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Chapter 4: Environmental Consequences

Introduction

This chapter discloses the potential effects of each of the alternatives described in Chapter 2, including the scientific and analytical basis for the comparison of the alternatives (Table 2.4). Some scientific controversy exists over what management should take place after a catastrophic fire occurs. This controversy is briefly described in the beginning of this chapter, followed by a discussion of incomplete and unavailable information, the process used to determine cumulative effects, the potential effects of the proposed action and its alternatives on area resources, and compliance with other laws and regulations. The effects discussion is generally organized in the same order as the issues listed in Chapter 1:

- **Forest Vegetation** (covers Significant Issue 1)
- **Water and Soils** (covers Significant Issue 2)
- **Fish and Aquatic Habitat** (covers Significant Issue 3 and the Proposed, Endangered, Threatened and Sensitive species tracking issue, as well as Forest Plan required Management Indicator Species)
- **Recreation** (covers Significant Issue 4, and recreation, roadless area, and wild and scenic river tracking issues)
- Wildlife Habitat (covers wildlife habitat, Proposed, Endangered, Threatened and Sensitive species, and Management Indicator Species tracking issues)
- Socio-Economic (covers economics/social tracking issue)
- Non-Forest Vegetation (covers noxious weed and Proposed, Endangered, Threatened and Sensitive species tracking issues)
- Fuels/Air Quality (covers fire management/air quality tracking issue)
- Transportation System (covers accessibility and maintenance tracking issue)
- Cultural Resources (covers Cultural Resources tracking issue)

Effects are shown as being direct (occurring at the same time and place as the triggering action), indirect (separate in time and space from the action that caused them), or cumulative (the incremental effect of the project when added to effects from other past, present, and reasonably foreseeable actions). These effects are described in terms of increases or decreases, intensity, duration, and timing. The discussion of these effects also provides a comparison of the trade-offs associated with each alternative. The chapter ends with a discussion of compliance with the Forest Plan, various laws, and executive orders. For more detailed information, see the individual resource reports found within the analysis file for this proposal.

Scientific Controversy

A concern was identified during scoping that a scientific controversy exists regarding harvest and other management activities following wildfire. In March 1995, the Pacific Rivers Council released an unpublished report by a group of scientists whom the organization had invited to discuss and consider the ramifications of fire in western landscapes (electronic communication from Beschta to Powell, 1999). The paper, entitled "*Recommendations for Ecologically Sound Post-Fire Salvage Logging and Other Post-Fire Treatments On Federal Lands In the West*", has become known as the "Beschta Report" based on the first name in the list of authors - Dr. Robert Beschta, a hydrology professor in the Department of Forest Engineering at Oregon State University. The objective of the Beschta Report was "*to propose guidelines concerning wildfire salvage logging and other post-fire treatments, particularly from an aquatics perspective, that maintain or improve the integrity of ecosystems and landscapes and maintain the ecological processes that support sustainable resource extraction and utilization.*" In general, these

guidelines recommend that "*human intervention should not be permitted unless and until it is determined that natural processes are not occurring*," and strongly advises against salvage logging in most instances.

In August 1995, Richard Everett, Science Team Leader at the Wenatchee Forest Sciences Laboratory, reviewed the Beschta Report at the request of the Pacific Northwest Regional Forester and commented on the issues it raised. Everett commended the scientists of the Beschta Report and states they "*are justified in asking land managers to consider an array of hazards, both natural and man-induced, to the conservation of natural resources following fire.*" However, he goes on that the Beschta Report asks land managers to consider all post-fire hazards and management alternatives, yet the recommendations are often biased towards a hands-off approach. Everett points out that a single management action applied to all situations is inappropriate; every situation is different and should be handled on a case-by-case basis. He states,

> *"Resource scientists provide scientific information, but this information can be conflicting because resource conditions and processes differ from site to site, and scientists focus on different aspects of the same problem...Contrary to the custodial management theme of the Beschta et al. approach there are other scientists that believe intensive science-based management can be used in concert with natural processes to restore sustainability of post-fire eastside forests and is, in fact, required if ecosystems are to be conserved under an ever increasing human population and rising resource demands. The inefficiencies of natural disturbance and recovery processes may preclude meeting future public expectations and place property and resource values at risk."*

He then goes on to address each point brought up in the Beschta Report, with citations documenting research that runs counter to the views of the authors.

The Washington Office of the Forest Service also requested an evaluation of the Beschta Report by the Forest Service Research Branch. In September 1995, Sterling Wilcox, acting for the Deputy Chief of the Forest Service, released the reviews of eight scientists who specialize in fire ecology and fuels, ecosystem processes, root diseases and soil microbiology, aquatic/land interactions, vegetation management, and watershed and fisheries. The Research Branch's review, although supporting a number of the principles expressed in the report, expressed reservations about the tone, specificity, and general application of many of the report's recommendations. They noted an apparent contradiction that while the report emphasizes the complexity and diversity of ecosystems, the recommendations tend to present a one-size-fits-all approach to management; some of the reviewers even felt that the Beschta Report was strongly slanted toward ecosystems west of the Cascade Range. They found that the authors of the report presented many sound principles in common with those that can be found in a number of Forest Service white papers and task force reports, yet the report did not reflect this commonality of thought and, instead, revealed a disturbing lack of trust in the intentions and abilities of federal land managers. Also, most Research Branch reviewers disagreed with the Beschta Report's basic premise that humans and nature are separate and that human-caused disturbances are inherently bad. A number of the reviewers noted that many statements in the Beschta Report were unsubstantiated, and that the authors referred to only a very limited selection of the available literature.

In January 2000, the Forest Service Pacific Northwest Research Station published General Technical Report PNW-GTR-486 entitled "*Environmental Effects of Postfire Logging: Literature Review and Annotated Bibliography*". The review includes 129 documents through August 1998 (commentary and scientific study) specific to the question of what happens when logs are salvaged after fire. The editors found only 21 studies worldwide that examined the environmental effects of post-fire logging. In general, several studies measured higher sediment yields in stands harvested after fire, but increases were short-term (3 and 4 years). However, some studies concluded that logging may disrupt water repellant layers (and thus decrease overland flow during severe hydrologic events), and logging residue can mitigate erosion by impeding overland water flow. One study found that post-fire logging undertaken after establishment of new seedlings resulted in significant mortality of those seedlings, but another study showed that by creating patches of disturbed soil, post-fire logging can encourage establishment of a unique array of plant species (including non-natives). Still another study concluded that while post-fire logging can reduce vegetation biomass, increase exotic species and graminoid cover, and reduce overall plant species richness, it also can increase conifer growth (by 17% in the study). With regard to wildlife,

several studies showed that post-fire logging caused significant changes in abundance and nest density of cavity-nesting birds, although in at least one instance species abundance increased after logging. Generally, post-fire logging enhances habitat for some wildlife species, and diminishes it for others; the result is changes in species composition but not necessarily in species richness. Unfortunately, no studies were found which specifically looked at how post-fire logging alters the size distribution of fuel and the accompanying changes in future fire risk. Examination of harvested green tree stands suggests that post-fire logging may increase short-term fuel loads and fire risk, but reduce intermediate and long-term fire risk.

Relative to the Tower Fire area, several statements made in the Beschta Report at least partially apply. The concept that *"Certain forest types (low elevation ponderosa pine, for example) may currently be susceptible to burning in ways that have not been seen for centuries, but in other areas (the higher elevation and moister, mixed-conifer forest types for example) the fire situation is probably not too different from historical patterns."* fits well with the situation found within the Tower Fire analysis area. However, the report then concentrates on the natural recovery of moist sites, ignoring the impact on and recovery process of dry site pine forests that have undergone a stand replacement fire.

In significantly altered ecosystems, natural disturbance processes may no longer be operating within historical ranges of variability (Agee 1994b, Hessburg et al. 1994) and their effect may be as foreign to the functioning of the ecosystem as are human activities (Everett 1995). In the dry forest type of eastern Oregon, fire effects are now operating outside of the natural range of variability (Mutch et al, 1993). The interdisciplinary team believes this was the case with the Tower Fire, which occurred within warm, dry-forested settings (33% of the area). According to Agee (1993), this setting historically experienced low mortality fires (0-20% of large trees) that occurred every 1 to 25 years. Such fires ranged in size from 150 to 2,000 acres (Powell and Erickson 1996). Dry sites that were outside the historic range of variability in tree densities and fuel loadings prior to fire, are outside the historic ranges of variability in amounts of snags and logs (USDA Forest Service 1996). In fact, mortality resulting from the Tower Fire exceeded historic trends in all but the cold/dry and lodgepole pine settings, and in all the settings, the size of the fire was much larger than the historic range (Tower Fire Ecosystem Analysis 1997). The Record of Decision for the Summit Fire Recovery Project further discusses this condition and the Beschta Report recommendations in its "Decision and Rationale" section under "Active v. Passive Management". The Summit Fire occurred in similar stand types 20 miles to the south and at the same time as the Tower Fire, so the general description of site conditions that warrant action in the Summit area apply in the Tower Fire area as well

One set of practices the Beschta Report cautions against is seeding or planting because these activities have not been shown effective in advancing regeneration except under limited conditions (including several years of evidence that natural regeneration is not occurring). However, neither references or reasoning was offered to support this position. Generally, encouragement of grass and herbaceous cover over the soil, including seeding, is recommended in order to improve infiltration, reduce runoff, and prevent soil erosion (Brooks et al, 1991). Several portions of the Tower Fire still lack adequate vegetative cover and tree regeneration. Some riparian areas are now far from seed sources for some species of trees that would otherwise normally occur. Without management intervention, much of the Tower Fire area would regenerate as nearly pure stands of lodgepole pine, a species that seldom grows large enough to supply large snags or woody debris for streams. In this case, the interdisciplinary team believes that active planting could certainly advance regeneration of vegetative cover, particularly later seral-stage species.

As part of their argument against salvage logging, authors of the Beschta Report dispute that there is a need to remove dead wood *"...because of the perceived increased likelihood that an area may reburn. It is the fine fuels that carry fire, not the large dead woody material*." From a fire spread sense this is true. Yet, reburn potential is not the concern; it is the greater intensity and potential destructiveness of future fires. Fuel projections for the Tower Fire area indicate that for the first 20 years following the fire, grass would continue as the primary fuel, whether harvest occurs or not. Logged areas could have an elevated fire hazard over unharvested areas during this time, because branches and non-merchantable trees that are brought to the ground by harvest would prematurely increase fuel loads. However, 20 to 50 years after the fire a significant difference would exist between stands that have been salvaged and those that

have not. In salvaged stands, particularly on pine sites, fuel loads would not contain large tree boles (which were removed through harvest). These stands would also be managed through thinning and underburning to maintain a relatively open nature with low overall fuel loading. Fires that occur in these stands would have a lower intensity, could be more controllable, and would not likely result in much, if any, mortality in the emerging overstory. Stands which were not salvaged, on the other hand, would have a significant component of large dead material that would accumulate on the ground over 10 to 40 years (in excess of 30 tons of fuel per acre), which would make use of controlled fire impossible. Fires burning in these stands, while spreading at rates similar to fires in salvaged stands, would burn with much greater intensities due to the larger available fuels. This increase in intensity is supported by studies by Rothermal (1963), Ottmar and Vihnanek (1990) and Countryman (1969). Mortality levels would be much higher (as high as 100% in places under dry conditions), and the potential to expose large areas of mineral soil would be high. While the District intends to continue to reintroduce fire in pine and mixed conifer stands on dry sites regardless of post-Tower Fire activities, the presence of snags and heavy accumulations of down fuel would make the use of prescribed fire a risky, expensive, and less than effective means of managing future stands.

Incomplete Or Unavailable Information

Incomplete or unavailable information was sometimes encountered in the process of preparing this EIS. The purpose of the environmental analyses contained in this EIS is to "*present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public*" (40 CFR 1502.14).

Uncertain Data and Estimates

Data and information collected for the various analyses in this EIS, as well as the resulting estimates of effect and conclusions, vary in precision and accuracy. Environmental effects are reasonably well understood. However, the uncertainty associated with estimating the magnitude of an environmental effect is due to the (often great) inherent variability and diversity associated with the natural environment. This is the basis for the disagreement over which actions to take after catastrophic fire. By using assumptions based on available research and professional field experience, effects of actions can be reasonably estimated with confidence. Such assumptions used for analysis are listed under each resource heading, along with the scale at which analysis was conducted. While no estimate of effects for a given alternative is absolute, the interdisciplinary team believes there is sufficient information with regard to environmental effects to provide a clear basis for choice among the alternatives. These estimated effects are presented as the heart of this chapter.

Where available, analysis was based on site-specific data such as stream surveys, fish population surveys, sediment and temperature monitoring. Even with hard, site-specific data, it was often not possible to produce reliable estimates of effects. For instance, 10 years of sediment monitoring has been conducted in this area (pre- and post-fire); however, sediment measurements have an accuracy of plus or minus 100 percent (personal communication Bruce McCammon, Pacific Northwest Regional hydrologist) due to the variability of the hydrologic system (weather, management practices, catastrophic events). Also, in many cases pre-fire information was not available for comparison, so analysis based on photos and personal experience was necessary.

Much of the analysis was based on field observations and non-statistical sampling (as was done to estimate the amount of herbicide needed for control of competing vegetation). Where possible, this was crosschecked with observations and experiences with other fires in the vicinity (Wheeler Point Fire which occurred on the Heppner Ranger District in 1996, Boundary Fire adjacent to the Tower Fire which occurred in 1994**,** Summit Fire which occurred on the neighboring Malheur National Forest in 1996). In addition, cause and effect relationships were mapped and used to draw conclusions. Often premises were discussed with experts outside the interdisciplinary team, such as the evaluation of possible effects on sediment movement, which was discussed with the Forest hydrologist, Pacific Northwest Regional hydrologist, and hydrologists from other regions. Therefore, while much of the information may be qualitative and incomplete, it was developed with much thought about the effects of activities.

Cumulative effects are a prime example of incomplete or unavailable information. The lands affected by the Tower Fire have been intensively managed at least since the time of European settlement and likely even before that. Grazing occurred throughout most of the Blue Mountains since the late 1800's, as did fire suppression and timber harvest. There is no data available to use as a baseline for analysis of incremental changes related to management, although some very good information exists from mapping, photos, and surveying conducted in 1900 and 1937. This information was used to estimate the historic range of variability for various forest stand conditions (detailed in the Tower Fire Ecosystem Analysis and discussed under the Forest Vegetation section). Even recent information regarding management in the last 20 years is unavailable because documented monitoring of many management actions and effects was begun mainly in the 1990s. The Umatilla National Forest has considered at length the question of how to estimate cumulative effects, including hosting a training on cumulative effects analysis for the three Blue Mountain national forests. The interdisciplinary team further used information from the handbook *Considering Cumulative Effects Under the National Environmental Policy Act* produced by the Council on Environmental Quality; identified in detail all past, ongoing and reasonably foreseeable future projects (see Appendix A); and delineated the relationships between the proposed action, cumulative management activities, and the environment. The specialists then used this information to identify cumulative effects.

Economic Impact

The treatment of dead trees, deficient ecosystem components, and damaged infrastructure (roads and recreation facilities) will affect the Forest Service's ability to provide goods and services and payments to local governments. While the economic benefits or costs of non-market goods such as ecologic diversity or soil are not economically quantifiable, sufficient information exists to reasonably estimate the economic impacts of each alternative.

Cumulative Effects Analysis Process

The cumulative effects analysis began with a thorough documentation of activities in the planning area that could cause environmental effects in addition to the Tower proposals. This resulted in the detail included in Appendix A and served as a template for interdisciplinary team specialists to ensure all actions were considered in analyses. Then, the interdisciplinary team considered the 11 methods for analyzing cumulative effects listed in CEQ's "*Considering Cumulative Effects Under the National Environmental Policy Act*"[1] and included them as follows:

Method 1 - Questionnaires, Interviews, and Panels: The interdisciplinary team functioned as a panel of specialists that gathered information, explored cause-effect relationships, and predicted outcomes and cumulative effects (refer to team meeting notes, particularly those using Decision Protocol methodology).

Method 2 – Checklists: The interdisciplinary team did not use checklists due to the complexity and potential for interaction amongst the many proposed actions.

Method 3 - Matrices: Table 2.4 is a matrix that compares the response of various alternatives to the key issues associated with the original proposed actions. Specialists individually used matrices in their analysis to organize and compare long-term to short-term consequences and to compare alternatives and the proposed actions.

Method 4 – Networks and System Diagrams: Cause/effect relationships were occasionally formatted in this fashion to illustrate process interactions. For example, Tower Fire Ecosystem Analysis contains a diagram borrowed from Swanson (1978) that outlines fire effects on vegetation, soil properties, hydrology, and geomorphic processes.

[1] In fact, the Council on Environmental Quality states in its handbook *Considering Cumulative Effects Under the National Environmental Policy Act* that "In a review of 90 individual methods, Granholm et al. (1987) determined that none of even the 12 most promising methods met all of the criteria for cumulative effects analysis. Most of the methods were good at describing or defining the problem, but they were poor at quantifying cumulative effects."

Method 5 – Modeling: The WATSED model was used to predict sediment that would result through time from the fire, past activities, and proposed actions. Several fuel prediction models were also considered, but the decision-maker felt the amount of time required for data collection and to adapt models to local conditions (estimated to be a year or more) would be inappropriate given the need to address recovery as soon as possible to establish vegetation, stabilize soil, and treat large fuels.

Method 6 – Trends Analysis: The interdisciplinary team silviculturist in particular used trends analysis to predict reforestation success and progress toward desired forest stocking levels and species diversity. The interdisciplinary team wildlife and fish biologists and fire/fuels specialists also used this tool

Method 7 – Overlay Mapping and GIS: This tool was used extensively, both by individual specialists and together as an interdisciplinary team. This tool allowed for spatial analysis of past, proposed, and foreseeable future projects.

Method 8 – Carrying Capacity Analysis: This tool was not used due to a lack of site-specific information on thresholds (for instance, total maximum daily loads, known as TMDLs, have not yet been established for this watershed). In a broader context, the Forest Plan established such thresholds for the Umatilla National Forest as “standards and guidelines”, and was the more appropriate level to conduct this type of analysis.

Method 9 – Ecosystem Analysis: This method was conducted through the Tower Fire Ecosystem Analysis, which analyzed effects up to and immediately following the fire, but not the proposed actions.

Method 10 – Economic Impact Analysis and Method 11 – Social Impact Analysis: This analysis was conducted through the use of the TEA_ECON model to predict advertised bid rates for the timber harvest portion of the project, the IMPLAN model to predict employment impacts to the region of influence, and an economic efficiency analysis to quantify overall present net values to maximize net public benefits.

Forest Vegetation

Tree Stocking

The effects of the various proposed alternatives were assessed in terms of tree stocking, including reestablishment of trees within the fire area, and potential or existing overstocking or understocking. This analysis was based upon observed mortality both from the fire’s effects and secondary mortality as a result of post-fire insect infestations. Aerial photography was used as a preliminary assessment of stand densities (refer to South Tower Upland Forest and Competing Vegetation Report 1998 and Tower Fire Ecosystem Analysis Forest Vegetation Report 1997). Actual location of thinning units was confirmed by field visits, although many of the acres proposed for reforestation within the roadless area were too distant for such confirmation. Lodgepole pine appears to be reproducing very well in many areas, although a fire-wide survey has not been conducted.

The proposed treatments would have significant and beneficial effects within the Tower Fire area. All treatments were proposed as a direct result of the fire and were designed to have a significant effect so that the cost of implementation would be warranted. Proposed planting would ensure species diversity and tree stocking in 20 percent of the burned area, in addition to the 12 percent planted since 1997. The herbicide treatment would ensure that the planted areas have good survival and growth. And the proposed thinning would reduce stress on the remaining live trees and promote a species composition that more resembles historic compositions. Overall, these three silvicultural treatments would affect 36 percent of the fire area. However, at larger scales (such as the Umatilla National Forest or Blue Mountains) proposed treatments would not have a significant effect due to the site specificity and relatively small area of treatment.

ALTERNATIVE 1

Direct/Indirect Effects: In a large portion of the fire area, conifer seed sources are severely lacking and regeneration of trees would continue to be low. Over 30 percent of the burned area is estimated to be beyond seed dispersal limits of the remaining live mature trees and long delays in natural regeneration are expected (Tower Fire Ecosystem Analysis 1997). Even where live trees of seed-bearing age are present, long delays in natural regeneration of five to twenty-five years are expected (Tower Fire Ecosystem Analysis 1997). In areas of high tree mortality, natural regeneration of sun-loving seral tree species could be hindered by shade from either standing or downed trees (Tower Fire Ecosystem Analysis 1997). This could slow recovery of tree cover, and leave these areas sparsely stocked for a longer period. Where lodgepole pine seed was not entirely consumed by the fire, this species is regenerating prolifically, because it produces abundant and frequent seed crops. Lodgepole pine has a tendency to develop high-density stands, often to the exclusion of other tree species if the lodgepole pine becomes established first. In addition, vegetation that competes with seedling establishment has done well in the growing seasons since the fire; this would cause further difficulties for natural regeneration of tree species (USDA Forest Service 1998).

The opportunity to promote healthy stocking levels would be precluded at this time. Insect mortality is expected and endemic, however, the magnitude of mortality could be undesirable if retention of forest cover in this area is a priority. Live trees that survived the fire with moderate to severe crown, bole, or root scorch would be highly susceptible to insect attack and would likely be killed within the short-term (Tower Fire Ecosystem Analysis 1997). Dense ponderosa pine and mixed conifer stands in the southern part of the fire that were not burned or that burned at low intensities would become increasingly overstocked. As time goes on and the understories continue to fill in, these stands, as well as the densely regenerated lodgepole pine stands, would be under greater and greater risk of insect- or disease-caused mortality (Blue Mountain Forest Health Report 1991). Highly susceptible trees that invite attack would also put other live trees at risk by allowing insects to sustain and build their populations. Some insect-related mortality has been observed in an area that burned at low intensity the southern portion of the fire area.

Armillaria root disease would continue to slowly spread and infect susceptible trees, decreasing tree stocking within the zone of infection. Armillaria spreads most commonly by healthy roots contacting infected roots; in young trees this disease girdles the tree, in older trees it most commonly weakens the roots and the tree is blown down by wind (USDA Forest Service 1993). Regeneration within infected areas would likely be slow, as susceptible species try to reestablish in the infected area and succumb to the disease.

Taken as a whole, natural regeneration of forest cover, retention of dense accumulations of dead and injured trees, continued mortality from Armillaria, and increased overstocking would slow tree recovery in severely burned areas of the fire and result in a combined overall decline in established green stands. Tree growth and productivity would be irretrievably lost.

ALTERNATIVE 2

Direct/Indirect Effects: In this alternative, planting a mix of native tree species would restore stocking on 10,285 acres that burned at moderate to high intensities (both within and outside proposed salvage harvest units) to at least the minimum tree stocking levels described in the Forest Plan. A new forest would be established in 1 to 5 years, as opposed to the 25 or more years estimated if no action occurs. Competition from vegetation that established after the fire would be reduced within artificially reforested areas (11,029 acres[2]) by spot applying herbicides in a three-foot radius around planted seedlings. Herbicide application would result in at least 70% survival of planted seedlings in areas where competing vegetation has had several seasons to become firmly established (USDA Forest Service 1998). For instance, out of the 10,285 acres planted, 7,200 acres could be expected to survive[3]. Animal damage

[2] This acreage includes the proposed planting plus some areas planted in 1998 and 1999.

