for those riparian stands that would be thinned to 50 percent closure. Based on the rationale provided in previous paragraphs, we assume that thinning the forest to a canopy closure of 40 percent may have some effects on the amount of water available for runoff, but that changes at the site scale would be moderated by the remaining forest cover, and not likely to get translated into measurable changes in stream discharge because of the complexities of water routing from hillslopes into nearby streams.

The proposed action includes thinning of 1,080 acres within the analysis area. This represents approximately 3.5 percent of the entire upper East Fork Lewis River watershed. At the 6th-field level, the proposed thinning treatments cover approximately eight percent of the Upper East Fork Lewis River subwatershed, and two percent of the Copper Creek subwatershed (Table 3.13). Based on the intensity of the proposed thinning treatments and proportion of the subwatersheds treated, the probability of this project measurably modifying peak or base flows is low in the Upper East Fork Lewis subwatershed, and so low as to be discountable in the Copper Creek subwatershed.

Table 3.13. Acres of treatment by subwatershed and percent subwatershed treated.

	Alt A	Alt B	Alt C	Alt D
Copper Creek—Total Acres	9,656	9,656	9,656	9,656
Copper Creek—Acres Proposed Thinning	214	214	214	0
Copper Creek--% Area Proposed for Thinning	2%	2%	2%	0%
Upper East Fork—Total Acres	11,270	11,270	11,270	11,270
Upper East Fork—Acres Proposed Thinning	891	776	891	0
Upper East Fork--% Area Proposed for Thinning	8%	7%	8%	0%

In a sensitivity analysis conducted on subwatersheds in the Wind River watershed, approximately five 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 (Mount Adams District Hydrology files). For each five 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 Tee analysis area, so results are presumed to be applicable to this analysis. However, because the Tee Timber Sale does not convert stands to an open condition, but leaves 40 percent canopy, 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 clearcut. Based on this, the magnitude of any changes in peak flows resulting from Tee thinning is estimated to be low and probably undetectable in the normal variation of streamflow levels found in these streams.

Direct and Indirect Effects of Alternative B

Alternative B proposes to thin approximately 901 acres in the Copper Creek and Upper East Fork Lewis subwatersheds. This is about 180 acres less than would be thinned under Alternatives A and C. Direct and indirect effects of this action would be similar, but smaller than the effects described in the previous section for Alternatives A and C.

Cumulative Effects of Alternatives A, B and C

These alternatives would cumulatively affect forest canopy conditions in the analysis area due to the proposed modifications in canopy cover. For the period of approximately 1939 to the year 2000, some three percent of the national forest lands within the watershed were clearcut harvested, two percent were commercially thinned, and less than one percent were salvage logged (USFS 2002(c)). An unknown amount of the non-National Forest ownership has also been harvested. Table 3.14 summarizes harvesting activity on National Forest land by subwatershed.

Table 3.14. Harvested area on National Forest System Lands within the Upper East Fork Lewis River Watershed (1939-2000).

Sub-watershed	Acres	Regeneration Harvest	Commercial Thinning	Total Harvested	% of sub-watershed
Headwaters East Fork Lewis	9,839	784	175	959	10
Upper East Fork Lewis	9,497	63	313	376	4
Copper Creek	8,473	59	152	211	2
Total	**17,970**	**122**	**465**	**587**	**3**

The East Fork Lewis River Watershed Analysis identified potential peak flow increases of approximately four to eight percent in each of the subwatersheds draining the analysis area, and approximately the same potential increases occurring from the entire upper East Fork Lewis River watershed. Those estimates were based on current conditions at the time of the analysis (2002(3)). The increases predicted in that modeling effort were presumably driven by stand conditions resulting from the past wildfires and the limited harvest that had been done in the watershed by that time.

More recently, the Divot Timber Sale was (and is) being implemented in the analysis area. The Divot sale includes a total of approximately 317 acres or three percent of the Upper East Fork Lewis subwatershed, and 110 acres or one percent of the Copper Creek subwatershed. The total combined harvest in the Upper East Fork Lewis subwatershed, including all past thinning and regeneration harvest, and the proposed thinning under Alternatives A, B and C of the Tee sale represents approximately 15 percent of that subwatershed. Similarly the total of past and proposed harvest for Copper Creek represents approximately five percent of that drainage. Most of the canopy modification in past harvest and all of the work proposed under the Tee project is characterized by thinning as opposed to regeneration harvest. As a result, even on the treated portions of the watershed, a functional forest and forest canopy has remained intact. Based on the proportion of these subwatersheds in which canopies have been modified, and the degree of modification of the treated stands, the cumulative effect of this project would not likely measurably changed peak or base flows in the East Fork Lewis River or its tributaries.

Direct, Indirect and Cumulative Effects of Alternative D

No actions are proposed under Alternative D, and as a result there would be no direct, indirect or cumulative effects of this alternative on peak or base streamflows.

Stream Temperature

Existing Condition

The Regional Ecosystems Assessment Process Report (REAP 1993) estimated that historic maximum stream temperatures for the entire Lewis River watershed ranged between 14 and 19 degrees Celsius (USDA, 1993). Recent temperature monitoring in the upper East Fork Lewis watershed has found maximum temperatures reaching over 21ºC in the mainstem of the East Fork near the Forest boundary.

High water temperatures during summer months represent the most important water quality concern in the upper East Fork Lewis River. The Washington State Department of Ecology temperature standard is 16°C; excursions beyond 16°C are considered “water temperature exceedances.” Because the East Fork Lewis River exceeds WDOE water quality standards, the river was listed in the Washington 1998 §303(d) list (WAC 173-201-080).

Table 3.15 contains a summary of current and recent-past temperature conditions across the entire upper East Fork Lewis River watershed. Temperatures of most streams within the watershed meet WDOE temperature criteria. The mainstem of the East Fork has the highest water temperatures and most frequent excursions beyond the WDOE temperature criterion of 16°C within the watershed (Table 3.15). Temperatures are highest downstream of Slide Creek and continue to rise downstream of Sunset Falls. Temperatures upstream of Green Fork are higher than the East Fork tributaries and mainstem between the Green Fork and Slide Creek. Cool temperatures contributed by the Green Fork and other tributaries appear to moderate temperatures downstream.

Table 3.15. Maximum stream temperatures in the upper East Fork Lewis Watershed.

Stream Name	Monitoring location	Maximum temp. in 2005 (°C)	Maximum 7-day average temp. in 2005 (°C)	Years monitored	Years 7-day ave. exceeded 16.0°C	Maximum 7-day ave. (°C) during monitoring period (Year)
East Fork Lewis	Above Green	**16.6**	**16.3**	1999-	6	17.6 (2004)

River	Fork			2005		
Green Fork	1 mile above East Fork	15.3	14.5	1996-1999 2001-2005	0	15.7 (2004)
East Fork Lewis River	Just Below Green Fork	*	*	2001-2002	0	15.9 (2002)
East Fork Lewis River	Below Little Creek	*	*	1999-2001 2003-2004	3	17.2 (2000)
East Fork Lewis River	Below McKinley Ck	*	*	1996-1998	3	17.2 (1998)
East Fork Lewis River	Just Above Slide Creek	*	*	2001-2002	1	16.7 (2001)
Slide Creek	¼ Mile above East Fork	*	*	2001-2002	0	15.8 (2001)
East Fork Lewis River[*]	Below Slide Creek	*	*	2001-2002	2	17.6 (2001)
East Fork Lewis River	Below Sunset Falls Campground	**18.4**	**17.9**	2001-2005	3	19.1 (2004)
Copper Creek	Above Bolin Creek	*	*	1996-2002	4	17.2 (2002)

The largest heat input to the East Fork Lewis River on National Forest System Lands appears to begin downstream of Slide Creek, near river mile (RM) the highest number of temperature standard exceedances occur at Sunset Falls and downstream. Downstream of Slide Creek, the 42 Road lies parallel to the river, acting as a heat sink and limiting opportunity to increase riparian shade. A sediment pulse that has been working its way downstream along Slide Creek has added sediment along this reach as well, possibly resulting in widening and reducing depth, which may contribute to increased temperatures. The aspect of the river changes downstream of Slide Creek as well, resulting in the reduced effect of topographic shading. All these factors contribute to increased temperatures downstream of Slide Creek.

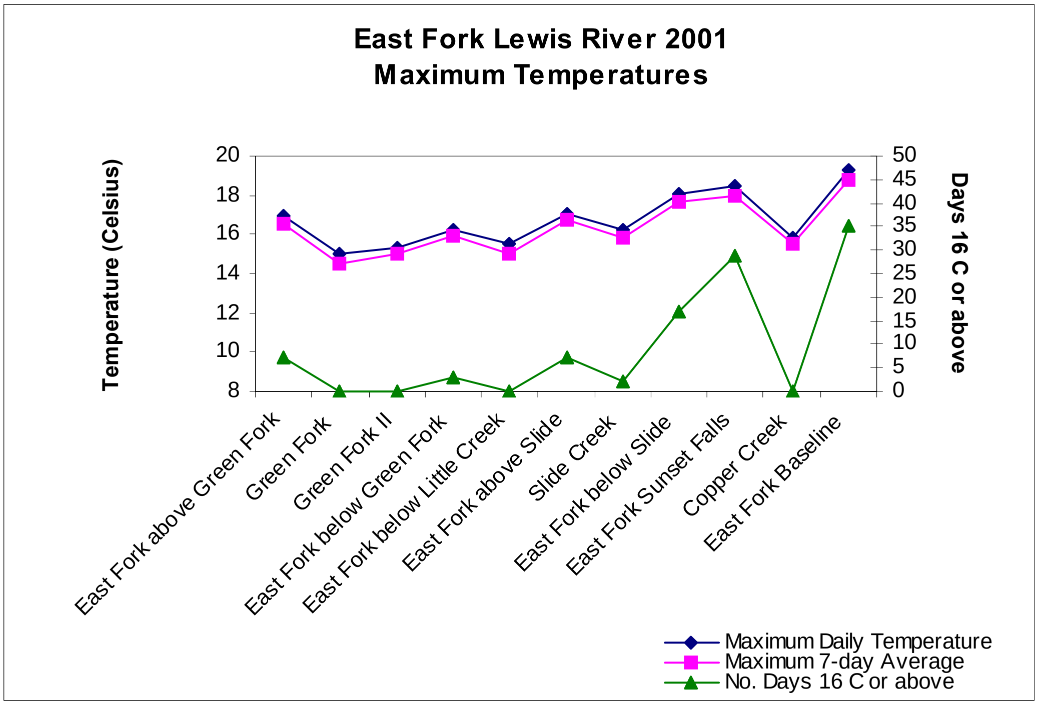

Figure 3.6. 2001 maximum temperature observations in the East Fork Lewis River and its tributaries.

Figure 3.6 displays maximum temperatures measured at various locations within the East Fork Lewis River watershed during the summer of 2001. Each temperature datapoint represents conditions at a point on the East Fork Lewis River or one of its tributaries. In general, the chart is organized so that upstream on the East Fork Lewis River is to the left side of the chart, and downstream is to the right. Tributary temperatures are included in the datapoints shown on the horizontal axis.

Direct, Indirect, and Cumulative Effects of All Alternatives

Water temperatures would not be affected by this project because no shade producing vegetation would be cut.

No thinning would occur in close proximity to streams. Non-thinned buffers have been prescribed on all streams in part to protect existing shade-producing trees from being cut. Fishbearing streams would have an untreated buffer of at a minimum 170 feet, and non fishbearing perennial streams would be protected by untreated buffers of at least 100 feet in width. There are also no new stream crossings to be established for roadways, and no new landings in riparian areas.

The probability of increased temperatures as a result of this project would be entirely discountable due to the project design features that would not permit removal of any shade-producing trees.

Suspended Sediment/Turbidity

Existing Condition

Of the various surface erosion processes at work in the watershed, sediment delivery via roads is the most prevalent (USFS 2002(c)). Principal mechanisms for sediment delivery to streams from roads in the East Fork Lewis River Watershed were identified as: surface ravel from exposed cut- and fill-slopes, side-cast and fill-slope failures, and undermining of roadbeds due to gully erosion associated with insufficient drainage. Unlike the composition of landslide sediments, finer materials including sand and silts are believed to dominate the largest fraction of sediments delivered via roads to stream channels. Most fines are transported from roads to streams during storms that mobilize fine sediments from the road surface. Sediment production and transport during periods of runoff is positively correlated with traffic levels, so increased road traffic—particularly heavy truck traffic—has a significant influence on levels of sediment in road drainage during wet conditions. Road drainage is typically delivered to streams through roadside ditches and culvert outlets.

Estimates of sediment production and storage in the East Fork watershed upstream of Sunset Falls were provided by PWI (1998) using methods described in the Washington Forest Practices Board Manual (1997) (Table III-1). The *Rehabilitation Assessment for the Upper East Fork of the Lewis River Watershed* (PWI 1998) and the *Washington Forest Practices Board Manual* (1997) provide assumptions and limitations of the method. The sediment budget results should be viewed as first approximations that may approach actual values within an order of magnitude. The time period for which these values were computed extends from 1902 to 1997, representing an approximation of sediment yield following a large, stand replacement fire. Soil creep rates for areas burned during the Yacolt fires of 1902 were introduced to reflect the effects of the fire.

Table 3.16. Sediment budget for the East Fork Lewis River above Sunset Falls (adapted from PWI 1998). One cubic meter of basaltic gravel is assumed to equal 2850 kg (Hunt 1984).

Process	Estimated Rate ($m^3/km^2/yr$)	Estimated Yield ($tons/mi^2/yr$)
Sediment Production: Upper East Fork Watershed		
Landslides	12	97.4
Road-surface erosion	30	243.6
Fire-related surface ravel	4	32.5
Sediment Storage – Upper East Fork Watershed		
Active channel storage (bars, debris fans)	15	121.8
Inactive channel storage (floodplains, islands)	21	170.5
Balance	**10**	**81.2**

Spawning substrate in the East Fork above Sunset Falls is basically “supply limited”, meaning that there is little influx of material from landslides and debris flows to replace gravels that are transported downstream during periodic high flow events. The apparent reason for this condition is that most of the landslides and major mass movements occurred during the 1950s, following the large stand-replacement fires and subsequent salvage logging operations (PWI 1998). Secondly, the type of gravel commonly found in spawning substrate is a subdominant fraction of the hillslope sediment found in this watershed.

The largest accumulations of spawning gravel commonly occur in the more sinuous segments of stream channels in the form of irregularly spaced, alternating lateral bars. These bars are transient in that they tend to become reconfigured or move within the channel, particularly after high flow events. Mid-channel bars, where present, have formed directly downstream from or at the confluence of tributaries that where debris fans rest on the valley bottom. These features have been modified and have reduced in size over time due to stream down cutting and transport of material during high flow events. A third factor further limiting the transport of gravels to spawning reaches includes roads, which have the effect of intercepting downstream passage of gravels because of inadequate culvert size.

Chemical Contamination/Nutrients

There are a number of active and past active mines in the watershed. No water quality data have been collected at these mines that we know of, and there are no other known sources of chemical or nutrient pollution in the watershed.

Direct and Indirect Effects of Alternative A

Thinning

Thinning outside of Riparian Reserves would occur in all 39 units of the sale. Based on Riparian Reserve widths, this thinning would occur at least 170 feet away from non fishbearing streams, and a minimum of 340 feet away from fishbearing streams. The probability of sediment from these thinning and yarding activities entering the stream would be so remote as to be discountable. This is due to the distance of the activities from streams and the presence of intervening riparian areas that would provide filtering of any sediment laden surface discharges from thinning and yarding outside of Riparian Reserves.

Thinning would occur within Riparian Reserves on 12 units under the proposed action. Of the 15 Riparian Reserve treatments proposed, only one is on a stream reach that is used by anadromous fish (Unit 6 on Slide Creek). Six of the Riparian Reserve treatments would be on stream reaches that support resident fish, and seven Riparian Reserve treatments would be on perennial or intermittent streams that are not known to support fish.

All thinning and yarding activities within Riparian Reserves would be separated from stream channels by an untreated buffer that would be established along the stream in each unit. Fishbearing streams would have an untreated buffer of at least 170 feet. Non fishbearing perennial and intermittent streams would have untreated buffer widths ranging from 50 feet to 170 feet.

The probability of sediment from thinning and yarding activities in Riparian Reserves reaching the stream would be very low. The probability is a function of the amount of disturbed soil made available for delivery to the stream from felling and yarding of the trees, and the presence of a pathway and mechanism for moving that material to the stream.

Because the felling of trees would not be expected to cause appreciable ground disturbance, surface soil disturbance from thinning inside Riparian Reserves would occur primarily as a result of yarding activities when the trees are dragged along the ground surface to landings. Under the proposed action, approximately half of the units proposed for riparian thinning would be logged by helicopter and the remaining units would be skyline logged (Table 3.17).

Table 3.17. Logging systems, untreated buffer widths, and stream class for all proposed thinning units in the Tee Timber Sale.

Unit	Stream Class*	Untreated Buffer Width	Logging System in Riparian Reserves
18	IV	50	Skyline
35	III/IV	100	Skyline
36/42	III/IV	100	Skyline
37	III/IV	100 (east stream)	Skyline
44	II	100	Skyline
18	II	170	Skyline
35	II	170	Skyline
28	III/IV	50	Helicopter
27	III/IV	100	Helicopter
31	III/IV	100	Helicopter
32	III/IV	100	Helicopter
6	I	170	Helicopter
19	II	170	Helicopter
26	II	170	Helicopter
28	II	170	Helicopter

* Definitions of Stream Class:
Class I streams support anadromous fish
Class II streams support resident fish
Class III streams have perennial flow and are not known to support fish
Class IV streams have intermittent flow and are not known to support fish

Ground disturbance in helicopter logged units would be minimized because logs would not be dragged across the slope as they are with either tractor or skyline logging systems. Trees cut in the units identified for skyline logging would be yarded upslope by cable, with the leading edge of the tree suspended above the ground and the trailing end of the tree dragging along the ground surface. Soil disturbance would be expected to occur along skyline paths in these units, making soil available for transport to the stream. However, the probability of this material entering the stream would be low because of the distance of the disturbance to the stream and because the untreated forest between the thinning area and the stream would provide significant opportunities for any sediment-laden surface runoff to infiltrate the ground or be detained and filtered as it flows across the undisturbed forest floor.

Due to the distance of thinning from the stream, the intervening untreated riparian forest between thinned areas and the stream, and the use of helicopter logging for most of the riparian thinning, the magnitude of any sediment reaching the stream from thinning and yarding activities would be very low and probably immeasurable.

Hauling and Road Activities

Road networks are the most important source of accelerated delivery of sediment to anadromous fish habitats in forested watersheds of the Pacific Northwest (Ice 1985; Swanson, *et al.* 1987). Sediment from the road system can be delivered to streams by direct erosion of cut and fillslopes associated with stream crossings, or by surface runoff from roads and ditches that carries sediment-laden water directly or indirectly to streams. Not all sediment production from roadways reaches the aquatic system, because surface runoff from road surfaces and ditches is often directed to unchanneled slopes below the road where runoff has the potential to infiltrate the ground surface or to be filtered by forest debris before entering streams.

Two of the greatest factors affecting rates of sediment production from surface erosion on roads are road traffic levels and precipitation. Studies done on the Olympic Peninsula and in southwest Washington found that sediment production was increased by two orders of magnitude when comparing lightly trafficked and heavily trafficked forest roads during periods of runoff (Reid and Dunne 1984, Sullivan, *et al.* 1989). These studies also found that when traffic levels remained heavy during a runoff event, sediment concentrations in road drainage waters remained at a relatively high level throughout the storm.

In general, roads lacking surface rock, those with steep grades and steep sideslopes, and those that cross streams or are in proximity to streams are the greatest contributors of sediment from surface erosion. Because many of the roads in the vicinity of the Tee Timber Sale are poorly surfaced, and are in many cases directly linked to the stream network through roadside ditch drainage, timing of haul for this project would be been limited to the summer months and to dry periods of the early fall to reduce rates of sediment introduction to the East Fork Lewis River and tributaries.

Approximately 38 miles of FS road would be used for this project under Alternatives A and B. Some segments of the road network parallel or are in proximity to streams and there are some 76 perennial and intermittent stream crossings on these segments of road to be used for this project. In addition to the stream crossings, there are an unknown number of ditch relief culverts, some of which would have surface channel connectivity with nearby streams during periods of runoff.

Primary haul routes for this project would be Forest Roads 41 and 42, and some combination of arterial systems including the roads identified in Table 3.18. A majority of the haul routes on the national forest are unpaved, gravel or native surface roads.

Table 3.18. Summary of roads used in haul routes for the Tee Timber Sale.