[3] This is a relative measurement; survival would be spread across most of the acres planted, but in some areas would be very sparse, requiring repeated tree planting.

control measures associated with reforestation (Vexar tubing and gopher trapping) would decrease damage to seedlings and increase the likelihood of tree reestablishment.

Thinning (reducing the basal area to 80 square feet per acre[4]) would allow remaining trees on the 1,023 treated acres more access to sunlight, nutrients, water and growing space. This would create healthier, more sustainable conditions for trees and increase their chances of survival by reducing stress (Tower Fire Ecosystem Analysis 1997). Reducing stress would also make trees less susceptible to damage and mortality from insects and disease. In addition, the wider distance between trees would reduce the risk of damaging crown fires in the future, although trees will not be evenly spaced (Tower Fire Ecosystem Analysis 1997).

Salvage of dead and severely damaged trees would reduce the amount of shade created by standing and downed trees, increasing the chance of establishing early seral, shade-intolerant tree species (Tower Fire Ecosystem Analysis 1997). On the 3,028 acres proposed for salvage harvest, the quantity of future downed fuels would be reduced, decreasing the risk of high intensity fire and subsequent damage to recovering vegetation.

On 271 acres infested with Armillaria root rot, removal of at-risk species (grand fir and Douglas-fir) and planting of disease-resistant species (western larch, Engelmann spruce, and lodgepole pine) would promote future viability of infected stands (Schmitt and Scott 1996). Since most of the Armillaria-infected stands contain a large number of standing dead trees (with mortality occurring from fire damage as well as disease), removal of at-risk trees would result in very open stands with few green trees in the short-term (25-30 years). Soil compaction from harvesting with ground-based systems has the potential to increase Armillaria activity; however, subsoiling these sites would reduce the effects of compaction in restoration treatments (Schmitt 1994). The use of Best Management Practices would also limit compaction or damage to residual trees by confining skidding disturbance to designated skid trails and limiting skidding to periods where the soil is dry or frozen.

Cumulative Effects: Past management activities (primarily fire suppression) created densely stocked, stressed stands. The Tower Fire has reduced this condition over much of the area by killing a large number of trees. However, many lodgepole pine stands and lightly burned stands still pose a stocking concern that would be reduced in some areas by this alternative. It is reasonably foreseeable that additional thinning would take place in the future, although this would likely occur 10 or more years from this proposed thinning. Cumulatively, proposed and future thinning would offset the effects of past activities on stocking levels and reduce risk of losses from future insect or disease outbreaks. In addition, salvage, thinning, hazard tree removal, and fuel break creation, together with harvest that has already occurred since the fire, would reduce fuel loadings and continuity to the point where a prescribed burning program could be initiated to manage for historic stand densities.

District experience of the effects of livestock grazing on seedlings includes occasional trampling and browsing. Trampling and browse damage has been consistently low under normal grazing practices, with appreciably more damage to seedlings received from big game browsing. Several studies document the effects of livestock grazing on seedlings; most have found that damage caused by livestock is minimal, and some have even found that grazing reduced grass competition with the trees. Allen and Bartolome (1989) found that *"no significant trampling damage occurred and browsing damage to white fir and Douglas-fir seedlings was primarily caused by deer."* Ratliff and Denton (1995) compared season-long grazing with other deferred- and rest-rotation regimes, finding that *"pine seedling survival and damage did not differ* [between regimes]*, but the seedlings were significantly taller, with longer leaders with season-long grazing than without grazing."*

[4] Basal area is a measure of the amount of horizontal growing space occupied by the tree bole. It is usually measured on a "per acre" basis.

ALTERNATIVE 3

Direct/Indirect/Cumulative Effects: Reestablishment of forest cover in severely burned areas would be much less than under Alternative 2, due to an estimated 35 percent seedling survival[5] per planted acre and low levels of natural regeneration. Tree seedlings would be planted at the same density over the same number of acres as Alternative 2, but without the benefit of herbicide application to reduce competition from established grasses and shrubs. Previous and proposed planting would be much less effective than under Alternative 2 due to competing vegetation, with an estimated 3,600 acres of expected survival. As discussed under Alternative 1, natural regeneration would also be limited due to a lack of seed sources and competing vegetation. Other activities proposed in Alternative 3 would have the same direct, indirect, and cumulative effects as discussed in Alternative 2.

ALTERNATIVE 4

Direct/Indirect/Cumulative Effects: Since competing vegetation would not be treated in this alternative, the effects on tree planting would be the same as under Alternative 3. Thinning would occur on 779 acres through girdling (cutting through the live wood) or felling of excess trees. Effects would mirror those regarding thinning in Alternative 2, but would occur on 244 fewer acres. Since this alternative would not salvage trees or otherwise treat large standing fuels, establishment and survival of shade-intolerant planted and natural seedlings could be decreased where densities of standing dead trees are high. This alternative would not treat root rot-infested stands, so the results in infested stands would be the same as those discussed under Alternative 1.

Cumulatively, girdling trees would reduce stocking as discussed under Alternative 2; however, it would increase fuel loads by increasing the number of dead trees within the fire. This would greatly reduce the possibility of reintroducing fire to its historic role in shaping forests and would likely perpetuate recent trends toward overstocking, even more so than Alternative 1 because fuel loads would be even higher. Since fire would be reintroduced at a landscape scale, these girdled stands could be totally destroyed during prescribed burning due to the created fuel levels. Survival of planted trees would be 50 percent less than would occur under Alternative 2 due to a lack of control of competing vegetation, resulting in sparse stocking of most areas reforested since 1998.

ALTERNATIVE 5

Direct/Indirect/Cumulative Effects: Effects of tree planting and thinning (through helicopter harvest or girdling and leaving on site) would be the same as those discussed for planting and thinning under Alternative 4. Salvage would occur on 2,629 fewer acres, making seedling establishment of shade-intolerant species more difficult in stands that retain high dead tree densities (see discussion under Alternative 2). Since this alternative would not treat root rot-infested stands, the effects within infested stands would be the same as under Alternative 1.

Cumulatively, this alternative would reduce stocking (see Alternative 2) and remove fuels, but from fewer stands than initially proposed for thinning and salvage. Planting would have the same effects as described under Alternative 2.

ALTERNATIVE 6

Direct/Indirect/Cumulative Effects: All activities would have the same direct, indirect, and cumulative effects as Alternative 2, with the exception that fuel reduction (through salvage, slashing, and underburning) would occur on 760 fewer acres, which would maintain heavy fuel loads and make seedling establishment of shade-intolerant species more difficult.

[5] This estimate is an average based on experience with tree planting following fires on the Umatilla and Wallowa-Whitman National Forests. Some acres could have a higher survival rate and other acres could have no survival depending on site conditions (e.g. hot, dry southern aspect) or density of competing vegetation.

Stand Structure and Species Composition

Past fire suppression, selective timber harvest, and the Tower Fire changed forest stand structures and species compositions from their historic range of variability. The concept of a “historic range of variability” was originally developed to describe the condition of elements within the landscape as a way of measuring ecosystem health (USDA Forest Service 1992a). These elements consist of many things, including different sizes and compositions of forest stands (i.e. open, mature, ponderosa pine stands vs. mature, dense, grand fir stands). Elements within a landscape are naturally dynamic and fluctuate in response to natural processes and disturbances; the upper and lower limits of these fluctuations are called their “range”. The historic range of variability is an estimate of distributions across the Umatilla National Forest before fire exclusion and timber harvest became prominent. The historic range of variability has been estimated for this area using historical accounts and photos (particularly stand surveys and maps completed in 1900 and 1936), local knowledge of Blue Mountain ecosystems, and professional experience with ecosystem processes and growth dynamics of trees (USDA Forest Service 1992a).

When ecosystem elements are pushed outside their historic range of variability, by fire exclusion for example, there is a substantial risk that biological diversity and ecological function will not be maintained and, as a result, the system cannot be naturally sustained (USDA Forest Service 1992a). The Tower Fire greatly reduced the amount of acres within, above, or approaching their historical range of variability for each plant association group and stand structural stage except early seral. As a result there is a deficiency of most structural stages, a reduction in species diversity (with massive regeneration of lodgepole pine), and a risk of extirpating western white pine from this portion of the Blue Mountains. To move toward a sustainable ecosystem, where disturbances occur at more natural intervals and scales with little chance of broad catastrophic disturbance, forest stand structures and species compositions must change toward the levels at which they occurred historically.

In the following cumulative effects analysis, qualitative estimates are made whether the alternative and other activities within the fire area would accelerate achievement of the historic range of variability, move away from the predicted range, or remain unchanged. This related to both species composition and structural diversity. “Short-term” changes in the historic range of variability considers acres of successful planting, thinning, and root rot treatment, while “long-term” increases include the same acres as “short-term” as well as acres of fuel reduction which would allow reintroduction of periodic prescribed fire to mimic historical fire regimes.

ALTERNATIVE 1

Direct/Indirect Effects: Tree species compositions before fire-suppression (Blue Mountain Forest Health Report 1991) may not be achieved in the long-term. The Tower Fire was a natural event insofar as lightning ignited it, however, due to the effects of years of fire suppression, many areas burned more severely than the same forest types would burn under a natural fire regime. These results could affect the area's rate and quality of recovery as Everett (1995) stated, "*the inefficiencies of natural disturbance and recovery processes may preclude meeting future public expectations and place property and resource values at risk*.”

Allowing the fire area to naturally regenerate may result in less species and structural diversity. The fire set large portions of the burned area back to a homogenous, early age structure. Seed sources are lacking for most tree species, and competing vegetation is hindering natural regeneration in some areas. In other areas, lodgepole pine is regenerating prolifically. This could lead to a large amount of a single species repopulating the fire area. Lodgepole pine has a tendency to form dense stands with intense inter-tree competition that stagnates growth. This results in highly stressed, stunted trees with no height or crown differentiation (USDA Forest Service 1998). Homogenous stands of a single species are also at high risk for widespread mortality if insects or diseases reach outbreak levels because the supply of susceptible host trees is continuous. The lodgepole pine bark beetle epidemic of the 1970's and more recent spruce budworm epidemic are excellent examples of this. By contrast, in mixed species stands host trees for an insect or disease disturbance would be interspersed with non-host trees, making it more difficult for the disturbance to cause widespread mortality and possibly build to epidemic levels. Host trees may die, but live non-host trees would mitigate such loss (Blue Mountains Forest Health Report

1991). In the long-term, shortages of large diameter, old trees (which contribute large wood and structural diversity in forest stands) would occur in areas that experience delayed regeneration or heavy lodgepole pine regeneration (USDA Forest Service 1998).

Western white pine would not regenerate under this alternative because local seed sources were destroyed. This species would likely be extirpated from the fire area and the landscape would lose the diversity and uniqueness this species provided in the past.

Continued inaction and fire suppression in unsustainably stocked ponderosa pine and mixed conifer stands on the southern edge of the fire would broaden the gap between the historical range of variability for stand structure and species composition. These stands were historically maintained as open, park-like stands of ponderosa pine, western larch, and lesser amounts of Douglas-fir by frequent, low-intensity fires. Typical historical stand structures were well spaced to clumpy, large diameter trees with pockets of smaller trees in large openings. An opening was created when several large, old trees succumbed to insects or disease (Agee 1993). Fire suppression allowed shade tolerant species (such as grand fir) to fill in the open understories, and selective logging of ponderosa pine and larch reduced the seed sources for species more tolerant of the local dry, harsh conditions. Under this alternative, shade tolerant species would increasingly dominate the understory, eventually dominating the overstory as well. In the long-term, this could result in a loss of most of the ponderosa pine from these stands, an important contributor to stand structures of the past. Fire-killed trees would eventually fall, increasing the risk of another high intensity fire for several decades (until wood deteriorates). This would hamper any efforts to reintroduce periodic, landscape-level, prescribed fire in an effort to reflect historic fire regimes, because the fuel loads would make such fire difficult to control. The decreased ability to reintroduce fire and the risk of losing natural recovery to another catastrophic fire could impede the desired trend toward the historical range of variability for not only fire regimes, but stand structures and species compositions as well.

Stands infested with Armillaria root rot would continue to lose trees that provide structure. The infested acres would convert to an early seral stage because regeneration from susceptible species would quickly succumb to the disease and there are few nearby seed sources for resistant species (see Alternative 1, Tree Stocking discussion). This would add to the already excessive area that was set back to an early seral stage by the fire, moving further away from the historic mix of age classes.

ALTERNATIVE 2

Direct/Indirect Effects: Many activities in this alternative would aid recovery of forest stand structure and species compositions. Planting 10,285 acres, together with improved survival due to the use of herbicide to reduce vegetative competition, would establish tree species such as western larch, ponderosa pine, Englemann spruce, western white pine, and Douglas-fir much sooner in many cases than would occur naturally (such as where lodgepole pine has heavily seeded in). Species that are better adapted to dry sites would be favored where appropriate, although all species would be represented. This would also establish trees more quickly and, therefore, trees would be available to provide structure sooner than if allowed to recover naturally. In addition, the diversity of tree species would increase structural diversity in the long-term by assuring establishment of a mix of species in areas where they historically occurred, but where lodgepole pine regeneration is now prevalent (see discussion under Alternative 1). This variety would provide trees that are more likely to grow to larger sizes than the lodgepole pine typically does, as well as provide different bark textures, branch configurations and crown shapes. Diversifying species compositions where lodgepole is currently prolific would reduce the potential impacts of future insect and disease outbreaks, and species compositions in the entire fire area would move toward historical ranges of variability. Across the landscape, establishing diverse tree species would promote long-term sustainability and ecosystem resiliency and increase structural diversity.

Western white pine would be planted to reestablish the species in those areas that had natural stands of white pine growing in them prior to the fire. Without planting, this ecologically important species most likely would not reestablish itself due to loss of seed sources in the fire. The Blue Mountains have a restricted, outlier population of white pine, and the burned stands in the Tower Fire were an important component (Tower Fire Ecosystem Analysis 1997). The planting would enhance species diversity, and provide the opportunity for future natural regeneration of white pine in the landscape.

Thinning on 1,023 acres would remove species in the ponderosa pine/mixed conifer stands that have grown in as a result of fire suppression, moving those stands back to species compositions that resemble what occurred historically. This would also promote open understories more attuned to historic stand structures. Reducing competition from understory trees would help maintain the health of the few remnant, large, old ponderosa pine in the stands and provide the late, old, single-storied structural characteristics desirable in this area (Tower Fire Ecosystem Analysis 1997, Eastside Screens 1994). Opening the understories would allow managers to implement scheduled underburning at intervals that mimic the historic fire regime, which would also help maintain the stand structures developed by thinning. Thinning in small diameter stands (non-commercial thinning) would shift the site's growing potential to fewer trees, allowing those trees to grow large more quickly—this would be beneficial since large trees are currently lacking. Thinning could be accomplished in several entries with closer spacing to begin with, then letting the stands' growth dictate future prescriptions for treatment.

Removing susceptible trees and planting resistant species in Armillaria-infested stands would allow establishment of disease-resistant trees on 271 acres, which could provide stand structure in the future. Removing fire-killed trees through salvage and fuel treatments would reduce future fuel loading in stands with high mortality, allowing prescribed fire activities to take place. Re-introduction of periodic fires into the landscape would assist in moving the area toward historical ranges of variability, especially in those ponderosa pine and warm, dry plant associations that evolved with frequent natural fire disturbances (Agee 1993).

Cumulative Effects: Thinning (both proposed and reasonably foreseeable future), treatment of root rot infested stands, and reforestation with control of competing vegetation would begin to move stand structures and species compositions toward historic conditions. The proposed activities would increase the number of acres containing historic species mixes by 8,494 acres in the short-term. In addition, the dense stands of dead trees removed through proposed salvage would promote regeneration of early and mid seral species, especially in the drier forest types, by reducing the current amount of shade. This would also allow initiation of a prescribed burning program to manage for historic stand structures and species compositions in those areas. As a result, thinning, salvage, treatment of root rot pockets, and successful reforestation would further increase the trend toward historic species mixes to 9,402 acres in the long-term. The proposed fuel break and reasonably foreseeable future thinning would increase long-term trends even more, but the associated amount of acres affected is not predictable at this time.

ALTERNATIVE 3

Direct/Indirect Effects: Seedling survival would be much less successful in this alternative (no reduction in competing vegetation); consequently, enhancement of future stand structures and species compositions would be minimal to none. This could also affect the success of reestablishing white pine in the area, because survival of these tree seedlings would also be diminished (an estimated 70 acres as compared to 200 acres estimated for Alternative 2). Progression of stand structure and species compositions toward the historic range of variability would take many decades and perhaps centuries. Thinning, removal of dead stems, and treatment of Armillaria would result in the same effects discussed in Alternative 2.

Cumulative Effects: Thinning, treatment of root rot, salvage, and the fuel break would have the same cumulative effects described under Alternative 2. However, since vegetation that would compete with planted seedlings would not be controlled, reforestation would not be as successful. The estimated survival rate would be approximately 35 percent overall, although in some areas there could be complete mortality of seedlings, while other areas may have a higher than 35 percent survival rate. The combination of planting without control of competing vegetation, thinning, and treatment of root rot would still increase the area containing a species mix within the historic range in the short-term, although the number of acres (4,894) would be almost half of the acres that would result from Alternative 2. The long-term improvement (which includes previously discussed activities and salvage) would also be reduced, with an estimated 6,862 acres containing historic species mixes. Again, the proposed fuel break and reasonably foreseeable future thinning would increase long-term trends even more, but the associated amount of acres affected is not predictable at this time.

ALTERNATIVE 4

Direct/Indirect Effects: For the effects of planting, this alternative would be the same as Alternative 3. Thinning would occur under this alternative through girdling (cutting through the live wood) or felling of excess trees on 598 acres, so the effects would mirror those regarding thinning in Alternative 2. This alternative would not salvage or reduce fuels in fire-killed stands or treat root rot-infested stands, so the results in infested stands would be the same as those discussed under Alternative 1.

Cumulative Effects: Thinning (through girdling or felling and leaving) and planting would move species compositions toward historic mixes on an estimated 4,379 acres in the short-term. This reflects less thinning and no treatment of Armillaria root rot. With no treatment of fuels, long-term improvement would remain the same at 4,379 acres. The high fuel loads would discourage future reintroduction of fire, which would reduce the chance of maintaining short-term gains into the future and forgo conversion of additional acres to historic species mixes. Thinning would likely occur in the future as well, but it is not possible to estimate the acres affected at this time.

ALTERNATIVE 5

Direct/Indirect Effects: The effects of this alternative would be the same as Alternative 2, with the following exceptions: root rot infestations would not be treated so those areas would continue to lack structure, and 2,629 fewer acres would be salvaged so the ability to treat future fuels build-up would be reduced (consequently reducing the ability to re-introduce periodic fire).

In particular, Alternative 5 would increase buffers on each side of Class 3 streams by 150 feet, excluding that area from harvest. It should be noted that a no-cut buffer precludes management in both overstory and understory trees and would affect vegetation valuable to the stream corridor. Prohibiting harvest would greatly limit the ability to adjust stand density, species composition, fuel loads, or addressing existing and potential insect infestations adjacent to Class 3 streams. These limitations, in turn, would reduce sustainability and resiliency of trees, contrary to goals of maintaining riparian habitat and overall landscape health. The only other tools for managing forest species in the no cut buffer would be girdling, which would increase already high fuel loads, and prescribed fire, which is less-selective and runs a risk of exceeding desired mortality levels.

Cumulative Effects: Effects of moving stand structures and species mixes created by past management toward the historic range of species would be similar to Alternative 2, except that thinning would be reduced (at 779 acres) and pockets of root rot would not be treated. This would result in a short-term trend toward the historic range of species compositions of 7,979 acres and a long-term movement toward historic stand structures and species compositions on 8,098 acres. Reintroduction of fire to restore historic stand conditions would be limited. Reasonably foreseeable future thinning and limited prescribed burning would increase long-term trends even more, but the associated amount of acres affected is not predictable at this time.

ALTERNATIVE 6

Direct/Indirect Effects: Effects of this alternative would be the same as Alternative 2, although 760 fewer acres of fuels would be treated through salvage or other methods such as underburning or slashbusting.

Cumulative Effects: Effects of moving species mixes created by past management toward the historic range of species composition would closely resemble Alternative 2, except that fewer acres of fire mortality would have fuels removed. The short-term trend would increase the number of acres containing historic species compositions by 7,979 acres. In the long-term, the reduction in salvaged acres would result in 8,668 acres containing historic species compositions. Reasonably foreseeable future thinning and prescribed burning would increase long-term trends even more, but the associated amount of acres affected is not predictable at this time.

Seedling Survival

A competing vegetation canopy cover of 30% was defined as the damage threshold within the fire area based on studies by Blake and Crooker 1986, McDonald and Fiddler 1989, Miller 1986a, Oliver 1984, Ross et al 1986, and Petersen 1982. This means that *"control treatments would be considered for any reforestation unit in which highly-competitive shrubs and herbs occur individually, or in combination, at a density high enough that their foliage covers 30% or more of the ground surface in the vicinity of planted seedlings"* (USDA Forest Service 1998).

Without control of competing vegetation, the survival rate for planted seedlings is estimated at 35% per acre. Therefore, for the purposes of measuring and displaying effects, the acres enhanced by planting have been reduced to this amount in alternatives that would not treat competing vegetation (e.g. a 100 acre planting unit would only have 35 net acres of surviving seedlings). The effects would vary across the landscape with some acres having more surviving trees and other acres having zero survival. The survival rate for planted seedlings *with* herbicide application to treat competing vegetation is expected to be at least 70%. This estimate is supported by a number of studies (Oliver 1984, Ross et al 1986, Miller 1986a, Petersen 1982 and 1988, Oester et al 1995).

Please note in the Comparison of Alternatives Table 2.4, that the total acres of herbicide application exceed the total acres of planting. This is due to proposed application on areas of the fire planted in previous seasons. Field reconnaissance has shown that seedlings planted the spring of 1997 have high rates of survival and appear to be growing well, whereas seedlings planted in 1998 and beyond have experienced high levels of mortality. This mortality appears to have resulted from a combination of hot dry summers and increased competition from existing vegetation.

ALTERNATIVE 1

Direct/Indirect Effects: This alternative does not include planting as an activity.

ALTERNATIVES 2, 5, AND 6

Direct/Indirect Effects: Seedlings planted under these alternatives would have the benefit of herbicide treatment to reduce competing vegetation, which is expected to greatly increase their chance of survival (70 percent of the gross acres planted). In general, other strategies for managing competing vegetation are preferred; including prevention of the condition and early treatment before damage thresholds are reached (Managing Competing and Unwanted Vegetation EIS 1988). However, species that compete with tree seedlings recovered very well in many parts of the burn area, and that, coupled with three good growing seasons since the fire, precluded the chance of using any strategy other than correction (the strategy prescribed after damage thresholds have been exceeded). Other methods of treating the vegetation were dropped from further consideration due to the well-established nature of the vegetation, higher cost of those treatments, and concerns over soil disturbance. The proposed reforestation of 10,285 acres would take several years to implement and site conditions can change rapidly, so field reconnaissance of planting units would be done the summer or fall before implementation to verify need for reforestation or herbicide treatment.

Three different herbicides could be used singly or in conjunction with each other, dependent upon the vegetation. Targeted species include snowbrush ceanothus, pinegrass, elk sedge, thistles, red fescue, and bracken fern. All have a high risk of competing aggressively with planted seedlings. Regionally approved herbicides proposed for use are: Glyphosate (Accord, with Agridex as surfactant), Hexazinone (Pronone 25G), and Triclopyr (Pathfinder II). Application would be by hand, and would only cover 13% of each reforested acre, with 87% of each reforested acre remaining untreated.