Arterial Road	Collector Road	Local Road	Project Miles
4100			2.7
		4100544	4.2
	4104		4.0
4200			2.4
	4205		3.0
		4205523	0.5
		4205524	2.7
	4211		2.3
		4211538	1.2
		4211539	0.4
		4211541	1.7
5300			13.0
Total	**Miles**		**38.1**

Prior to hauling, portions of the haul route would be treated to repair and improve drainage structures, improve the running surface of the road, and to clear vegetation along roadsides. Following haul, portions of the haul route would again be treated to repair damage done during logging and to restore the roads to a condition that supports normal forest uses and to ensure proper drainage and stability of the roads. Portions of the haul route that are in particularly poor condition would be reconstructed prior to haul activities. Road reconstruction would include application of surface rock, replacing damaged or poorly functioning culverts, adding ditch relief culverts where necessary, and replacing or stabilizing fill and subgrade materials. Table 3.19 summarizes the road reconstruction work proposed under Alternative A and B of this project

Table 3.19. Road reconstruction associated with Alternatives A and B of the Tee Timber Sale. Alternative C would include the same roads and treatments except for the highlighted roads which would be not be reconstructed or used, or where reconstruction would be significantly reduced under that alternative.

Road Number	Crushed Rock Surfacing (miles)	Subgrade/ Embankment (# sites)	Replace Existing Stream Culverts (# sites)	Install New Ditch Relief Culverts (# sites)
4100	0.4	0	3	2
4100544	1.8	0	0	3
4104	1.0	3	2	4
4200	0.35	0	0	2
4205	3.0	1	3	3
4205523	0.2	1	0	1
4205524	0.7	0	0	4
4211	0.6	4	3	6
4211538	0.3	0	0	1
4211539	0.1	0	0	1
4211541	0.4	1	0	1
5300	0.25	2	0	2
Total	**9.1**	**12**	**11**	**30**

Construction of approximately 1.9 miles of temporary roads would occur to access various units and the helicopter landings under Alternative A. None of the temporary roads would cross aquatic features or be located within Riparian Reserves. Temporary roads, if in use more than one season, would be weatherized prior to the onset of wet weather in the fall. Table 3.20 summarizes the lengths of temporary road to be constructed under each alternative.

Table 3.20. Approximate length (feet) of temporary road construction by alternative and unit for the Tee Timber Sale.

Unit #	Alt A	Alt B	Alt C	Alt D
26	2,000	0	0	0
44	1,680	0	0	0
47	4,200	0	0	0
Helicopter landings F and G	2,400	0	2,400	0
Total	**10,280**	**0**	**2,400**	**0**

Approximately 14 helicopter landings have been identified for the sale, each averaging one acre in size. Most of these would be located on existing road systems and would require only minor brushing around the edges to make them functional. However, some earthwork would be required to clear and establish a site that is suitable to landing logs and to provide access for log trucks. Helicopter landings that lie outside normally traveled road surfaces would be rehabilitated by scarification, waterbarring where necessary, and application of seed and/or mulch as described in mitigation measures.

With this alternative, there would be a high probability that sediment from the road surface would enter the East Fork Lewis River and tributaries from haul traffic, but also as a result of the road reconstruction and maintenance activities. The operating season for road reconstruction and maintenance work and for hauling logs would be limited to include only the months of June through September, with possible extensions into October if conditions remain dry. This has been done to reduce the amount and duration of erosion that occurs from the road-related activities. Nevertheless, 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.

Assuming all haul activities and road work would occur during the dry months, and that there are no unseasonable precipitation events, the amount of material actually transported to streams would be expected to be relatively low during the period of haul and maintenance or reconstruction, except for those sites where live culverts will be upgraded. 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. Although best management practices would be used to minimize the actual sediment introduced to the stream (see Mitigation Measures, Chapter 2 and Project Design Features, Appendix A), there is no way to avoid sediment introduction and disturbance of the stream channel in this process.

There would be a total of approximately 11 stream culverts to be replaced as part of the reconstruction of roads for this project. Some of these streams flow only intermittently, so would likely be dry at the time of the work. It is estimated that 50 percent of these streams have perennial flow and would likely have flow at the time of the work. Replacement of culverts at perennial stream crossings would have the potential for mobilizing and entraining some of this material at the time the work is conducted. Perennial streams would experience two primary periods of increased turbidity. The first would occur during project construction, and the second would occur in subsequent periods of increased runoff, particularly in the early fall and winter. Streams that are dry during construction activities would not experience the increased turbidity until they are rewatered and as loose fill material and soil is mobilized and entrained in the flow.

These effects, occurring in either during construction (for perennial streams) or in subsequent periods of storm runoff, would be relatively short term pulses of high turbidity and sediment movement in the impacted streams. Past experience with culvert removals on road decommissions has shown that turbidity levels increase rapidly as culverts are removed and material from around the culverts is eroded. As transportable material is removed from the site, the turbidity levels would decrease rapidly to near pre-project levels.

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 the summer months from the dust created by these activities and by subsequent vehicle traffic on the newly treated roads. But because the road work and hauling would be scheduled for the dry months, most of the sediment delivery from these actions would occur later in the fall when precipitation and runoff levels increase. During the first significant runoff event of the fall, there would be substantial flushing of sediments from road surfaces and roadside ditches into tributaries and surface channels that are connected to the stream. Based on research conducted elsewhere in the state of Washington, 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 the precipitation and runoff (Reid 1981, Reid and Dunne 1984, Bilby 1985). Subsequent periods of traffic on the roads would cause turbidity levels to climb again, or to be sustained at higher levels.

Simple sediment production models were employed to estimate the rates of sediment production from roads in the Tee Timber Sale. For these model runs it was assumed that the roads would have basaltic parent material, that cut and fillslopes would be 50 percent vegetated, that all roads would have two to six inches of gravel surfacing, that annual precipitation would be 47 inches or more, and that log haul would occur over a four month period from June through September with only light traffic on the roads for the balance of the year. Results suggest that sediment production on the Tee roads would range from 529 tons/year under Alternative D to over 1500 tons/year under Alternatives A and B, and approximately 1015 tons/year under Alternative C. Although these figures are considered reasonable in that they fit into the range of sediment production values found in the literature, they are considered extremely rough estimates 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. More accurate estimates of sediment production and delivery would require much more extensive information on road surfacing, drainage frequency, distance between road drains and streams,

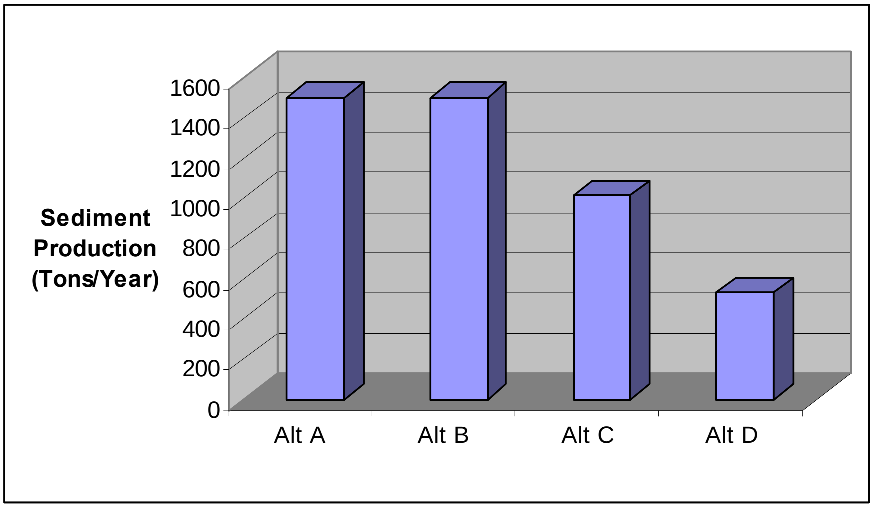

Figure 3.7. Estimated sediment production from roads used in the Tee Timber Sale assuming haul is concentrated in the June through September period.

Modeling was also conducted for the scenario of all-season haul and Figure 3.8 provides a comparison of sediment production levels under each alternative for the dry season and all-season haul options. Sediment production would increase by more than 100 percent in each action alternative under the all season haul scenario. The significant increase in sediment production that occurs when hauling during wet periods is the reason that haul is restricted to the months of June through September, with exceptions occurring only when conditions remain dry into October (see Mitigation Measure H.3).

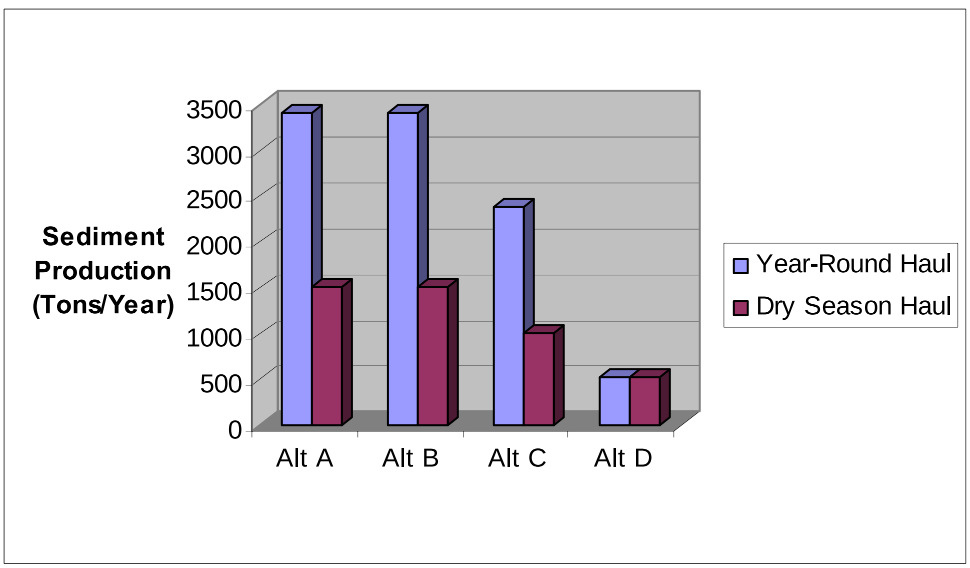

Figure 3.8. Estimated sediment production from roads used in the Tee Timber Sale comparing all season haul with haul occurring only in the June through September period.

Sediment production as described above would lead to increases in turbidity and suspended sediment in the receiving surface waters. Since most of the roads in the planning area would have active inboard ditches, these channels would form the avenue for routing this sediment to streams. Ditches would be drained at some spacing along roads by either ditch relief culverts or live streams. Some portion of the ditch relief culverts would not deliver sediment to the stream system because they would discharge to unchanneled slopes where water could infiltrate the ground surface and/or sediment could be filtered and dropped out of suspension. There is no measure of the number of culverts in this planning area that would deliver to streams or that would discharge to forested slopes, but it is likely that the proportion would change based on the intensity and duration of the runoff event.

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, we estimate that fines delivered to surface channels would remain in suspension and be delivered downstream to fishbearing 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 typically 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.

Direct and Indirect Effects of Alternative B

This alternative is similar to Alternative A except that there would be no thinning within Riparian Reserves, and there would be no construction of temporary roads. As described under the previous sections, riparian thinning and temporary road construction are both likely to cause soil disturbance and to create a supply of erodable material. However, because these activities would be occurring well away from aquatic features, they would not be likely to cause substantial amounts of sediment introduction to the aquatic system. This alternative would have essentially the same treatments and haul patterns on existing roads as Alternative A, and this would be the largest potential source of sediment delivery to streams in the analysis area. As a result, the effects of this alternative would be nearly identical to those described for Alternative A.

Direct and Indirect Effects of Alternative C

This alternative uses approximately 30 miles of road, or some 21 percent fewer road miles than Alternatives A and B. As a result, there would be eight fewer miles of road needing reconstruction, pre- and post-haul maintenance, and receiving haul traffic. Effects of this alternative would be similar to those described for Alternatives A and B except that estimated sediment production levels would be reduced by some 30 percent due to the reduction in miles of haul and road treatments (Figure 3.7).

Cumulative Effects of All Action Alternatives

The effects described above for Alternatives A, B and C would be cumulative with other forms of sediment production and introduction in the East Fork watershed. Within the analysis area, mass wasting has not been found to be a significant contributor of sediment over the recent past. Roads and road uses from general forest uses and from other projects including the Divot Timber Sale contribute sediment to the East Fork system, and would add to the sediment estimates provided in this analysis.

Direct, Indirect and Cumulative Effects of Alternative D

Alternative D proposes no vegetative or road actions and as such would have no effects on turbidity or suspended sediment levels either singly or cumulatively.

Fisheries

The analysis of Fish Habitat draws on the conditions as presented in the Hydrology section (pages 35, *ff.*). A complete assessment of effects to fish and fish habitat is contained in the comprehensive fisheries Biological Assessment (USDA 2006) and the associated Analytical Process. These reports are in the Tee Timber Sale project file.

Fish Habitat

Existing Condition

Streams adjacent to harvest units are both perennial and intermittent. Many perennial streams provide habitat for anadromous, and resident fish. Intermittent streams are normally dry in summer months and therefore do not provide habitat for fish. Refer to the analysis file for a map of fish distribution and complete data from the surveys.

Sediment Generation and Effects to Fish

Direct and Indirect Effects

Fine sediments, even at relatively low levels, deposited on spawning areas during critical life cycle states (fall and spring) could decrease survival of eggs or emerging fry. Sediments deposited over streambeds could also reduce the habitat available for spawning and for aquatic insect communities, which in turn influences the available food supply for larger aquatic organisms. Refer to the Suspended Sediment/Turbidity section (pages 54, *ff*) for a complete discussion of sediment generation sources and differences between alternatives.

Alternative B would provide a lower risk of increasing channel sedimentation and negative impacts to fish populations than Alternatives A and C, in the short term. However, the fish populations in the East Fork and its tributaries would not be likely to experience cumulative effects from sediment-related habitat loss due to implementation of design features of this project, including no harvest areas immediately adjacent to streams. Fish populations would not change through implementation of any Alternatives. With Alternative B, the decommissioning and/or weatherization of some roads, and no temporary road construction would reduce the long-term sedimentation potential. Alternative C would still create a short, temporary road that gives it more potential to deliver sediment than Alternative B. Alternative D allows conditions to remain unchanged.

Physical Barriers

Direct and Indirect Effects

There would be a very low probability any Alternatives would create or remove physical barriers. The Tee Timber Sale would not build roads or modify flows on any fish-bearing stream. In addition, channel stability would be maintained on all planning area streams, reducing the risk of management-induced mass failure that might lead to migration corridor alteration.

Cumulative Effects

Low intensity timber harvest and associated haul and transport activities would be expected to have a neutral effect on physical barriers and migration corridors. High retention of leave trees inside and outside the riparian reserve would reduce the risk of any catastrophic failure, which could result in blocked fish passage. Other nearby projects include Divot Timber Sale. No cumulative effects on physical barriers are expected from combined actions of Tee and Divot Timber Sales.

Substrate Character and Embeddedness

Direct and Indirect Effects

Alternatives A and C would have a slightly negative but discountable effect on substrate character and embeddedness due to the small size of sediments that would be expected to be delivered from roads and the high stream power of streams draining the planning area. Alternative B would have less effect on substrate character and embeddedness than A or C because no temporary roads would be created, and in the long term because 8.5 miles of road would be decommisioned. Alternative D would have the potential to cause more embeddedness than B over the long term because roads would remain in disrepair.

Cumulative Effects

Other nearby projects include Divot Timber Sale. If wet season haul continues in Divot in similar conditions as fall 2005, then it is possible for the stream to become more embedded over time because of the combined actions.

Large Woody Debris (LWD)

Direct and Indirect Effects

Alternatives A and C include 67 acres of thinning in riparian areas. Large woody debris sources would be enhanced in the long term by implementation of Alternatives A and C. Larger trees would be available for shade and large woody debris sooner if the Riparian Reserves are thinned than if left in their current condition. Alternatives D and B have no riparian thinning so LWD would continue growing at a slower than optimum pace.

Cumulative Effects

Implementation of Alternatives A and C would be expected to increase the size of large woody debris available over the long term by accelerating the growth of conifers in riparian reserves. Other nearby projects include Divot Timber Sale. No cumulative effects on LWD would be expected from combined actions of Tee and Divot Timber Sales because there was no riparian thinning in the Divot Timber Sale.

Pool Frequency and Quality, Off-Channel Habitat, Refugia and Rearing

Direct and Indirect Effects

There would be a discountable probability of the Alternatives modifying instream habitat conditions. The principal factors influencing instream habitat features include sediment delivery and changes in flow deflectors (e.g. LWD) serving as pool scouring agents and lower bank stability. Sediment sources would be minimized because best management practices (BMP's) and mitigation measures would result in minimal ground disturbing impacts and roads would not be built over any fish bearing stream. In addition, channel stability would be maintained on all planning area streams reducing risk of management induced mass failure leading to reduced habitat. LWD sources would be maintained in Alternatives B and D, or enhanced (Alternatives A and C) by prescribed no-disturbance riparian buffers.

The principal factors influencing stream channel stability include ground cover, changes in flow deflectors (e.g. LWD) serving as flow dissipation, bank armoring agents (eg. living root mass, instream LWD) and abnormal channel constraints (e.g. road construction or loss of streamside root cohesion). No Alternative would negatively affect these stream channel stability factors.

Cumulative Effects

There would be no cumulative effects considering other projects in the planning area such as Divot Timber Sale, that would affect channel habitat indicators. The no disturbance buffers in Units 6, 18, 19, 26, 27, 28, 31, 32, 35, 36, 37, and 44 would protect stream banks from erosion, sloughing, and compaction.

Width to Depth Ratio and Stream Bank Condition

Direct and Indirect Effects

All Alternatives would have a low probability of modifying width to depth ratios or stream bank condition. Typically width to depth is a function of stream bank stability. Decreased channel stability often leads to increased width to depth ratios. Channel instability would be minimized because all alternatives would not build roads over any fish-bearing stream. In addition, channel condition would be maintained on all planning area streams reducing risk of management induced mass failure leading to reduced pool habitat. LWD sources would be maintained or enhanced by prescribed "no disturbance" riparian buffers.

Cumulative Effects

All alternatives would not affect width to depth ratio and stream bank stability. The "no disturbance" buffers in Units 6, 18, 19, 26, 27, 28, 31, 32, 35, 36, 37, and 44 would protect stream banks from erosion, sloughing, and compaction in Alternatives A and C. Alternatives B and D would have no riparian harvest. Width to depth ratio and stream band stability would be retained through project design and mitigation which retain channel stability, prevent sediment delivery and promote long term development of streamside vegetation. The combined effect of Divot Timber Sale and Tee Timber Sale on this feature would be minimal.

Flood Plain Connectivity

Direct and Indirect Effects

Typically, a channel may be prone to lose floodplain connectivity as a result of excessive channel scour or downcutting. Therefore, the principal influences on connectivity include stream channel stability, erosive energy, reduced channel roughness through loss of LWD, or large size class substrate (cobble or larger). Stream morphology would be expected to remain consistent with the baseline condition. For all alternatives there would be no measurable change in channel transport capabilities due to minimal road reconstruction, sufficient streamside buffers and general retention of upland vegetation retaining quantity and timing of stream flows.

Cumulative Effects

The combined effect of other projects in this planning area such as Divot Timber Sale, Green Fork and Twin Barrels Culvert Replacements on this feature would be minimal.

Federally Listed Fish and Designated Critical Habitat

Existing Condition

The following is a summary of fish distribution for streams in the planning area.

The East Fork of the Lewis River enters the mainstem Lewis at river mile (RM) 3.5. Anadromous species that use the East Fork include: chinook (*Oncorhynchis tshawytscha*); coho (*Oncorhynchis kisutch*); steelhead (*Oncorhynchis mykiss*); and sea-run cutthroat trout (*Oncorhynchis clarki*), however Lucia Falls at RM 21.3 is a migration barrier for chinook and coho salmon. Therefore only steelhead (listed as Threatened under the Endangered Species Act in 1998) and possibly sea-run cutthroat trout are the only anadromous forms of fish in the planning area. Resident fish include: cutthroat trout (*Oncorhynchis clarki*); rainbow trout (*Oncorhynchis mykiss*); whitefish (*Prosononium williamsi*); and sculpin (*Cottus* spages). Each of these species have specific habitat requirements for their various life stages that are well documented in current literature (refer to project file).

Bull trout (*Salvelinus confluentus*) are present in the Lewis River Basin above Merwin Dam. Extensive surveys in the Upper East Fork Lewis River watershed have determined there are no bull trout populations present.

Direct and Indirect Effects of Alternative A

The analysis determined that the project elements of the Tee Timber Sale would have a neutral or slightly positive effect in the long-term to temperature; chemical contamination/nutrients; physical barriers; large woody debris; pool frequency; pool quality; off-channel habitat; refugia; width/depth ratio; streambank condition; floodplain connectivity; peak/base flows; drainage network increases; road density and location; disturbance history; riparian reserves; sediment/turbidity; substrate; and disturbance regime indicators at the site and 6th field watershed scales.

The Tee Timber Sale would have a neutral influence on essential features of designated critical habitat.

The analysis determined that the effects of the Proposed Action to the indicators and essential features would be either:

- Neutral;
- Positive in the long-term in the case of the Riparian Reserve indicator; or
- Negative in the short-term with insignificant, discountable effects to the habitat of Lower Columbia River steelhead in the East Fork Lewis River watershed with long-term positive effects to listed fish; and,
- There would be no direct effects to individuals of listed Lower Columbia River (LCR) steelhead.

Consequently, the effects determination for the Tee Timber Sale is "may affect, not likely to adversely affect" (NLAA) LCR steelhead trout and Designated Critical Habitat for steelhead.

Project design criteria and analysis conclusions that contribute to the NLAA effect determination are summarized below:

The Proposed Action would contain project design features that will minimize or eliminate sediment delivery into streams including limited activity in Riparian Reserves, no-disturbance buffers on all streams, and obliteration and planting of roads and landings.

Roads in the Tee Timber Sale Planning Area would be upgraded to minimize road related sediment concerns. Reconstruction would involve adding crushed rock to 9.6 miles of existing road, replacing 11 culverts, installing 30 new ditch relief culverts, and improving subgrades and embankments at 12 sites.

Approximately 1.9 miles of temporary roads would be constructed on native surfaces. These roads would be obliterated after harvest.

Thinning in Riparian Reserves would only affect 67 acres and all riparian thinning would occur in the outer portion of the interim buffer width. This would not be expected to have any effect on stream temperature or LWD recruitment in listed fish habitat.

No new permanent roads are proposed.

There would be some potential for sediment input into local streams along the haul routes, but this would be minimized with the restriction to dry weather hauling. The haul roads adjacent to perennial fish bearing streams in the East Fork would be improved or maintained with this proposal. Fine sediment entering the East Fork and tributaries would likely be expected to enter as suspended sediment and not bedload. However the amount of sediment produced would be expected to be insignificant and would not likely result in an adverse affect to LCR steelhead and their designated critical habitat.

Direct and Indirect Effects of Alternative B

No detrimental cumulative effects would be expected as a result of implementing Alternative B. Alternative B would be the least impactive of the action alternatives to LCR steelhead and their designated critical habitat. This is because no thinning in riparian areas would occur, fewer acres would be thinned overall, and no temporary roads would be constructed. In addition, 8.5 miles of existing road would be decommissioned, creating an overall long term positive benefit for fish habitat.

Direct and Indirect Effects of Alternative C

No detrimental cumulative effects would be expected as a result of implementing Alternative C.

Alternative C would have the potential to create more overall risk of affecting fish and fish habitat than Alternative B, and less than Alternative A. Only 2,400 feet of temporary roads would be created in this alternative, while 10,280 feet would be created in Alternative A. Thinning would occur on the same amount of riparian and upland acres as Alternative A, but the logging method would be mostly helicopter based. Two fewer helicopter landings would be proposed as well.

Direct and Indirect Effects of Alternative D

This is the No Action Alternative. If this Alternative is selected fish habitat would remain unchanged from present day conditions. This alternative would create the least amount of short-term impact, however no roads would be decommissioned as proposed in Alternative B. Therefore, in the long term this alternative could create more fine sediment to be introduced into the East Fork System.

Table 3.21. Key Indicators Related to the Analytical Process Objectives.

Indicators	Alternative A	Alternative B	Alternative C	Alternative D
Fish Habitat Effects	1	3	2	4
Stream Temperature*	1	4	2	4
Sediment/Turbidity*	1	4	2	3
Peak/Base Flows*	1	3	2	4
Drainage Network Increases*	1	4	2	3
Road Density and Location*	1	4	2	3
Riparian Reserves*	4	1	3	1
Chemical Contam.*	4	4	4	4
Disturbance History*	1	3	2	4
Physical Barriers	4	4	4	4
Substrate Character and Embeddedness (long term effect)	1	4	2	3
Large Woody Debris (long term effect)	4	1	4	1
Pool Frequency, Quality, Off Channel Habitat, Refugia, and rearing	4	4	4	4
Width to Depth	1	4	2	4

Indicators	Alternative A	Alternative B	Alternative C	Alternative D
Ration and Stream Bank Condition (long term effect)				
Flood Plain Connectivity	4	4	4	4
Total Score	33	51	41	50
ESA Determination**	**NLAA**	**NLAA**	**NLAA**	**NE**

Individual Scores-
1-most potential
2-some potential
3-minimal potential
4-least potential
A lower overall score = most potential to effect fish habitat.

*Refer to hydrology report
**ESA Determination
NLAA= May Effect, Not likely to Adversely Affect
NE = No Effect

Essential Fish Habitat Assessment

The Sustainable Fisheries Act of 1996 (Public Law 104-267) amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to require federal agencies to consult with National Marine Fisheries Service (NMFS) on activities that may adversely affect Essential Fish Habitat (EFH). EFH is defined in the Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH includes all freshwater streams accessible to anadromous fish, marine waters, and intertidal habitats. EFH excludes areas upstream of certain impassable artificial barriers and long-standing naturally impassable barriers.

Existing Condition

Essential Fish Habitat in the Lewis River has been designated for coho and chinook salmon. Approximately 11 miles downstream of the forest boundary is a long-standing naturally impassable migration barrier to coho and Chinook, known as Lucia Falls. However, steelhead trout and possibly sea-run cutthroat trout do migrate over Lucia Falls. Therefore it has been determined that there is no EFH for coho or Chinook in the Upper East Fork Lewis River above Lucia Falls.

Direct and Indirect Effects of Alternatives A, B, and C

A comprehensive fisheries Biological Assessment was completed on Alternative A of the Tee Timber Sale in 2006 (USDA 2006). The effects of the Alternative A was determined to have No Effect on listed and proposed NMFS fish species and proposed critical habitat.

Minimal ground disturbance would result in low risk to EFH under Alternative A primarily due to sediment production related to reconstruction of temporary roads, landings and skid roads. Alternative A would prescribe no new stream crossings. The impacts on riparian reserves would be minimized by the substantial retention of forest canopy and considerable riparian buffer.

Thinning activities in the outer portions of the riparian reserve would retain a canopy closure of 50 percent.

The Proposed Action would have no effect on EFH inside or outside of the analysis area. Since Alternatives B and C would have less impact than the proposed action, these alternatives would similarly have no effect on EFH inside or outside of the analysis area.

Coho Salmon

Lower Columbia River coho salmon (*O. kisutch)* have been observed in the East Fork of the Lewis River approximately 11 miles below the forest boundary at Lucia Falls. The proposed activity in Alternative A of the Tee Timber Sale would have no effect on Lower Columbia River coho salmon in the Lewis River Watershed.

Spring Chinook Salmon

Spring chinook salmon *(O. tshawytscha)* have been observed in the East Fork of the Lewis River approximately 11 miles below the forest boundary at Lucia Falls. In 2002 an unconfirmed pair was sighted above this barrier, but below the Forest Boundary.

The proposed activity in Alternative A of the Tee Timber Sale would have no effect on Lower Columbia River chinook salmon in the Lewis River Watershed.

There would be no effects to chinook or coho salmon because they are at least 11 miles downstream of the project area boundary.

Vegetation

The following analysis is a summary of the Silvicultural Report, which is located in the Tee Timber Sale project file. The stand numbers indicated correspond to Tee Timber Sale unit numbers. The units are located within these stands.

Vegetation Characterization

Stand Composition

The Upper East Fork Lewis River Watershed lies within the Southern Washington Cascades Province of the Pacific Northwest (Franklin & Dyrness 1973). On a broad scale, the vegetation is temperate coniferous rainforest. Most of the watershed is within the Western Hemlock Zone (49 percent) and Pacific Silver Fir Zone (38 percent). Five percent of the watershed is comprised of deciduous hardwoods (alder). Table 3.22 illustrates the acreages (National Forest) within each vegetative zone for the entire Upper East Fork Lewis River Watershed

Table 3.22. Vegetation Zones with the Upper East Fork Lewis River Watershed.

Vegetation Zone	Percent	Acres	Elevations
Western Hemlock	49	14,408	<3000
Pacific Silver Fir	38	11,387	3000-4000
Alder	5	1,380	<4000
Dry Meadows	<1	38	All
Non Forest	7	1,983	All

Wet Meadows	1	398	All
Total	**100**	**29594**	

The majority (95%) of proposed 38 stands for treatment are within the western hemlock zone. In particular, the western hemlock/dwarf Oregon grape/swordfern (TSHE/BENE/POMU) and western hemlock/dwarf Oregon grape/salal (TSHE/BEBE-GASH) 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. Potential for site degradation following careful timber management practices is low, according to The Plant Association and Management Guide for the Western Hemlock Zone (USDA 1986).

The TSHE/BEBE-GASH association sites occur on drier south to west facing ridges and side-slopes. It is less productive than the moist-site western hemlock associations, though still quality commercial forested land. Site indices at 100 years average 127 feet (height) for Douglas-fir. Management of this association offers few complications according to The Plant Association and Management Guide for the Western Hemlock Zone (USDA 1986). The relative dryness, steep slopes, and abundant brush cover are the major concerns.

Two stands (#5 and #40) are within the Pacific silver fir zone (Pacific silver fir/coolwort foamflower (ABAM/TIUN) plant association). Overall, productivity is high for these stands. Site indices at 100 years average 122 feet (height) for Douglas-fir and 117 feet for noble fir. Management constraints for thinning are not significant, although soil compaction could be a potential problem since these soils are deep and hold moisture well into the growing season (USDA 1983).

All of the timber stands proposed for commercial thinning originated since the Yacolt burn of 1902 and/or the Dole Valley burn of 1929. These young stands are essentially dense, even-aged and are comprised of mostly Douglas-fir. The exception being stands #5 and #40, which contain a mixed component of Douglas-fir, noble fir, and scattered 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 3.23 contains the results of field examination conducted on some of the units during the summers of 1993 and 2005/6. The diameter at breast height (dbh) data from the 1993 exams was projected to the current year (2006) using growth data collected during the 1993 exam. Due to time and logistical limitations, stand exams were not taken on all of the proposed units.

Table 3.23. Tee stand information summary.

Unit	Acres	Species	Age	DBH	TPA	BA	RD	MAC
1	32	DF,H	80	12.6	325	280	79	TS
2	20	DF	--	--	--	--	--	TS
4	28	DF	--	--	--	--	--	ES/TS
5	11	DF,NF,H	94	14.3	271	300	79	TS
6	23	DF	64	10.9	296	193	58	ES/NL
7	10	done						TS
8	57	DF	63	11.8	276	210	61	TS/ES/NL

Unit	Acres	Species	Age	DBH	TPA	BA	RD	MAC
9	32	done	--	--	--	--	--	ES/TS
10	3	DF	--	--	--	--	--	TS
11	14	DF	--	--	--	--	--	TS
16	38	DF	62	14.5	280	320	84	ES/NL
18	22	DF,H	64	13.5	283	280	76	ES/TS
19	32	DF	68	12.4	357	300	85	ES
20	28	DF	67	15.6	--	--	--	ES
21	16	DF	80	13.9	209	220	59	ES
22	16	DF	--	--	--	--	--	TS
23/24	14	DF	--	--	--	--	--	TS
25	35	DF	64	11.3	284	220	64	ES/NL
26	48	DF	62	16.0	--	--	--	ES
27	7	DF	--	--	--	--	--	TS
28	51	DF	--	--	--	--	--	ES
29	41	DF	63	17.0	--	--	--	ES
30	25	DF	63	14.8	--	--	--	ES/TS
31	56	DF	64	14.8	266	320	83	ES/TS
32	27	DF	64	15.7	--	--	--	ES
35	14	DF	--	--	--	--	--	TS
36/42	23	DF	--	--	--	--	--	TS
37/38/39	20	DF	63	15.4	--	--	--	TS
40	19	NF,DF,H	96	18.3	--	--	--	TS
41	15	NF,DF,H	12	1.5	--	--	--	TS
43	20	DF	63	17.3	--	--	--	ES/TS
44	77	DF	61	18.0	--	--	--	TS/NL
45	40	DF	64	17.5	--	--	--	ES
46	39	DF	59	13.3	--	--	--	ES
47	49	DF	62	15.1	--	--	--	ES
48	28	DF	59	14.1	--	--	--	ES/NL
49	18	DF	67	13.6	--	--	--	ES/NL
50	32	DF	--	--	--	--	--	TS

Table notes:

Species: DF = Douglas-fir, NF = noble fir, H = western hemlock.
DBH – Average stand diameter measured at breast height.
TPA – Average number of trees per acre.
BA – Average stand basal area measured in square feet per acre.
RD – Relative Density (Curtis).
MAC: NL = Scenic River Mgt. Area, ES = Deer/Elk Mgt. Area, TS = General Forest.
-- = Data not collected

Stand Structure

Stand structure is the physical and temporal distribution of trees within a stand. Stand structure provide 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 Appendix A for definitions). Table 3.24 shows structure stages present for the entire Upper East Fork Lewis River watershed.

Table 3.24. Vegetation structures for the Upper East Fork Lewis River Watershed.

Structure Stage	Acres	%
Grass/Forb	1,022	4
Shrub/Seedling	3,650	13
Open Sapling/Pole	1,251	4
Closed Sapling/Pole	4,414	15
Open Small Tree	4,036	14
Closed Small Tree	8,399	29
Large Tree/ Single Story	700	2
Large Tree/ Multistory	335	1
Hardwoods	2,701	9
Rock	2,342	8
Total	**28,850**	**100**

All of the timber stands proposed for commercial thinning treatment (1,065 acres) are within the closed small tree structural stage. The exception being stand 41 (15 acres), which is a closed sapling/pole stand scheduled for a pre-commercial thinning.

Structure and composition of forested stands within the Upper East Fork Watershed are a result of a variety of disturbances. Fire is the most obvious disturbance. The most recent large-scale fire events occurred from early 1900 to 1930. The largest fire was in 1902. Re-burns occurred during 1917, 1918, 1919, 1922, 1927 and 1929. The worst fire occurred during 1929 when it destroyed natural regeneration and most seed trees within the area. These fires burned significant acreage within the watershed. Following the fires, most areas were strategically planted to assure adequate reforestation of the area. Between 1902 and 1929 approximately 3,500 acres were planted. The rest of the backlog was planted from 1929 until the mid 1980’s. In total, approximately 20,400 acres were planted over the years.

Most of the tree planting was done on ridge tops and on alternate strips in the lower elevations. The theory was that “intervening gullies and valleys would seed in naturally from seed from these planted stands” (taken from 1955 Yacolt burn pre-planting survey report, on file). The effects of this practice on the current watershed is that some areas were not successfully regenerated either artificially or naturally with conifers and instead seeded in naturally to red alder (*Alnus rubra*) and other hardwoods such as big leaf maple (*Acer macrophyllum*). Most of the planting was primarily with Douglas-fir (*Pseudotsuga menziesii*) seedlings. However, ponderosa pine (*Pinus ponderosae*), Pacific silver fir (*Abies amabilis*), and western white pine (*Pinus monticola*) were also planted. Many of these seedlings, including the Douglas-fir, were sown from off-site seed that was not genetically adapted to the site.

Snag falling was conducted after the fires throughout much of the area to reduce the risk of future lightning fires. Today these areas still contain a component of large, down wood debris. Several to many large diameter broken top, short remnant snags also exist within the stands.

Aerial application of fertilizer to promote tree growth in the nitrogen deficient soils was completed on several of the timber stands within the watershed in the mid-late 1900’s. The result of these activities, combined with tree planting and natural vegetation development contributed to a watershed that has conifer-dominated stands between 41 and 80 years of age (70%) with 30 percent of the stands greater than 80 years of age. Hardwood communities have developed significantly along streams and wet areas where they presently dominate over a highly scattered conifer component. The 41 to 80 year old age class represents approximately 45 to 50 percent of the forested landscape with younger age classes (1–40 years) representing about 20 percent. Older age classes (81+ years) represent about 32 percent of the forested landscape located on national forest lands. Figure 3.3 (page 36) illustrates the breakdown of these age classes.

The first timber harvest of young stands within the watershed and after the Yacolt fires occurred with the Alder and Hake timber sales in the early 1990’s. A total of 711 acres of dense, closed, small tree stand types, 41–80 years old were thinned by these two sales. Currently, the Divot timber sale is thinning an additional 122 acres of the same stand structures and age classes within the planning area.

Stand Density

Existing Condition

Stand density is a primary factor affecting growth and vigor of the timber stands within the Tee Planning 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 (ACS) 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 larger diameter trees faster and provide large diameter coarse woody debris quicker. In addition, thinning can provide revenues to create snags and woody debris and plant shade tolerant trees for the establishment of a multi-layered, species diverse timber stand. Underplanting within these areas would accelerate the development of secondary tree canopies and increase species diversity.

Acres of treatment activity that accomplishes density management and creates multi-layered stands within the riparian reserves was used to evaluate the alternatives. Table 3.25 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 3.25. Summary comparison of treatments by alternative.

Forest Element	Alternative A	Alternative B	Alternative C	Alternative D
Density Management Treatment (Acres)	1,080	901	1,080	0
Establishes Multi-Layered/species diverse stands within the riparian (Acres)	67	0	67	0
Percent of the Upper East Fork Lewis River Watershed Treated.	3.7%	3.1%	3.7%	0

Methodology

The Forest Vegetation Simulator (FVS) was used to simulate forest growth and portray structural and compositional characteristics for the vegetation analysis. It was assumed for this analysis that no additional thinning would occur after the initial thinning.

Tree data collected in 1996 within stand 19 of the proposed action was used as an example to simulate forest growth projections for the Tee Timber Sale stands. This data was entered into FVS and used in the growth projections. Table 3.26 illustrates the current condition of stand 19 in 2006, based on the FVS Simulator. The majority of the timber stands within the proposed action are likely more dense and the existing, average stand condition and stand projections created for the alterative analysis are most likely conservative.

Table 3.26. Current stand conditions (Stand 19).

Stand Age	Trees/Acre	Basal Area	Average Diameter	Average Height	Volume/Acre
60	314	219	11.3	124	53,395 bf

Direct and Indirect Effects (1-5 years) of Alternative A

A total of 998 acres of upland timber stands and 67 acres of riparian stands would be treated. The proposed thinning grade to thin the upland timber stand to a 40 percent canopy closure would allow adequate density reduction for individual tree growth. This type of thinning grade would be sufficient to allow the residual trees approximately 20 years of free growth. At the end of this period, the tree canopies would begin to close, inter-tree competition would begin, and another density reduction treatment would usually be needed again. Both vertical and horizontal structure would develop, but the rate of development would slow markedly as the tree canopy closes over time. A 50 percent canopy closure would produce the same growth increases (Table 3.27), however, there would be a logging economics issue (fewer trees removed). A 60 percent canopy closure thinning would not be sufficient enough to produce any significant growth/vigor benefits and would have the same economic issue as with the 50 percent thinning, There would also be a complex logistical issue of removing the cut logs from the stand, especially by helicopter due to closer spacing of the leave trees. With the 40 percent thinning grade, the FVS simulation shows that approximately 209 trees per acre would be cut. As a result from choosing the smaller trees to remove, or “thinning from below”, mortality within a stand caused by inter-tree competition would be reduced. This alternative captures and utilizes a portion of this small-tree component for wood products. An indirect benefit after the initial thinning treatment is that the average stand diameter would increase from 11.3 inches to 18.5 inches.

Alternative A would help establish 67 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 50 percent thinning, proposed for these acres would allow a short-lived window for sufficient growing space for understory tree, shrub, and herb 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. Restoring ACS conditions would improve riparian dependent and associated species habitat and provide quality connectivity corridors through the watershed.

Within the next five years, it is anticipated that both the Divot timber sale (122 acres) and the Tee Timber Sale (998 acres) would be completely logged. No additional, planned, large-scale vegetative treatments are proposed or foreseen during this one to five year time period on national forest system lands within the watershed.

Cumulative Effects (10 and 50 years) of Alternative A

Table 3.27 displays the projected average diameter growth that would occur under four different thinning regimes over time. The inter-tree competition would not be expected to be a 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 ten years compared to the no action alternative. The significant point here is the rate of diameter increase that would occur after the density reduction treatment in 10 and 50 years as a result of thinning at the various thinning grades (very light, light, medium, and heavy). The rate of increase is higher as spacing of the residual trees increase. For example, no thinning shows an average stand diameter increase of 3.8 inches and moderate thinning shows an average stand diameter increase of 5.7 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 deficit acres within the late-successional stand structure (Figure 3.3, page 36) in a more, timely manner. Late-successional stands require large trees. Thinning accelerates diameter tree growth. In 2006, the Upper East Fork of the Lewis River contained only four percent, 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 3.27. Projected diameter growth.

Treatment (spacing)	% Canopy Closure	Trees/Acre	Increase in Average Stand Diameter	
			In 10 years	In 50 years
No Thinning		240+	0.9”	3.8”
Very Light Thinning (16’x16’)	60	165	1.2”	5.0”
Light Thinning (18’x18’)	50	140	1.3”	5.4”
Moderate Thinning (20’x20’)	40	105	1.3”	5.7”
Heavy Thinning (25’x25’)	30	70	1.4”	6.3”

No additional planned, large-scaled vegetative treatments are proposed or foreseen, on national forest system lands within this watershed during the next ten-year time period. 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 Tee Timber Sale and also on new acres needing thinning.