> **Glyphosate** is absorbed by leaves and is non-selective (kills most plants except broadleaf woody shrubs). This herbicide works by preventing the plant from producing amino acids essential for growth (USDA Forest Service 1997a). Once it contacts the soil, glyphosate does not have herbicidal properties - it is not absorbed by plant roots and is readily immobilized by organic matter in the forest floor (Neary and Michael 1996). It has very low potential for leaching into groundwater (USDA Forest Service 1997a).

Hexazinone is absorbed by plant roots and leaves, and kills by inhibiting photosynthesis. It is selective, killing only certain plant types. This herbicide is moderately persistent in soil at low concentrations and controls vegetation for up to three years until degraded by soil microorganisms (USDA Forest Service 1992b). This herbicide has higher leaching potential than the other two because it is not absorbed well by the soil.

Triclopyr is absorbed by roots, leaves, and green bark, and kills by acting like a growth hormone that interferes with normal growth processes. This herbicide would be used to control ceanothus brush; it is selective, not injuring grasses, and is a low risk to non-target species. Soil microorganisms readily degrade Triclopyr; however, it can be leached in soils with low organic matter and a dry, cold climate (USDA Forest Service 1998).

The effect of controlling competing vegetation would be short term, covering the five-year seedling establishment period and possibly a few years beyond. There would be a short-lived reduction in plant diversity and species richness, with species rebounding to the point of resembling diversity and richness found in similar unburned areas (USDA Forest Service 1998). In contrast, untreated areas that contain competing vegetation that has exceeded damage thresholds would likely show a long-term reduction in tree species diversity (USDA Forest Service 1998). For an in-depth discussion of herbicides and their effects, request Powell's report.

Herbicide application would not disturb the forest floor; organic matter and soil surface horizons would remain on the site. In the soil, the identified herbicides tend to be immobile or move only short distances, unless overland flows occur immediately after application. Herbicides could temporarily damage mycorrhizal fungi in the soil; they could also increase diversity of mycorrhizal populations (USDA Forest Service 1998).

Cumulative Effects: The planting of trees with control of competing vegetation would help offset past reductions in seed sources due to logging and the Tower Fire. Distribution of white pine (which are rare in the Blue Mountain region) would be restored and over time increased as planted stands repopulate the landscape.

ALTERNATIVES 3 AND 4

Direct/Indirect Effects: Only 35 percent of the planted seedlings would be expected to survive (at most) due to heavy competition from existing vegetation. Planting would occur at the same density and over the same acreage as previous alternatives, but without the benefit of a reduction in competing vegetation. Professional judgment based on past experience, surveys conducted on the Wallowa-Whitman National Forest (personal communication), recent experience with plantations established within the fire area since the second spring following the fire, as well as observations of competing vegetation densities, all indicate that seedling survival would be very low if some relief from competition is not provided.

Cumulative Effects: The planting of trees would help offset past reductions in seed sources due to logging and the Tower Fire, however the result would be patchy since competing vegetation would greatly reduce survival in some areas. It is possible that distribution of white pine would not be restored to the amount that existed before the fire and that this population would decline over time.

Water and Soil

Hydrology/Stream Flow

ALTERNATIVE 1

Direct/Indirect Effects: Much of the precipitation would continue to leave the analysis area via stream flows or as deep percolation into the aquifer. This is because natural recovery of forest vegetation within the fire area would continue at a slow pace, so evapotranspiration and precipitation interception would be far below pre-fire levels. No new activities would occur, so these watersheds should continue to

experience high stream flows for some time. Timing of peak discharge would likely occur earlier in the spring (as compared to pre-fire timing) due to the reduction in canopy cover, which has increased exposure of the snow pack to sunlight and higher air temperatures.

ALTERNATIVES 2 - 6

Direct/Indirect Effects: As discussed in detail in Chapter 3, the Tower Fire would continue to have the greatest influence on hydrology and stream flows within the analysis area. Because of the massive tree mortality that resulted from the fire, the proposed activities would have no measurable effect on hydrology or stream flows. While some precipitation adheres to dead trees and returns to the atmosphere, harvest would not measurably reduce this. Where live trees would be removed through precommercial and commercial thinning, sufficient tree cover would remain so that evapotranspiration processes and interception of precipitation would not be altered. Recovery of evapotranspiration processes and precipitation interception in the long-term would be more rapid under alternatives 2-6 because planting would restore tree cover more quickly than “No Action” under Alternative 1. Accordingly, stream flows should return to pre-fire levels more quickly.

Soil compaction caused by logging equipment, temporary roads, and the proposed Roundaway 4-wheeler trail would decrease infiltration of water into the soil. A lower infiltration rate could reduce soil water content and aquifer recharge, while increasing surface runoff. Soil compaction would also decrease the water holding capacity of the soil. Proposed wide skid trail spacing, subsoiling and water barring of skid trails, landings, and temporary roads would mitigate these effects. In addition, approximately 75 percent of the Roundaway 4-wheeler trail would traverse ground that has already been compacted; new compaction would only occur where the trail does not follow an existing road or fire line. Overall, these alternatives should have little effect on stream flow because few live trees would be harvested and much of the forest's interception ability was lost after the trees' needles were burned or shed.

Cumulative Effects: The Tower Fire has reduced the amount of water that leaves the watershed through the atmosphere, making more water available for soil water, aquifer recharge, and stream flow. High soil moisture and deeper snow packs resulting from the fire have likely caused higher peak discharge rates from the burned subwatersheds. The timing of the peak discharge has likely occurred earlier in the spring because the reduction in canopy cover has increased exposure to sunlight and higher air temperatures. These alternatives would have little, if any, effect on the current hydrologic condition. Past harvest only continues to affect stream flows where it occurred outside of the fire boundary. Known future projects may propose tree thinning, but since a fully stocked stand would be left, evapotranspiration and precipitation interception would not measurably change.

Water Temperature

Water temperatures have been measured before and after the Tower Fire on most of the major streams using electronic thermographs. While temperature increases of about 4° F have been recorded at monitoring sites within the burn, it is difficult to adequately estimate the period of recovery. Therefore, rough estimates were based on the assumption that riparian shrubs and trees would grow between one to two feet per year.

ALTERNATIVE 1

Direct/Indirect Effects: Streams that have already been listed by the State of Oregon as water quality limited due to stream temperatures would continue to have elevated temperatures as a result of the destruction of riparian vegetation during the Tower Fire, and monitoring indicates that Oriental Creek (which lost riparian vegetation to flooding as well) could be added to the list. Streamside shade from shrubs and hardwoods should recover rapidly since much of the burned vegetation has resprouted, but it could take 20 years for full recovery of shade to occur. Livestock grazing (an ongoing activity in the area which could potentially affect stream shade recovery) has been deferred during the last four years within the burn, however, livestock could return to the burned area in 2001. This could reduce vegetation in those riparian areas that have been historically preferred by livestock.

Conversely, fire-induced increases in base stream flows could lessen increases in water temperature by providing a greater volume of water, which would take more energy to heat. Stream water temperatures

could decrease to or below pre-fire levels within 15 to 20 years if recovery of riparian vegetation continues unimpeded.

Severe flooding in the Upper Hidaway, Upper North Fork Cable, and Oriental subwatersheds likely contributed to increases in water temperature. Streams in the flood zone were scoured and widened in the floods. In addition, sediment from eroded uplands also caused channel widening and shallowing, and this widening has exposed more surface area to solar heating. Several factors may be responsible for the additional 5° F temperature increase recorded in Oriental Creek following the 1998 flood: smaller tributaries were scoured down to bedrock, removing the alluvium that covered the cooler subsurface flow; unburned riparian vegetation that shaded the creek downstream from the burn was destroyed; and excessive bedload movement increased the width/depth ratio of the channel.

ALTERNATIVES 2 - 6

Direct/Indirect Effects: In these alternatives, no trees would be harvested within 300 feet of fish-bearing streams or within 150 feet of perennial non-fish bearing streams, so stream shade would not be reduced. Riparian hardwoods and conifers would be planted along 22.8 miles of Hidaway, Winom, and the South and North Fork Cable creeks (which were burned at high and moderate severities) to accelerate stream shade recovery in areas lacking adequate hardwood regeneration. Planting of hardwoods and conifers within riparian areas would assist in the natural recovery of stream shade. Perhaps more importantly, planting would provide a diversity of tree and shrub species that may have declined because of increased overstory shade caused by 100 years of fire exclusion. Stream water temperatures might decrease at a faster rate than if stream shade recovery were allowed to occur through natural regeneration.

Timber harvesting would not likely result in increased landslides because of the use of streamside buffers (described above), harvest systems tailored to site conditions, and location of temporary roads on slopes of less than 5 percent. The stabilizing effect of tree roots was already destroyed when the fire killed the trees, and removal of the tree boles would have no effect on the decomposition of the roots. Ground-disturbing activities would not likely affect stream shape (width to depth ratio) because sediment would be limited by applying the Best Management Practices described in Appendix B. Activity sediment that does reach streams would generally be fine-textured and mobile. Because of its size, such sediment would remain suspended and transport through the system, rather than being deposited and influencing channel shape.

Cumulative Effects: The single most important event affecting water temperature within the analysis area would continue to be the Tower Fire. Many of the hardwoods destroyed by the fire have resprouted, but conifer regeneration has been sparse except at the higher elevations where excellent regeneration of lodgepole pine has occurred. During the last three springs, hardwoods and conifers have been planted along the perennial flowing reaches of Texas Bar and Oriental creeks, and the proposed plantings would cumulatively accelerate riparian recovery within the burn. Future projects such as timber harvesting would not likely affect stream temperatures because of restrictions placed on riparian disturbance identified in the Forest Plan standards and guidelines (in particular, Forest Plan amendments #10 and #11 which add protection for anadromous fish and riparian habitat).

Reintroduction of grazing, which is beyond the scope of this document (see Chapter 1), could potentially affect riparian recovery and, indirectly, stream temperatures. Where riparian shrubs and hardwoods have grown above the height that livestock can graze, stream shade should be maintained by the current practice of riding to redistribute livestock. However, if grazing is reinstated before shrubs and hardwoods gain enough height, then grazing could set back recovery of stream shade. The proposed fencing of four meadows, two springs, and three ponds would partially reduce the effects of future livestock grazing on riparian vegetation and stream temperatures.

Soil Erosion, Stability, and Sedimentation

Analysis for water and soil resources was done at the subwatershed scale encompassing all subwatersheds that were affected by the Tower Fire (33A-Lower Cable, 33B-Lower North Fork Cable, 33C-South Fork Cable, 33D-Upper North Fork Cable, 35B-Texas Bar, 35C-NFJD/Turner, 35D-NFJD/Otter, 35E-NFJD/Oriental, 95A-Winom Creek, 95B-Big Creek, 96A-Lower Hidaway, and 96B-Upper

Hidaway subwatersheds). These subwatersheds cover 88,658 acres, 83 percent of which are composed of Federal lands that are managed by the Forest Service.

Effects of proposed activities on soil resources were conducted in terms of risk of erosion increases, subsequent movement of any mobilized soil fines, and changes in risk of mass-movement of soil or rock bodies. Comparisons were made primarily based on experience with these activities in similar conditions or in this particular area, and monitoring results. It is assumed that average weather conditions will prevail (unless otherwise noted) and normal recovery of both natural and planted or seeded vegetation will occur or continue. Soil erosion effects were considered at local site or unit scale and from a subwatershed scale.

With the exception of proposed activities that are point sources[6] (which have the opportunity to disturb streambanks, i.e. road crossing repair), proposed activities would not directly affect water quality during project implementation; the effects would occur during subsequent rainfalls or snow melts. Sediment yield increases were correlated with the amount of mineral soil exposed during a proposed activity, so with a larger amount of disturbance higher sediment yields would be expected. In this section, soil stability refers to effects that would have an influence on mass movement of soil or geologic stability (as opposed to surface stability or erosion effects).

Components of the Northern and Intermountain regions erosion model (Potyondy 1991) were used to estimate the current sediment yield from the Tower analysis area and to predict accelerated average annual levels resulting from existing management activities, the Tower Fire, and proposed ground disturbing management activities. The erosion model was incorporated into the WATSED model (Forest Service, Northern Region), which is used to predict the effects of land management activities on water quantity and timing, and sedimentation. It is important to note that sediment yields predicted from this model are not absolute; the results are best used to compare between the various alternatives. Direct application of the WATSED model to the Tower analysis area was not possible because erosion response curves and land type databases required for the model have not been developed for the Blue Mountain Province. Also, the model has not been calibrated or validated with measured runoff and sediment data from the Blue Mountains. A derivation of the erosion model was tested on the Wallowa-Whitman National Forest, 20 miles northeast of the Tower analysis area (Gill 1994). Modeled sediment production was 70 times greater than what was actually measured for the same area over a three-year period. Gill (1994) noted that measured sediment yields were extremely variable, even with the limited data set.

Depending upon the amount of area impacted by a specific activity, evaluation of the sediment yield effects was done at the watershed[7] or analysis area scale. Notable increases in sediment yield at these scales were backtracked to identify the source subwatersheds and activities. Sediment yields were converted to percent increase above background level to provide a more meaningful comparison between alternatives. Background level was defined as relatively free of human-caused or natural disturbance, and quantified for use in the model by using data from a gauged watershed representative of the northern Blue Mountains—High Ridge Watershed 3 (located about 50 miles north of the Tower Fire). Although the High Ridge area receives more rainfall and has deeper soils and higher vegetation density than the watersheds within the Tower analysis area, the High Ridge area provided a reasonable representation of "pre-management" background conditions. Between 1984 and 1995, sediment yield from the untreated High Ridge Watershed 3 was 18.1 tons/mi^2 (Helvey and Fowler 1997). Modeled sediment yields were divided by this value to obtain the percent increase above background levels.

Assumptions regarding sediment delivery to the nearest stream channel were based on the travel distance from disturbance, summarized in Table 4.1. For example, 30 percent of the soil erosion resulting from disturbance within 50 meters of a stream would be delivered to the stream, while the remaining 70 percent would be redeposited on the hill slope and would not contribute to instream

[6]Point sources of pollution can be traced to a specific point of introduction. Non-point sources of pollution cannot be traced (i.e. agricultural runoff.

[7]Affected watershed sizes range from 17,717 acres to 27,464 acres.

sediment yield. Sediment is often detained within the channel network, such as behind woody debris, until a high flow flushes the sediment downstream. No attempt was made to simulate the routing of sediment through the channel network, so the predicted sediment yield at the watershed scale is the hypothetical maximum.

Overall, results from sediment modeling are considered representative of the relative differences between pre and post-fire conditions, and differences between alternatives. Sediment modeling results do not represent actual values of sediment production.

Table 4.1: Estimated Sediment Delivery Ratios.

Distance from Stream Channel (meters)	Delivery ratio (%)
0 – 50	30
51 – 100	20
101 – 150	10
> 150	1

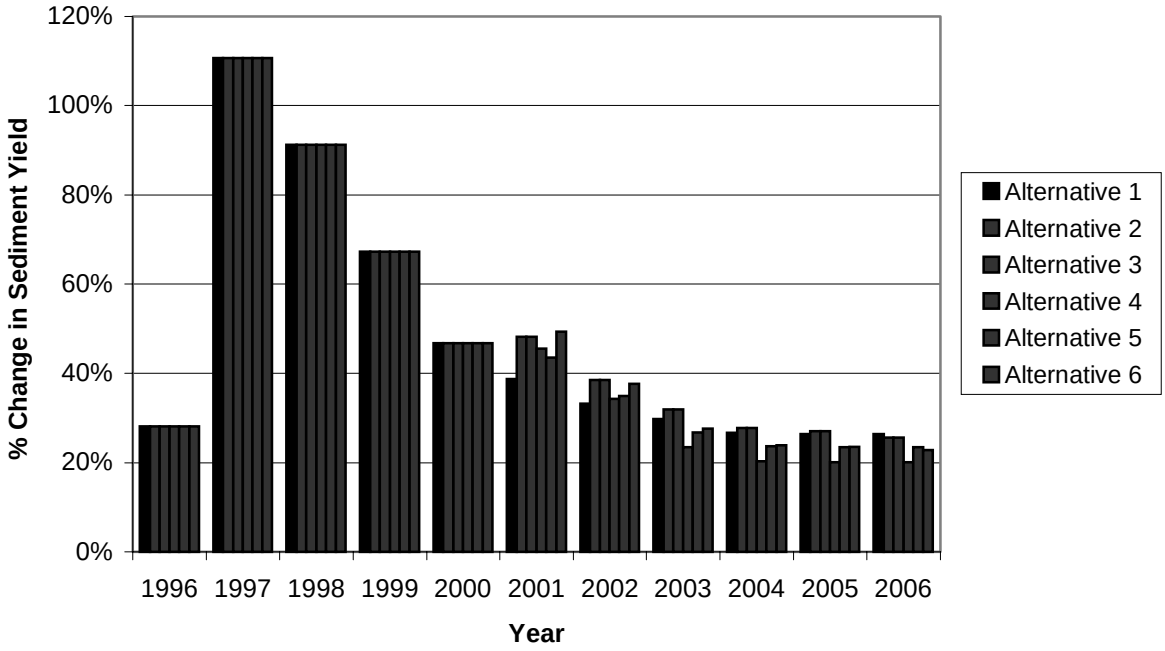


Figure 4.1: Predicted change from background sediment yield within the analysis area, with implementation occurring in 2001.

Table 4.2: Proposed transportation activities.

	Alternatives					
	1	**2**	**3**	**4**	**5**	**6**
Road Reconstruction or repair (miles)	0	60.2	60.2	43	36.2	52.4
Temporary Reopening of Abandoned Roads (miles)	0	1.2	1.2	0	0	1.2
Temporary Road Construction (miles)	0	4.0	4.0	0	0	1.1
Road Obliteration (miles)	0	6.4	6.4	48.9	24.3	39.5

ALTERNATIVE 1

Direct/Indirect Effects: The occurrence of overland flow and soil erosion within the burned area has increased following the Tower Fire due to consumption of much of the ground cover that protected the soil, especially within the areas that burned at high intensities. Soil erosion rates would continue at elevated levels until vegetation, including soil cover, is fully restored. Some of the areas that have experienced mass soil movement would likely continue to worsen because vegetation would have difficulty establishing in such areas of high disturbance. Changes in vegetation type and density resulting from the fire have already caused peak discharge rates to increase, accelerating channel scour, and this would continue until vegetation has recovered. Residual effects of past management activities would gradually decrease; however, areas where soil has been lost or compacted may not achieve noticeable improvements within many years or decades. Exotic plants and noxious weeds could out compete native plants and are often not as beneficial in protecting the soil surface.

Modeled sediment yield estimates for the existing conditions of the analysis area show that prior to the Tower Fire, sediment yield was about 28% above predicted background levels and was primarily caused by the existing transportation network. Following the Tower Fire, the predicted average annual sediment yield for the analysis area increased 83% above the pre-fire conditions, totaling 111% above background levels (see Figure 4.1). The floods and associated sediment movement observed in Upper North Cable and Upper Hidaway subwatersheds in 1997 and in Oriental Subwatershed in 1998 support these predictions, though the simplicity of the model used could not have predicted the spatial extent or magnitude of these floods. The predicted sediment yield would be 39% above the baseline in 2001 and would not reach pre-fire conditions until 2004.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: Activities that disturb the soil have the potential to accelerate soil erosion, and a percentage of the sediment is delivered to streams and transported out of the watershed. For this analysis, sediment yield predictions were made as mean annual values, even though sediment yield is highly dependent upon extreme events that are distributed randomly in time and space.

Activities which would cause ground disturbance and increase sediment production in the short-term include: road repair and obliteration, removal of fish barriers, planting of trees and riparian vegetation, subsoiling, prescribed burning for forage enhancement, rehabilitation of recreation sites and trails, construction of the Roundaway 4-wheeler trail, hazard tree removal, salvage of dead trees, and construction of a fuelbreak. Mitigation to limit the amount of sediment increase is listed in Chapter 2. Several of the proposed activities would not cause ground disturbance or an increase in sediment yield: fencing, pre-commercial thinning, snag enhancement, designation of new C1 areas, and use of herbicides. Activities which would reduce overall sediment yields in the long-term include: road repair and obliteration, fencing, revegetation of unstable slopes, planting of trees and riparian vegetation, subsoiling, and rehabilitation of recreation sites and trails.

Hardening of road surfaces and cut/fill slopes and improvement of drainage outflows would occur on 60.2 miles of open and closed roads, which would reduce erosion, increase the capacity of the drainage system to handle higher flows during storms, and spread out the concentrated flows so they have less energy to cause erosion. This would limit the amount of sediment that accumulates within drainage structures[8], reduces their capacity, and eventually plugs them.

Widening Forest Road 5510 to serve as the main mid-slope road in Oriental Subwatershed would increase mass wasting and surface erosion on cut and fill slopes because this area is steep and has unstable geology. Instability and erosion would be partially mitigated by stabilization of existing problems and reducing sediment accumulation in drainage structures, which would lower the risk of road fill failure during extreme storms. In addition, widening is proposed only for outside curves along ridge crests, not on inside curves where the road crosses stream channels. Avoiding implementation during wet road conditions and seeding of disturbance when repair is complete would also reduce the risk of erosion and sedimentation. Short-term sediment yield increases would result from instream work associated with removal of one culvert, replacement of seven culverts, and installation of one low water ford. During the short period of instream work (several hours per culvert, and up to a day for the low water ford) suspended sediment concentrations would be increased. Work would be conducted during the period of lowest stream flows between July 15 and August 15. The low water ford at Forest Road 5506 would allow larger floods, similar to the 1998 flood, to pass over the structure with minimal effect on the stream channel.

Obliteration (recontouring) of approximately 6.4 miles of closed road would contribute sediment in the short-term. However, this activity would improve slope stability and reduce sediment yield levels below pre-disturbance levels once the soil stabilizes and is revegetated (2 years). Obliteration would decompact the road surface, remove drainage obstructions, and excavate soil from the fill slope to place it against the cut slope in a close approximation of the original contour. This would reduce cross-slope interception of water, decrease slope failures, prevent erosion associated with water from running down the unused road, and eliminate culvert or other drainage obstructions that lead to road failures. The disturbed soil would be seeded with grass, and observations of past obliteration in this area have shown that after two growing seasons erosion rates would be similar to adjacent soils. Assuming the road width (including cut and fill slopes) is 20 feet wide, approximately 15.5 acres of ground disturbance would occur with the potential to increase sediment levels by 4% during the first year and 2% during the second year.

The removal of fish passage barriers would involve the use of heavy equipment or movement of road fill or other soil materials, which would cause ground disturbance within the riparian area increasing the potential for fine sediment inputs into streams. Track driven excavators travel faster, but would cause a greater amount of ground disturbance than Super Hoe-type excavators[9]. There would be an increased risk of erosion and sediment for up to a year following project completion if the machine crosses a creek. This risk would be reduced by limiting implementation to periods of low flow and designating all travel routes for heavy equipment. In the long-term, these projects would reduce erosion.

Slope stabilization projects would accelerate establishment of vegetative soil cover, which would reduce surface erosion, limit the potential for further movement of existing landslides, hasten stabilization of the cutbank on Forest Road 5510, and provide a localized reduction in sediment yield. The only potential for increased erosion risk would occur during the planting or seeding activity itself, with disturbance limited to walking on the unstable slopes, digging, or any scalping necessary to plant trees or shrubs. These alternatives would not correct the Texas Bar landslide where it has caused the creek to laterally erode into the silt hill slope. A change in sediment yield at the watershed or analysis area scale would not be detectable due to the small scale of the slope stabilization projects.