Direct and Indirect Effects (1-5 years) of Alternative B

A total of 886 acres of upland timber stands and 0 acres of riparian stands would be treated within the first five years. The proposed thinning of upland timber stands to a 40 percent canopy closure would, like Alternative A, allow adequate density reduction for individual tree growth. The vegetative effects are the same as discussed in Alternative A, except that this alternative treats 179 fewer acres. A loss of tree vigor, especially in the overtopped and intermediate tree crown class, would continue on these 179 acres due to the high tree densities. The vegetative effects, especially the high densities, would be the same as discussed in Alternative D.

Alternative B does not enter and treat 67 acres of riparian area, as does Alternatives A and C. There would be an opportunity loss associated with this action. Approximately 61 percent of the proposed 67 riparian acres require a helicopter logging system due to steep terrain and inaccessibility. Because of the high economics associated with helicopter logging, an efficient logging operation requires several hundred acres to be logged. The decision to defer these acres in the Tee Timber Sale would mean that these acres would remain untouched until the next proposed helicopter commercial timber sale entry in 20 years. The opportunities of accelerating the establishment of multi-layer, species diverse riparian stands would not occur during this entry. The vegetative effects, especially of not restoring ACS objectives, would be the same as discussed in Alternative D.

Cumulative Effects (10 and 50 years) of Alternative B

In ten years, Alternative B would continue to provide growth and vigor benefits to the 886 acres that received a density management treatment. The 179 acres of dense stands deferred from a density reduction treatment would experience the same vegetative effects discussed in Alternative D. The 67 acres of deferred riparian entry and underplanting of shade tolerant species would also experience the same vegetative effects as discussed in Alternative D.

Decommissioning of approximately 8.5 miles of road in Alternative B should not hinder future density reduction treatments on those stands located on these roads. Road decommissioning will increase the logging costs for these stands, however they should still be economically viable to log in the future using a helicopter, based on the economic analysis results from the Divot and Tee Timber Sales.

Direct and Indirect Effects (1-5 years) of Alternative C

A total of 998 acres of upland timber stands and 67 acres of riparian stands would be treated. Alternative C is identical to Alternative A except for the logging system, slash treatment, and landing locations. There would be no significant vegetative effects difference between these two alternatives.

Cumulative Effects (10 and 50 years) of Alternative C

There would be no significant vegetative effect differences between Alternative A and C.

Direct and Indirect Effects (1-5 years) of Alternative D

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 would 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 also would forgo the opportunity to improve the percentage of desirable species and increase the biodiversity within portions of the riparian reserves. Approximately 67 acres of riparian reserves proposed for underplanting of shade tolerant species would not occur. Natural stand development would be relatively slow. The existing 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 lost in the Yacolt burns of the last century, and natural regeneration occurs. Restoring ACS objectives in a timely manner would be delayed within these acres.

Cumulative Effects (10 and 50 years) of Alternative D

In 10 years the landscape within the Upper East Fork Lewis River watershed would continue on the same trajectory as described for the first one to five years. The dense Douglas-fir component would continue to grow in the overstory. However, individual tree growth would remain stable or slightly decline due to moisture, light, and nutrient stress within the trees. Table 3.27 illustrates an average tree diameter growth increase of 0.9 inches at the end of the ten-year period. 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 model shows the stand suffers about four percent mortality by the end of the ten-year period. The forest floor of these stands would remain shaded and suppress the establishment and growth on shade intolerant grass, forbs, brush, and conifer species.

In 50 years, a small percentage of these stands may start to become populated in the understory with scattered shade tolerant conifer species, most likely western hemlock. The FVS model indicates the individual growth rate for the average tree diameter growth (50-year period) within stand 19 has reduced from 0.9 inches by 2016 to 0.7 inches by 2056. Mortality of single and groups of trees would continue and accelerate in denser stands.

Botany

The following is summarized from the Botanical Resource Report, located in the Tee Timber Sale project file.

Botanical Characterization

Most stands within the project area lack late successional legacy features such as large remnant trees (though large down woody debris can be locally abundant). According to the Upper East Fork Lewis River Watershed Analysis (2002(3)), by around 1960, most of the snags created by the fires that occurred during the early to mid 20th century had either fallen naturally or been felled for the purpose of fire prevention. Fire generated snags that persist are relatively short (most less than 30 feet tall), with relatively large diameters (most greater than 20 inches dbh), and in advanced stages of decay. Down wood resulting from fallen snags are abundant in some areas, but are also in advanced stages of decay. Because the conifer stands within the watershed are relatively young and heterogeneous, it will be decades before a new source of large woody debris develops.

Despite the overall lack of vegetative diversity, the Upper East Fork Lewis River Watershed provides important habitat for a number of rare and uncommon species. *Corydalis aquae-gelidae* (cold water Corydalis) is a notable example. This species is both a Regional Forester's Sensitive Species within Region 6, and a Survey and Manage Category A species under the Northwest Forest Plan (USDA and USDI 1994, amended 2004). Cold water Corydalis is a regional endemic, which is found from southwestern Washington to northwestern Oregon, with the largest and most robust populations found on Gifford Pinchot and Mount Hood National Forests. In addition, Tee Timber Sale planning area provides excellent habitat for some species of lichens and bryophytes that require large down woody debris as substrate, such as *Tetraphis geniculata* (bent-knee moss).

Within the fairly uniform forest stands that comprise the Tee Timber Sale planning area, there are pockets of vegetative diversity. Most often, these pockets are found associated with riparian zones, seeps or springs. There are also areas where larger trees exist with well developed, diverse shrub and herb layers. These habitat pockets provide an important element of diversity in an otherwise homogeneous landscape.

Threatened, Endangered & Proposed Plant Species

Direct, Indirect, and Cumulative Effects of All Alternatives

At this time there are no federally listed (Proposed, Endangered, or Threatened) 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. No such wetland habitats will be impacted by the implementation of this project. In addition, wetlands to be impacted by this project were surveyed and no listed species were located. Thus, project action alternatives would have no effect on federally listed species.

Sensitive Plant Species

Existing Condition

Table 3.28 lists all Regional Forester's Sensitive species known or suspected to occur within the project area. Species that are considered "non-surveyable" are highlighted in the table.

Table 3.28. Regional Forester's Sensitive botanical species documented or suspected to occur within the Tee Timber Sale planning area. Species considered "non-surveyable" are highlighted.

SENSITIVE BOTANICAL SPECIES				
Scientific name	**Documented (D) or Suspected (S) within project area**	**Site location identification within project area**	**Documented (D) or Suspected (S) within adjacent 5th field watershed**	**Number of occurrences within adjacent 5th field watershed**
VASCULAR PLANTS				
Agoseris elata	S			
Bolandra oregana	S		D	8
Carex densa	S			
Chrysolepis chrysophylla	S		D	1
Cimicifuga elata	S		D	6
Corydalis aquae-gelidae	D	Unit 1; Unit 39	D	10
Cypripedium fasciculatum	S			
Erigeron howellii	S		D	3
Erigeron oreganus	S		D	4
Euonymus occidentalis	S			
Fritillaria camschatcensis	S			
Galium kamtschaticum	S			
Howellia aquatilis	S			
Montia diffusa	S		D	1
Parnassia fimbriolata v. hoodiana	S			
Piyopus californica	S			
Platanthera sparsiflora	S			
Poa laxiflora	S			
Poa nervosa	S			
Polemonium carneum	S		D	3
Sidalcea hirtipes	S			
LICHENS				

SENSITIVE BOTANICAL SPECIES				
Scientific name	Documented (D) or Suspected (S) within project area	Site location identification within project area	Documented (D) or Suspected (S) within adjacent 5th field watershed	Number of occurrences within adjacent 5th field watershed
Cetrelia cetrarioides	S		D	2
Chaenotheca subroscida	S			
Collema nigrescens	S			
Dendriscocaulon intricatulum	S			
Dermatocarpon lurdium	S		D	5
Hypotrachyna revoluta	S			
Leptogium burnetiae	S			
Leptogium cyanescens	S			
Nephroma bellum	S			
Nephroma occultum	S			
Pannaria rubiginosa	S			
Peltigera neckeri	S			
Peltigera pacifica	S		D	2
Pilophorus nigricaulis	S			
Platismatia lacunosa	S		D	2
Pseudocyphellaria rainierensis	S		D	11
Tholurna dissimilis	S			
Usnea longissima	S		D	1
BRYOPHYTES				
Encalypta brevicola var. crumiana	S			
Schistostega pennata	S		D	2
Scouleria marginata	S			
Tetraphis geniculata	S		D	33
FUNGI				
Albatrellus ellisii	S			
Bridgeoporus nobilissimus	S			
Cordyceps capitata	S			
Gomphus kauffmanii	S			
Gyromitra californica	S			
Leucogaster citrinus	S			
Mycena monticola	S		D	1
Otidea smithii	S			
Ramaria cyaneigranosa	S			
Ramaria gelatiniaurantia	S			

SENSITIVE BOTANICAL SPECIES				
Scientific name	Documented (D) or Suspected (S) within project area	Site location identification within project area	Documented (D) or Suspected (S) within adjacent 5th field watershed	Number of occurrences within adjacent 5th field watershed
Ramaria rubrievanescens	S			
Sarcodon fuscoindicus	S			
Sowerbyella rhenana	S			
Spathularia flavida	S			

Direct, Indirect, and Cumulative Effects of All Alternatives

Multiple sites for four Sensitive Species were found within the Tee planning area, including *Corydalis aquae-gelidae*, *Tetraphis geniculata*, *Peltigera pacifica*, and *Cetrelia cetrarioides* (Table 3.29).

Table 3.29. Sensitive species locations within Tee Timber Sale located during 2005 surveys.

Location (Unit)	Species
1	*Corydalis aquae-gelidae*
4	*Tetraphis geniculata, Cetrelia cetrarioides*
5	*Tetraphis geniculata*
6	*Tetraphis geniculata*
7	*Tetraphis geniculata*
8	*Tetraphis geniculata, Peltigera pacifica*
9	*Tetraphis geniculata*
15	*Tetraphis geniculata, Peltigera pacifica*
16	*Tetraphis geniculata,*
18	*Tetraphis geniculata, Corydalis aquae-gelidae*
19	*Tetraphis geniculata*
20	*Peltigera pacifica*
21	*Tetraphis geniculata*
23	*Tetraphis geniculata*
24	*Tetraphis geniculata*
26	*Tetraphis geniculata*
28	*Peltigera pacifica*
29	*Tetraphis geniculata, Cetrelia cetrarioides*
38	*Tetraphis geniculata*
39	*Corydalis aquae-gelidae, Tetraphis geniculata*
42	*Cetrelia cetrarioides*
43	*Tetraphis geniculata*
44	*Tetraphis geniculata*

48	*Tetraphis geniculata*
50	*Tetraphis geniculata*
Landing A	*Tetraphis geniculata*

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 sites found on the Gifford Pinchot National Forest. Of these, 10 sites are located within the Upper East Fork Lewis River Watershed. On the Gifford Pinchot National Forest, *Corydalis aquae-gelidae* is most often found associated with headwaters and tributaries (stream order 0 to 2). 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 Tee Timber Sale discovered six new sites for this species (Table 3.29). Within Unit 1, sites were found along a stream on the east side of the unit, and in a spring on the northern boundary of this unit. Project design features incorporate a 170 foot riparian reserve buffer along this creek, and a 75 foot. buffer around the spring, which will protect these sites, and maintain desirable habitat conditions for the species. Within Unit 18, plants were found growing along Bolin Creek and associated tributaries. Project design features incorporate a riparian reserve buffer of 170 foot along Bolin Creek and a 75 foot buffer along the stream and spring on the western boundary of the unit, up to the crossing of Forest Road 4104, which will protect sites and maintain desirable suitable habitat in this area. In Unit 39, *Corydalis* was found growing along the stream channels which border this unit on both the western and eastern boundaries. Project design features incorporate a 170 foot riparian reserve along the stream channel located on the western boundary, and a 100 foot riparian reserve along the channel along the eastern boundary of this unit. These riparian reserves will maintain desirable habitat conditions and protect the species at this site.

Although surveys for this species revealed new sites for this species within the timber sale area, other sites and habitat for this species might also exist within the project area, which were not detected. Alternatives A and C would incoporate riparian thinning, which poses the greatest risk for this species. Alternative B would not incorporate riparian thinning but would include some culvert replacements which also pose a more limited risk to the species. For this reason, the action alternatives A, B and C may impact individuals or habitat for this species, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species as a whole. Alternative D will 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. One hundred and three sites for this species have been located in Washington and Oregon, 60 from the Gifford Pinchot National Forest. 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).

All action alternatives of the Tee Timber Sale would incorporate project design features designed to minimize the impact of project activities upon the known *Tetraphis geniculata* sites, by maintaining riparian reserves of 170 feet along many streams, maintaining the moist shaded microclimate around known sites found within the harvest area of units through implementation of site buffers (see Table 1, Appendix A for buffer specifications), and by providing large coarse woody debris for potential future substrate. Although surveys for this species revealed 34 new locations within the Tee Timber Sale area, other sites and habitat for this species might also exist within the project area. For this reason, the action alternatives may impact individuals or habitat for this species, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species as a whole. Alternative D will have no impact upon this species.

Peltigera pacifica

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. Four new sites for this species were located in the Tee Timber Sale during 2005 surveys. One hundred and fourteen 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.

All action alternatives of the Tee Timber Sale would incorporate 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 through implementation of 170 foot riparian reserves, 90 foot radius buffers around sites located within timber harvest units, and by providing large coarse woody debris for potential future substrate. Although surveys for this species revealed four new locations within the Tee Timber Sale area, other sites and habitat for this species might also exist within the project area. For this reason, the action alternatives may impact individuals or habitat for this species, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species as a whole. The No Action alternative for this project will have no impact upon this species.

Cetrelia cetrarioides

Cetrelia cetrariodes is an epiphytic lichen found most often growing in riparian zones on hardwood trees and shrubs (particularly *Alnus rubra*), but is occasionally found growing on conifers. *Cetrelia* is known from 78 sites across the Northwest Forest Plan area, two of which are located on the Gifford Pinchot National Forest.

Three new sites for this species were located during 2005 surveys of Tee Timber Sale, in Units 4, 29, and 42. Project design features would protect these sites and maintain suitable habitat. In Unit 4, a riparian reserve buffer of 170 feet would protect the sites, and maintain habitat conditions for the species along the riparian corridor. In Units 29 and 42, sites would be protected by a buffer of 75 foot radius centered on the site and through the silvicultural prescription that will maintain *Alnus rubra* and hardwoods within these stands.

Suitable habitat for this species is concentrated within riparian corridors and near wet pockets in uplands (such as near springs or seeps). The Tee Timber Sale project would incorporate many riparian zones that would be protected through riparian reserve buffers, or (in some cases) selectively thinned. These activities would help protect suitable habitat for this species within the project area. Although surveys for this species revealed three new locations within the Tee Timber Sale area, other sites and habitat for this species might also exist within the project area. For this reason, the action alternatives may impact individuals or habitat for this species, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species as a whole. The No Action alternative for this project will have no impact upon this species.

Non-surveyable Sensitive Species

It is unknown whether the 'non-surveyable' Sensitive species (refer to Table 3.28) occur within the project's area of impact. For the purpose of analysis, we assume that there is potential for occurrence within the project area and estimate whether the likelihood of occurrence is low, moderate or high, using guidelines set by Region 6 of the Forest Service (Likelihood of Occurrence Key 2004); the impact analyses reflect this assumption. For all species, this project may impact individuals or habitat, but will not likely lead to a trend towards federal listing or a loss of viability to the species. The no action alternative will result in no impact to these species.

Cumulative Effects

None of the Sensitive botanical species that were located within the project area, or that are (for the sake of analysis) presumed to exist within the project area (non-surveyable species) are either so limited in distribution, habitat, or number that project activities (with incorporated design features), in combination with past or reasonably forseeable future actions on nearby federal land and adjacent private land, would 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 and Manage Plant Species

Existing Condition

In addition to being Sensitive Species, *Corydalis aquae-gelidae* and *Tetraphis geniculata* are Category A Survey and Manage Species, while *Peltigera pacifica*, and *Cetrelia cetrarioides* are both Category E Survey and Manage Species.

Table 3.30 lists Survey and Manage Category A and C botanical species documented or suspected to occur within the project area.

Table 3.30. Survey and Manage Category A and C botanical species documented or suspected to occur within Tee Timber Sale area*

Scientific name	Documented (D) or Suspected (S) within project area	Documented (D) or Suspected (S) within adjacent 5th field watershed	Also Sensitive on the Gifford Pinchot NF? (Y/N)
VASCULAR PLANTS			
Botrychium montanum	S	S	**N**
Coptis asplenifolia	S	S	**N**
Coptis trifolia	S	S	**N**
Corydalis aquae-gelidae	D	D	Y
Cypripedium fasciculatum (WA; outside eastern Cascades Physiographic Province)	S	S	Y
Cypripedium montanum (WA; outside eastern	S	S	**N**

Scientific name	Documented (D) or Suspected (S) within project area	Documented (D) or Suspected (S) within adjacent 5th field watershed	Also Sensitive on the Gifford Pinchot NF? (Y/N)
Cascades Physiographic Province)			
Galium kamtschaticum	S	S	**N**
Platanthera orbiculata	S	S	**N**
LICHENS			
Dendriscocaulon intricatulum	S	S	Y
Hypogymnia duplicata	S	S	**N**
Leptogium cyanescens	S	S	Y
Lobaria linita, var. *tenuoir*	S	S	**N**
Nephroma occultum	S	S	Y
Pseudocyphellaria rainierensis	S	D	Y
BRYOPHYTES			
Schistostega pennata	S	S	Y
Tetraphis geniculata	D	D	Y
FUNGI			
Bridgeoporus nobilissimus	S	S	Y

Based on the low likelihood of occurrence of these species within the project area, the line officer has opted to omit further surveys specifically targeting the species listed in Table 3.31.

Table 3.31. Likelihood of occurrence of Survey and Manage species not included in 2005 surveys, based on use of Interagency Special Status Sensitive Species Program Likelihood of Occurrence Key (http://www.or.blm.gov/ISSSP/Conservation_Planning-and-Tools.htm).

Species	Likelihood of occurrence
Coptis aspleniifolia	Low
Coptis trifolia	Low
Cypripedium montanum	Low
Platanthera orbiculata	Low
Botrychium montanum	Low
Hypogymnia duplicata	Low
Lobaria linita var. *tenuoir*	Low

Direct, Indirect, and Cumulative Effects of All Alternatives

Corydalis aquae-gelidae and *Tetraphis geniculata* are both Survey and Manage Category A species. This designation requires management of all known sites. Project design features would be incorporated into Tee Timber Sale that provide for the protection of all known sites of these species within the project area. Project design features would be designed 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, Project Design Criteria.

Other botanical resources of concern

Because of the low level of vegetative diversity within the project planning area, 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 homogeneous forest.

Noxious Weeds/Invasive Plants

Existing Condition

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) – low
Cytisus scoparius (scotch broom) – low
Hypochaeris radicata (cat's ear) – moderate
Leucanthemum vulgare (oxeye daisy) – high
Polygonum cuspidatum (Japanese knotweed) – low
Senecio jacobaea (tansy ragwort) – high

Class C Weeds

Hypericum perforatum (St. John's wort) – moderate
Circium arvense (Canada thistle) – moderate
Circium vulgare (bull thistle) – moderate
Phalaris arundinacea (canary-reed grass) – moderate to high

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

Ilex sp. (holly) – low
Lathyrus latifolius (perennial pea) – low (but locally abundant)
Arctium minus (common burdock) – low (but locally abundant)

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

Direct, Indirect, and Cumulative Effects of All Alternatives

Under all Tee Timber Sale action alternatives, there would be a substantial 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 above). From the perspective of prevention and control, alternatives that emphasize ground based logging methods would be less desirable than Alternatives that emphasize helicopter logging. For this reason, Alternative C, which incorporates 117 acres of ground-based logging, would be more desirable that Alternatives A or B, which both incorporate 414 acres of ground-based logging. Alternative A also would incorporate the greatest distance (1.9 miles) of temporary road construction, making it less desirable than B (0 miles) and C (0.4 miles). All alternatives would incorporate a similar number of acres (12–14) for construction of helicopter landings. In summary, Alternative C would have lower potential to cause establishment and spread of noxious weeds and invasive plants than either Alternatives A or B.

In order to control noxious weed colonization and spread under the action alternatives, weed-spread prevention and weed eradication activities should be implemented before, during and after project activities (refer to Appendix A, Project Design Criteria).

Wildlife

The following is summarized from the Wildlife Biological Evaluation and Biological Assessment for Consultation on Northern Spotted Owl.

Wildlife Characterization

Table 3.32 lists the federally Threatened, Endangered, and Proposed species considered in this evaluation, and summarizes the effect to each.

Table 3.32. 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	Potential	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	Potential	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	No	No	No Effect
Northern Spotted Owl *Strix occidentalis caurina*	Threatened	Yes	No	NLAA**
Critical Habitat for the Northern Spotted Owl	Designated	No	No	No Effect
Marbled Murrelet *Brachyramphus marmoratus*	Threatened	No	No	No Effect

Species Name	Species Status	Species habitat present within or adjacent to the project area?	Species documented in the project area?	Effect Determination*
Critical Habitat for the Marbled Murrelet	Designated	No	No	No Effect
Common Loon *Gavia immer*	USFS Sensitive	No	No	No Impact
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

Species Name	Species Status	Species habitat present within or adjacent to the project area?	Species documented in the project area?	Effect Determination*
VanDyke's Salamander *Plethodon vandykei*	USFS Sensitive	Yes	No	NTFL**
Cope's Giant Salamander *Dicampton copei*	USFS Sensitive	Yes	No	NTFL**
Cascade Torrent Salamander *Rhyacotriton cascadae*	USFS Sensitive	Yes	Yes	NTFL**
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	No	No Impact
Warty Jumping Slug *Hemphillia glandulosa*	USFS Sensitive	Yes	Yes	NTFL**
Malone's Jumping Slug *Hemphillia malonei*	USFS Sensitive	Yes	Yes	NTFL **
Panther Jumping Slug *Hemphillia pantherina*	USFS Sensitive	Yes	No	No Impact
Columbia Duskysnail *Lyogyrus n. sp. 1* *(Amnicola sp. 4 - G2)*	USFS Sensitive	No	No	No Impact
Blue-gray	USFS	Yes	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*
Taildropper *Prophysaon coeruleum*	Sensitive			
Dalles Sideband *Monadenia fidelis minor*	USFS Sensitive	No	No	No Impact

*NLAA – May impact, but not likely to adversely affect
NTFL – May impact individuals, no trend towards federal listing
** Applies to all action alternatives

Species Dropped from Further Analysis

Only those species that were identified in the table above as having a potential to be affected by this project will be discussed further in this analysis.

Federally Listed Wildlife – Northern Spotted Owl

Existing Condition

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.

Due to a series of large stand-replacing fires that burned in the East Fork Lewis River watershed beginning in 1902, there is very little late-successional or old-growth forest (suitable spotted owl habitat) in the analysis area. 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 on the Forest in 1999 found that the East Fork Lewis River fifth-field watershed is comprised of only about four percent late-successional stands.

The amount of suitable spotted owl habitat in the analysis area is shown in Table 3.33. The data is from the vegetation database for the Gifford Pinchot National Forest.

Table 3.33. Spotted Owl Habitat in the Analysis Area

Analysis Area	Acres	Percent
Suitable Nesting Habitat	53	0.3
Suitable Foraging Habitat	2,787	15
Dispersal Habitat	3,748	20 (Total 35% available for dispersal)

Figure 3.9 shows the suitable spotted owl habitat in the analysis area.

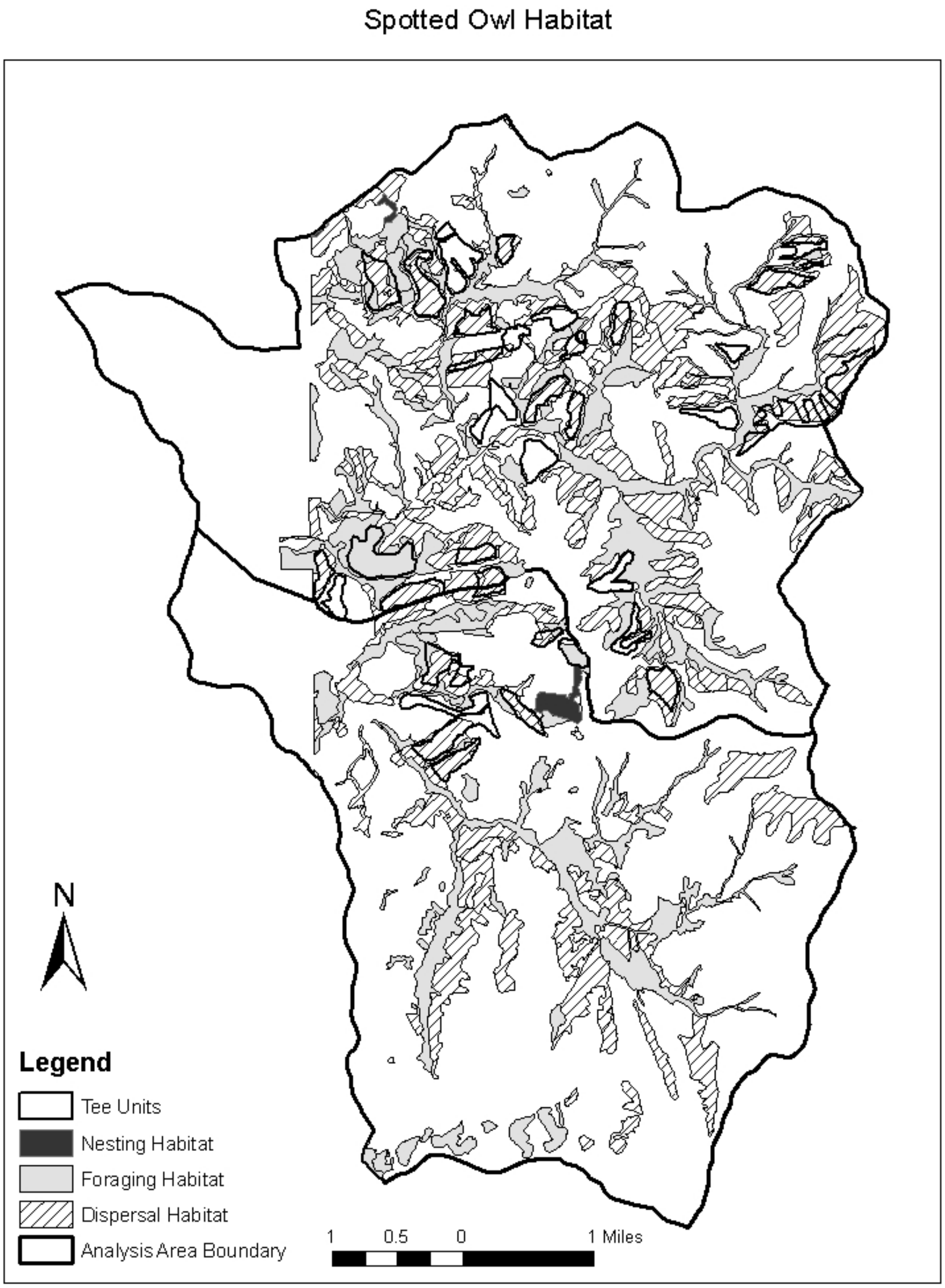

Figure 3.9. Spotted Owl habitat in the Tee analysis area.

The scarcity of suitable nesting habitat or large green remnant trees within the younger stands in the analysis area make it unlikely that spotted owls would be nesting there. There is one historic activity center (#8206) higher in the watershed, outside of the analysis area. It is in an area that was missed by the fires and that contains old-growth habitat. It is located about 1.6 miles east of proposed Unit 9. There are other historic activity centers in the Canyon Creek Watershed to the north, but none of those are within 1.82 miles of any proposed Tee units. Surveys have not been conducted in the watershed since the implementation of the Northwest Forest Plan, so it is unknown if spotted owls still nest there. During the spring of 2005 a pair of barred owls was heard on one occasion and sighted on a second occasion near proposed Units 43 and 44. They responded to spotted owl vocalizations, and it's likely that they were nesting in the area. The habitat in the area of the barred owl sighting consists of a relatively large block of mapped spotted owl foraging habitat that contains relatively large trees, but is only a single-story stand.

Mapped spotted owl dispersal habitat is found primarily along the stream drainages in the analysis area. According to the Forest's GIS database, only about 35 percent of the analysis area supports habitat that is suitable for spotted owl dispersal (stand average dbh at least 11 inches and canopy closure at least 40 percent). Although spotted owl dispersal is considered hindered in areas that have less than 50 percent dispersal habitat, the dispersal habitat in the analysis area is fairly continuous along the major stream drainages, and so spotted owls may still be able to disperse across the analysis area.

There is no designated Critical Habitat in the watershed.

Direct and Indirect Effects of Alternative A

Four of the proposed units are between 80 and 96 years old (Units 1, 5, 21, and 40), and the remainder of the units are 70 years old or younger. Stand exams in the units show that the number of commercial-sized trees in the units ranges from about 209 to 375 per acre. The average is about 250 to 280 per acre.

All of the proposed units are single-story stands that contain very few hard snags or hard logs. After the fires in the early 1900s, many of the snags were felled by the Civilian Conservation Corps, and the proposed units all contain large remnant logs that resulted from this activity. Many of the units also contain one to four large remnant snags per acre, but most of these are broken and relatively short (less than 30 feet tall). These remnants are all well-decayed. Elsewhere on the Gifford Pinchot N.F. spotted owls are known to nest within younger stands if there are also old-growth green trees that are remnants of the previous stands within them. The analysis area contains very few trees that pre-date the fires.

Mapped foraging habitat can be found in five of the proposed units and totals about 120 acres. Units 40 and 44 are comprised entirely of mapped foraging habitat, totaling 96 acres. The proposed thinning would reduce the overstory canopy closure to forty percent and thereby downgrade foraging habitat in Units 40 and 44, to dispersal habitat.

The other 24 acres of mapped foraging habitat that would be thinned is found within three other units: Unit 5 (about 2 acres), Unit 26 (about 16 acres), and Unit 46 (about 6 acres). These acres are all along the edges of larger foraging habitat patches that will not be thinned. Thinning along the edges would not likely affect the ability of owls to forage in these stands if owls were present.

Units 40 and 44 are both single story stands that are not near large blocks of spotted owl nesting habitat, and are not within the home range of any historic spotted owl activity centers. For these reasons, and because the largest patch (Unit 44) appears to be currently occupied by barred owls, it is unlikely that these patches are used as foraging areas by nesting spotted owls at this time. The downgrade of foraging habitat to dispersal habitat in these units would also be relatively short-term (10 to 15 years), since the canopy cover will increase fairly quickly and the growth on the retained trees would be accelerated.

This is also true for the dispersal habitat that would be thinned. Within a relatively short time the habitat would be improved as the canopy cover increased and growth accelerated on the retained trees. In addition, this alternative would thin a total of 366 acres that are currently mapped as non-habitat for spotted owls. The average diameter of these stands is not sufficient to meet the definition of dispersal habitat. The thinning treatment would accelerate growth in these stands and shorten the time needed for them to become dispersal habitat for spotted owls. Treating these stands would also reduce the time needed to develop habitat in the large tree structure stage in the watershed, and thereby reduce the time needed to meet the 15 percent standard and guideline in the Northwest Forest Plan.

Table 3.34 summarizes the project effects to spotted owl habitat in the analysis area.

Table 3.34. Summary of project effects to spotted owl habitat (Alternative A).

	Before Treatment		After Treatment	
	Acres	Percent	Acres	Percent
Foraging Habitat	2,787	15	2,667	14
Dispersal Habitat	3,748	20	3,868	21
Non-Habitat Improved			366	2

Since it is unlikely that spotted owls are currently nesting in the analysis area due to the lack of suitable nesting habitat, is also unlikely that spotted owls would be disturbed by the noise generated by activities associated with the logging activity, such as timber felling, helicopter yarding, and log haul. For these reasons, a limited operating period (LOP) specific to spotted owls is not required. However, a LOP would be implemented in ground-based yarding units to protect residual trees from damage during the sap flow period. The LOP would be April 15 to July 1, and would apply to Units1, 5, 22, 23, 24, 29, 35, 36, 37, 40, 44, and 45. In reality, it is doubtful that any logging activity would take place in the spring before April 15 due to wet weather, so this LOP would probably also cover the early spotted owl nesting season (March 1 to June 30).

Effects determination for consultation: Alternative A may affect, but is not likely to adversely affect spotted owls.

Direct and Indirect Effects of Alternative B

The effects of this alternative to spotted owls would be similar to Alternative A except that fewer acres would be treated since the Riparian Reserves would not be thinned and the dispersal habitat in Unit 8 would not be thinned. With this alternative a total of about 104 acres of foraging habitat would be downgraded to dispersal habitat, again primarily in Units 40 and 44 (82 acres), and 526 acres of dispersal habitat would be treated. In addition, 271 acres that is not currently dispersal habitat would be thinned reducing the time needed for these stands to become dispersal habitat.

Table 3.35. Summary of project effects to spotted owl habitat (Alternative B).

	Before Treatment		After Treatment	
	Acres	Percent	Acres	Percent
Foraging Habitat	2,787	15	2,667	14
Dispersal Habitat	3,748	20	3,868	21
Non-Habitat Improved			271	1.5

Since the two units comprised entirely of foraging habitat would be thinned with this alternative as in Alternative A, the short-term effects to spotted owls would be similar to Alternative A. However, in the long-term, 179 fewer acres would be thinned with this alternative. Tree growth would not be accelerated on these acres, increasing the time needed for these stands to become suitable for spotted owls.

For this alternative the sap flow LOP would be applied to Units1, 5, 22, 23, 24, 29, 35, 36, 37, and 40.

Alternative B may affect, but is not likely to adversely affect spotted owls.

Direct and Indirect Effects of Alternative C

The effects of this alternative would be essentially the same as Alternative A. The same units would be treated with the same prescription.

The main difference between Alternatives A and C is that under Alternative C the LOP for sap flow would only be needed on three units: 5, 29, and 40. For this reason, and due to the greater use of helicopters in general, Alternative C would have a greater risk of disturbing owls during the early part of the nesting season if any were present in the analysis area. Because of the minor amount of suitable nesting habitat in the analysis area, the risk of affecting nesting spotted owls is very low.

Alternative C may affect, but is not likely to adversely affect spotted owls.

Cumulative Effects of the Action Alternatives

The Divot III Timber Sale is currently being logged in the analysis area. This timber sale will thin 13 acres of habitat that meets the definition of spotted owl foraging habitat, and 74 acres that meets the definition of dispersal habitat. These stands will all be dispersal habitat following treatment. An additional 35 acres outside of the Tee analysis area is being thinned as well. The effects of this project would be similar to those described for Tee, and there would be minor cumulative effects associated with downgrading 13 acres of foraging habitat to dispersal habitat. No other timber harvest is proposed in the watershed at this time.

Direct and Indirect Effects of Alternative D

With this alternative none of the proposed units would be treated. In the short-term, no spotted owl foraging habitat would be downgraded to dispersal 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 results the death of overtopped trees. This would result in natural thinning of the stands, but this process would take longer without the treatment.

There would be no cumulative effects.

Alternative D would have no effect to spotted owls.

Sensitive Species

Larch Mountain Salamander

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 Tee 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 several sites in the East Fork Lewis River watershed, which is outside of the portion of its range that has been influenced by volcanic eruptions. In nearly all cases in the East Fork Lewis River watershed, it is found in relatively open talus and in timbered talus edges around the open talus. Timbered talus in the watershed is largely inhabited by western redback salamanders (*Plethodon vehiculum*), and these two species are not often found together, except in the fringe areas.

Surveys to protocol for Larch Mountain salamanders were conducted in the original proposed Tee units in 2002 and 2003. Two sites were found in the southeastern end of Unit 6 near the riparian reserve. A site was documented south of Unit 22, and another site south of Unit 19. Another site was located near a proposed unit along Forest Road 41, however this unit has been dropped from the current proposal. Surveys were not conducted for Larch Mountain salamanders in the old Divot units that were added to the Tee proposal because the habitat does not appear to be suitable in these units, and so they are not likely to be found there. Surveys were conducted for mollusks in these units, and Larch Mountain salamanders were not detected.

Direct and Indirect Effects of Alternatives A, B, and C

The effects of these alternatives would be similar in that no occupied habitat would be affected. The portion of Unit 6 that was found to be occupied was deleted from these alternatives (the entire unit was dropped from Alternative B). The sites near Units 19 and 22 are outside of the area to be thinned. Known occupied habitat will not be affected by timber harvest activities or road and landing construction. For these reasons, there would be no impacts to this species. There would be no cumulative effects.

Direct, Indirect, and Cumulative Effects of Alternative D

This alternative would have no impact to this species.

Van Dyke's Salamander

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).

Surveys to protocol for Van Dyke's salamanders were conducted in upland portions of the original proposed Tee units in 2002 and 2003. No Van Dyke's salamanders were detected. Surveys were not conducted in upland portions of the old Divot add-on units because the habitat does not appear to be suitable.

There are no documented Van Dyke's salamander sites in the East Fork Lewis River watershed, although suitable habitat appears to be widespread.

Direct and Indirect Effects of Alternative A

With this alternative a total of 67 acres of Riparian Reserve would be thinned on 12 of the proposed units. The minimum no-cut buffer for this treatment is 50 feet, and for most the treatment areas it is 100 feet or more. In addition, the residual canopy closure in the thinned Riparian Reserves would be fifty percent on 51 of the 67 acres treated. The no-cut buffers would protect the habitat that is most likely to be occupied from disturbance, and there would be no new road construction across streams.

Road reconstruction has the potential to impact streams where culverts have to be replaced. Surveys have not been conducted in these stream crossings. However, only a very small proportion of the potential habitat has the potential to be affected, and mitigations that would be required to protect fish would also protect salamanders. 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. These are the same measures that would be taken if salamanders were known to be occupying these streams.

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. There is an unlikely chance that individual animals could be impacted if animals existed in the watershed, but the viability of the population would not be affected.

There would be no road decommissioning with this alternative, so the opportunity to reconnect habitat blocked by road culverts would be forgone.

Direct and Indirect Effects of Alternative B

With this alternative, no Riparian Reserves would be thinned, so the habitat most likely to be occupied would not be affected by timber harvest activity.

The number of miles of road reconstruction would be the same as in Alternative A. The associated road decommissioning projects would require removal of culverts across streams that may be suitable habitat. In the long-term, culvert removal would benefit this species by removing potential barriers to upstream and downstream movement, and by reducing the amount of sediment entering these streams annually from roads. In the short-term though, there is a potential to impact Van Dyke's salamanders by disturbing substrate material and adding sediment to the streams. Only a very small proportion of the potential habitat in the analysis area would be affected, and the mitigations that would be required to protect fisheries habitat would also protect salamanders. 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. These are the same measures that would be taken if salamanders were known to be occupying these streams.

Because of the road decommissioning there is an unlikely chance that individual animals could be impacted if animals existed in the watershed, but the viability of the population would not be affected. This activity would have long-term benefits to the species if it exists in the watershed, and the planned mitigations would be the same if the sites were occupied by Van Dyke's salamanders.

Direct and Indirect Effects of Alternative C

This Alternative would treat the same acres as in Alternative A, but it would not require road reconstruction and use of the 4211 road system, and about 1.7 miles less reconstruction on Forest Road 4100-544 and 4104.

Since the habitat most likely to be occupied would be within no-cut buffers and since less road reconstruction would be needed than in the other action alternatives, it is not likely that there would be significant negative impacts to the species' habitat, life cycle, microclimate, or life support requirements. There is an unlikely chance that individual animals could be impacted if animals existed in the watershed, but the viability of the population would not be affected.

There would be no road decommissioning with this alternative, so the opportunity to reconnect habitat blocked by road culverts would be forgone.

Cumulative Effects of the Action Alternatives

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 the action alternatives of the Tee Timber Sale. The mitigations for these projects would be the same as required for the work in Tee. The mitigations would minimize sediment, and only a minor percentage of the total available habitat would be disturbed. The cumulative effects of Tee would not be significant.

Direct, Indirect, and Cumulative Effects of Alternative D

With this alternative there would be no impacts 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 road culverts, and reduce long-term sedimentation would be forgone.

Cope's Giant Salamander and Cascade Torrent Salamander

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 ten 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 in the analysis area in both 6^{th} field watersheds.

Direct and Indirect Effects of 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.

Road reconstruction under this alternative would have the potential to impact these species as well. Cascade torrent salamanders have been documented in tributaries to McKinley Creek, so it is possible that individuals could be in the vicinity Forest Road 4104 during reconstruction activities. If stream crossings need to be improved during reconstruction there is a potential to impact these species. The mitigations described that would be in place to protect fish habitat would also benefit salamanders, and only a very small amount of the suitable habitat would be affected.

Alternative A may impact individuals but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Direct and Indirect Effects of Alternative B

Since Cope's giant, and Cascade torrent salamanders are tied closely to perennial stream courses, leaving the Riparian Reserves unthinned would be effective in protecting their habitat.

Road reconstruction, and road decommissioning under this alternative would have the potential to impact these species. Cascade torrent salamanders have been documented in tributaries to Little Creek and in McKinley Creek, so it is possible that individuals could be in the vicinity of Forest Roads 4211-541, and 4104-573 when they are decommissioned. If stream crossings need to be improved during reconstruction there is a potential to impact these species. The mitigations described that would be in place to protect fish habitat would also benefit salamanders, and only a very small amount of the suitable habitat would be affected. The removal of culverts would benefit these species in the long-term by removing barriers to upstream and downstream movement, and by reducing the amount of sediment entering these streams annually from roads.