[8]Accumulation of sediment and debris in road drainage systems inside and downslope of the burned area has greatly increased since the Tower Fire. This is because the fire greatly reduced vegetation and organic debris that intercepted precipitation, slowed overland flows, and protected the soil surface. See Chapter 3 for a more detailed discussion.

[9]A “Super Hoe” is a brand of low impact excavator with opposable legs that can move independently to “walk” over obstacles and can rotate 360 degrees without moving on the ground.

Subsoiling scattered, old landings and skid trails (totaling about 25 acres) would disturb the soil surface, increasing the risk of erosion and sediment yield in a few areas with moderate slopes for about three years after implementation. This risk would be offset by increased infiltration rates. In some cases, vegetation has re-inhabited the compacted areas and would be damaged or removed by implementation. However, vegetation would re-invade quickly due to the reduced compaction and improved water infiltration. During the first year after implementation, the predicted sediment yield increase was less than one-half percent over background levels. Long-term erosion potential would also be reduced through improved water infiltration and better vegetation coverage. Monitoring of subsoiling around the Umatilla National Forest has shown this technique to be effective in reducing the effects of excessive soil compaction. Areas that had experienced overland flow due to decreased infiltration capacity showed improved conditions and increased survival of planted seedlings (personal observation; personal correspondence Mike Geist, Ralph Walker, others; Umatilla National Forest Monitoring Report 1996, 1997, 1998). Landings, temporary roads, and major skid trails in old logging units that had been subsoiled as a demonstration area for the Umatilla and Wallowa-Whitman National Forests showed no sign of erosion several years after treatment. Detectable decreases in soil compression were still evident, despite no obvious visual indication that any treatments had occurred. Use of improper equipment, careless operators, or soil conditions can create or at least fail to improve erosion problems. Improper use of subsoilers, especially modified ripping implements, can create channels of loosened soil where water can concentrate and cause gully erosion. Operational controls, use of appropriate equipment, identification of treatment areas, and on-site direction by experienced personnel would be adequate to avoid potential problems.

Prescribed fire for big game forage enhancement would potentially increase erosion in the short-term. The erosion risk would be increased until plant leaf area recovers to pre-fire conditions, but the activity would not likely have a measurable effect on sediment yield. Varying amounts of organic material would be burned depending on fire intensity and the extent of coverage, but this protective layer is often replaced by development of cryptogams[10] (Johnson 1998). As a result, a net loss in cover would be negligible soon after treatment. Most of the surface vegetation that burned would not be killed and would vigorously resprout in the spring. Grass vigor would improve, which would increase for up to four years following treatment. However, increased use by animals could negate some or all of these benefits due to additional consumption of vegetation and hoof impact. Still, the intent of the enhancement is to draw animals away from other areas that may be more sensitive or experiencing heavy use. Observations of prescribed fire in similar habitats or settings around the Blue Mountains have not detected accelerated erosion rates, except in rare instances where severe storms occurred immediately following the fire (personal observation; personal correspondence Karl Urban). Ignition prescriptions that designate such objectives as burn intensity and effective ground cover retention (see Forest Plan page 4-80), would be adequate to reduce risk of erosion.

Proposed fencing would reduce domestic livestock use of several meadow areas that have stream banks susceptible to erosion, allowing bank stability to increase and reducing the amount of sediment entering the drainage network.

Recreation site rehabilitation projects would reduce soil disturbance and erosion in each localized area, but would not result in a measurable decrease in sediment yield. Seeding next to recreation trails with steep slopes would increase soil cover, and installation of signs at trailheads would inform recreationists about their effects on soils and enlist their participation in minimizing off-trail soil disturbance. Relocation of 4-wheeler traffic away from the landslide area on the Roundaway Trail would increase the potential for erosion from the new trail section, but would reduce erosion from the existing section. Most of the new route (4.5 miles) would be located on existing roadbeds, which would need to have encroaching vegetation cut back to allow a 50-inch-wide trail. The only ground disturbance associated with construction of the trail would occur where water barring and outsloping is required along portions of the 1.25 miles of old fire lines and skid trails used for the trail. Limiting the amount of soil disturbance, working during periods of low soil moisture content, and revegetation treatments or placement of sediment traps if critical areas are crossed would mitigate this risk. The 4-wheeler route would add 6.5

[10] A cryptogam is a protective crust, composed of microorganisms, that forms on the soil surface.

miles of compacted, bare tread which could increase surface erosion; however, it would occur on much gentler terrain than the existing trail, so erosion hazard would be low. The existing Roundaway Trail would be easier to maintain and less disturbance would occur outside of the trail tread. During the first year, construction of the 4-wheeler trail in the Cable and Hidaway watersheds would cause a 0.3% sediment yield increase within the analysis area, with a 1% increase in the Hidaway Watershed alone (where most of the new trail construction is located). This amount is likely an over prediction, since little or no tread would be constructed.

Ground-based salvage logging of burned and diseased trees, hazard tree removal, and commercial thinning (including associated temporary road construction) is proposed on 3,407 acres. This would have the potential to elevate sediment yield above existing conditions during the first year after implementation. This would be mitigated by not allowing whole-tree yarding on tractor ground, designating use of full suspension systems, and requiring slash or logs to be placed back onto skids where effective ground cover is deficient. Helicopter or skyline logging systems would be used to harvest an additional 1,401 acres that is located on slopes steeper than 35%. Unlike ground-based systems, aerial methods of harvest have little effect on the rate of soil erosion because there would be little ground disturbance. During the first year, helicopter logging would account for less than 0.4% of the modeled sediment increase, but during subsequent years, no harvest-related sediment was predicted from helicopter units. The effects of ground-based timber harvesting is assumed to last for about six years, while the effect of helicopter logging would persist for only one year. Sediment yield resulting from logging activities would have a silt particle size because it would have been derived from erosion of the soil surface. This size of particle would move through the system and not accumulate.

Concerns identified in the Beschta Report regarding felling, skidding, and associated temporary road construction and use were considered during analysis. Other research and experience indicates that salvage and restoration activities can be accomplished with proper planning and controls (Everett 1995; Sesco et al. 1995). The Tower area is sensitive from a soil texture and geology standpoint and any treatments need to proceed with care. Based on the data and analysis (together with site-specific planning, system and equipment selection, and mitigation), erosion increases from harvest operations would meet Forest Plan standards and guidelines for soils and sediment. The actual removal of standing trees would not increase erosion, instability, or sedimentation because the processes of precipitation interception and evapotranspiration provided by the foliage was lost shortly after mortality occurred. The stabilizing effect of tree roots was reduced by the fire and would not be further affected by harvest because only aboveground wood would be removed. However, heavy equipment used to remove trees would affect soils within the zone of operation by removing protective vegetation where it has reestablished, disturbing or displacing soil, and causing compaction which would reduce infiltration of overland water flows. This is particularly true on 2,274 acres where tractor skidding, the logging system most likely to reduce ground cover and compact soils would occur. Temporary roads, skid trails, and landings pose the primary risk and could temporarily divert water runoff into the area of disturbance or onto undetected areas of instability. The magnitude of these effects would depend primarily upon the weather conditions as they relate to soil saturation and overland flow. To mitigate potential effects, temporary roads would be constructed to minimum widths and their surface sloped outward with drainage dips where necessary so that water is quickly diverted off the disturbed surface. Heavy machines used for salvage would be restricted to designated areas and areas of compaction would be subsoiled. An excavator would obliterate temporary roads and place available logs and slash material across the disturbed area. Logs and slash would also be placed as needed on skid trails and landings. The Riparian Habitat Conservation Areas adjacent to streams would also trap sediment before it enters the drainage network.

Mitigation measures and timber Best Management Practices for erosion control, described in Chapter 2 and Appendix B, have been designed to reduce the occurrence, intensity, and duration of potential effects. Field monitoring of past projects, including the Wheeler Point Fire Salvage on the neighboring Heppner Ranger District, has shown these measures to be effective in achieving the desired mitigation when implemented as designed. Erosion and sedimentation would return to pre-disturbance levels after grasses and forbs become established on the affected areas (2 to 5 years after yarding and hauling corridors are treated).

Commercial thinning would have the potential to increase erosion rates as a result of yarding activities and associated transportation networks. Effects discussed under salvage would be similar to the results of this activity, with the exception that these stands were only lightly burned so vegetation and soil cover are currently intact. Design and mitigation measures listed for timber harvest would keep any effects on soils or sediment within Forest Plan standards and guidelines.

Reforestation would occur on 10,285 acres, much of which would occur in the Cable Watershed (which experienced the largest amount of high intensity fire). In both alternatives, 2¼ square feet around each seedling would be scraped free of vegetation (scalped). Under Alternative 2, 26 square feet of herbicide would also be sprayed outside the scalp. The net area sprayed with herbicide would be 1,544 acres. Although herbicides would kill vegetation on 14% of each acre treated under Alternative 2, the dead vegetation would still provide short-term soil cover until new vegetation grows (1 to 2 years). Alternative 3 would not involve the use of herbicides, so the reduction in vegetation cover would be limited to the two square foot scalp around each seedling. However, the competing vegetation would result in a lower success of establishing forest cover. This would be very patchy with high tree survival rates where there is little existing vegetation, but low to no survival in areas that have had good recovery of vegetation. As with any ground disturbing activity, scalping and herbicide use would increase the potential for soil erosion and sedimentation. In all but the most extreme events, soil detached from the scalp/herbicide zone would likely deposit in the adjacent untreated area surrounding each seedling. Off-site movement of soil would not be expected, and erosion would decrease to its current level after about 3 years. In addition, ground cover next to streams would be maintained by excluding herbicide use within Riparian Habitat Conservation Areas, providing an additional opportunity to trap any mobilized soil before it reaches the stream network. Overall, reforestation was predicted to cause about a 1% increase in sediment yield during the first year after implementation and none in subsequent years.

Six and a half miles of shaded fuel break would be constructed on ridges within the Hidaway and Cable watersheds. The fuel break would be 300 feet wide and the total area affected would be about 224 acres. Within the fuel break most dead trees would be cut, live trees would be thinned to eliminate contact between tree crowns, and slash would be piled and burned. Grass and forb vegetation would not be destroyed. Most of the fuel break would be cleared manually, though heavy equipment could be used for brush disposal or piling on each end of the break where it is accessible by road. Erosion could increase if mechanical treatment exposes the soil. Still, little effect on sediment yield would result from this activity because manual methods would primarily be used, and the break is located on ridge tops that are more than 100 meters from the nearest Class 4 stream. Less than 1/10 of a percent increase in sediment yield was predicted to result from fuel break construction in the affected watersheds.

Cumulative Effects: In the short-term, proposed road repair and obliteration activities and construction of the Roundaway 4-Wheeler Trail would cumulatively increase erosion risk created by the fire and the existing road and trail system. The new trail and repaired roads would continue to produce low levels of sediment because these surfaces lack protective vegetative cover. Trails, road surfaces (especially native surfaces), and cut banks tend to generate fine sediment during rainstorms and snowmelt. This sediment tends to settle out a short distance from the road or trail, so features close to the stream network have the greatest effect on water quality. Erosion and related sediment levels would decline as the soil surface seals or become revegetated (2-5 years). Longer-term benefits to soil and water resources include an overall reduction in chronic and catastrophic erosion potentials posed by the existing road system, and increased slope stability. These activities would help offset future soil disturbance associated with other activities such as commercial thinning, mining, or recreational use (see Appendix A for details). The relocated Roundaway 4-wheeler traffic would operate on much gentler terrain and, coupled with the identified mitigation, erosion and sediment levels would be within the standards and guidelines identified in the Forest Plan for recreation trails and soils.

Short-term risk of erosion from ground disturbance related to subsoiling and fish habitat improvements would be increased when combined with other soil disturbing projects such as past and proposed timber harvest. This would last for one to two years until vegetation reclaims the area of disturbance (recovery would be quicker than with road obliteration because less disturbance would occur). In the long-term, proposed subsoiling, fish habitat improvements, meadow protection, and recreation site hardening projects would serve to decrease erosion hazard as erosion problems are repaired, water infiltration

improved, and vegetation growth improved. This would add to prior enhancement projects aimed at reducing erosion (see Appendix A) and help mitigation measures offset increases in soil erosion related to other actions proposed in this document.

Before the Tower Fire, about 30% of the National Forest System lands within the analysis area had been logged from 1979 to 1996 (see Table 3.2 and Map 3); with fire salvage associated with Big Tower (2,739 acres) and private lands (360 acres) the only harvest that has occurred since that time. Only the effects of logging associated with the Big Tower sales, which logged 1.3% of the analysis area in 1998, would still be contributing elevated levels of sediment. Remaining exposed surfaces from this harvest activity is estimated less than 3% of any unit based on photo interpretation, field observations, and monitoring. Additional amounts of exposed soils (perhaps 4% of a unit) remain from some temporary roads, landings and major skid trails related to the post-fire Dragon, Lone, and Hairy Hazard salvage sales and from the Placer Salvage Sale (which was largely completed by 1995). Proposed salvage and commercial thinning would add 4,145 acres to this amount, cumulatively affecting approximately 14% of the area within the burn. In the short-term, the cumulative effects of management activities on upland soil erosion caused by the interactive effects of the fire, past and proposed timber harvest, and temporary road construction has the potential to further increase erosion rates. Elevated levels of channel erosion can primarily be attributed to the fire's destruction of vegetation, which has increased peak discharge levels, superseding the effects of past harvest.

Sediment resulting from proposed actions would be additive to sediment resulting from the fire. Results from modeling the combined activities proposed under Alternative 2 showed a 3% increase in mean annual sediment yield from the analysis area during the first year after implementation. The cumulative mean annual sediment yield would be 48% above background levels. Timber harvest proposed with this alternative would not contribute to elevated channel erosion, because vegetation type and density would not be greatly modified. Sediment associated with proposed activities would be finer textured (silt) than sediment mobilized as a result of the fire because management-related sediment would be derived from soil surface erosion and would not include channel scour (coarser sediment). Fine sediment entering the drainage network would tend to remain in suspension and move greater distances.

Sediment yield would remain elevated until 2006, when yields would drop slightly below the level predicted for Alternative 1. This reduction is due to reduced road miles. Road obliteration would lower annual sediment yield about 1% by 2006; however, the total sediment yield would remain at 26% above background levels even after the effects of the wildfire and Alternative 2 actions have diminished. The largest sediment yield increase would occur in the Cable Watershed, with the mean annual sediment yield predicted to increase 3.3% above the existing condition during the first year after implementation. This would drop to 9% below the existing condition during the second year and would drop below pre-fire conditions by 2006. Some road obliteration was proposed for this watershed, so post-project sediment yield levels should be below pre-fire levels. At the other extreme, the Big Creek Watershed would experience a predicted 1% decrease in mean annual sediment yield after implementing Alternative 2 projects, but levels would not drop to pre-fire conditions by 2006.

Future projects being considered within the analysis area in addition to those associated with this EIS include commercial thinning in unburned areas. The exact number of acres is not known because the projects are still early in the planning phase and surveys have not yet been conducted to identify specific treatment areas. The amount that these projects would contribute to sediment yield cannot be predicted until harvest areas have been delineated. Up to 5,000 acres of prescribed fire per year could also occur adjacent to the analysis area depending on weather conditions. The low intensity burns would have little affect on sediment yield because the fire would not detrimentally affect soil properties and most of the surface vegetation burned would resprout the following spring.

Just before the court injunction, a separate interdisciplinary team had determined that vegetative conditions were sufficiently recovered to allow re-entry of livestock for grazing. This activity had been deferred since the fire under the annual operating plans for each affected allotment. Cumulative effects from proposed activities and the ongoing grazing of area allotments (see Table 4.4) would vary depending on the timing of re-entry of livestock. If grazing in areas disturbed by the proposed projects results in a delay of vegetative recovery, the length of time that erosion would occur would be extended.

Table 4.3: Potential Area to be Grazed.

Subwatersheds	Total Area (ac)	Grazed (ac)	Rested (ac)
Upper N. Fork Cable, Lower N. Fork Cable, S. Fork Cable, and Lower Cable	19,236	2,139	17,097
Texas Bar, NFJD/Oriental, NFJD/Turner, NFJD/Otter, NFJD/Dixon Bar, NFJD/Corral, NFJD/Basin, and NFJD/Meengs	16,037	3,029	13,008
Winom, Big, Lower Meadow, S. Fork Meadow, and Upper Meadow	6,584	0	6,584
Lower Hidaway and Upper Hidaway	24,272	6,005	18,267

ALTERNATIVE 4

Direct/Indirect Effects: Activities associated with this alternative which would cause ground disturbance and increase sediment production in the short-term include: road repair and obliteration, removal of fish passage barriers, placement of large instream wood in Round Meadow, planting of trees and riparian vegetation, subsoiling, prescribed burning for forage enhancement, rehabilitation of recreation sites and trails, and burning of felled hazard trees around the Pearson summer homes. Mitigation to limit the amount of sediment is listed in Chapter 2. Several of the proposed activities would not cause ground disturbance or an increase in sediment yield: pre-commercial thinning, fencing, snag enhancement, and designation of new C1 areas. Activities which would reduce overall sediment yields in the long-term include: road repair and obliteration, fencing, revegetation of unstable slopes, planting of trees and riparian vegetation, subsoiling, and rehabilitation of recreation sites and trails.

Road repair would result in effects similar to those discussed under Alternative 2, except 17.2 fewer miles would be treated. Closing Forest Road 5506 at Oriental Creek would allow three miles of road that parallel the North Fork John Day River to revegetate, reducing the amount of fine sediment entering the river. Closure of Forest Roads 5448, 5506-130, 5506 at the Oriental Creek crossing, and a portion of 5510 would be expected to slightly increase risk of instability as closed roads are less likely to receive proper maintenance and monitoring than open roads and are at greater risk of drainage problems going undetected; this should not be a concern on those portions of closed road that would be obliterated. The reopening of Forest Road 5507 as the major access in the Oriental Subwatershed would allow obliteration of 3.6 miles of Forest Road 5510 (which is located on steep and unstable terrain), reducing the amount of sediment from the transportation system in the long-term. Access to the upper portion of the Oriental Subwatershed would still be provided from the east side of Forest Road 5510, which would be closed, but not obliterated.

Road obliteration would also result in effects similar to those described under Alternative 2, except that 36.1 miles more obliteration and 6.4 miles of decommissioning would occur, causing a greater short-term erosion risk. Assuming that road widths including cut and fill slopes are 20 feet wide, approximately 119 acres of ground disturbance would occur with the potential to increase sediment levels by 28 percent during the first year and 14 percent during the second year. Operational controls identified in the mitigation section of Chapter 2 would lower this additional risk. In the long term, the additional obliteration would increase stability and decrease erosion more than under Alternative 2 because there would be more area treated with increases in vegetative cover, increased infiltration, and reduced runoff. After the third year, net annual sediment yield would decline to below pre-fire levels and would level off at 8 percent below pre-fire levels by 2004.

The inclusion of grass seeding in the proposed stabilization plantings of the two landslides and the subsoiling would speed up restoration of soil cover and establishment of stabilizing roots, while the trees (which would grow more slowly) would eventually add the stabilizing benefit of deeper roots. This would result in less erosion and quicker achievement of stability than under Alternatives 2 and 3. Seeding would not correct where the Texas Bar landslide has constricted the stream causing it to laterally erode

into the hillslope. A change in sediment yield at the watershed or analysis area scale would not be detectable due to the small area treated.

Fish and wildlife habitat improvements would result in the same effects described under Alternative 2 with the following exception: placement of large instream wood associated with rehabilitation of Round Meadow would increase fish habitat complexity and enhance streambank stability. Because the bole of the tree would be cut from root wad, instream wood might not remain in place, which could reduce or eliminate its effectiveness.

Recreation projects (not including the Roundaway 4-wheeler Trail) would result in the same effects described under Alternative 2. In addition, several campsites along Big Creek and within the adjacent meadow would be moved to less sensitive sites outside of the Riparian Habitat Conservation Area. Movement of these sites would stabilize streambanks, resulting in less sedimentation, and closure of vehicular access to the meadow would reduce soil displacement and erosion. The relocation of the sites would result in negligible adverse effects on erosion, stability, and sedimentation due to the gentle terrain, small amount of soil cleared of vegetation and proximity of the sites to the stream. Any effects that would occur would be offset by the benefits of removing the old sites.

Retention of the Roundaway 4-wheeler trail in its present location would maintain the slight increase of instability risk that exists where the trail crosses the Hidaway landslide. Erosion risk would be somewhat less from the Roundaway Trail as the new trail proposed in Alternative 2 would not be constructed and current 4-wheeler use would be eliminated.

No timber harvest would occur under this alternative (hazard trees and commercial-sized, thinned trees would remain on site), so sediment associated with construction of temporary roads would be eliminated.

Trees planted to restore forest cover would not involve the use of herbicides, so the reduction in vegetative cover would be limited to the scalp around each seedling. However, the competing vegetation would result in a lower success of establishing forest cover. Successful reforestation would be very patchy with high tree survival rates where there is little existing vegetation, and low or no survival in areas that have had good recovery of competing vegetation. Where forest cover is not restored, precipitation interception and water infiltration would be less than the pre-fire condition. As a result, risk of gully erosion and slope instability would be greater than under fully reforested conditions.

Disturbance related to construction of a fuel break within the Cable and Hidaway watersheds would not occur.

Cumulative Effects: Cumulative effects would be similar to those discussed under Alternative 2, with the following exceptions: no additional logging or associated temporary road construction would occur, the Roundaway 4-wheeler Trail would not be constructed, and an additional 42.5 miles of road would be obliterated. Total road obliteration and decommissioning would equal 48.9 miles. In the absence of unusual storms or floods, sediment yields would fall below pre-fire levels by 2003. The reduction in total road miles within the analysis area would lower overall sediment yields by approximately 8 percent below pre-fire levels. This alternative would have the greatest reduction in erosion and sediment rates over the long term.

ALTERNATIVE 5

Direct/Indirect Effects: Activities that would cause ground disturbance and increased sediment production in the short-term include: road repair and obliteration, removal of fish passage barriers, placement of large instream wood in Round Meadow, planting of trees and riparian vegetation, subsoiling, rehabilitation of recreation sites and trails, burning of felled hazard trees around Pearson summer homes, and salvage of dead trees (using helicopters only). Mitigation to limit the amount of increased sediment production is listed in Chapter 2. Several of the proposed activities would not cause ground disturbance or an increase in sediment yield: pre-commercial thinning, fencing, snag enhancement, designation of new C1 areas, and herbicide application. Activities which would reduce overall sediment yields in the long-term include: road repair and obliteration, fencing, revegetation of unstable slopes, planting of trees and riparian vegetation, subsoiling, and rehabilitation of recreation sites and trails.

Most projects would result in effects similar to those described in Alternative 4, except as follows. The Forest Road 5506 crossing of Oriental Creek would be repaired using an open arch or bridge. Because this road runs adjacent to the North Fork John Day River for three miles, road-associated sediment would continue to move into the river with little filtering. Many of the restoration projects (i.e. subsoiling) would include seed and mulch to further stabilize soils. The 900 acres of prescribed fire near the North Fork John Day River would not be conducted, which would maintain current vegetative soil cover.

Where the landslide diverted Texas Bar Creek into the silt toe of a hill slope, a new channel would be established using heavy equipment. Currently, spring high flow is eroding the silt hill slope along a 100-foot reach. Approximately 2,000 cubic feet of silt has eroded and additional soil erosion would occur until the capacity of the channel is large enough to pass high flow events. Establishing a new channel would cause a short-term increase in sediment yield when the creek is first diverted into the new channel, but would prevent additional erosion of the silt hill slope.