Alternative B may impact individuals but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Direct and Indirect Effects of Alternative C

This Alternative would treat the same acres as in Alternative A, but it would not require road reconstruction and use of the 4211 road system, and about 1.7 miles less reconstruction on Forest Roads 4100-544 and 4104, including about one mile in the McKinley Creek drainage.

Since the habitat most likely to be occupied would not be thinned and since less road reconstruction would be needed, it is not likely that there would be significant negative impacts to these species' habitat, life cycle, microclimate, or life support requirements. There is an unlikely chance that individual animals could be impacted but the viability of the population would not be affected.

There would be no road decommissioning with this alternative, so the opportunity to reconnect habitat blocked by road culverts would be forgone.

Alternative C may impact individuals but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Cumulative Effects of the Action Alternatives

There are various road improvement and culvert projects planned in the analysis area that in the long-term would improve habitat for these salamander species by removing barriers to movement, and reducing sedimentation. However the short-term effects are cumulative to the road work that is proposed in the action alternatives of the Tee Timber Sale. The mitigations for these projects would be the same as required for the work in Tee. The mitigations would minimize sediment, and only a minor percentage of the total available habitat would be disturbed. The cumulative effects of Tee would not be significant.

Direct, Indirect, and Cumulative Effects of Alternative D

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

Under the 2003 Annual Species Review the following species are Category A (pre-disturbance surveys, manage known sites): *Cryptomastix devia*, *Cryptomastix hendersoni*, *Monadenia fidelis minor*, and *Prophysaon coeruleum*. The following species is Category C (pre-disturbance surveys, manage high-priority sites): *Hemphillia malonei*. The following species are Category E (manage known sites): *Hemphillia burringtoni*, 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. *Cryptomastix devia* is closely associated with mature big-leaf maple trees, which are only found in the analysis area near the edges of streams. These trees would not be affected by the project. *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 N.F. The management recommendations for this species reports that there is no reason to expect this species on the Gifford Pinchot N.F., but that surveyors should be able to recognize it. *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 in the East Fork Lewis River watershed have been conducted for a fisheries habitat restoration project (41 acres) and the Tee Timber Sale (1,699 acres). Since 1999 a total of about 1,740 acres have been surveyed in the watershed, resulting in the location of 427 Malone's jumping slug (*Hemphillia malonei*) sites and 18 warty jumping slug (*Hemphillia glandulosa*) sites. These sites are well-distributed in the watershed. No other Survey and Manage mollusk species have been documented.

Surveys for the original Tee proposal were done in the spring 2002 and 2003, and one survey visit to each of the old Divot add-on units was done in spring 2005. A total of 423 Malone's jumping slug sites and 13 warty jumping slug sites were found in or near the proposed Tee units. All but four of the Tee units have at least one mollusk location documented, and most units have several.

Given the fact that this watershed was extensively burned over by stand-replacing fires in the early 1900s, an assumption can be made that these mollusk species are fairly resilient to the effects of disturbance, and are likely able to reoccupy disturbed areas from adjacent undisturbed areas as habitat conditions become suitable. As another example of the apparent resilience of the species, Malone's jumping slug has been found elsewhere on the District at high densities within 40 to 50-year old stands where the previous stands had been clear-cut and the slash burned.

The proposed Tee units where these mollusks were not found are generally south-facing slopes with an abundance of rock near the surface. These are areas that may have burned hotter during the large fires and taken longer to recover from the fires. Mollusks that may have existed there before the fires would have been less likely to survive the effects of the disturbance.

Under the mollusk survey protocol only a small percentage of the acres within a given survey area are physically searched, so the actual number of acres physically surveyed is much less than the 1,740 reported above. Even so, there was approximately one Malone's jumping slug site found for each four acres of survey area, and the species appears to be well-distributed in the watershed. While found much less frequently, warty jumping slug sites are also distributed across the watershed. Therefore, it is assumed that these species can also be found in similar concentrations in unsurveyed suitable habitat outside of the proposed Tee units.

The management recommendation document for Malone's jumping slug was prepared in 2002. It defined suitable habitat as conifer stands below 5000 feet elevation that are at least 50 years old, and have a canopy closure of at least 50 percent. Habitat for warty jumping slug is similar, and these species were often found in close proximity to each other in the watershed.

About 52 percent (9,740 acres) of the federal land in the analysis area is suitable habitat, and about half of these acres (4,938 acres) are within Riparian Reserves. The surveys done in the analysis area up to this time constitute about 18% of the suitable habitat.

Direct and Indirect Effects of Alternative A

In general, terrestrial mollusk species would be impacted by reduction of the overstory canopy, which would result in warmer and drier conditions at the ground surface, and by use of heavy machinery in the units. The Management Recommendation for Malone's jumping slug requires it to be protected at high priority sites sufficient to ensure its persistence in a watershed. Under this management recommendation, given that the species is well-distributed in the watershed, at least 70 percent of the suitable habitat in each 6^{th} 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.

This would likely result in the loss of some of the known sites in the proposed units where the residual canopy closure would be taken below 50 percent. In addition, machine piling of slash on 72 acres and ground-based yarding on 351 acres within thinned units would result in ground disturbance that may destroy sites that may otherwise have been maintained. Mitigation to protect the existing large logs and extensive use of helicopter yarding, which would result in less ground disturbance on 714 acres, will probably allow many known sites to persist in the units after thinning. In addition, canopy closure (and habitat suitability) would increase relatively quickly as growth on the residual trees is accelerated.

The Survey and Manage requirement for warty jumping slug is to protect all known sites. The known sites in the proposed units would be buffered by 100 feet to protect microclimatic conditions at the site. There are a total of 9 warty jumping slug sites that would have to be buffered; they are located in Units 19, 24, 28, 29, and 40. One of these sites is apparently located adjacent to Forest Road 4104 in Unit 19. If it is actually that close to the road, there may be no way to effectively protect the site. There would be negligible effects to the other known warty jumping slug sites in the units.

Individual Malone’s jumping slugs in the harvest units are likely to be impacted by planned thinning and slash treatment, however individuals will persist in the high priority sites, and other suitable habitat in the analysis area and in the watershed that is not being treated. In addition, it is expected that the jumping slugs will repopulate the harvest units from adjacent habitat as conditions become suitable. It is expected that the populations of Malone’s jumping slug and warty jumping slug will persist in the watershed.

Eventually the remnant logs that are important habitat for these mollusks will become too decayed to support them. In the absence of large hard logs to replace them, habitat suitability may decline in the watershed. In the long-term the commercial thinning treatment on 1,065 acres would improve habitat in the units by accelerating the development of large trees that eventually could become large logs as the stands mature.

Direct and Indirect Effects of Alternative B

The effects of this Alternative would be less than in Alternative A because 80 acres of occupied habitat would be left undisturbed by dropping Units 6 and 8, and 155 acres of occupied habitat would be logged with helicopter instead of ground-based/skyline (Units 26, 44, and 47), significantly reducing ground disturbance in these units.

As with Alternative A, warty jumping slug sites would be protected, and sufficient habitat for Malone’s jumping slug will be protected within high priority sites that it is expected to persist in the watershed.

Eventually the remnant logs that are important habitat for these mollusks will become too decayed to support them. In the absence of large hard logs to replace them, habitat suitability may decline in the watershed. In the long-term the commercial thinning treatment on 886 acres would improve habitat in the units by accelerating the development of large trees that eventually could become large logs as the stands mature.

Direct and Indirect Effects of Alternative C

This alternative would treat the same acres as with Alternative A, but there would only be 71 acres of ground-based yarding compared with 351 acres under Alternative A, and there would be about 3.5 acre less machine piling of slash. Since there would be less ground disturbance, there would be a greater chance that individual mollusks could survive and persist in these units after thinning.

As with Alternative A, warty jumping slug sites would be protected, and sufficient habitat for Malone’s jumping slug will be protected within high priority sites that it is expected to persist in the watershed.

Eventually the remnant logs that are important habitat for these mollusks will become too decayed to support them. In the absence of large hard logs to replace them, habitat suitability may decline in the watershed. In the long-term the commercial thinning treatment on 1,065 acres would improve habitat in the units by accelerating the development of large trees that eventually could become large logs as the stands mature.

Cumulative Effects of the Action Alternatives

The Divot Timber Sale (122 acres), also in the East Fork Lewis watershed, was approved before the requirement to conduct mollusk surveys. Divot is also a thinning sale and it's likely that a number of Malone's jumping slug sites, and perhaps warty jumping slug sites were affected. Although occupied habitat was likely affected, identifying and protecting high priority sites will ensure the persistence of Malone's jumping slug in the watershed. Based on the density of known warty jumping slug sites in the watershed, one or two sites may have been affected by Divot. Since Malone's and warty jumping slugs are expected to persist in the watershed, the cumulative effects of Tee would not be significant. No other timber harvest is planned in the watershed at this time.

Direct, Indirect, and Cumulative Effects of Alternative D

With this alternative there would be no impacts to the known mollusk sites in the proposed Tee units. Without the thinning treatment it will take longer to develop large logs to replace the well-decayed remnants.

Management Indicator Species

Cavity Excavators

Cavity excavators represent species requiring snags and down logs.

Within the East Fork Lewis watershed, most of the snags created by the fires early in the century were either felled by the 1960's to reduce the potential for new fire starts, or have fallen naturally. The fire-generated snags that still persist are several decades old and are well-decayed and generally less than 30 feet tall. The forest stands that regenerated following the fires are generally healthy at this time, and do not yet contain snags resulting from 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. In the Westside Lowland Conifer-Hardwood Forest Habitat Type, abundance of snags and down wood generally peaks in the first 50 years after a fire or other disturbance and is least abundant at about 150 years post disturbance, and increases again after about 200 years (DecAid, Mellen, *et al.* 2006) The 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.

The following table contains estimates of snag numbers and condition in the East Fork Lewis watershed based on data from 17 Current Vegetation Survey (CVS) plots. Only the snags with a diameter of ten inches or larger are reflected in this table.

Table 3.36. Estimates of snag condition by structure stage in the East Fork Lewis Watershed.

CVS plot	Structure Stage	Snags/ acre	Height Range	Median Height	DBH Range	Median DBH	Decomposition Stage
1158140	Open small tree	11.8	6 – 33 ft.	16 ft.	13.9 – 47.5 in.	20 in.	100% soft decomp.
1160144	Closed sap/pole	25.5	9 – 53 ft.	19 ft.	15.3 – 35.7 in	26.3 in.	4% hard recent dead 17% soft decayed 79% soft decomp.
1160148	Grass/forb	2.2	15 – 20 ft.	17.5 ft.	22.9 – 32.7 in.	27.8 in.	100% soft decayed
1162144	Shrub/ seedling	17.1	8 – 55 ft.	20 ft.	16 – 38.3 in.	29.8 in.	19% soft decayed 79% soft decomp.
1162148	Large tree multi-story	19.5	6 – 132 ft.	15 ft.	14.1 – 54 in.	32.3 in.	11% hard loose bark 11% hard no bark 34% soft decayed 45% soft decomp.
2158142	Wet/ mesic	3.2	11 – 27 ft.	13 ft.	17.7 – 28.7 in	20.6 in.	100% soft decomp.
2159142	Closed small tree	30.2	6 – 79 ft	30.6 ft.	16.1 – 42.7 in.	30.6 in.	7% hard no bark 23% soft decayed 70% soft decomp.
2159144	Closed small tree	22.4	9 – 79 ft.	23 ft.	17.5 - 47.5 in.	35.2 in.	10% hard no bark 75% soft decayed 15% soft decomp.
2160142	Closed small tree	6.4	6 – 16 ft.	9 ft.	25.1 – 35.4 in.	31.2 in.	17% soft decayed 83 % soft decomp.
2160146	Hardwood small tree	37	7 – 58 ft.	22 ft.	10.6 – 61.3 in.	32.3 in.	32% hard recent dead 11% hard loose bark 40% soft decayed 17% soft decomp.

CVS plot	Structure Stage	Snag s/ acre	Height Range	Median Height	DBH Range	Median DBH	Decomposition Stage
2161142	Hardwood small tree	4.4	5 – 64 ft.	10 ft.	14.2 – 47.2 in.	34.4 in.	25% hard loose bark 50% hard no bark 25% soft decayed
2161144	Closed small tree	3.3	5 – 6 ft.	6 ft.	14.8 – 50.2 in.	42.8 in	100% soft decomp.
2161146	Closed sap/pole	47.7	7 – 54 ft.	19 ft.	16.3 – 41.2 in.	28.2 in.	18% hard no bark 47% soft decayed 36% soft decomp.
2161148	Shrub/ seedling	1.1	37 ft. (n = 1)		38 in. (n = 1)		100% soft decomp.
2161150	Shrub/ seedling	2.2	5 – 9 ft.	7 ft.	26.3 – 37.5 in.	31.9 in.	100% soft decomp.
2162146	Shrub/ seedling	0.4	13 ft. (n = 1)		51.7 in. (n = 1)		100% soft decomp.
2162142	Closed sap/pole	14.8	7 – 43 ft.	17.5 ft.	12.7 – 37.8 in.	31.3 in.	27% hard loose bark 7% hard no bark 29% soft decayed 37% soft decomp.

The estimated number of snags per acre in the CVS plots shown in the table above is highly variable, which is to be expected due to the clumpy nature of snags in the environment. Whether or not a high number of snags per acre are estimated depends on the number of snags that happened to fall within the plot, so it’s difficult to use these numbers to average the number of snags in the watershed. The height, diameter and decay stage in the data above however, can be used to characterize the condition of snags in the watershed. The following can be said about snags in the watershed in general:

- The majority of the snags are relatively short (most less than 30 feet tall).
- Snag diameters are relatively large (most greater than 20 inches dbh).
- Most snags are soft and well decayed.

The structure stage that contains a high percentage of hard snags is the “hardwood small tree” structure. This is due to the existence of alder snags in these stands. Since the alders grew after the fires in early part of the century, and since alder lives a relatively short time, many of these snags represent recently dead trees.

There is no quantitative data on down wood levels in the watershed, but logs resulting from falling snags created by the fire are fairly abundant in some areas. However, these logs are in advanced stages of decay. Since most of the conifer stands in the watershed are young, it will be decades before there is again a source of large woody debris (pieces greater than 20 inches diameter). For this reason large woody debris may be deficient between the period of time when existing logs have decayed, and before large logs are again recruited into the ecosystem.

The web-based Decayed Wood Advisor (DecAid, Mellen, *et al.* 2006) was consulted to compare the existing condition in the analysis area with the historic range of variability for this habitat type. Data in DecAID for westside lowland conifer-hardwood forest in the small to medium tree vegetation condition, in the western Washington Cascades lowlands (WLCH_WCA_S) was considered for this analysis. This habitat type makes up about 55 percent of the analysis area, and all of the proposed Tee commercial thin units are in this type. Based on the inventory data in DecAID of the entire plot sample within this habitat type, approximately 48 percent of the area on all ownerships is in the small/medium tree structure class. The distribution of this structure class in the analysis area is similar.

Snags

According to data in DecAID, all inventory plots in unharvested stands in this habitat type found that the range in the density of snags that are at least 10 inches diameter was 0 to 67.2 per acre. Thirty percent of the area would have a density of 11 per acre or less (30% tolerance), 50 percent of the area would have a density of 17 per acre or less (50% tolerance), and 80 percent of the area would have a density of 31 per acre or less (80% tolerance), DecAID (Mellen, *et al.* 2006) Figure 3.10.

The following data describe distribution of snags on unharvested plots (n=176) in the WLCH_WCA_S vegetation condition.

- 7% of the unharvested area has > 90 snags/ha (36/acre) that are ≥ 25.4 cm (10.0 in) dbh; the value of snags/ha is similar to the high end of the 80% tolerance level for wildlife.
- 17% of the unharvested area has > 35 snags/ha (14/acre) that are ≥ 50.0 cm (19.7 in) dbh; the value of snags/ha is similar to the midpoint of the 80% tolerance level for wildlife. -23% of the unharvested area has 30 to 45 snags/ha (18/acre) that are ≥ 25.4 cm (10.0 in) dbh; this range of snags/ha is similar to the high end of the 50% tolerance level for wildlife.
- 34% of the unharvested area has > 20 snags/ha that are ≥ 50.0 cm (19.7 in) dbh; the value of snags/ha is similar to the data points at the 50% tolerance level for wildlife. 81% of the unharvested area has > 15 snags/ha (6/acre) that are ≥ 25.4 cm (10.0 in) dbh; the value of snags/ha is similar to the data points at the 30% tolerance level for wildlife.
- 31% of the unharvested area has >0 to 15 snags/ha (4/acre) that are ≥ 50.0 cm (19.7 in) dbh; this range of snags/ha is similar to the data points at the 30% tolerance level for wildlife. 6% of the unharvested area either has no snags or no snags ≥ 25.4 cm (10.0 in) dbh and ≥ 2.0 m (6.6 ft) tall
- 11% of the unharvested area has no snags ≥ 50.0 cm (19.7 in) dbh.

Figure 3.10 from DecAID depicts the distribution of snags greater than 10 inches diameter that would be expected in this habitat type. This data indicate that 18 percent of the watershed would be expected to have from 0 to 6.1 snags per acre (0 to 15 per hectare).

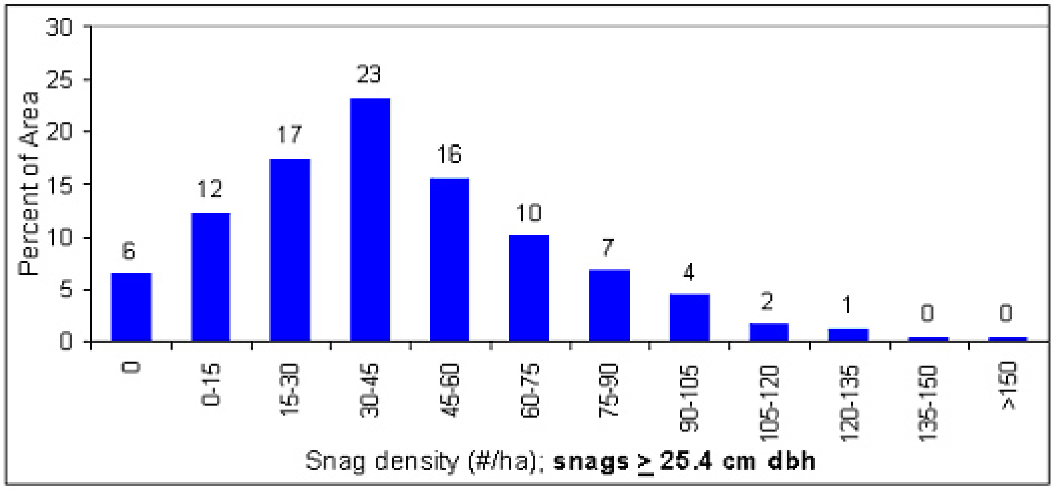

Figure 3.10. Distribution of the unharvested area of the WLCH_WCA_S.inv-2 Vegetation Condition among snag density classes (#/ha) for snags ≥ 25.4 cm dbh, based on 176 unharvested inventory plots.

Wildlife Use of Snags

As stated above, the majority of the existing snags in the watershed are less than about 30 feet tall. Data in DecAID show that of 19 species studied where the height of snags used for nesting were recorded, only four nested in snags less than 10 meters (32 feet) tall. Only one of these four (downy woodpecker) is a cavity excavator managed under the Gifford Pinchot Forest Plan.

Thirty percent of the primary excavator population was found to be nesting in snags up to 21.3 inches dbh, fifty percent of the population was found to be nesting in snags up to 34.2 inches dbh, and eighty percent of the population was found to be nesting in snags up to 53.6 inches dbh, DecAID (Mellen, *et al.* 2006) Table WLCH_S.sp-17.

In one study with a sample size of eight, thirty percent of the population of cavity nesting birds was found to be nesting in areas that had up to 5.2 snags per acre that were at least 10 inches dbh, fifty percent of the population was found to be nesting in areas that had up to 18.4 snags per acre this size, and eighty percent of the population was nesting in areas that had up to 36.6 snags per acre this size, DecAID (Mellen et al. 2006) Table WLCH_S.sp-22.

The density and diameter of snags in this habitat type in the watershed are within the historic range of variability, and are at about 50 percent tolerance level for wildlife species that would be expected to use snags. However, it is possible that there are not enough tall snags to meet the needs of populations of cavity excavators at this tolerance level.

Down Wood

There is no quantitative data on down wood in the watershed. DecAID data for all inventory plots in this habitat type show a range in down wood cover from 0 to 31 percent. Thirty percent of the area would have a cover of 3.2 percent or less (30% tolerance), 50 percent of the area would have a cover of 5 percent or less (50% tolerance), and 80 percent of the area would have a cover of 8.9 percent or less (80% tolerance), DecAID (Mellen, *et al.* 2006) Figure WLCH_WCA_S.inv-10.

The proposed Tee units generally contain a fairly high number of large down logs that are remnants of the stands that were destroyed in the fires of the early 1900s. These structures are all well-decayed. There are also some smaller diameter hard logs that are the result of trees in the existing stands falling over. An estimate for the Tee units is that they have three to five percent cover of woody debris.