Erosion risk would be reduced, as total acres involved in harvest would be 3,810 acres less than proposed in Alternative 2. In addition, no ground-based harvest systems would be used, further reducing likelihood of exposed soils and subsequent risk of erosion, instability, or sedimentation. A 3% decrease in predicted sediment yield would occur during the first year after implementation. Doubling the buffer of Class 3 streams would provide additional area for filtering mobilized sediment before it reaches the stream. However, most mobilized sediment tends to be in concentrated flow, which is often channeled through buffers (e.g. via road drainage ditches).

Cumulative Effects: Cumulative effects would be similar to those discussed under Alternative 2, with the following exceptions: logging would be limited to 998 acres using only a helicopter yarding system (no temporary road construction), the Roundaway 4-wheeler Trail would not be constructed, and an additional 17.9 miles of road would be obliterated. Total road obliteration and decommissioning would equal 24.3 miles. In the absence of unusual storms or floods, sediment yields would fall below pre-fire levels by 2003. The reduction in total road miles within the analysis area would lower overall sediment yields by approximately 5 percent below pre-fire levels.

ALTERNATIVE 6

Direct/Indirect Effects: Activities are the same as those discussed under Alternative 2 with the following exceptions: a fuel break would not be constructed, there would be 1,643 fewer acres harvested, harvest would only use full suspension yarding systems (which would limit exposure of soil surfaces because no dragging of logs would occur), standing fuels up to 15” d.b.h. would be felled and either skidded to a pile or treated with a slashbuster on 371 acres, and standing fuels up to 15” d.b.h. would be felled and burned in place on 207 acres. This alternative would also limit the length of new temporary roads to 1,000 feet or less (resulting in 1.5 miles of new temporary road construction) and avoid stream crossings (though some would occur where no other access is available). This would reduce the interception of subsurface water flows, limit the area of disturbance, and keep sediment from draining directly into streams. Given the size of the trees involved (less than 20 inches in diameter), the majority of the ground-based salvage and thinning would likely involve the use of mechanized cut-to-length harvest systems which would expose less soil than tractor skidding. As a result of these differences, this alternative would create less erosion hazard and lower sediment yields compared to Alternative 2.

Cumulative Effects: The cumulative effect of all activities proposed with this alternative would be similar to Alternative 2 except that first year sediment yield increase would be slightly (1%) higher because of 33.1 added miles of road obliteration and decommissioning. By 2003, sediment yield would decline to below pre-fire levels, about 3% lower than Alternative 2.

Soil Productivity

Soil productivity as discussed here means an inherent productive capacity of a site to grow vegetation (all types) as modified by disturbance factors, whether man-caused or ‘natural’. This includes nutrient availability, water-holding capacity, etc. Effects of proposed activities on soil productivity were analyzed primarily at the site or activity unit scale.

ALTERNATIVE 1

Direct/Indirect Effects: Roads would remain in their current condition, so site productivity downslope of poorly drained roads would continue to slowly degrade as erosion gradually removes soils, which reduces the nutrient content and the nutrient holding capacity of the soil. There would also be some risk of a mass loss of productivity due to the potential for road failures during future storm events. Closed roads that are no longer needed for administrative use would not be returned to productivity. The two highly erodible slopes and two landslides would recover naturally, with the productive capability (including nutrient content and the nutrient holding capacity) of these areas continuing to decrease through erosion until they are stabilized.

Areas which were highly compacted by past tractor logging techniques would recover slowly as plants roots, burrowing animals, and physical processes gradually loosen soil over many decades. Productive potential of these areas would continue to be below pre-management levels. The existing Roundaway Trail would be kept at current standards, thereby maintaining a more unstable area in trail service. The trail surface and soil adjacent to this section of trail would continue to erode and it is possible that the landslide that exists downslope of the trail could eventually expand to involve the trail.

In general, plant growth in the Blue Mountains tends to be limited by low levels of nitrogen and sulfur in the soil. These nutrients also have low volatilization temperatures, so the high temperatures of the Tower Fire further reduced the amount of these nutrients. For example, measurements completed after the Entiat fire in 1970 showed that 97 percent of the nitrogen in the forest floor was lost, and that 33 percent of nitrogen in the upper layer of mineral soil (A1 horizon) was also volatilized (Grier 1975). These and other nutrients remain in lesser amounts within the dead trees that were not fully consumed in the fire. With this alternative, all of the estimated 25 to 35 tons of wood per acre would remain on the forest, so remaining nutrients and organic matter nutrients would be returned to the soil as trees fall and decay. Downed wood would also trap eroding soil and increase habitat for ants, other invertebrates, and small mammals that contribute to soil productivity (Tower Fire Ecosystem Analysis 1997). Nitrogen fixing plants (such as Ceanothus) that were stimulated by the fire would increase the amount of nitrogen within the soil. On the other hand, soil erosion related to the fire would transport adhering nutrients off-site, continuing to reduce the nutrient content and the nutrient holding capacity of the soil. Retention of all woody material would also contribute to increased fuel loads and continuity, which would add to fire intensity if wildfire occurs in the future.

ALTERNATIVES 2, 3, AND 6

Direct/Indirect Effects: Proposed road repair, particularly drainage improvements, would tend to protect productivity of sites adjacent to the road, because concentrated water flows would be less damaging during storms and other periods of heavy runoff. The road obliteration (which would involve subsoiling and movement of soil from fill slopes to cut slopes in an attempt to restore roads to their prior contour) would temporarily reduce vegetative growth for the first year or two after implementation. However, as the recontoured slope stabilizes, growing conditions for vegetation of all types would improve because plant roots would be able to penetrate the soil, water infiltration would increase, more natural routing of surface and/or subsurface water flows would occur, and related erosion or mass slope failures would decrease.

Planting of trees or other vegetation on the two highly erodible slopes and two landslides would stabilize these areas and reduce erosion, which would stop soil losses and reinitiate soil development.

Subsoiling would involve deep tillage of old tractor skid trails and landings. This would restore some productivity to severely compacted or puddled soils by increasing soil aeration and infiltration, decreasing soil strength, and helping restore favorable soil structure (Miles and Froehlich 1986).

Effects of prescribed fire for big game forage enhancement are dependent on the duration and intensity of the fire, as well as the condition of the soil including its moisture content. Burning of range sites using contemporary prescriptions and conditions (i.e. moisture levels and humidity readings, etc.) would generally be beneficial and release available nitrogen and other nutrients for a few years. Considerable nitrogen (in particular) is lost to volatilization; however, otherwise unavailable nitrogen is made available to the plants, invigorating growth. Nitrogen-fixing species are often stimulated into greater activity,

capturing additional atmospheric nitrogen. However, where herbicides are used to control competing ceanothus in reforestation units (alternatives 2 and 6), nitrogen recovery could actually be set back.

Construction of the Roundaway 4-Wheeler Trail would not greatly reduce production on most of the 6.5 miles of new trail (approximately 3.2 acres), since much of the proposed trailbed (5.75 miles) currently exists as closed roads or old skid trails. As a result, trail construction would not further reduce productivity of these areas. Removal of 4-wheeler traffic from the existing Roundaway Trail would eliminate damage to the narrow trail tread and adjacent soils, conserving productivity adjacent to the existing trail.

Salvage harvest and commercial thinning would affect the amount of on-site productivity by reducing tree boles an average of 19 tons per acre, though a minimum of 2 tons/acre and 3 tons/acre would be left in ponderosa pine and Douglas fir forest types, respectively, as recommended under the Tower Fire Ecosystem Analysis. While tree boles make up the majority of biomass in a tree (61%), boles contain relatively few of the tree's nutrients. Needles and branches (15% of a tree's biomass) contain the highest concentration of nutrients. Roots, which comprise 24% of a tree's biomass, contain the most nutrients in the tree (although the woody roots have very little). These relationships are summarized in Table 4.5 for nitrogen and phosphorus, and for a true fir stand and a ponderosa pine stand. A large amount of branches and needles were consumed by the fire. Those that were not consumed would be left on site, since no whole tree yarding would be allowed. Within the fuelbreak proposed under alternatives 2 and 3, woody material of all sizes would be piled and burned, which would change the distribution of nutrients and somewhat reduce total nutrient capital through volatilized nutrients. Harvest (including already completed past harvest and fire salvage), commercial thinning, burning to enhance wildlife habitat, and the fuelbreak (in alternatives 2 and 3 only) would affect 26 percent of the analysis area, so the amount of future downed wood would still be much greater across the landscape than in unburned stands. Alternative 6, which would not include the fuelbreak, would affect only 22 percent of the analysis area. Long-term fuel loads and continuity would decrease, which could protect soil productivity when fires occur in the future by reducing their intensity.

Table 4.4: Nutrient Distribution in Pine and True Fir Forests (Powers 1989).

COMPONENT	TRUE FIR STAND		PINE STAND	
	Nitrogen	Phosphorus	Nitrogen	Phosphorus
Trees: Above-ground	3%	1%	8%	1%
Trees: Roots	< 1%	< 1%	1%	< 1%
Understory	< 1%	< 1%	< 1%	< 1%
Forest Floor	13%	3%	14%	2%
Soil to 1-meter depth	83%	96%	77%	96%

Temporary roads, skid trails, and landings associated with salvage and commercial thinning, and heavy equipment used to treat slash within the fuel break would decrease productivity in highly variable amounts depending upon the degree of resulting soil disturbance and compaction. Harvest system design, operational control (e.g. maximizing the capability of equipment; working in proper weather conditions), and mitigation measures listed in Chapter 2 regarding harvest and use of heavy machinery would keep soil disturbance within the limits identified by the Umatilla Forest Plan standards and guidelines. Helicopter logging systems would be used in areas with a high erosion hazard**,** with ground-based systems employed on gentler slopes where mitigation measures would be most effective. Alternative 6 would have less soil disturbance and compaction than alternatives 2 and 3 because no fuel break would be constructed and harvest would only occur where full suspension of logs could be achieved and temporary roads would be limited in length. Monitoring of the Overlook and Lone salvage sales within the Tower Fire area and of logging operations elsewhere within the last three to five years has shown that

helicopter logging typically limits soil disturbance to about two to three percent of each harvested unit. Tractor operations (with mitigation such as designated skid trails, etc.) affected 10 to 14 percent of each unit, with cut-to-length harvest systems typically in the eight to ten percent range. Implementation of soil erosion best management practices, such as water barring and slash placement on skid trails and working when soils are not overly wet, would further limit soil erosion and keep soil on-site which would maintain productive capacity.

Cumulative Effects: Road improvements and obliteration, and slope stabilization plantings would reduce down slope nutrient loss, reductions in nutrient holding capacity, and physical changes which have occurred due to past management. In addition, ongoing and future use of the repaired roads would not create as much erosion or loss of productivity. Closed roads that previously provided little productive potential due to compaction or lack of topsoil would be restored through obliteration to a greater productivity potential than presently exists.

Proposed salvage and commercial thinning would further decrease woody material, which has already been decreased by the Tower Fire, prior harvest, and associated transportation. Within past regeneration-type harvest areas, harvesting methods removed all woody material, except for a prescribed number of seed trees (5 to 15 per acre), which affected approximately 12% of the fire area. Merchantable logs were sold and the remaining wood was burned in piles at the landings, volatilizing most of the nitrogen and sulfur. Woody debris in these past harvest units was further reduced where the Tower Fire burned at high or moderate intensities. Proposed salvage and commercial thinning would remove more wood. Improvement activities (e. g. road obliteration or subsoiling, erosion control, and soil stabilization) would serve to reduce the overall level of detrimental impacts remaining and increase the rate of recovery. Mitigation of proposed salvage and commercial thinning would include leaving down woody material at levels designed for the plant association and site to maintain short-term soil productivity. Also, many of the dead trees would remain because they are no longer merchantable. Still, removal of wood would also remove nutrients that could contribute to site productivity in the long-term. This could be offset by a reduction in future fire intensities (due to removal of future large fuels), which would assist in maintaining productivity. Commercial thinning would also allow reintroduction of low intensity prescribed fire in treated stands, which would actually release nutrients from dead material on the forest floor back into the soil instead of volatilizing them. Future harvest within the high to complete tree mortality areas would be confined to occasional salvage of trees that succumb to insects after the fire, because fire-killed trees are quickly losing value. Most units salvaged under this proposal would not likely be entered for many years until recovery of anticipated restocked stands might require pre-commercial thinning. Future thinning would add small branches and needles to the ground, making more nutrients available as they decompose. While prescribed fire would volatilize some level of nutrients, it would also make additional nutrients available for plant use.

ALTERNATIVE 4

Direct/Indirect/Cumulative Effects: Effects related to road repair, road obliteration, stabilization planting, and subsoiling would reflect those described under Alternative 2; however, this alternative would obliterate or decommission 42.5 more miles of road than alternatives 2 and 3. Therefore, improvements in soil productivity would be greater in Alternative 4. Herbicide application, construction of the Roundaway 4-Wheeler Trail, salvage, and the shaded fuel break would not occur, and hazard trees and commercial-sized trees in the proposed thinning units would remain on site so the effects would reflect those detailed under Alternative 1. Risk of high intensity future fires and related loss in soil productivity could advance a couple decades where hazard trees or thinned trees which are commercial-sized are felled and left in place.

ALTERNATIVE 5

Direct/Indirect/Cumulative Effects: Effects related to road repair, road obliteration, stabilization planting, and subsoiling would reflect those described under Alternative 2. However, this alternative would obliterate 17.9 more miles of road than alternatives 2 and 3 and mulch would be applied to further reduce soil erosion during the period that soil is disturbed. Harvest would only involve helicopter yarding systems, fewer acres would be harvested, and construction of the Roundaway 4-Wheeler Trail or the shaded fuel break would not occur. As a result, soil compaction and disturbance would be very limited.

Mulch and seeding would also be applied to some of the slope stabilization and subsoiling areas. Effects related to herbicide application would result in effects similar to those described under Alternative 2.

Fish & Aquatic Habitat

Data regarding fish distribution and aquatic habitat conditions before the fire were derived primarily from Forest Service stream surveys, which follow the Hankin and Reeves protocol. Oregon Department of Fish and Wildlife biologists also provided data, and Chris Torgerson of Oregon State University supplied additional information regarding fish distribution. Only one stream within the analysis area has been resurveyed for aquatic habitat condition since the fire: Winom Creek, which was resurveyed in 1999. Therefore, effects to fish and aquatic habitat were assessed by comparing pre-fire data to PACFISH objectives and information from the summaries for the John Day Sub-basin and Ecological Reporting Unit 6 - Blue Mountains (ERU 6), then estimating additional effects from the fire and the proposed activities. The effects of changes in habitat components on fish were estimated based on comparison with published scientific literature. The Tower EIS hydrology report provided much of the information relating estimated sediment yields and other stream characteristics to fish and fish habitat. Information was integrated, in part, through GIS mapping to portray spatial relationships between fish species, their habitat and conditions and activities that could affect fish and their habitat.

Numerical estimates of fish populations before the fire are not available. While it is well established that steelhead and chinook salmon runs in the Columbia Basin have declined substantially in recent years, numerical values specific to the Tower Fire area are not available. Even less is known about past population sizes of bull trout in this location. Sampling for fish began within the creeks affected by the Tower Fire in the early 1990s, and was not conducted on a yearly basis until after the fire occurred. Consequently, existing sampling data may be limited due to timing and extent of collection. For example, not finding a species currently in a stream from which they had been recorded historically (e.g. bull trout in Hidaway Creek) does not prove absence, because more intensive sampling could have a positive result. Therefore, assumptions were made based on the information available (e.g. after many years of not finding bull trout in Hidaway Creek, the Forest Service now assumes that it represents unoccupied bull trout habitat).

Much of the available habitat data (e.g. pool and riffle widths and lengths) are based upon visual estimates. These estimates have been calibrated from a measured subset, but the variability inherent to visual estimation is a source of potential error. Other components of the habitat data (e.g. pool frequency) depend upon the judgment of the surveyor, which may not be consistent between surveyors. This weakens comparisons to standards such as those in PACFISH or the Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin summary.

In this section, projects that would be expected to produce similar effects to aquatic habitat are discussed together as a group. Effects of the proposed projects on aquatic species and habitats would potentially accrue from alterations to several (sometimes interacting) habitat components, including:

1. changes in habitat complexity (large wood distribution, pool frequency, riparian vegetation, quality of spawning substrate)
2. changes in the amount of habitat available (barriers such as culverts)
3. changes in sediment flux (from management, from the fire, and from other natural causes)
4. changes in water temperature (from changes in the amount of shade, alteration of the streamflow regime, changes in the width/depth ratios)
5. chemical water quality (potential contamination from herbicides, fertilizer, mining; changes in nutrients)

Effects depend partly upon the location of the proposed activities relative to factors such as fire intensity, hill slope, proximity to streams, soil and base rock characteristics, and past management activities. Because many management activities are not readily quantifiable in terms meaningful to fish or aquatic habitat, they must sometimes be described in more qualitative terms or evaluated using surrogate values such as area treated per subwatershed. Potential effects to fish are discussed by subwatershed,

because for fish, the immediate effects of most management activities are probably felt at the stream reach or subwatershed level.

Habitat Complexity and Availability

ALTERNATIVE 1

Direct/Indirect Effects: This alternative would allow aquatic habitat to continue recovering from the fire at a natural rate. Tree mortality caused by the fire would increase recruitment of wood into the channels as trees fall over the next 20-40 years. This would increase aquatic habitat quality by increasing fish cover and habitat complexity. However, where large trees adjacent to streams are lacking as a result of the fire or past harvest, those stream reaches would be deficient in large wood for many decades to come. Barriers to fish passage posed by existing roads would not be removed, so no change is expected in the amount of stream habitat available under this alternative.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: The following proposed activities would have no effect on fish or aquatic habitat: snag enhancement, installation of interpretive and educational signs, improvement of road crossings on the Round Meadows and Cut Across trails, and noncommercial thinning.

Correcting fish passage barriers would open up 11.2 miles of stream that fish could then occupy (Table 4.6). Presence of juvenile chinook salmon a ½ mile upstream of a road crossing that had previously posed a barrier on Oriental Creek the year following the removal of the barrier shows promise that this habitat would be used. In some locations, the configuration of the road and surrounding topography may require use of step weirs to improve fish passage. While Beschta et al. (1995) argue that hard in-stream structures should be generally discouraged, they refer to structures intended to trap sediment or directly provide aquatic habitat. Construction of step weirs below currently inaccessible culverts would not be for those purposes.

Table 4.5: Approximate amounts of fish habitat upstream of passage barriers

Subwatershed (Stream)	Miles of Stream
33C (Upper South Fork Cable Creek[1])	2.5
35B (Texas Bar Creek[2])	4.2
95A (Winom Creek[1])	1.7
35E (Oriental Creek[3])	2.8

[1]Probably a barrier to juvenile fish only

[2]There are several barriers in this stream. Value is for total habitat above the most downstream barrier.

[3]Barrier has already been removed by a localized storm. Project would be to ensure that passage for fish is retained regardless of road management activities.

Placement of large wood in streams would improve fish habitat complexity in Cable Creek, Big Creek, and Hidaway Creek, which, according to stream survey records, all had low amounts of large wood before the fire as compared to ERU 6 means. Placement of large wood would provide cover, trap sediment, increase channel complexity, and improve width/depth ratios. This activity would require the use of heavy equipment within the Riparian Habitat Conservation Area and occasionally within the stream channel. This would compact soils and disturb the soil surface, which would increase erosion and related sediment. Salvage harvest and commercial thinning within a tree height of Class 4 streams could result in a reduction in the recruitment of large instream wood. However, since these streams would have a ‘no

harvest' buffer of at least 100 feet on each side, and since most trees in the fire area are not much taller than 100 feet, the reduction would be minor.

Riparian planting would accelerate production of stream shade, stabilize streambanks, produce future large instream wood, and add to overall habitat complexity along 22.8 miles of stream (Table 4.7).

Table 4.6: Proposed riparian planting.

Subwatershed & Stream	Miles of Proposed Riparian Planting
33A (Lower Cable Tributary)	0.7
33C (South Fork Cable Creek)	13.6
33D (Upper North Fork Cable Creek)	2.8
95A (Winom Creek)	1.7
96B (Upper Hidaway Creek)	4.0
Total	**22.8**

Fencing projects that exclude cattle from riparian areas would allow more rapid recovery of riparian vegetation (Case and Kauffman 1997), which would mean more rapid development of stream shade and root strength of stream bank vegetation, enhancing channel stability and complexity and also eventually development of large instream wood. Protection of streambank stability would promote a narrower, deeper cross-sectional channel profile and more undercut areas for fish cover.

Prescribed burning to enhance big game forage could reduce shade in the short-term where vegetation within the Riparian Habitat Conservation Area is burned. In the long-term, burning could speed development of high canopy cover over the stream and recruit large wood into the water, thereby increasing pool frequency.

Repair of the River Trail would probably not immediately alter fish habitat, but could alter habitat of other wetland species depending upon the method used. Hardening and raising ½ mile of tread could involve the use of a turnpike structure (a dike-like mound of compacted soil) with installation of culverts. A turnpike would reduce disturbance to wet soils, but at the same time could alter the drainage pattern of the wet area. This drainage pattern has already been altered by the presence of an old road (now the existing trail tread), which water is currently flowing across and down. While reducing trail-related disturbance of wet soils could reduce erosion and stream sedimentation, further restriction of water movement by the turnpike and culverts could produce channelization of flow, and might eventually alter the nature of the wetland. Moreover, the earth-moving necessary for construction of a turnpike and resulting channelization of flow could produce small amounts of sediment. Another method of repair would involve installation of a puncheon structure (a series of low bridge-like structures laid into position). This would reduce disturbance to wet soils while allowing nearly natural movement of water across the wet area, which would not result in the riparian effects associated with the turnpike method.

Shaded fuelbreak construction would occur primarily on ridge tops mostly distant from streams or riparian areas, so there should be no effect to large instream wood or pool frequency.

ALTERNATIVE 4

Direct/Indirect Effects: Correcting fish passage barriers would result in the same benefits to habitat complexity and availability as discussed under alternatives 2 and 3. In addition, Alternative 4 would install an open bottom arch or bridge on Forest Road 5506 at its crossing of Sheep Creek and on Forest Road 5507 at its crossing of Oriental Creek. The natural channel roughness and/or deeper water that would develop under an open arch or bridge would provide the best fish passage short of elimination of the road crossing.

Large wood placement would occur only in Round Meadow using horses or helicopter to minimize soil compaction. While this would eliminate soil compaction and sediment concerns, the addition of large wood would not be as effective because of constraints of those methods. In some cases, the tree may have to be severed from its root wad, which would not add as much complexity to aquatic habitat and would not anchor the large wood in place, which could also reduce its effectiveness. Large wood would not be placed in Big, Cable, or Hidaway creeks because review of existing conditions indicates that although large instream wood frequency was low before the fire in some reaches, it has increased since the fire and will continue to increase as fire-killed trees fall into these streams. The expense that would be required to add instream wood and additional risk that would be incurred by operating machinery in and near the stream channel is not justified when compared to the small benefit.

Salvage and commercial thinning would not occur under this alternative, so there would not be any reduction of future large instream wood recruitment on Class 4 streams.

Improvements to Big Creek Meadow Campground trailhead parking lot and (gravelling the parking lot, moving campsites away from the creek, blocking vehicular access to a nearby wet meadow) would protect and improve aquatic habitat in the adjacent section of Big Creek.

Riparian planting, fencing, prescribed burning, and repair of the River Trail would all result in the same effects as discussed under alternatives 2 and 3.

ALTERNATIVE 5

Direct/Indirect/Cumulative Effects: This alternative would have effects would be similar to those described under Alternative 4 with a few exceptions. An additional road crossing (Forest Road 5506 at Oriental Creek) would be repaired using an open arch or bridge, which would improve fish access to rearing habitat. No prescribed burning would occur. Salvage harvest would occur on 399 acres and commercial thinning on 598 acres, using a helicopter yarding system only. Associated reductions in future recruitment of large instream wood on Class 4 streams would be insignificant.

ALTERNATIVE 6

Direct/Indirect/Cumulative Effects: This alternative would result in effects similar to those described under Alternative 2. However, an open bottom arch or bridge would be installed on Forest Road 5506 at its crossings of Sheep Creek and Oriental Creek and Forest Road 5507 at its crossing of Oriental Creek, which would result in the effects discussed under Alternative 4. Improvements to Big Creek Campground would result in the effects discussed under Alternative 4 as well. Alternative 6 would involve 1,771 fewer acres of salvage harvest and 248 fewer acres of commercial thinning than Alternative 2, so associated reductions in future recruitment of large instream wood on Class 4 streams would be insignificant.

Large wood would not be placed in Big, Cable, or Hidaway creeks because review of existing conditions indicates that although large instream wood frequency was low in some reaches before the fire, it has increased since the fire and will continue to increase as fire-killed trees fall into streams. The cost of implementation, as well as the additional risk that would be incurred by operating machinery in and near the stream channel, is not justified under these conditions. Also, the shaded fuelbreak would not be constructed. Large wood would be placed in Round Meadows as described under Alternative 4.

Sediment and Substrate Embeddedness

ALTERNATIVE 1

Direct/Indirect Effects: As discussed under the Water and Soil section, the elevated sediment yields associated with the fire would gradually decrease. Existing roads and trails would contribute sediment in the future, as would the landslide on Texas Bar Creek (which constricted the stream causing erosion of the silt-textured stream bank). Grazing, which is planned to resume upon completion of this EIS, could also contribute sediment, particularly in preferred areas along streams.

Sediment yields would return to levels that existed before the fire by 2005 in all subwatersheds (see Figure 4.1 on page 4-19 and Table 4.8 on page 4-39). Since no mathematical relationship is available to relate sediment production to fish health or population strength, quantitative conclusions regarding effects

to fish cannot be made. In most cases, increased fine sediment production negatively impacts macro invertebrates, which provide food for fish, and can reduce fish habitat capacity and fry emergence by decreasing pool volume and filling spaces between larger substrate particles. This alternative would produce the least amount of short-term sediment-related impacts to fish habitat.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: The most likely effect on aquatic habitat resulting from proposed projects would be sediment production, which could affect aquatic habitat in several ways by:

1. filling spaces between larger substrate particles (embeddedness), which reduces escape and hiding cover for fish
2. increasing width/depth ratios and reducing pool volume, which can increase solar heating of water and also decrease fish hiding and escape cover and fish mobility
3. decreasing the quality of spawning substrate, which reduces reproductive success

Road repair/improvements (e.g. water barring, insloping, outsloping, installation of energy dissipaters, and hardening of ditch lines, road surfaces, and cut and fill slopes) would not likely deliver fine sediment to stream channels and would benefit aquatic habitat in the future by lessening sediment influx. However, widening Forest Road 5510 would produce larger exposures of bare soil in cut banks, road surfaces, and fill slopes, which would slightly increase the area susceptible to erosion and this increase would persist for the life of the road. Because this road crosses granitic soils and unconsolidated landslide deposits, the existing condition of raveling cutbanks and slumps could increase. Since Forest Road 5510 is located near the top of the ridge and widening is only proposed for five outside curves (not where the road crosses stream channels), a very small increase of sediment in fish habitat would initially occur, followed within a year by stabilization at a level slightly more than in the past.

Road obliteration would disturb soils and result in delivery of some fine sediment to stream channels, particularly where this activity would occur near streams. Generally, this sediment production should subside to background levels in three years following the project (refer to Water/Soil section). In the long term, road obliteration would reduce stream sedimentation, which would provide more hiding cover within the substrate and better spawning conditions (through reduced substrate embeddedness). Road densities within Riparian Habitat Conservation Areas would be reduced by the obliteration of 1.6 miles of road. The total road density (open and closed roads) for the analysis area would be reduced 0.44 miles per square mile.

Removal of fish passage barriers would introduce small amounts of sediment into the stream and mobilize some of the sediment already in the channel, which could reduce the quality of spawning, rearing, and over-wintering habitat. Removal of barriers would involve excavating problematic culverts and replacing them at a lower level in the stream channel or constructing one or more log or rock step weirs below the culvert outfall (treatment varies by specific location). Confining work to the period of low stream flows would limit the amount of sediment introduced or mobilized.

Salvage harvest of fire-killed or *Armillaria*-infected trees could affect aquatic habitat in the Lower Cable, Lower North Fork Cable, South Fork Cable, Upper North Fork Cable, North Fork John Day/Turner, North Fork John Day/Otter, North Fork John Day/Oriental, Winom, Big, and Upper Hidaway subwatersheds through effects on soils and hydrologic characteristics of the watershed. The largest contributor of erosion would be skid trails, landings, and construction of temporary roads across Class 4 streams to access harvest units. Effects to fish would depend upon stream channel and substrate conditions in those reaches. The minor reduction in recruitment of coarse wood into Class 4 streams could slightly reduce the amount of sediment storage and grade control provided by such wood.

Commercial thinning would be conducted in a location where the fire burned so lightly that soil surface litter was left mostly intact or has regenerated sufficiently that it can function well at trapping sediment. Since commercial thinning would occur outside Riparian Habitat Conservation Areas and because sediment is seldom transported over undisturbed forest soil far enough to cross Riparian Habitat Conservation Areas, risk of adverse indirect effects to aquatic habitat is low, but could vary with the harvest prescription, yarding methods, and Riparian Habitat Conservation Area dimensions (see Water

and Soil section). The greatest effect on fish or aquatic habitat would come from temporary roads or landings built to remove commercial-sized trees. This would be particularly true where temporary roads would enter Riparian Habitat Conservation Areas or cross streams, because they generally produce more sediment than other aspects of harvest and would produce sediment closer to streams.

Hazard tree removal would mostly be done from the roadside, so the amount of off-road travel by tractors or rubber-tired skidders would be much less than with other proposed harvest, with correspondingly lower sediment yield. Modeling predicted increased sediment yield from hazard tree removal in the South Fork Cable, North Fork John Day/Otter, North Fork John Day/Oriental, and Lower Hidaway subwatersheds. Most of the increase would occur in the first three years and would decrease to background levels by seven years after implementation.

Upland reforestation would produce some soil erosion and related sedimentation through "scalping"[11] to provide a small clearing to plant seedlings. This would expose soil on about 0.011 acres per acre planted, so risk of direct effects to fish or aquatic habitat from these scalps would be small. Some yield is expected to result from reforestation in all subwatersheds except Lower Hidaway Creek. Even with riparian planting of trees and shrubs, the small size of the scalp, usually about 18 inches square, and its infrequent occurrence (15 ft. spacing, or 0.011 acres per acre planted), allows little opportunity for delivery of additional sediment to stream channels. Elevated sediment yield is expected in only the first year after planting, and in the long-term, planting would benefit fisheries by stabilizing soils and reducing erosion through the more rapid recovery of forest vegetation. Herbicide use as planned in conjunction with upland reforestation should not promote additional sediment delivery to streams within the burn.

Fencing projects that restrict potential cattle access to riparian areas would reduce destabilization of stream banks and associated sediment yield.

Prescribed burning to enhance big game forage on 900 acres would vary in effect with proximity to streams. Risk of erosion and stream sedimentation could increase if destruction of ground cover and the soil binding abilities of plant roots occurs (Rieman and Clayton 1997; Rinne 1996; Gresswell 1999).

Recreation projects, including rehabilitation of 20 dispersed campsites, repair of Pearson Guard Station facilities, and repair of Oriental Campground facilities should produce a slight benefit to fish and aquatic habitat. While removal of large, charred logs, harvest of hazard trees, and repair of the Pearson water system would cause soil disturbance, site leveling and the addition of gravel should reduce erosion as compared to the present bare-ground conditions. Also, definition of campsite boundaries would reduce risk of soil damage and erosion by focusing camping activities and vehicle use within the delineated area.

Roundaway 4-wheeler Trail construction would have little effect on fish habitat. Only ¾ of a mile out of 6½ miles would require actual construction, and modeling predicts slightly increased sediment yield in the Lower North Fork Cable and Lower Hidaway subwatersheds. The greatest increase in sediment would be in the first year after construction, with a decline in sediment until the third year when a constant level would be reached.

Repair of the River Trail through installation of a puncheon-type structure (a series of low bridge-like structures laid into position) should allow nearly natural movement of water across the wet area and would reduce disturbance to wet soils. Since leaving the trail as is would continue to produce rutting and erosion, installation of a puncheon-type structure would reduce risk to aquatic habitat. This would probably not immediately alter fish habitat, but would benefit habitat of other species such as amphibians and a variety of invertebrates that typically inhabit wetlands.

Shaded fuelbreak construction would increase sedimentation risk due to the use of machines to pile fuels along up to 1 mile of the 6¼-mile-long fuelbreak. This project is located on a ridge, and soil movement would not likely reach streams.

ALTERNATIVE 4

Direct/Indirect Effects: Increases in short-term sediment yields would primarily result from 48.9 miles of road obliteration, since there would be no harvest under this alternative. However, chronic sediment

[11] This involves scraping surface debris, vegetation, and other organic matter out of an 18-inch square to a 2 to 4 inch depth.

yields from existing roads would decrease as a result of obliteration, so that sediment yields in all subwatersheds except Winom would level off below pre-fire levels (see Table 4.8). Road densities within Riparian Habitat Conservation Areas would be reduced by the obliteration of 23.2 miles of road. The total road density (open and closed roads) for the analysis area would be reduced 0.7 miles per square mile.

This alternative would include seeding of the landslides with grass, as well as planting with shrubs and trees, and seeding of subsoiled areas, which would further reduce sediment, though reductions would be very minor due to the small scale. Improvements to Big Creek Meadow Campground and Trailhead parking lot (gravelling the parking lot, moving campsites away from the creek, blocking vehicular access to a nearby wet meadow) would stabilize streambanks and reduce sediment production and transport. No new OHV trails would be constructed and the existing Roundaway Trail would be closed to 4-wheeler use, which should slightly reduce erosion. Activities such as snag longevity enhancement and construction of the fuel break would be accomplished by manual means only to eliminate soil compaction and sediment concerns.

Other projects identified for this alternative would result in the effects discussed under Alternative 2.

ALTERNATIVE 5

Direct/Indirect Effects: Effects would be similar to those described under Alternative 4. However, road obliteration would occur on 24 fewer miles of road, so short-term risk of increased sediment yield would be less, but reductions in chronic sediment yield would be less as well. Road densities within Riparian Habitat Conservation Areas would be reduced by the obliteration of 13.4 miles of road. The total road density (open and closed roads) for the analysis area would be reduced 0.57 miles per square mile. Alternative 5 also offers more soil protection than Alternative 4 through application of weed-free mulch where obliteration would occur, which would reduce erosion and potential sediment even more than if just seeded. Predicted chronic sediment yields in the Upper North Fork Cable, South Fork Cable, North Fork John Day/Oriental, Texas Bar, Upper Hidaway, and Lower Hidaway subwatersheds would level off below pre-fire levels (see Table 4.8). In these subwatersheds, implementation of Alternative 5 would not only facilitate hydrologic recovery of the stream channel, but would even improve aquatic habitat conditions compared to the pre-fire situation.

Another variation from Alternative 4 is that the stream channel would be rerouted where a landslide pushed Texas Bar Creek against a fine-textured bank. This would result in a short-term pulse of sediment, but the project would reduce long-term, chronic fine sediment. Conducting this work during the period of lowest flow should limit sediment movement and its effects on aquatic habitat.

Alternative 5 would not include prescribed fire, so sediment yields from this source would be slightly less in the North Fork John Day/Otter and North Fork John Day/Turner subwatersheds than under Alternative 4.

While Alternative 5 would allow salvage and commercial thinning (Alternative 4 would have none), harvest would occur using a helicopter logging system. Using helicopters would eliminate any temporary road construction or reopening of abandoned roads, which are the activities associated with harvest that would increase sediment most. Because of harvest, first year sediment yields would increase in the North Fork John Day/Turner, North Fork John Day/Otter, North Fork John Day/Oriental, and Winom subwatersheds. One subwatershed would experience a sediment yield increase over 10% above current trends—North Fork John Day/Oriental (14%); in this subwatershed, there is at least some risk of a small amount of degradation of aquatic habitat quality with additional stress to listed fish species. Sediment in the Lower North Fork Cable and Upper Hidaway subwatersheds immediately following implementation would exceed 2000 yields. This would be somewhat mitigated by increasing the no-harvest buffer along Class 3 streams from 150 feet to 300 feet, which would increase entrapment of soil particles before they reach streams.

Although Alternative 5 would apply herbicides together with tree planting, this would have no effect as discussed under Alternative 2.

ALTERNATIVE 6

Direct/Indirect Effects: Effects would be similar to those described under Alternative 2 with a few exceptions. Alternative 6 included 33.1 more total miles of road obliteration than Alternative 2, which would initially increase sediment delivery to streams. However, by the end of the second year post-implementation, the additional sediment initially produced by road obliteration would decline to background levels. In other words, the additional risk posed by road obliteration would last two years (primarily during the spring runoff period of March and April) after which sedimentation from roads would be less than if the roads had been left in place. This would occur in all subwatersheds except Winom. Road densities within Riparian Habitat Conservation Areas would be reduced by the obliteration of 17.8 miles of road. The total road density (open and closed roads) for the analysis area would be reduced 0.6 miles per square mile.

Harvest in Alternative 6 was greatly reduced, requiring full suspension of logs. Temporary roads would be restricted to lengths of less than 1,000 feet each. These design criteria would limit soil erosion and compaction, resulting in much lower sediment yields than what was described under Alternative 2.

Improvements to Big Creek Campground would result in the effects discussed under Alternative 4, and rerouting of the portion of Texas Bar Creek constricted by a recent landslide would result in the effects discussed under Alternative 5. The fuelbreak proposed in Alternative 2 would not be constructed.

Cumulative Effects for All Alternatives: The set of subwatersheds within the analysis area do not constitute a true watershed. That is; they do not form a single outlet drainage basin, and in fact, most of the flow exiting the area does not originate within the identified boundaries of the analysis area. Because of this, a summary of sediment yields over the entire analysis area could be misleading in terms of effects to fish, since effects would not be additive over the analysis area. Instead, cumulative effects of the proposed projects in conjunction with past, present, and reasonably foreseeable activities are presented by subwatershed, and compared to appropriate standards.

As Table 4.8 shows, some subwatersheds have experienced more past management activities or effects from the fire than others. Moreover, proposed actions are not distributed evenly across subwatersheds. The least managed subwatersheds generally contain a substantial proportion of wilderness or roadless area.

Table 4.7: Predicted cumulative sediment yields per subwatershed by alternative.

Subwatershed	Sediment Yields (% above background)							Steady State (% above background/year achieved)				
	Pre-fire past mgt. Effects	Recovery by 2000	After Implementation in 2001									
			Alternative					Alternative				
			1	2 & 3	4	5	6	1	2 & 3	4	5	6
Lower Cable (33A)	11.2	12.8	12.1	24.3	18.7	12.1	18.7	11.2/ 2005	11.8/ 2006	8.0/ 2004	11.2/ 2004	8.0/ 2004
Lower North Fork Cable (33B)	37.6	47.6	43.6	65.9	46.8	43.6	52.5	37.6/ 2004	38.7/ 2006	36.1/ 2004	37.6/ 2004	36.3/ 2006

Subwatershed	Sediment Yields (% above background)							Steady State (% above background/year achieved)				
	Pre-fire past mgt. Effects	Recovery by 2000	After Implementation in 2001									
			Alternative					Alternative				
			1	2 & 3	4	5	6	1	2 & 3	4	5	6
South Fork Cable (33C)	28.8	83.9	64.0	80.9	66.4	58.2	74.8	28.8/ 2005	20.3/ 2006	15.2/ 2005	19.0/ 2005	15.7/ 2006
Upper North Fork Cable (33D)	17.6	59.7	42.9	48.5	47.1	43.6	52.5	17.6/ 2004	17.8/ 2006	15.6/ 2004	17.3/ 2004	15.9/ 2006
Texas Bar (35B)	68.6	98.0	83.9	84.4	83.9	102.7	88.4	58.6/ 2005	57.9/ 2005	25.6/ 2005	49.8/ 2005	56.5/ 2005
NFJD/ Turner (35C)	32.1	37.7	35.5	45.5	36.0	35.8	39.2	32.1/ 2005	32.6/ 2006	31.8/ 2005	32.1/ 2004	31.9/ 2006
NFJD/ Otter (35D)	23.4	44.8	37.1	47.3	44.5	38.0	51.1	23.4/ 2005	23.9/ 2006	19.9/ 2005	23.4/ 2005	20.3/ 2006
NFJD/ Oriental (35E)	62.9	86.2	69.1	96.0	113.0	100.8	113.8	51.0/ 2005	45.4/ 2006	30.4/ 2005	36.6/ 2005	33.6/ 2006
Winom (95A)	8.9	54.7	37.2	49.9	37.2	37.2	49.5	8.9/ 2005	9.3/ 2006	8.9/ 2005	8.9/ 2005	9.3/ 2006
Big (95B)	8.3	13.3	11.3	13.7	13.5	11.3	16.0	8.3/ 2004	8.4/ 2006	7.2/ 2004	8.3/ 2004	7.4/ 2006
Lower Hidaway (96A)	32.3	32.3	32.3	34.4	35.6	35.6	35.1	32.3/ 1999	32.3/ 2004	30.8/ 2003	30.8/ 2003	32.2/ 2003
Upper Hidaway (96B)	20.6	27.3	24.6	27.7	32.0	32.0	33.6	20.6/ 2004	20.8/ 2006	17.1/ 2004	17.1/ 2004	17.2/ 2006

Table 4.8 uses the modeling done by van der Zweep and recalculated by Clifton and Groves to estimate magnitude of sediment resulting from projects. One widely used measure of sediment effects to aquatic habitat is cobble embeddedness. Use of cobble embeddedness for evaluation of aquatic habitat quality has serious drawbacks in that the precision possible from the usual (visual) methods of evaluating it is very low. Nevertheless, in many cases it is the only information available, particularly for habitat inventories done more than four or five years ago. It is used here with the precaution that it is really more a qualitative than quantitative parameter. Chapter 3 revealed that six reaches in four streams were

reported as embedded. Presumed effects to embeddedness of the projects associated with each alternative are displayed in Table 4.9 below. Streams with embedded reaches were South Fork Cable Creek, Camp Creek, and tributaries of Oriental Creek and Camp Creek.

Table 4.8: Summary of effects to cobble embeddedness and other sediment related habitat parameters.

Subwatersheds	Alternatives											
	1		2		3		4		5		6	
	LT	ST	LT	ST	LT	ST	LT	ST	LT	ST	LT	ST
33A Lower Cable Creek	0	0	-	-	-	-	+	-	0	0	+	-
33B Lower North Fork Cable Creek	0	0	-	-	-	-	+	-	0	0	+	-
33C South Fork Cable Creek	0	0	+	-	+	-	+	-	+	+	+	-
33D Upper North Fork Cable	0	0	-	-	-	-	+	-	+	-	+	-
35B Texas Bar Creek	0	0	+	-	+	-	0	-	+	-	+	-
35C NFJD-Turner	0	0	-	-	-	-	+	-	0	0	+	-
35D NFJD-Otter	0	0	+	-	+	-	+	-	0	-	+	-
35E Oriental Creek	0	0	+	-	+	-	+	-	+	-	+	-
95A Winom Creek	0	0	-	-	-	-	0	0	0	0	-	-
95B Big Creek	0	0	-	-	-	-	+	-	0	0	+	-
96A Lower Hidaway Creek	0	0	0	-	0	-	+	-	+	-	0	-
96B Upper Hidaway Creek	0	0	-	-	-	-	+	-	+	-	+	-

LT = Long Term Effect, ST = Short Term Effect

+ = Improve, - = Degrade, 0 = No Change (based on increase or decrease in estimated sediment yield, as compared to no action).

Streams with embedded reaches are highlighted in grey.

To the extent that embeddedness is linked to changes in sediment yield, all of the alternatives would have a short-term adverse effect on embeddedness in those watersheds. The scale of the sediment modeling does not permit distinction of effects among individual reaches, and it is possible that effects to individual embedded reaches may be none or profound, depending on location and type of management activity. In any case, the sediment modeling predicts a long-term beneficial effect in all but one of the subwatersheds (Subwatershed 35D, Alternative 5) with embedded reaches. The greater risk from sediment introduction by proposed activities probably lies in other subwatersheds that were not reported as having embedded reaches. In some of those, even the long-term trend would be to degrade aquatic habitat, particularly for Alternatives 2 and 3 (at least as measured by embeddedness).

Lower Cable Creek, Subwatershed 33A

Alternative 1 (no change in management activity) would allow recovery in the 14 percent of the subwatershed affected by the fire to continue at a natural rate. Most of this subwatershed is under ownership other than National Forest; the Forest Service manages only the headwaters of a few small tributary streams in this subwatershed (Map 1). Habitat conditions downstream in unburned Lower Cable Creek would be similar to those before the fire.

As indicated in the table above, proposed activities under **alternatives 2 and 3** would produce a second, much higher sediment peak than what occurred post-fire. This would slightly increase the potential for embeddedness, increased width/depth ratios, and decreased quality of spawning substrate.

Alternatives 4 and 6 would also cause a slight increase in sediment yield, but would accelerate recovery by one year and steady state yields would be lower by about 3 percent when compared with Alternative 1 (no action). Implementation of road decommissioning and obliteration would actually improve recovery in the long-term.

Alternative 5 would not increase sediment yield over the pre-implementation conditions and the steady state yield would be reached one year sooner than no action. Implementation of road decommissioning and obliteration would actually improve recovery in the long-term.

Lower North Fork Cable Creek, Subwatershed 33B

Alternative 1 (no change in management activity) would allow recovery in the 55 percent of the subwatershed affected by the fire to continue at a natural rate. About half of this subwatershed burned in the fire, then in 1997, a large debris flow in Cable Creek introduced substantial quantities of sediment into the stream channel, which may have altered substrate particle size distribution. These reaches have not been resurveyed, although similar debris flows in other areas of the inland Northwest have resulted in simplification of higher gradient channels, but increasing complexity of downstream lower gradient channels (Rieman et al. 1995). In most cases, this would translate to degradation of aquatic habitat in upper headwater reaches and improvement to lower gradient reaches.

Alternatives 2 and 3 would take two years longer to reach steady state than Alternative 1 (no action). Also, alternatives 2 and 3 would produce a second peak in sediment yield in the year of implementation; higher than current sediment yield, but not as high as yields immediately following the fire (which reached levels of approximately 94% above background). The steady state would remain slightly higher than if no activities took place. Substrate embeddedness and proportion of fine particles in the substrate would follow the sediment yield pattern (post-fire increase, short decrease with vegetation recovery, then increase in the year of project implementation). Embeddedness would be expected to decrease over time as the combined sediment yield from the fire and projects decreases, until they reach equilibrium at about the same level as before the fire, which was less than the Pacific Northwest Region's threshold of 35% embeddedness.