For the most part, the hard snags and logs in the analysis area 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.

Direct and Indirect Effects of Alternative A

With this alternative a total of 1,065 acres in the small tree structure stage would be thinned, which is about six percent of the analysis area, and 13 percent of the conifer habitat in the analysis area that is in the Small Tree structure stage or larger. The thinning treatment would have minor effects to the existing snags as some may need to be felled for safety reasons. The fact that the majority of existing snags are relatively short, reduces the potential that safety considerations would require that they be felled. Helicopter yarding on approximately 714 acres (67% of the thinned acres) also would reduce the need to fell the shorter snags for safety reasons, and would minimize potential effects to existing large logs. Snags currently existing in the hardwood stands would not be affected since these areas would not be treated.

After thinning, an average of one tree per acre that is at least 17 inches diameter will be topped or girdled to create snags, and one tree per acre felled to create logs.

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 50 percent for snag density and diameter after thinning, and snag and log creation, but would decline gradually as the existing old snags fall over. At a watershed scale, the condition would be within the natural range of variability with the Tee 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.

Direct and Indirect Effects of Alternative B

With this alternative a total of 886 acres would be thinned, which is about five percent of the analysis area, and 11 percent of the conifer habitat in the analysis area that is in the Small Tree structure stage or larger. The thinning treatment would have minor effects to the existing snags as some may need to be felled for safety reasons. The fact that the majority of existing snags are relatively short, reduces the potential that safety considerations would require that they be felled. Helicopter yarding on approximately 697 acres (79% of the acres to be thinned) also would reduce the need to fell the shorter snags for safety reasons, and would minimize potential effects to existing large logs. Snags currently existing in the hardwood stands would not be affected since these areas would not be treated.

After thinning, an average of one tree per acre that is at least 17 inches diameter will be topped or girdled to create snags, and one tree per acre felled to create logs.

The thinning treatment would reduce the number of small 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 50 percent for snag density and diameter after thinning, and snag and log creation, but would decline gradually as the existing old snags fall over. At a watershed scale, the condition would be within the natural range of variability with the Tee 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.

Direct and Indirect Effects of Alternative C

With this alternative a total of 1,065 acres in the small tree structure stage would be thinned, which is about six percent of the analysis area, and 13 percent of the conifer habitat in the analysis area that is in the Small Tree structure stage or larger. The thinning treatment would have minor effects to the existing snags as some may need to be felled for safety reasons. The fact that the majority of existing snags are relatively short, reduces the potential that safety considerations would require that they be felled. Helicopter yarding on approximately 994 acres (93% of the thinned acres) also would reduce the need to fell the shorter snags for safety reasons, and would minimize potential effects to existing large logs. Snags currently existing in the hardwood stands would not be affected since these areas would not be treated.

After thinning, an average of one tree per acre that is at least 17 inches diameter will be topped or girdled to create snags, and one tree per acre felled to create logs.

The thinning treatment would reduce the number of small 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 50 percent for snag density and diameter after thinning, and snag and log creation, but would decline gradually as the existing old snags fall over. At a watershed scale, the condition would be within the natural range of variability with the Tee 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.

Cumulative Effects of the Action Alternatives

The Divot Timber Sale, also in the East Fork Lewis watershed, thinned a total of 122 acres that are also in the small to medium tree structure type. It is likely that some snags were felled due to safety concerns, and the potential to develop snags naturally on these acres is reduced. Mitigation for the Divot sale will create about two snags per acre, partially offsetting what was lost. The 122 acres of Divot represent additional acres where the development of large trees will be accelerated. The effects of Divot on a unit basis are similar to the effects described for Tee, and the cumulative effects are not significant.

Direct, Indirect, and Cumulative Effects of Alternative D

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 on five to six percent of the analysis area with this project would be forgone.

Pileated Woodpecker and Pine Marten

Pileated woodpecker and pine marten represent species that require old-growth and mature forest conditions. The analysis area does not currently provide very much of this type of habitat (only about 53 acres of old coniferous habitat exists in the analysis area), but it could provide dispersal habitat and cover for individual animals moving within their home ranges. 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.

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.

Direct and Indirect Effects of Alternatives A, B, and C

The effects of these alternatives is similar, the degree of beneficial and negative effects is proportional to the number of acres treated. 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 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 be recruited into 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 majority of habitat is not being thinned. There will likely be suppression mortality in the untreated areas that would provide small dead wood.

In the long-term, habitat 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 trend towards meeting the Forest Plan standard and guideline of 15 percent late-successional habitat in the watershed would be accelerated.

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

Direct and Indirect Effects of Alternative D

With this alternative the stands 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 Alternatives A and B. Suppression mortality would mean that there would be more small snags in the analysis area.

Deer and Elk

In general on the Gifford Pinchot National Forest, and especially in winter range areas, the reduction in regeneration timber harvest since the mid-1990s has reduced the amount of high quality forage available to the elk and deer herds.

Conditions in the East Fork Lewis River Watershed for large ungulates are fair to good during the snow-free months. Higher ridges in the watershed have not regenerated into closed stands, and contain abundant forage. Clear-cuts in the higher elevations, as well as in adjacent watersheds to the northeast have created a good mix of forage and cover that are in close proximity. The young dense stands on the middle and lower slopes in the watershed provide good hiding cover and connectivity throughout the watershed (USDA 2002(c)).

Optimal habitat on summer range would have 50 percent to 60 percent of the area in foraging habitat and about 40 percent of the area in thermal and optimal cover. Cover Types on National Forest Land in the watershed include about 9,212 acres of open foraging (35%), 7,309 acres of hiding cover (27%), 10,389 acres of thermal cover (38%), and 614 acres of optimal cover (2%). Non-habitat (rock and other non-vegetated areas) constitutes about 1,577 acres of the watershed. Elk and deer summer range would improve by increasing foraging areas in the watershed.

Ungulate numbers in the watershed have probably fluctuated since the major fires in the early 1900s. After the fires forage would have increased, benefiting ungulates, but this benefit may have been partially offset by the dramatic increase in road miles since the 1940s. As the regenerated stands developed into closed pole-size stands, available forage has declined, and it's likely that elk and deer numbers have dropped as well. This type of fluctuation in ungulate populations has probably always occurred in areas west of the Cascades in response to large disturbance events that tend to be stand-replacing.

Biological winter range in the watershed contains about 26.5 miles of open roads, which equates to a road density of about 2.1 miles per square mile. This figure reflects a reduction of approximately 2.5 miles of road that have been decommissioned since 1995 and 3.3 miles of road that are behind a washed-out bridge that have been converted to a trail. Approximately 4.7 additional miles of road in winter range would have to be seasonally closed 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.

Acres and percent of four cover types on National Forest in Biological Winter Range in the watershed are: open forage – 1,003 acres (13%), hiding cover – 2,112 acres (27%), thermal cover – 4,697 acres (60%), and optimal cover – 51 acres (<1%). Approximately 251 acres in biological winter range is non-habitat. Additional forage in winter range areas adjacent to thermal cover would benefit deer and elk.

The standard in the Forest Plan for winter range states that 44 percent of the area should be in optimal cover. It is not known how much optimal cover existed in biological winter range in the watershed before 1902, but based on historic burn patterns, and fire intervals, it is assumed that riparian stands would generally be composed of late-successional conifer stands. These areas would have provided optimal cover in the past. The fire interval on the adjacent upland stands at these lower elevations was shorter, and likely did not support the multi-storied late-successional conifer stands that comprise optimal thermal cover.

Analysis Area

The analysis area contains about 6,264 acres that are classified and biological winter range for elk and deer. This constitutes one-third of the analysis area. Approximately 680 acres out of 1,080 acres in the proposed units are located in winter range. The 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.

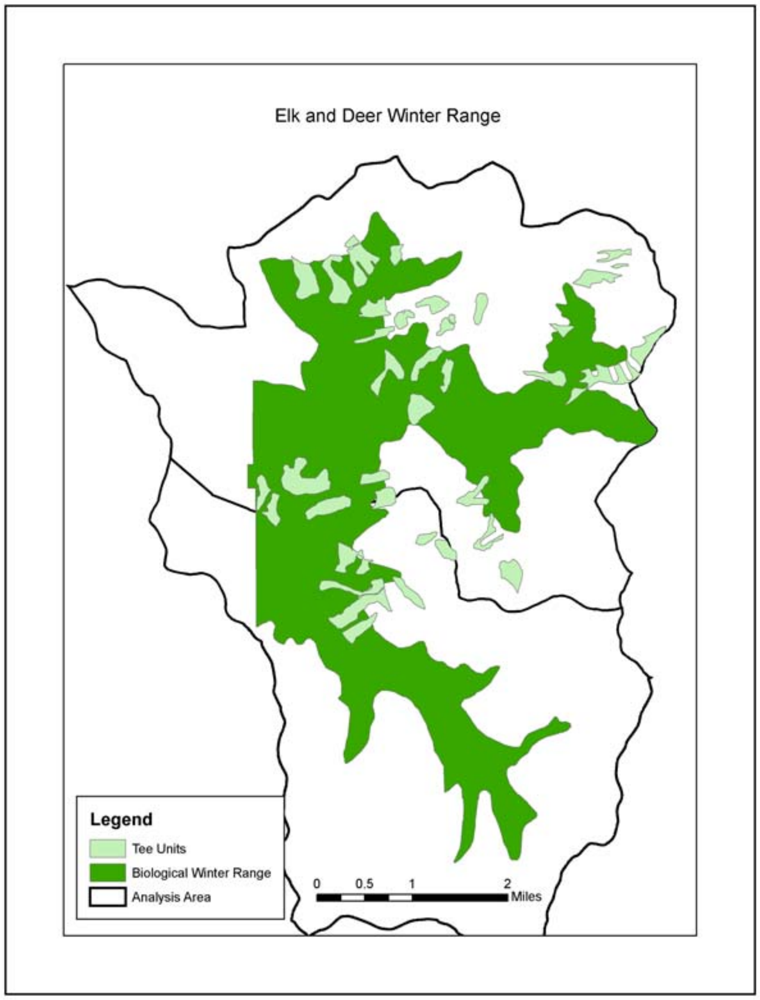

Figure 3.11. Biological Winter Range in the Tee Analysis Area

Direct and Indirect Effects of Alternative A

Proposed thinning on 1,080 acres, including 680 acres in winter range would likely slightly increase forage production in the areas that are thinned. Reducing the overstory canopy and allowing more light to reach the forest floor would probably increase growth on browse and herbaceous plant species in the understory. This effect would be short-term, lasting 10 to 15 years, and within the scope of the watershed, would not be significant.

In the long-term growth on the residual trees in the thinning units would be accelerated, and these area could become optimal thermal cover in the future. This would probably take 50 years or more.

Road reconstruction, especially on Forest Road 4211 may encourage more traffic on these roads after the project than what currently occurs. The effect is difficult to quantify because the current traffic levels are unknown, but it may result in a slight increase in disturbance to elk and deer.

Direct and Indirect Effects of Alternative B

Proposed thinning on 1,001 acres, including 623 acres in winter range would likely result in a slight increase in forage production in the areas that are thinned. Reducing the overstory canopy and allowing more light to reach the forest floor would probably increase growth on browse and herbaceous plant species in the understory. This effect would be short-term, lasting 10 to 15 years, and within the scope of the watershed, would not be significant.

In the long-term growth on the residual trees in the units would be accelerated, and these area could become optimal thermal cover in the future. This would probably take 50 years or more.

This alternative would decommission a total of 8.5 miles of road, including two miles of road within winter range, moving the open road density within winter range toward the desired condition.

Direct and Indirect Effects of Alternative C

Proposed thinning on 1,080 acres, including 680 acres in winter range would likely result in a slight increase in forage production in the areas that are thinned. Reducing the overstory canopy and allowing more light to reach the forest floor would probably increase growth on browse and herbaceous plant species in the understory. This effect would be short-term, lasting 10 to 15 years, and within the scope of the watershed, would not be significant.

In the long-term growth on the residual trees in the thinning units would be accelerated, and these area could become optimal thermal cover in the future. This would probably take 50 years or more.

The 4211 Road system would not be used with this alternative, so existing traffic levels would not change.

Cumulative Effects of the Action Alternatives

The benefit of increased forage production in the thinned units of Tee would be cumulative to the acres that were thinned with the Divot Timber Sale (122 acres). Roads that were improved to facilitate logging Divot are the same roads that would be used for Tee, so negative cumulative effects are insignificant.

Direct, Indirect, and Cumulative Effects of Alternative D

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 will 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

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.

Direct and Indirect Effects of Alternatives A, B, and C

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.

Direct, Indirect, and Cumulative Effects of Alternative D

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

Neotropical Migratory Birds

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 will be maintained.

The following table displays the focal species potentially positively or negatively affected changes in habitat, and the forest conditions and habitat attributes they represent.

Table 3.37. Focal bird species.

Forest Conditions	Habitat Attribute	Focal Species
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 3.38 displays the number of acres in different structure stages in the analysis area. Data is from the second iteration of the Upper East Fork Watershed Analysis (2002).

Table 3.38. Structure stages in the analysis area.

Structure Stage	Sub-basin 170800020502	Sub-basin 170800020503
Grass/Forb	218 ac. 2%	224 ac. 3%
Shrub/Seedling	949 ac. 10%	770 ac. 9%
Open Sapling/Pole	576 ac. 6%	248 ac. 3%
Closed Sapling/Pole	1,714 ac. 18%	810 ac. 10%
Open Small Tree	1,411 ac. 15%	1,503 ac. 18%
Closed Small Tree	2,898 ac 30%	2,102 ac. 26%
Large Tree Single Story	106 ac. 1%	160 ac. 2%
Large Tree Multi-story	1 ac. Trace	46 ac. Trace
Hardwood	1,480 ac. 16%	887 ac. 11%
Rock	176 ac. 2%	1,403 ac. 17%

The most common habitats in the analysis area are the small tree structure stages, which include all the proposed Tee Tiimber Sale units. Also significant in the analysis area for the diversity it provides is the hardwood habitat. The hardwood habitat consists of stands dominated by red alder that are all located within riparian areas. These hardwood riparian habitats are relatively rare on the Mount St. Helens District.

The proposed Tee Timber Sale units would currently provide habitat for birds species found in mature/young stands represented by hermit warbler, Hammond's flycatcher, 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. The hardwood stands found in the riparian areas would provide habitat for the species represented by Pacific slope flycatcher, and are also important for various cavity excavators.

Direct and Indirect Effects of Alternatives A, B, and C

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 thinning would occur within the band of deciduous trees in the riparian areas. There would be no effects to this habitat.

These alternatives 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 the most 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.

Alternatives A and C would have a slightly greater beneficial effect than B because more acres would be treated.

Cumulative Effects of the Action Alternatives

The beneficial effects of Tee that would improve habitat diversity in the analysis area would be cumulative to the similar effects of the Divot timber sale (122 acres).

Direct, Indirect, and Cumulative Effects of Alternative D

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

The Tee Planning Area covers the East Fork Lewis River Watershed on National Forest lands. It includes the following scenic resources per the Gifford Pinchot National Forest Land and Resource Management Plan (USDA 1990).

Scenery

Existing Condition

East Fork Lewis River (Eligible Wild and Scenic River)

This river has been identified as eligible for Wild and Scenic River designation. The outstandingly remarkable values are its anadromous and resident fisheries. The river also provides an outstandingly remarkable recreation value for white water sports, fishing, scenic features, and waterfalls (see USDA 1990, EIS Appendix E, page 57). The Forest Plan recognizes the potential for “Scenic” classification for Segment 1 (river source to National Forest boundary) and has allocated the land within ¼ mile of the river as Wild and Scenic River (code NL) to protect its outstandingly remarkable values. The suitability of the river in order to recommend designation has not been determined. Additional study and environmental analysis is required in a separate analysis.

Within the Wild and Scenic River allocation, code NL, scheduled timber harvest is permitted. Regarding scenery “evidence of timber harvest may be visible, but the shorelines are largely undeveloped” (USDA 1990, page VI-109) Scenery is managed at a Retention visual quality objective (VQO). Retention requires activities not be visually apparent. The goal is to repeat the line, form, color and texture of the characteristic landscape. Other specific requirements applicable to timber harvest in this allocation include the following:

- Firewood cutting for home or commercial use should not be permitted in area recommended for Wild river classification. It may be permitted where timber has been harvested in Scenic and Recreation Rivers. Gathering firewood for campfire use may be permitted in any classification.
- To minimize visual disturbance, log and debris removal within the foreground of the river should be done by aerial or cable systems, with low ground pressure equipment, or hand piling.
- Logs and debris should be skidded away from foreground areas as seen from the river, use areas, and major travel routes.

Silver Star Viewshed (#33)

The visual quality of lands within the viewshed of the Silver Star Trailhead and trail are to be managed in a near-natural appearance per the Forest Plan. Specific direction is that both the foreground and middleground viewsheds be managed to a Retention objective.

Sunset-Hemlock Road Viewshed (#34)

The visual quality of lands within the viewshed of Forest Road 42 are to be managed in a near-natural appearance per the Forest Plan. Specific direction is that the foreground and middleground viewsheds are be managed to a Modification objective. The Modification VQO allows alterations to dominate the original characteristic landscape. However, alterations must borrow from natural line and form to such an extent and on such a scale that they are comparable to natural occurrences.

Though this viewshed direction prescribes a Modification objective in the foreground of Forest Road 42, Forest Road 42 closely parallels the East Fork Lewis River. Consequently, applied foreground direction is the more restrictive Retention VQO prescribed for Wild and Scenic River allocation.

Trail Scenery

Trails in the planning area also have specific scenic requirements tied to their management level. These trails and their management needs are indicated in Table 3.39.

Table 3.39. Scenic requirements of trails within the Tee Timber Sale planning area.

<table>
<tr><th>Trail No.</th><th>Name</th><th>Management Level</th><th>VQO Foreground</th><th>VQO Middleground</th></tr>
<tr><td>172</td><td>Bluff Mtn.</td><td>II</td><td rowspan="2">Partial Retention</td><td rowspan="2">Modification</td></tr>
<tr><td>175</td><td>Stairway</td><td>II</td></tr>
<tr><td>173</td><td>Summit Springs</td><td>III</td><td colspan="2" rowspan="3">Same as underlying management allocation.</td></tr>
<tr><td>180</td><td>Silver Star</td><td>III</td></tr>
<tr><td>180A</td><td>Ed's Trail</td><td>III</td></tr>
</table>

Direct and Indirect Effects of Alternatives A, B, and C

The action alternatives are comprised of silvicultural thinning prescriptions. These thins would remove trees from the intermediate and co-dominant crown classes, leaving the majority of the larger trees in the stand, distributed evenly. The logging methods would be primarily by helicopter.

Resulting canopy closure would be 40 to 50 percent based on a vertical projection. Because tree crowns extend 1/3 to 1/2 of the total tree height, when viewed obliquely the evidence of timber harvest would not be apparent. The harvest unit edges would be indistinct, and the color of the stand would be similar to surrounding stands. The texture of thinned stands would differ from unthinned stands, but this difference diminishes in proportion to viewing distance. In the East Fork Lewis River drainage, the expected texture of thinned stands would be within the range of textures exhibited by naturally occurring forest stands. A canopy cover of 40 to 60 percent is within Forest Plan standards for foreground and middleground retention (Tilton and Becker 1999).

Thinned stands do not result in “created openings” which are subject to other limitations in the Forest Plan.

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.

East Fork Lewis River

Units 6, 8, 15, 16, 25, 29, 44, 48, and 49 would extend into the Wild and Scenic River allocation. All units would maintain a retention visual quality objective when view from Forest Road 42 or the East Fork Lewis River.

Silver Star Viewshed #33

Units 19, 31, 32, and 46 wouldextend in the Silver Star Viewshed. All of the units would be in the middleground when viewed from Silver Star Trailhead. All units would maintain a retention visual quality objective.

Sunset-Hemlock Viewshed #34

Units 6, 8, 15, 16, 25, 29, 44, 48, and 49 would lie within the foreground view of Forest Road 42. All other proposed units (except Units 31, 32, and 46) would lie within the middleground view. All units would maintain a retention visual quality objective. Project design criteria (Appendix A) to keep Units 6, 8, 25, 48, and 49 a minimum of 100 feet from Forest Road 42 would avoid the appearance of ground disturbance as viewed by motorists traveling Forest Road 42.

Trail Scenery

Summit Springs Trail #173 would pass through Units 43 and 44, near Units 29 and 30, and through the recently cut Divot Timber Sale Unit 28. While the thinning would maintain a semblance of forest cover, ground disturbance and slash would be plainly evident and would detract from the scenic quality. Mitigation to pull slash back from 20 feet of the trail will minimize this impact. When viewed at this close proximity and slow speed, the scenic impact in the trail foreground would be considered Modification. This would remain consistent with the underlying allocation’s (Deer/Elk Winter Range, code ES) VQO which is Modification, and the Sunset-Hemlock Viewshed VQO which is also Modification

All other Tee units lie far enough away, that if they were visible, it would be in the middleground or background view. At these distances, these Tee units would achieve a Retention VQO.

Cumulative Effects of the Action Alternatives

Divot III Timber Sale will cut stands in the East Fork Lewis River drainage. This sale is using similar cutting (thinning) and logging methods (primarily helicopter) as would Tee. The resulting scenic impacts are similar to what is expected of Tee. In combination, these sales would make timber harvest more discernable throughout the drainage, however, the lines, colors, and textures follow existing patterns, would meet Retention objectives.

Direct, Indirect, and Cumulative Effects of Alternative D

No Action means that Tee Timber Sale would not go forward. Forest vegetation and scenery would be unchanged from the present in the short term. In the long term, the growth of young trees in previously harvested stands would soften visually contrasting lines (timber harvest edges and roads) and colors that result from widely divergent stand ages. Scenery would progress toward the objectives for the East Fork Lewis River Wild and Scenic River allocation, Silver Star Viewshed, Sunset-Hemlock Viewshed, and system trails.

Heritage

Existing Condition

There are a number of documented archaeological sites along the East Fork Lewis River and its tributaries. People were undoubtedly attracted to the area because of the opportunity for fishing and for the hunting of game animals. An aboriginal trail led up the East Fork Lewis River, possibly extending as far as Cougar Rock.

Discoveries of copper and gold were made in the late 1890's near the headwaters of the East Fork Lewis River, and near the headwaters of the Washougal River. At the turn of the century, mining districts in the project area included Copper City and Miners Creek. There were reportedly 150 men working at the Copper City Mine in 1893. Around 1930 these and three others were consolidated into the Washougal Mining District. Prior to and during World War I attempts were made to locate commercial copper deposits at Copper City and Miners Creek, but after the decline of the copper market after the war, they were abandoned.

The Tee Timber Sale area is situated within the Yacolt Burn, a large forest fire that burned over 200,000 acres of forested land between the towns of Carson and Yacolt in 1902. The Dole fire of 1929 re-burned much of the area. In order to reduce future fire hazard, snags were dropped throughout the area by Civilian Conservation Corps (CCC) crew in the 1930's. The CCC also planted trees and constructed roads throughout the area.

Several of the trails within the Tee Timber Sale are of considerable antiquity. The Summit Springs Trail #173 was part of a route which connected Fort Vancouver to the Yakima Valley as early as the 1870's. It reportedly originated in the Dole Valley in Clark County, entering the Forest somewhere in the vicinity of Silver Star Mountain, then turning north to cross Copper Creek. It then followed the ridgeline to Lookout Mountain and continued east to the Wind River Valley. It may coincide with the route followed by John Work of the Hudson's Bay Company in 1830, when he traveled from The Dalles to Fort Vancouver along an Indian trail.

Forest Road 41 was constructed from Sunset Camp to Summit Creek by 1932, and by 1938 it connected Sunset Camp to Hemlock. It was built along the route of a trail which appears on maps as early as 1900, and may have been in use in the 1800's.

Direct and Indirect Effects of Alternative A

There are two heritage resource sites within the boundaries of proposed Tee units, and three additional sites are situated immediately adjacent to either unit boundaries or helicopter landings. In addition, two roads proposed for reconstruction within Alternative A have the potential to impact heritage resources. In all cases, either project design criteria or mitigation measures would insure protection of sites.

The heritage resource site within the boundary of Unit 36 would be designated on the ground for protection. No equipment would operate within the site boundaries, and no ground disturbance would occur within this area. Reconstruction of Forest Road 4211-538 within Unit 36 would be limited to the existing road prism.

The heritage resources within the boundary of Unit 31 consist of scattered features, and individual trees surrounding these features would be marked on the ground as leave trees. The unit boundary was drawn to exclude portions of the site.

In order to protect heritage resources, helicopter landing E would be confined to the area to the north of the intersection of Forest Roads 4211-539 and 4211-541. In addition, reconstruction of

Road 4211-539 would not extend to within 200 feet of the intersection of Roads 4211-539 and 4211-541.

Helicopter landing M would be limited in extent to the top of the ridgeline, and logs would be hauled from this landing to the north.

Direct and Indirect Effects of Alternative B

Effects of this alternative include all of those listed for Alternative A. In addition, decommissioning activities along Forest Roads 4107-507, 4107-539 and 4107-541 have the potential to impact heritage resources. Decommissioning activities would be restricted to areas outside of heritage site boundaries.

Direct and Indirect Effects of Alternative C

Effects of this alternative include all of those listed for Alternative A, with the exception of the reconstruction of Forest Road 4211-539, which would not occur under this alternative.

Direct and Indirect Effects of Alternative D

Under this alternative, there would be no impacts to heritage resources.

Economic Analysis

An economic analysis of the treatment alternatives 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) for each alternative. NEPA planning costs and surveys were not included in the analysis. The economic analysis was computed two ways, with and without a wet season haul road package. A wet season haul road package is more costly that a dry season haul, but does provide the purchaser with more operating season per year. The PNV and Benefit/Cost ratio for the alternatives, using a wet season haul, are displayed in Table 3.40. Alternatives A and C show a positive PNV, while Alternative B is deficiet. The PNV and Benefit/Cost ratio, using a dry seaosn haul, are displayed in Table 3.41. The PNV for all of the treatment alternatives, using a dry season haul, is a positive value. The benefit/cost ratio is also displayed for the economic efficiency of the alternatives.

Table 3.40. Economic Comparison of the Treatment Alternatives Using a Wet Season Haul

Alternative	Present Net Value (PNV)	Benefit/Cost
Alternative A	$480,376	1.13:1
Alternative B	-$99,314	1:-1.03
Alternative C	$60,844	1.02:1

Table 3.41. Economic Comparison of the Treatment Alternatives Using a Dry Season Haul

Alternative	Present Net Value (PNV)	Benefit/Cost
Alternative A	$742,657	1.23:1
Alternative B	$162,967	1.05:1
Alternative C	$276,831	1.07:1

The following assumptions were used to determine the present net worth of the Tee alternatives:

- The alternatives were projected thru the fifth year after stand manipulation.
- An inflation free-discount of 4 percent 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
    - Logging costs (stump to truck) – Helicopter = $280/MBF – Alternatives A, B
    - $286/MBF – Alternative C
    - Truck hauling costs - $2.00/mile (75 miles from sale area to WKO mill)
    - Road Maintenance/Reconstruction costs Alternative A (wet season haul) - $730,664
    - Road Maintenance/Reconstruction costs Alternative B (wet season haul) - $726,124
    - Road Maintenance/Reconstruction costs Alternative C (wet season haul) - $618,050
    - Road Maintenance/Reconstruction costs Alternative A (dry season haul) - $457,892
    - Road Maintenance/Reconstruction costs Alternative B (dry season haul) - $453,352
    - Road Maintenance/Reconstruction costs Alternative C (dry season haul) - $394,041
    - Timber value (at mill) - $400/mbf
    - Prep (flagging, tagging, cruise) stands = $10/MBF.
    - Sale Administration = $3.00/MBF.
    - Temporary Road Construction = $7,000/mile
    - Road Decommissions = $20,000/mile.
    - Reforestation = $500/acre.
    - Noxious weed abatement = $25/acre
    - Create Snags = $50/tree
    - Create CWD = $15/tree
    - Grapple Pile/Cover and Burn Piles = $350/acre
    - Handpile/Cover and Burn Pile =$500/acre.
    - Precommercial Stand Thinning = $150/acre.

Table 3.42. Alternative Activities

Activities	Alternative A	Alternative B	Alternative C	Alternative D
CT Thin-uplands	998 acres	886 acres	998 acres	0
PCT Thin-uplands	15 acres	15 acres	15 acres	
Thin - riparian	67 acres	0	67 acres	0
Plant riparian	67 acres	0	67 acres	0
Temp. Rds	10,280 feet	0	2,400 feet	0
Helicopter Log	714	697	994	0
Skyline Log	167	86	0	0
Tractor Log	184	103	71	0
Grapple Pile Slash	71.9 acres	70.3 acres	68.3 acres	0
Handpile Slash	33.5 acres	33.5 acres	33.5 acres	0
Decommission Rds	0 miles	8.5 miles	0	0
Volume	10,516,000 bf	8,860,000 bf	10,516,000 bf	0

Table 3.43. Economic Analysis Alternative A

Date	Year	Treatment	2006 Costs	2006 Benefit	Discounted Cost	Discounted Benefit
2006	0	Prep Stands (10,516 mbf)	$105,160		$105,160	
2007	1	Noxious Weeds (1,065 ac.)	$26,625		$25,601	
2007	1	Road Reconstruction/maintenance (wet season haul)	$730,664		$702,562	
2007	1	Construct Temp. Rds (0 mi)	$13,629		$13,105	
2007	1	Logging Costs	$2,282,300		$2,194,519	
2007	1	Log Haul Costs (4.2 mbf/load)	$375,571		$360,560	
2007	1	Harvest 10,516 mbf		$4,206,400		$4,038,275
2007	1	Sale Admin.	$31,548		$30,287	
2007	1	PCT (15 ac.)	$2,250		$2,163	
2009	3	Grapple pile/cover/burn. (71.9 ac)	$25,165		$22,372	
2009	3	Handpile/Cover/burn (33.5 ac)	$16,750		$14,891	
2009	3	Reforestation (67 ac)	$33,500		$29,781	
2011	5	Create Snags (1/acre)	$53,250		$43,768	
2011	5	Create CWD (1/acre)	$15,975		$13,130	
2011	5	Decommission rds. (0 miles)	N/A		N/A	
TOTAL			--		**$3,557,899**	**$4,038,275**

The total Present Value Benefit is $4,038,275

The total Present Value Cost is $3,557,899

The Present Net Value is $480,376

The Benefit/Cost Ratio is 1.13:1

Table 3.44. Economic Analysis Alternative B

Date	Year	Treatment	2006 Costs	2006 Benefit	Discounted Cost	Discounted Benefit
2006	0	Prep Stands (8,860 mbf)	$88,600		$88,600	
2007	1	Noxious Weeds (886 ac.)	$22,150		$21,298	
2007	1	Road Reconstruction/maintenance (wet season haul)	$726,124		$698,196	
2007	1	Construct Temp. Rds (0 mi)	$0		$0	
2007	1	Logging Costs	$2,228,830		$2,143,106	
2007	1	Log Haul Costs (4.2 mbf/load)	$316,428		$304,258	
2007	1	Harvest 8,860 mbf		$3,544,000		$3,407,692
2007	1	Sale Admin.	$26,580		$25,558	
2007	1	PCT (15 ac.)	$2,250		$2,163	
2009	3	Grapple pile/cover/burn. (70.3 ac)	$24,605		$21,874	
2009	3	Handpile/Cover/burn (33.5 ac)	$16,750		$14,891	
2009	3	Reforestation (0 ac)	$0		$0	
2011	5	Create Snags (1/acre)	$44,300		$36,411	
2011	5	Create CWD (1/acre)	$13,290		$10,923	
2011	5	Decommission rds. (8.5 miles)	$170,000		$139,728	
TOTAL			**--**		**$3,507,006**	**$3,407,692**

The total Present Value Benefit is $3,407,692

The total Present Value Cost is $3,507,006

The Present Net Value is -$99,314

The Benefit/Cost Ratio is 1:-1.03

Table 3.45. Economic Analysis Alternative B

Date	Year	Treatment	2006 Costs	2006 Benefit	Discounted Cost	Discounted Benefit
2006	0	Prep Stands (10,516 mbf)	$105,160		$105,160	
2007	1	Noxious Weeds (1,065 ac.)	$26,625		$25,601	
2007	1	Road Reconstruction/maintenance (wet season haul)	$618,050		$594,279	
2007	1	Construct Temp. Rds (0.45 mi)	$3,182		$3,060	
2007	1	Logging Costs	$2,842,840		$2,733,500	
2007	1	Log Haul Costs (4.2 mbf/load)	$375,571		$360,560	
2007	1	Harvest 10,516 mbf		$4,206,400		$4,038,275
2007	1	Sale Admin.	$31,548		$30,287	
2007	1	PCT (15 ac.)	$2,250		$2,163	
2009	3	Grapple pile/cover/burn. (71.9 ac)	$23,905		$21,251	
2009	3	Handpile/Cover/burn (33.5 ac)	$16,750		$14,891	
2009	3	Reforestation (67 ac)	$33,500		$29,781	
2011	5	Create Snags (1/acre)	$53,250		$43,768	
2011	5	Create CWD (1/acre)	$15,975		$13,130	
2011	5	Decommission rds. (0 miles)	$0		$0	
TOTAL			**--**		**$3,977,431**	**$4,038,275**

The total Present Value Benefit is $4,038,275

The total Present Value Cost is $3,977,431

The Present Net Value is $60,844

The Benefit/Cost Ratio is 1.02:1

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 this 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 temporary roads and landings would not be anticipated despite efforts to reclaim these areas. The losses in productivity from the above would occur on a small part of the planning area, about one percent. 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 alternatives; 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 the construction of roads for surfacing and other needs would not be replaceable.

Old Growth

No late-successional (>170 years old) or old growth stands or trees are proposed for harvest in any alternative. Some of the stands proposed for thinning harvest may contain individual old growth trees. They would be included as leave trees in the thinning harvest units.

Irretrievable Commitments

Irretrievable commitments are opportunities for resource uses that are foregone 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 the 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 Irreversible Commitments of Resources.

Relationship to 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 Washington State Forest Practices Rules. The project design criteria (Appendix A) and mitigation measures in Chapter 2 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 the protection and recovery of threatened and endangered species. The effects determination for Northern Spotted Owl is "May Effect and is Not Likely to Adversely Affect". The Forest Service is requesting informal consultation with USFWS.

The United States Department of Commerce National Marine Fisheries Service (NMFS) is responsible for the protection and recovery of Threatened and Endangered fish species. The effects determination for Lower Columbia River steelhead, Lower Columbia River Chinook, and Designated Critical Habitat is " May Effect and is Not Likely to Adversely Affect ". Informal consultation was initiated with NOAA-Fisheries on April 21, 2006.

All steps in the cultural resource process are coordinated with the Washington State Historic Preservation Office (USDA, 1990). 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, by implementing the project design criteria (Appendix A) there would be no adverse effects to cultural resources by the implementation of any alternatives.

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

There are no prime farm lands or prime range lands within the Tee 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 communities 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 populations and low-income populations. The principle behind Environmental Justice is simple: 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, none of the alternatives would have a disproportionately high and adverse human health or environmental effect on minority populations and low-income populations.

Effects on Wetlands and Floodplains

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

LIST OF PREPARERS

In April of 2004, Clifford Ligons, former Monument Manager drew together a team of Forest Service employees to complete the effects analysis, and to incorporate it into the Tee Timber Sale Environmental Assessment. Members of the team were:

NAME	POSITION
Bruce Holmson	Silviculturist, Tee Timber Sale Planning Team Leader
Aldo Aguilar	Soil Scientist
Dave Allaway	Sale Administrator
Bengt Coffin	Hydrologist
Don Harm	Logging Systems
Adam Haspiel	Fisheries Biologist
Cynthia Henchell	NEPA Specialist, South Zone Planning Team Leader
Cheryl Mack	Archaeologist
Bob Obedzinski	Silviculturist
Jon Nakae	Recreation Planner, Wilderness Specialist, Silviculturist
Fred Netzel	Transportation Planner
Andrea Ruchty	Botanist
Mitch Wainwright	Wildlife Biologist
Gary Walker	Fuels Specialist

REFERENCES

Christner J., and R. D. Harr, 1982. Peak streamflows from the transient snow zone, Western Cascades, Oregon, paper presented at Western Snow Conference, Reno, Nev., April 19-23, 1982.

Franklin, J.F. & C.T. Dyrness. 1973. *Natural Vegetation of Oregon and Washington.* USDA Forest Service General Technical Report PNW-8. Pacific Northwest Forest Range Experimental Station, Portland, OR. 417pages

Hall, F.C., Brewer, L.W.; Franklin, J.F. and R.L. Werner. 1985. Plant Communities and Stand Conditions. IN: Brown, E.R. 1985. *Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington.* USDA Forest Service, Pacific Northwest Region. R6-F&WL-192-1985.

Harpel, J. and R. Helliwell. 2005. Conservation Assessment for *Tetraphis geniculata*. USDA Forest Service, Region 6 and USDI Bureau of Land Management, Oregon and Washington.

Harr, R. D., 1981. Some characteristics and consequences of snowmelt during rainfall in western

Oregon, J. Hydrol., 53, 277-304, 1981.

Jones, J.A. and G.E. Grant. 1996. Peak flow responses to clearcuttting and roads in small and large basins in western Cascades, Oregon. Water Resources Research 32:959-974.

Jones, Lawrence L.C., William P. Leonard, and Deanna H. Olson (editors). 2005. *Amphibians of the Pacific Northwest.* Seattle Audubon Society.

Mellen, Kim, Bruce G. Marcot, Janet L. Ohmann, Karen Waddell, Susan A. Livingston, Elizabeth A. Willhite, Bruce B. Hostetler, Catherine Ogden, and Tina Dreisbach. 2006. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 2.0. USDA Forest Service, Pacific Northwest Region and Pacific Northwest Research Station; USDI Fish and Wildlife Service, Oregon State Office; Portland, Oregon.

Pacific Watershed Institute 1998. Rehabilitation assessment for the upper East Fork of the Lewis River Watershed. Report completed for the Mt St Helens NVM. 120pages February 1998.

Reid, L.M., and T. Dunne. 1984. Sediment production from road surfaces. Water Resources Res. 20:1753-1761.

Reukema, D.L., Bruce, David. 1977. Effects of Thinning on Yield of Douglas-fir, Concepts and Some Estimates Obtained By Simulation. Portland, Oregon. 36p.

Swanson, F.J.; Benda, L.E.; Duncan, S.H. and others. 1987. Mass failures and other processes of sediment production in Pacific Northwest forest landscapes. In: Salo, E.O.; Cundy, T.W. (eds.). *Streamside Management: Forestry and Fishery Interactions. University of Washington Institute of Forest Resources Contribution* 57. 9-38. 471 p.

Tilton, Dave and Tom Becker. 1993. Forest canopy cover continuum, management guide for ecosystem management on the Gifford Pinchot National Forest. On file at Mt. Adams Ranger District, Trout Lake WA.

Tugel, A. J. and Lewandowski, A. M. eds. (February 2001 -- last update). Soil Biology Primer [online]. Available: http://soils.usda.gov/sqi/soil_biology_primer.htm [February 19, 2003].

USDA Forest Service and USDI Bureau of Land Management. 1994. *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl and Standard and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.* Pacific Northwest Region. Portland, OR.

USDA Forest Service. 1983. *Plant Association and Management Guide for the Pacific Silver Fir Zone.* PNW-130A.

USDA Forest Service. 1986. *Plant Association and Management Guide for the Western Hemlock Zone.* PNW-230A.

USDA Forest Service. 1990. *Land and Resource Management Plan Gifford Pinchot National*

Forest. Vancouver, WA.

USDA Forest Service. 1995. *Upper East Fork Watershed Analysis.* Mount St Helens National Volcanic Monument, Gifford Pinchot National Forest.

USDA Forest Service. 2002(a). *East Fork Lewis River Watershed Water Quality Restoration Plan.* Mount St Helens National Volcanic Monument, Gifford Pinchot National Forest.

USDA Forest Service. 2002(b). *Gifford Pinchot National Forest Roads Analysis.* Vancouver, WA.

USDA Forest Service. 2002(c). *Upper East Fork Watershed Analysis, Second Iteration.* Mount St Helens National Volcanic Monument, Gifford Pinchot National Forest.

USDA Forest Service. 2006. Tee Timber Sale Fisheries Biological Assessment: Lewis River Watershed (17080002), Sub-Watersheds Upper East Fork Lewis (170800020502) and Copper Creek (170800020503). Mount St. Helens National Volcanic Monument, Gifford Pinchot National Forest.

USDA Natural Resource Conservation Service Soil Quality Institute. (October 2002 – Last update)(d). Soil Biology: Key Educational Messages [online]. Available: http://soils.usda.gov/sqi/publications/education.html [November 17, 2005].

USDA Natural Resources Conservation Service. 1997. Introduction to Microbiotic Crusts. Soil Quality Institute; Grazing Lands Technology Institute.

USDI. 1990. Endangered and Threatened Wildlife and Plants; determination of threatened status for the northern spotted owl. Fed. Reg. Vol. 55, No. 23: 26114

Wade, J.; Herman, L.; High, C. T.; Couche, D. 1992. *Soil Resource Inventory. Gifford Pinchot National Forest.* Vancouver, Washington.

Washington Forest Practices Board, 1997, *Board Manual: Methodology for Conducting Watershed Analysis under Chapter 222-22 WAC.* Version 4.0, Nov. 1997. Washington Dept. of Natural Resources, Forest Practices Division, Olympia, WA. Single volume.

Wemple, B. C., J. A. Jones, and G. E. Grant, Channel network extension by logging roads in two basins, western Cascades, Oregon, Water Resour. Res., 32(6), 1195-1207, 1996.