Alternative 4 would produce more sediment than no action and steady state would be achieved in the same year as no action, but the sediment yield at steady state would be lower. Although Alternative 4 would not cause increase in substrate embeddedness, it would slow the return to pre-fire levels.

Alternative 5 would not cause a change in sediment yields or in the timing that steady state is reached.

Alternative 6 would produce an initial sediment yield higher than no-action, but the final, steady state sediment yield would be lower though it would take two additional years to achieve.

South Fork Cable Creek, Subwatershed 33C

Alternative 1 (no change in management activity) would allow recovery in the 97 percent of the subwatershed affected by the fire to continue at a natural rate. About 67 percent of the area burned experienced moderate to severe severities. In addition, Reach 1 of the stream was above the threshold level (35%) used by the Pacific Northwest Region for embeddedness.

Sediment modeling indicates that **alternatives 2 and 3** would produce an increase in sediment yield following implementation, but would result in a notable decrease in steady state yields (although steady state would take an additional year to achieve). This is primarily because road obliteration projects would reduce the long-term effects of roads. Reduction of substrate embeddedness would initially be slowed, but would ultimately reach a lower level than if no activities took place. In the first two years post-fire, sediment yields in South Fork Cable Creek were high and the fish survived or recolonized and increased in numbers, which implies that the risk of increased sedimentation is small and that long term benefits would outweigh the delay in reaching the steady state.

Implementation of **Alternative 4** would produce only slightly more sediment than no action in the year of implementation and an even greater reduction in steady state yields than alternatives 2 and 3 without the one-year delay. Although project implementation could cause an increase in substrate embeddedness in the year of implementation, it would speed the decrease thereafter. Embeddedness would eventually stabilize, at a level below pre-fire conditions.

According to the modeling, **Alternative 5** would actually decrease sediment yield the year of implementation. This seems unlikely, since in all other cases involving road obliteration, sediment yield increased in the first two years post-implementation, and did not drop to levels less than no-action until the third year. This is probably an artifact of the model or an error in its implementation. Alternative 5 would also notably decrease the steady state yield without any delay in achievement.

Alternative 6 would increase sediment the year of implementation but would achieve a steady state yield similar to Alternative 4's with a one-year delay in achievement.

In addition to those proposed projects modeled for sediment yield, other management activities proposed for this subwatershed (depending on the alternative) include: snag creation, herbicide treatment of reforestation areas, fish passage improvement, seeding for big-game forage enhancement, dispersed campsite improvement, meadow and riparian fencing and riparian planting. Only the fish passage improvement should produce any additional stream sedimentation, which would be very brief (a few hours) and immediately benefit fish by opening access to additional habitat for steelhead and juvenile redband trout.

Upper North Fork Cable Creek, Subwatershed 33D

Alternative 1 (no change in management activity) would allow recovery of the subwatershed to continue at a natural rate. The entire subwatershed burned in the fire, about half of which experienced moderate to severe burn intensities.

Alternatives 2 and 3 would produce an increase in sediment yield the year of implementation and would delay achievement of the steady state by 2 years, although steady state yields would then be similar to yields associated with no action.

Alternative 4 would also increase sediment yields the year of implementation, but would achieve steady state at the same time as if no activities occurred, with a slightly reduced steady state sediment yield. Most of the sediment produced would be associated with road obliteration.

Alternative 5 would produce only slightly more sediment in the year of implementation than if no activities occurred. Steady state sediment yield would not be delayed and would approximate yields that could be expected if no activities had been implemented.

Road obliteration under **Alternative 6** would contribute to the highest initial sediment yields in this subwatershed, but reduced steady state sediment yields similar to Alternative 4 (although steady state would take two additional years to achieve).

In addition to those proposed projects modeled for sediment yield, other management activities proposed for this subwatershed (depending on the alternative) include: herbicide treatment of reforestation areas, addition of large woody debris to reaches deficient in wood, seeding for big-game forage enhancement, dispersed campsite improvement. These projects would all either benefit or have no effect on fish and aquatic habitat.

Texas Bar Creek, Subwatershed 35B

Alternative 1 (no change in management activity) would allow recovery in the 78 percent of the subwatershed affected by the fire to continue at a natural rate. Steady state sediment yield would actually fall below pre-fire sediment yields due to road obliteration work done after the Tower Fire and before the 1998 court injunction halting all ground disturbing activities in the area.

Because a large proportion of the subwatershed burned in the fire, aquatic habitat may not return to pre-fire conditions until stream bank vegetation has substantially recovered and a more complete canopy cover develops, perhaps 10 to 20 years into the future or longer.

Alternatives 2 and 3 would produce a slight increase in sediment yield during the first year after implementation, but a slight decrease in the steady state sediment yield with no delay in achievement. Note however, that the estimated steady state value is relatively high in this subwatershed. This is related, at least partly, to the remaining effects of fairly intense past management.

Alternative 4 would result in the same amount of sediment yield the year of implementation as would occur if no activities were implemented. Alternative 4 would implement the most road obliteration in this subwatershed, producing the lowest steady-state sediment yield, roughly half that of the other alternatives, including the no-action alternative.

In this subwatershed, **Alternative 5** would produce the greatest initial sediment yield, and is the only alternative producing a second peak in sediment. However, because it includes a substantial amount of road obliteration, the steady state sediment yield would be lower than all but Alternative 4.

Alternative 6 would increase sediment yield the year of implementation and reduce the steady state sediment yield without a delay in achievement.

In this subwatershed, the proposed activity that would produce the greatest effect to fish and aquatic habitat would be removal of the fish passage barrier at the mouth of the stream. This would make several miles of relatively cooler water habitat more readily available to juvenile chinook salmon and steelhead from the North Fork of the John Day River. Other projects i.e. fencing, planting of the landslide, would have small effects which would be mostly beneficial.

Foreseeable future projects include additional timber harvest, but no locations or amount has been proposed to date. If implemented, additional timber harvest here would almost certainly increase sediment yield, the amount depending upon the extent of the harvest and yarding method. This could mean that the calculated reductions in steady state sediment yield for the action alternatives might not be realized. However, the part of these projects responsible for reductions in sediment yield (primarily road obliteration) would still affect a lower total sediment delivery to streams than if they were not implemented.

North Fork John Day/Turner, Subwatershed 35C

Alternative 1 (no change in management activity) would allow recovery in the 37 percent of the subwatershed affected by the fire to continue at mostly natural rates. This subwatershed consists of a small segment of the North Fork of the John Day River (which bisects the subwatershed) and several small tributary streams; none or which are known to be fish bearing. This is not a true watershed in that most of the flow exiting the area does not originate within the identified boundaries. Moreover, activities and events in the subwatershed on the south side of the river are mostly unaffected by and do not affect streams on the north side of the river (and vice versa). The fire occurred primarily on the north side of the river. That part of the subwatershed on the north side of the river is composed of several separate, very small drainages, which connect to the North Fork John Day River, but not to each other.

Alternatives 2 and 3 would increase sediment the year of implementation, as well as cause a second peak in sediment yields since the fire. Achievement of steady state sediment yields would be delayed by one year and yields would be slightly higher than if no activity occurred. The additional sediment delivery and prolongation of hydrologic recovery in the subwatershed would affect mainly the small tributary streams, and only on the north side of the river, although there should be a smaller (perhaps undetectable) effect on the North Fork of the John Day River. Lacking information on the substrate quality of the North Fork of the John Day River here and in near downstream reaches, judgment of cumulative effects is highly uncertain, but there is at least some risk of a small amount of degradation of aquatic habitat quality with attendant additional stress to listed fish species.

Alternative 4 would cause a slight increase in sediment yield the year of implementation than if no activity occurred, due to a small amount of road obliteration, and the steady state sediment yield would be slightly less.

Alternative 5 would generate a small amount of sediment associated with harvest and reforestation the year of implementation. However, no road obliteration would occur under this alternative. Steady state would equal the yield that would occur if no activity took place, but achievement would be accelerated by one year.

Implementation of **Alternative 6** would increase sediment yield the year of implementation, as well as cause a small, second peak in sediment yields since the fire. The small amount of road obliteration would result in a slight decrease in steady state sediment yields, although achievement would be delayed by one year.

North Fork John Day/Otter subwatershed 35D

Alternative 1 (no change in management activity) would allow recovery in the 46 percent of the subwatershed affected by the fire to continue at mostly natural rates. This subwatershed consists of a small segment of the North Fork of the John Day River (which bisects the subwatershed) and several small tributary streams; none or which are known to be fish bearing. This is not a true watershed in that most of the flow exiting the area does not originate within the identified boundaries. Moreover, activities and events in the subwatershed on the south side of the river are mostly unaffected by and do not affect streams on the north side of the river (and vice versa). The fire occurred primarily on the north side of the river. That part of the subwatershed on the north side of the river is composed of several separate, very small drainages, which connect to the North Fork John Day River, but not to each other.

Alternatives 2 and 3 would increase sediment the year of implementation, as well as cause a second peak in sediment yields since the fire. Achievement of steady state sediment yields would be delayed by one year and yields would be slightly higher than if no activity occurred. The additional sediment delivery and prolongation of hydrologic recovery in the subwatershed would affect mainly the small tributary streams, and only on the north side of the river, although there should be a smaller (perhaps undetectable) effect on the North Fork John Day River. Lacking information on the substrate quality of the North Fork of the John Day River here and in near downstream reaches, judgment of cumulative effects is highly uncertain, but there is at least some risk of a small amount of degradation of aquatic habitat quality.

Alternative 4 would cause an increase in sediment yield the year of implementation, but steady state sediment yield would be less than if no activity were to occur (even less than pre-fire levels).

Alternative 5 would only slightly increase sediment yield in the year of implementation and steady state yield would be the same as it would have been with no activity.

Implementation of **Alternative 6** would increase sediment yield the year of implementation, as well as cause a second peak in sediment yields since the fire (even higher than Alternative 2). Achievement of the steady state sediment yield would be delayed by one year, however, it would produce less sediment in the long-term than if no activity were to occur.

In addition to those proposed projects modeled for sediment yield, other management activities proposed for this subwatershed (varying by alternative) include: herbicide treatment of reforestation areas, snag creation, precommercial thinning, underburning for big-game forage enhancement, and dispersed campsite improvement. These projects would all either benefit or have no effect on fish and aquatic habitat.

North Fork John Day/Oriental subwatershed 35E

Alternative 1 (no change in management activity) would allow recovery in the 68 percent of the subwatershed affected by the fire to continue at mostly natural rates. This subwatershed consists of a small segment of the North Fork of the John Day River (which bisects the subwatershed) and several small tributary streams; none or which are known to be fish bearing. This is not a true watershed in that most of the flow exiting the area does not originate within the identified boundaries. In spring of 1998 a strong localized storm, together with conditions created by the Tower Fire, caused a severe flood in the upper Oriental Creek drainage.

Alternatives 2 and 3 would increase sediment the year of implementation, as well as cause a second peak in sediment yields since the fire. Achievement of steady state sediment yields would be delayed by one year, although steady state yields would be less than what would occur under no action—even lower than pre-fire levels. This reduction in long-term sediment would result from road obliteration. This subwatershed also has a high total road density (3.4 miles per square mile) and soils are granitic, which

is more erodible and produces coarser “fine” sediment that does not flush through the stream system as readily as silt. This could be problematic for salmonid spawning, incubation, and rearing.

It is important to note, that estimated sediment yields in Oriental Creek were much higher in the first two years post-fire than predicted yields related to implementation of these alternatives. The fact that the fish survived or recolonized the stream twice (after the fire, then after the flood) and increased in numbers implies that the risk is small and that long-term benefits from projects associated with these alternatives would outweigh higher short-term sediment yields and a delay in reaching steady state.

Alternative 4 would almost double sediment yield in the year of implementation when compared to no action and cause a second peak in sediment since the fire. However, the steady state sediment yield would drop about 20 percent more than if no activities occurred. The majority of the sediment produced under this alternative would result from road obliteration activities, which yield sediment only in the first two years. As discussed under alternatives 2 and 3, fish could probably tolerate the additional sediment for a short period and would benefit long-term sediment reductions.

Alternative 5 would also result in a substantially higher sediment yield than if no activities occurred, however, steady state yields would be much lower and there would not be a delay in achievement. As in previous alternatives, fish could probably tolerate the additional sediment for a short period and would benefit in the long-term from implementation of Alternative 5.

Alternative 6 would produce more sediment than the other alternatives initially and steady state yields would take a year longer to achieve, however, long-term yield reductions would be much greater than if no activity occurred. Only Alternative 4 would produce a bigger long-term reduction. As in previous alternatives, fish could probably tolerate the additional sediment for a short period and would benefit in the long-term from implementation of Alternative 6.

Winom Creek, Subwatershed 95A

Alternative 1 (no change in management activity) would allow recovery within the subwatershed to continue at mostly natural rates. This entire subwatershed was burned in the fire, and 42 percent experienced moderate to high burn severities. Since most of the subwatershed burned in the fire, aquatic habitat may not return to pre-fire conditions until stream bank vegetation has substantially recovered and a more complete canopy cover develops, perhaps 10 to 20 years into the future, or longer. Most of this subwatershed is part of the North Fork John Day Wilderness.

Alternatives 2 and 3 would increase sediment in the year of implementation when compared to no activity. These alternatives would also cause a small increase in steady state sediment yield as compared to no activity. Achievement of steady state sediment yields would be also delayed by one year and would remain slightly higher than no action. This could prolong risk to aquatic habitat for another year or longer, depending on the length of time it takes for the additional sediment to either work through the system or become stabilized.

Alternatives 4 and 5 would not increase sediment yield immediately after implementation, nor would they affect amount or timing of achievement of the steady state yield.

In addition to those proposed projects modeled for sediment yield by van der Zweep, other management activities proposed for this subwatershed (depending on the alternative) include: herbicide treatment of reforestation areas, fish passage improvement, and riparian planting.

Alternative 6 would result in almost identical effects on short- and long-term sediment yields as alternatives 2 and 3.

Big Creek, Subwatershed 95B

Alternative 1 (no change in management activity) would allow recovery of the 53 percent of the subwatershed that burned in the fire to continue at mostly natural rates. Of the burned portion, 84 percent experienced low fire severity. Most of this subwatershed is part of the North Fork John Day Wilderness.

Alternatives 2 and 3 would cause a small increase in sediment in the year of implementation due to harvest, but little change in the steady state sediment yield, although achievement of steady state would be delayed for two years.

Alternative 4 would cause a small increase in sediment in the year of implementation, primarily due to road obliteration. A lower steady state yield would be achieved than if no action were taken to a level below the pre-fire condition, again due to road obliteration. Improvements to Big Creek Meadow Campground and trailhead parking lot (graveling the parking lot, moving campsites away from the creek, blocking vehicular access to a nearby wet meadow) would protect and improve aquatic habitat in a section of the creek under this alternative.

Alternative 5 would not include road obliteration or timber harvest, so effects on sediment would be identical to Alternative 1. Improvements at Big Creek Meadow trailhead and campground would have localized benefits in the affected portion of Big Creek.

Alternative 6 would include both timber harvest and road obliteration, resulting in an increase in sediment yield the year of implementation. Because of the road obliteration, sediment yield would ultimately fall to levels well below the pre-fire conditions, but achievement of steady state would be delayed two years. The same improvements to the Big Creek Campground and Trailhead would be implemented under Alternative 6.

Lower Hidaway Creek, Subwatershed 96A

Alternative 1 (no change in management activity) would allow recovery of the subwatershed to continue at mostly natural rates. Only 39 acres were burned, so sediment yields have already recovered. However, this subwatershed has had extensive timber harvest in the past and is still extensively roaded. These roads are the main producers of sediment in the subwatershed, and would likely continue to be for the foreseeable future. Effects from upstream (Subwatershed 96B) would probably influence streams in this subwatershed more than recovery from the fire.

Alternatives 2 and 3 would cause a small increase in sediment in the year of implementation due to harvest and construction of the Roundaway 4-wheeler Trail. Sediment yield would then return to pre-fire levels by 2004.

Alternatives 4 and 5 would increase sediment in the year of implementation more than alternatives 2 and 3 due to associated road obliteration. However, no 4-wheeler trail would be constructed. Steady state sediment yield would drop below pre-fire levels by 2003. As discussed previously, fish could probably tolerate the small amount of additional sediment for a short period and would benefit long term from implementation of alternatives 4 or 5 in this subwatershed.

Alternative 6 would include road obliteration, a small amount of harvest, and the Roundaway 4-wheeler trail construction, which would increase sediment yields slightly in the year of implementation. The new trail construction would create a new permanent source of sediment, but the road obliteration would remove a former source of sediment, so that on balance, there would be less sediment produced over the long-term in this subwatershed than before the fire. As discussed previously, fish could probably tolerate the additional sediment for a short period and would benefit long term from the slight sediment reduction resulting from the road obliteration.

Upper Hidaway Creek subwatershed 96B

Alternative 1 (no change in management activity) would allow recovery of the 69 percent of the subwatershed affected by the fire to continue at a natural rate. Though a large proportion of the subwatershed burned in the fire, most acres experienced low fire severity (79 percent of the burned area). That portion of the aquatic habitat that burned at medium or high intensity may not return to pre-fire conditions until stream bank vegetation has substantially recovered and a more complete canopy cover develops, perhaps 10 to 20 years into the future or longer. Before the fire, all three of the tributary streams had fine sediment (sand) as the dominant substrate particle size and one tributary had passes the threshold for embeddedness (greater than 35 percent embedded). More than half of this subwatershed is a designated roadless area and has had very little active management in the past. The portion outside the roadless area has had timber harvest in the past and still has many roads. These roads are the main producers of sediment in the subwatershed, and will likely continue to be for the foreseeable future. In 1997, a strong storm, localized over a tributary in the upper part of the subwatershed eroded a large amount of sediment, which as it moved downstream, changed aquatic habitat conditions in the creek. Together these circumstances have probably created a stream condition that could be vulnerable to additional sediment.

Alternatives 2 and 3 would slightly increase sediment in the year of implementation, but would return to almost the same steady state as would occur with no activity. The steady state would be delayed by two years. All of the predicted increase in sediment yield comes from timber harvest and associated road building.

While **alternatives 4 and 5** would not involve harvest, their road obliteration would cause an increase in sediment yield the year of implementation. However, sediment yield at the steady state would also drop below pre-fire levels due to the obliteration. As discussed previously, fish could probably tolerate the additional sediment for a short period and would benefit in the long-term from implementation of alternatives 4 or 5 in this subwatershed.

Alternative 6 would include both harvest and road obliteration. This would result in the largest initial increase in sediment yield of all the alternatives, but would drop to a steady state yield almost identical to alternatives 4 and 5, though achievement of this would be delayed by two years. As discussed previously, fish could probably tolerate the small amount of additional sediment for a short period and would benefit long term from implementation of Alternative 6 in this subwatershed.

In addition to those proposed projects modeled for sediment yield, other management activities proposed for this subwatershed (varying by alternative) include: seeding for forage, construction of a shaded fuel break, landslide planting, herbicide application. These projects would all either benefit or have no effect on fish and aquatic habitat.

Water Temperature

ALTERNATIVE 1

Direct/Indirect Effects: The Tower Fire destroyed streamside vegetation along approximately 141 miles of stream. Where fire destroyed riparian vegetation, water temperatures could remain higher until a more complete canopy cover develops, perhaps 10 to 20 years into the future, perhaps longer. Where riparian shrubs (e.g. dogwood, alder, willow) had declined before the fire due to shading and browsing, there could be a localized loss of recovery due to a lack of seed sources and limited protection from further browsing.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: Road obliteration would at least partially restore natural ground water movement by eliminating road surfaces and ditches that otherwise function as stream channel extensions by converting ground water to surface flow and routing surface flow to existing stream channels. By keeping subsurface flow below ground, stream water temperatures would remain lower, so this activity would produce a dual benefit to aquatic habitat. These effects should be most pronounced in small headwater streams (Brown and Krygier 1970; Meehan 1970). Also, as discussed under the sediment section, the

reduction in sedimentation would improve water temperatures through lower width to depth ratios and increased pool depths.

Fencing to exclude ungulates from riparian areas would allow more rapid recovery of riparian vegetation (Case and Kauffman 1997), which would mean more rapid development of stream shade. Planting riparian trees and shrubs would increase streamside shade and accelerate development of overstory canopy shade, particularly where protected by fences.

Prescribed burning to enhance big game forage could increase water temperatures through a reduction of streamside shade (Amaranthus et al.1989). Such reductions have a low likelihood of occurring because riparian areas typically contain more moisture in the vegetation and dead organic matter than surrounding areas. Where the fire thins trees within the riparian zone, the reduction in vegetative competition could accelerate development of high canopy cover (and, thus, shade) in the long-term. In some areas, ground cover and the soil binding abilities of plant roots could be destroyed, which would increase risk of erosion and stream sedimentation (Rinne, 1996; Rieman and Clayton, 1997), indirectly increasing water temperatures through widening and shallowing of streams. Still, prescribed fire outside the riparian zone should have practically no effect to fish or aquatic habitat.

Commercial and noncommercial thinning would remove trees with live foliage; however, since harvest would avoid Riparian Habitat Conservation Areas, there would be no effect on stream shade or water temperature.

Herbicides (implemented only under Alternative 2) would not be applied any closer than 100 feet from flowing water (mitigation states that herbicide would not be applied within Riparian Habitat Conservation Areas), so there would be no effect on development of tree or shrub canopy over streams and, consequently, no direct effect on water temperature.

Construction of the shaded fuelbreak would occur primarily on ridge tops away from streams or riparian areas, so there should be no effect to stream shade or water temperature.

ALTERNATIVE 4

Direct/Indirect Effects: This alternative would include the road obliteration, fencing, riparian planting, prescribed burning for big game forage enhancement discussed under alternatives 2 and 3. However, the amount of road obliteration would be considerably increased, so risk of short-term increases in sediment-related effects on temperature would be greater, but the long-term benefits to temperature of maintaining subsurface water flows and reducing chronic sediment would also be greater. In addition, Alternative 4 would implement improvements at Big Creek Meadow Campground and Trailhead that would protect streambank stability and encourage development of stream shade.

ALTERNATIVE 5

Direct/Indirect Effects: This alternative would include the road obliteration, fencing, riparian planting, commercial and noncommercial thinning, and herbicide application discussed under alternatives 2 and 3. However, the amount of road obliteration would be considerably increased, so risk of short-term increases in sediment-related effects on temperature would be greater, but the long-term benefits to temperature of maintaining subsurface water flows and reducing chronic sediment would also be greater. Alternative 5 would not implement prescribed burning for big game forage enhancement, so loss of shade and increases in sediment-related temperature increases would be less. In addition, improvements would be made at Big Creek Meadow Campground and Trailhead that would protect streambank stability and encourage development of stream shade.

ALTERNATIVE 6

Direct/Indirect Effects: This alternative would include all the activities listed for Alternative 2. Road obliteration, however, would be much greater under Alternative 6. As a result, risk of short-term increases in sediment-related effects on temperature would be greater, but the long-term benefits to temperature of maintaining subsurface water flows and reducing chronic sediment would also be greater. In addition, Alternative 6 would also implement improvement at Big Creek Meadow Campground and Trailhead that would protect streambank stability and encourage development of stream shade.

Cumulative Effects for Alternatives 2 through 6: Riparian planting would increase shade along 17.1 miles of Cable Creek and its tributaries and 4 miles of upper Hidaway Creek, both of which were listed by the State of Oregon as water quality limited for water temperature. This would help reduce cumulative losses of stream shade due to past management activities and the fire, which would maintain cooler water temperatures. When coupled with the large amounts of road obliteration (which would maintain subsurface flows and reduce sediment-related increases in temperature) proposed in alternative 4, 5, and 6, the cumulative benefits to these streams would be even greater.

Livestock grazing could potentially contribute to cumulative effects through reduction in the amount of riparian vegetation, with accompanying reductions in stream shade and bank stability, as well as direct break down of stream banks through trampling. This could contribute to sedimentation of pools, substrate, and spawning gravel. Destabilization of streambanks and increased sediment could also make the cross-sectional profile of the stream wider and shallower, increasing temperature and decreasing escape and hiding cover. No changes in grazing management are proposed in the Tower Fire projects, but continuation of ongoing management practices would contribute to cumulative effects.

Water Chemistry

ALTERNATIVE 1

Direct/Indirect Effects: Streams with substantial lengths in areas burned with high severity often experience alterations in water chemistry, including increased amounts of some nutrients (Rieman and Clayton 1997; Brown 1989; Minshall, Brock and Varley 1989). The combined effects of increased sunlight and nutrients should actually enhance aquatic productivity over pre-fire conditions (Minshall and Brock 1991), although it should also alter the species balance (Minshall et al. 1989). Diatoms and moss should decrease and algae are expected to increase. Observations of streams affected by the Tower Fire appear to substantiate these expectations. Changes in species composition of aquatic invertebrate communities follow the floral changes. Density of “grazer” invertebrates usually increases, while “shredder” invertebrates become almost entirely absent in the first years following fire.

ALTERNATIVES 2 AND 6

Direct/Indirect Effects: Prescribed burning for forage enhancement could introduce ash into streams and change nutrient balances. Nutrient enrichment from introduction of small amounts of ash into the stream could increase productivity of the stream, especially where light has increased as a result vegetation mortality (Minshall et al. 1989; Minshall and Brock 1991). Since the proposed prescribed burning could include hand ignition inside Riparian Habitat Conservation Areas, there would also be a small risk of contamination from drip torch fuel, which would be toxic to fish.

Reconstruction of the Pearson Guard Station outhouse could reduce risk of water contamination, because the old, unlined pit would be replace with a sealed vault.

Where herbicide application (triclopyr, glyphosate, or hexazinone) would be used to control vegetation that would compete with planted seedlings, fish habitat could be affected in several ways, including direct toxic effects to fish, indirect effects leading to loss of aquatic vegetation, and toxic effects to invertebrates. However, because herbicides would not be used within Riparian Habitat Conservation Areas, the only immediate risk to fish or other aquatic life would come from a spill (e.g. an applicator falling while crossing a stream) or applicator noncompliance with Forest Service specified procedures.

Table 4.9 indicates maximum herbicide application rates; in most cases, actual quantities of herbicides applied to any given acre would be less. Table 4.11 on page XXX summarizes some characteristics of the herbicides proposed for use. Excluding herbicide use within Riparian Habitat Conservation Areas would mitigate the risk of direct contact with water. This avoidance and other application procedures discussed in the mitigation section of Chapter 2 as well as Appendix C would probably not result in detectable amounts of herbicides in surface waters.

Table 4.9: **Maximum application rates of proposed herbicides[1].**

Chemical	Active Ingredient kg/hectare (lbs/acre)		
	Contact Application Rate[2]	Equivalent Project Application Rate[3]	Typical Forest Application Rates[4]
Hexazinone	2.81 (2.5)	0.374 (0.3325)	1.12 - 2.24
Glyphosate	1.66 (1.5)	0.221 (0.1995)	<4.48
Triclopyr	1.46 (1.3)	0.194 (0.1729)	0.28 – 10.0

[1]Actual application rates would be less.

[2]Rate of application within treated spots. As per manufacturers recommendation.

[3]Rate averaged per treated acre.

[4]Norris et al, 1991

ALTERNATIVES 3 AND 4

Direct/Indirect/Cumulative Effects: The prescribed burning and outhouse reconstruction projects would result in the same effects as Alternative 2. However, no chemical (herbicide or fertilizer) application would occur, so there would not be a risk to aquatic habitat from a chemical spill and nutrients in streams would not increase because of management.

ALTERNATIVE 5

Direct/Indirect Effects: Herbicide application and outhouse reconstruction project would result in the same effects as Alternative 2; however, no prescribed burning would occur so there would not be a risk of water contamination from drip torch fuel.

Fish Populations

Preceding sections have discussed the effects of various alternatives on habitat complexity and availability, sediment and substrate, water temperature, and water chemistry. Because most activities would not occur within Riparian Habitat Conservation Areas, there would be no adverse effects on water temperature, recruitment of large instream wood, or pool frequency. As displayed, the component that would be most affected is sediment. Therefore, the index values calculated by the WATSED model for each subwatershed were added together and that total was used to indicate a relative risk rating with regard to fish within the burned area (Table 4.10).

Table 4.10: Overall sediment risk rating for fish within the burned area.

Alternative	Short-term risk rank (calculated index value)	Long-term risk (calculated index value)
1	6 (972)	3 (663)
2	3 (1264)	2 (638)
3	2 (1265)	2 (638)
4	4 (1206)	6 (531)
5	5 (1154)	4 (568)
6	1 (1291)	5 (561)

*Highest risk =1, lowest risk = 6.

While alternative 6 would produce the highest sedimentation risk in the first year, this is largely a consequence of many miles of road obliteration (second in amount to Alternative 4). This risk would only occur in the first year, and would decrease more rapidly and would reach a lower level of chronic sediment than if no activities occurred. Although Alternative 4 would not involve harvest, the extensive road obliteration and decommissioning would rank a higher risk in the first year after implementation than Alternative 5 (which has harvest and 50 percent less obliteration). However in the long-term, the steady state sediment yield would be the lowest of all alternatives due to the same road obliteration. More detail regarding the effects of each alternative on fish populations are provided below.

ALTERNATIVE 1

Direct/Indirect Effects: Sampling revealed that fish were extirpated from several stream segments on South Fork Cable, Oriental, and Texas Bar creeks immediately following the fire. Five years of monitoring indicates that fish have returned to all sample locations on these streams. This alternative would allow aquatic habitat and fish populations to continue recovering from the fire at a natural rate. The short-term risk to fish would be the least under this alternative; however, road densities and conditions would remain unchanged under Alternative 1, so alternatives 2 through 6 would all produce lower chronic sediment yields. Moreover, Alternative 1 would forgo benefits of projects such as road closing, stabilization or obliteration; riparian planting or fencing; or fish passage improvements.

ALTERNATIVE 2

Direct/Indirect Effects: Fish populations are expected to benefit from improved habitat conditions resulting from projects such as riparian planting and fencing (see discussion under previous sections), and many other proposed projects will have little to no effect. Some projects, such as timber harvest, reforestation, and prescribed burning could have indirect and cumulative effects to fish. The following projects address fish populations more specifically.

Fish should benefit from road obliteration projects. Chronic effects linked to roads and extended timber harvest activities have been responsible throughout the Pacific Northwest for fragmentation and isolation of salmonid populations and elimination or serious depression of historic life-history patterns (Rieman et al. 1995). Although implementation of road obliteration activities would involve calculated risk, risk is also inherent in leaving the roads as they are. There is good evidence that fish here could withstand the short episode of increased sediment yield (they quickly recolonized every stream from which they were known to be extirpated by the fire); the risk inherent in implementing road obliteration appears small as compared to the potential benefit.

Removal of fish passage barriers would facilitate upstream passage of juvenile fish, making several more miles of stream habitat immediately available for steelhead and chinook salmon rearing, and perhaps steelhead spawning, especially in Texas Bar Creek and Oriental Creek. One of the most important culverts proposed for treatment occurs the farthest downstream on Texas Bar Creek. This culvert (with an entry four feet above stream level) severely restricts fish access to nearly all of Texas Bar Creek and its removal would improve access to several miles of aquatic habitat. The very small amount of potential habitat degradation from sediment mobilization should be more than compensated by the amount of new habitat made accessible by the projects. This could help increased numbers of steelhead and chinook salmon to rear to a migratory stage, helping to increase numbers of adults returning to spawn in the North Fork John Day River and its tributaries within the Tower Fire. Improved connectivity between segments of resident fish populations would also aid normal gene flow between this population segment and the remainder of the population and help maintain the resiliency of the species.

As stated under the Water Chemistry section, avoiding use of herbicides within Riparian Habitat Conservation Areas, as well as other mitigation detailed in Chapter 2 and Appendix C would probably not result in detectable amounts of herbicides in surface waters. The only risks would be associated with a direct spill into streams or noncompliance by the herbicide applicator.

Triclopyr is moderately to highly toxic to fish, at least when used as the butoxyethylester (Wan et al. 1987; Johansen and Geen 1990; Kreutzweiser et al. 1994), which is the formulation proposed for use here. A

spill into surface waters could be expected to result in fish kills. Glyphosate along with Agridex®, the surfactant proposed for use in the Tower Fire area, are of relatively low toxicity. Hexazinone is practically nontoxic to fish (USDA Forest Service 1984,1992; Norris et al. 1991), has a short half-life in water (<5 days, see Solomon et al. 1988), and even in case of a spill is unlikely to produce direct toxic effects.

Table 4.11: **Characteristics of Herbicides Proposed for Use in Tower Restoration Projects.**

Characteristic	Chemical		
	Glyphosate (as Accord® + Agridex®)	Hexazinone (as Pronone®)	Triclopyr (as Pathfinder II®)
Persistence [1, a]	short - med	med – long	Med
Mobility[2,a]	low - moderate	High	moderate - high
Relative Acute Toxicity to Fish[3,a,b ,c, d]	Low	Low	moderate - high
Bioconcentration in Fish[4,b]	No	No	yes[5]

1. Persistence: short = half-life < 1 month; med = half life 1-6 months; long = half life > 6 months. Triclopyr and Hexazinone have much shorter half-lives when exposed to sunlight.

2. Mobility: an evaluation of the chemical's susceptibility to transport by water, based primarily on persistence, with consideration given to strength of adsorption to soil particles and water solubility. Environmental conditions, timing of application in relation to rainfall, and distance to surface or groundwater would affect actual concentrations reaching a water source.

3. Relative Acute Toxicity to Fish: The lowest 96-hour LC_{50} value found in the literature for a fish species, where low = > 10 ppm, mod = 1-10 ppm, high = < 1 ppm.

4. Bioaccumulation in Fish: uptake and temporary storage of a chemical in animal flesh and organs. no = does not bioaccumulate; yes = does bioaccumulate.

5. Available studies show no bioaccumulation (USDA Forest Service, 1984) One report showed slight, reversible bioconcentration (Norris et al , 1991)

a. USDA Forest Service, Pacific Northwest Region, 1988. Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation. USDA Forest Service, Portland, Oregon.

b. USDA Forest Service, Pacific Northwest Region, 1996, 1997. Herbicide Information Profiles. USDA Forest Service, Portland, Oregon.

c. USDA Forest Service, 1984. Pesticide Background Statements, Volume 1. Herbicides. Agriculture Handbook Number 633

d. Norris et al, 1991

Even when compounds do not cause immediate mortality, they may cause delayed mortality (Kreutzweiser et al. 1994) or other, sub-lethal, harmful effects (Little et al. 1990). Sub-lethal effects of these particular compounds are largely unknown, although Morgan et al. (1991) and others have documented changes in behavior of rainbow trout exposed to triclopyr at concentrations below the 96-hour LC_{50}. Such behavioral changes could make fish more susceptible to predation. Morgan and Kiceniuk (1992) found little overall effect to rainbow trout of a two-month exposure to sub-lethal concentrations of Vision®, a glyphosate herbicide. It is well established that other pesticides, at sub-lethal concentrations, do affect feeding, growth, behavior, reproduction, resistance to stress, migration, biochemistry and physiology of salmonids (Norris et al. 1991; Birge et al. 1993).

Many modern herbicides have not been thoroughly studied in terms of sub-lethal and chronic effects to salmonids, so the "margin of safety" associated with the proposed herbicides was considered as a way of expressing such risks. Margin of safety calculations incorporate both toxicity and amount of exposure to the substance in question. The margin of safety is defined as the ratio of the "no-effect" level to actual exposure for the compound in question. The "no-effect" level is the highest concentration that causes no immediate mortality of test animals in acute toxicity tests (sub-lethal and chronic effects may well occur at the "no-effect" level). When the exposure level is equal to the no-effect level, the margin of safety is 1.0. Margin of safety values less than 1.0 imply some mortality of exposed organisms, while margin of safety values greater than 1.0 should cause no immediate mortality and are presumed to imply reduced risk of sub-lethal or chronic effects.

No-effect level concentrations have not been experimentally determined for most herbicides. In the absence of such data, Norris et al. (1991) calculated estimates of both the no-effect levels and the margins of safety for acute and chronic toxicity for pesticide compounds used in forested situations. Their estimates assume minimum buffer strips and some overspray of surface waters (assumptions which do not apply to the Tower proposal). Their calculations assume the no-effect level for acute exposure to be 10% of the LC_{50}'s, and for chronic exposure, 1% of the LC_{50}'s. They estimate peak concentrations reaching streams and adjust for changing levels of exposure over time, as would be expected in flowing streams. Their margin of safety estimates for compounds proposed for use in Tower Fire are displayed in Table 4.12.

Table 4.12: **Herbicide Toxicity and Margins of Safety for Salmonids[1]**

Herbicide (test species)	Toxicity: 96-hr LC50 (mg/L)	Margin of safety for Acute Exposure[2]		Margin of Safety for Chronic Exposure
		Based on highest instantaneous observed field concentration from the literature	Based on highest estimated instantaneous peak concentration following BMP's	Based on continuous exposure at a specified level[1]
Hexazinone (rainbow trout)	322	727	1600	306
Triclopyr as Butoxyethyl ester (rainbow trout)	0.74	0.8	3.7	0.7
Glyphosate, technical (rainbow trout)	130	5	650	93
Glyphosate, liquid formulation[3] (rainbow trout fingerling)	8.3	0.3	41	6
Glyphosate, liquid formulation[3] (rainbow trout swim-up fry)	2.4	<0.1	12	1.7

[1] From Norris et al. 1991.

[2] The above figures assume a broadcast or aerial application and some overspray of surface waters. These assumptions would not be accurate for the Tower project, and so margins of safety would be higher than these figures indicate.

[3] Probably Roundup or a similar formulation, in which the surfactant is more toxic than the herbicide itself. Agridex, the surfactant proposed for use in Tower Fire projects is much less toxic.

The margin of safety for hexazinone implies a very low risk of sub-lethal and chronic effects to salmonid fishes. Margins of safety for triclopyr and glyphosate, on the other hand, might suggest a higher risk associated with the use of these compounds. However, the planned use in the Tower area differs in important respects from the assumptions used in the estimates produced by Norris et al. (1991). First, application rates in Tower would be lower (Table 4.9). Second, non-treated buffer strips around permanently flowing streams would be wider (150 to 300 feet). Finally, application methodology (spot application by hand) would allow very precise placement of the chemical, so that herbicides would not be directly applied to surface waters, and herbicide drift would not enter buffer strips. These three differences from the very conservative assumptions in Norris et al. make toxic effects to salmonids very unlikely when herbicides are used as planned. Moreover, recent studies (Thompson et al. 1995; Thompson et al. 1991) have noted that in forested settings, particularly in rapidly flowing streams, real world exposure regimes are much shorter than typical laboratory toxicity tests, so that standard laboratory toxicity tests (LC_{50}'s) would tend to overestimate potential impacts to natural systems.

Herbicides could also indirectly affect fish in the Tower Fire area through changes in their food chain; either by affecting the growth or abundance of aquatic invertebrate food species or through bioconcentration of the herbicide in those food species, which upon consumption by the fish, could serve as an additional source of exposure to the chemical. While herbicides are designed to kill plants and so should be capable of affecting aquatic plants (and related food chains, cover, and other habitat parameters), the application procedures proposed in this EIS would probably not result in detectable amounts of herbicides in surface waters and should not affect aquatic vegetation. Most observations of indirect herbicide effects on aquatic communities have followed direct applications of herbicide to water or shorelines for aquatic weed control, while mitigation for the proposed herbicide use would buffer perennial waters by 150 to 300 feet and 100 feet on ephemeral streams. Concentrations of herbicides in surface waters after forest applications have been found to be much lower than those needed to control aquatic weeds, and so are unlikely to cause indirect effects through death of aquatic vegetation in streams, except in unusual circumstances (Norris and Moore 1971, 1976 *as cited in*: Norris et al. 1991). In fact, very low herbicide concentrations in some applications may have slightly stimulated plant growth (Thompson et al. 1995). As for aquatic invertebrates, hexazinone appears practically nontoxic (Norris et al. 1991; Kreutzweiser et al. 1992) as does technical grade glyphosate, but triclopyr appears to have some toxicity (Kreutzweiser 1992). High water solubility of both glyphosate and hexazinone suggest little likelihood that they could bioaccumulate in fish food species. Triclopyr is much less water-soluble (more fat-soluble) than glyphosate or hexazinone. Kreutzweiser et al. (1998) found that triclopyr adsorbed onto organic material at much higher concentrations (90 to 250 times) than in the aqueous environment. Nevertheless, this did not appear to pose increased risk of mortality to aquatic detritus-consuming insects.

Again, based on the above considerations it seems that the only immediate risk to fish or other aquatic life would come from a spill (e.g. an applicator falling while crossing a stream), or applicator noncompliance with Forest Service specified procedures.

Cumulative Effects: The mosaic pattern in which wildfires usually burn, leaves some streams or stream segments relatively undamaged by fire and containing reserve fish populations that can recolonize the burned area—if those segments have not been degraded by other events or conditions. Historic management before the Tower Fire also followed a mosaic pattern, with most areas either intensely managed or nearly unmanaged. Although this pattern of management activity could cause fish population fragmentation, the fact that some rather large areas remain mostly unmanaged could mean that reserve populations would be available for repopulation of restored areas. Fish occupying the managed areas will have been subjected to chronic effects for many years, but fish inhabiting the unmanaged areas would have escaped most of the chronic effects (except livestock grazing), although they have occasionally been subjected to episodic disturbances (fire, flood, etc.). Those unmanaged areas that did not burn severely in the Tower Fire have probably functioned as source areas for repopulation of the burn. In particular, Hidaway and Oriental creeks have been repopulated twice—after the fire and after separate floods in 1997 and 1998 respectively. Unmanaged areas could probably also serve the same function in the unlikely event that sediment flushes resulting from implementation of projects under this alternative should overwhelm a local population.

Over time, however, it seems likely that the cumulative effects of sedimentation from the Tower Fire, past and ongoing management activities, and the proposed management activities would together slightly increase risk for salmonids in the Lower Cable, Lower North Fork Cable, North Fork John Day/Turner, North Fork John Day/Otter, and Winom subwatersheds because long-term, chronic sediment levels would increase and achievement of the steady state sediment yield would be delayed by one to two years.

ALTERNATIVE 3

Direct/Indirect/Cumulative Effects: This alternative would have the same effects as Alternative 2 except that no herbicide or fertilizer application would occur, so there would be no risk to aquatic habitat from a chemical spill.

ALTERNATIVE 4

Direct/Indirect Effects: Alternative 4 would include all projects from Alternative 2 that would benefit fish without the risk of an herbicide spill. Extensive road obliteration and decommissioning would increase risk to fish in the Lower Cable, Lower North Fork Cable, South Fork Cable, Upper North Fork Cable, North Fork John Day/Otter, North Fork John Day/Oriental, Big, Lower Hidaway, and Upper Hidaway subwatersheds, but this would rapidly decrease after the first year. However, long-term risks would be reduced in all subwatersheds except North Fork John Day/Turner and Winom. In fact, long-term risk would be reduced by more than 40 percent in the South Fork Cable, Texas Bar, and North Fork John Day/Oriental subwatersheds.

In the long-term, implementation of Alternative 4 would not only facilitate hydrologic recovery of the stream channel, but would even improve aquatic habitat conditions compared to the pre-fire situation.

Cumulative Effects: Although most of the proposed activities could potentially affect fish, effects other than sedimentation are mostly very small, more often beneficial than harmful, and generally similar to other alternatives. As discussed under Alternative 2, potential sediment flushes resulting from implementation of Alternative 4 projects should not permanently overwhelm local populations.

In addition, although quantitative estimates of effects to fish are not possible, proposed management activities would likely decrease the cumulative risk for salmonids from the Tower Fire and management activities (past, ongoing, and foreseeable) in all subwatersheds except Winom (where yield would remain unchanged) and North Fork John Day/Turner (where yield would stabilize at a slightly higher level).

ALTERNATIVE 5

Direct/Indirect Effects: Alternative 5 would include all projects from Alternative 2 that would benefit fish without additional nutrients from prescribed burning. Short-term risk to fish would be higher in Texas Bar, North Fork John Day/Oriental, Lower Hidaway, and Upper Hidaway due to extensive road obliteration, but this would rapidly decrease after the first year. Long-term risks would be substantially reduced in the South Fork Cable, and North Fork John Day/Oriental subwatersheds.

Cumulative Effects: Although most of the proposed activities could potentially affect fish, effects other than sedimentation are mostly very small, more often beneficial than harmful, and generally similar to other alternatives. As discussed under Alternative 2, potential sediment flushes resulting from implementation of Alternative 5 projects should not permanently overwhelm local fish populations. In addition, proposed management activities would likely decrease the cumulative risk for salmonids from the Tower Fire and management activities (past, ongoing, and foreseeable) in the Lower Cable, South Fork Cable, Texas Bar, North Fork John Day/Oriental, Lower Hidaway, and Upper Hidaway subwatersheds.

ALTERNATIVE 6

Direct/Indirect Effects: Alternative 6 would include all projects from Alternative 2 that would benefit fish. Like Alternative 2, there would be some risk due to use of herbicides under Alternative 6. Short-term risk to fish would be higher in all subwatersheds due to harvest and extensive road obliteration and decommissioning, but this would rapidly decrease after the first year. Long-term risks would be reduced to levels similar to Alternative 4 in all subwatersheds except North Fork John Day/Turner, Winom, and Lower Hidaway.

Cumulative Effects: Although most of the proposed activities could potentially affect fish, effects other than sedimentation are mostly very small, more often beneficial than harmful, and generally similar to other alternatives. As discussed under Alternative 2, potential sediment flushes resulting from implementation of Alternative 6 projects should not permanently overwhelm local fish populations.

OHV trail construction would create a new permanent source of sediment in the Lower Hidaway subwatershed, but proposed road obliteration would remove a former source of sediment, so that on balance, there would be less sediment produced over the long-term in this subwatershed than before the fire. As discussed previously, fish could probably tolerate the additional sediment for a short period and would benefit in the long-term from the slight sediment reduction resulting from the road obliteration.

Although quantitative estimates of effects to fish are not possible, proposed management activities would likely decrease the cumulative risk for salmonids from the Tower Fire and management activities (past, ongoing, and foreseeable) in all subwatersheds except North Fork John Day/Turner and Lower Hidaway (where yield would remain unchanged) and Winom (where yield would stabilize at a slightly higher level).

"Threatened", "Endangered" and "Sensitive" Fish and Aquatic Species

"Sensitive" redband trout and "Threatened" steelhead use the Lower North Fork Cable, South Fork Cable Creek, North Fork John Day/Otter, North Fork John Day/Turner, North Fork John Day/Oriental, Big, Lower Hidaway, and Upper Hidaway subwatersheds. In addition, the portion of the North Fork John Day River within North Fork John Day/Otter and North Fork John Day/Turner subwatersheds serve as migratory habitat for "Threatened" bull trout. Buchanan, Hanson, and Hooton (1997) show bull trout as probably extirpated in the Lower Hidaway and Upper Hidaway subwatersheds, which implies previous occupation of the stream by this species. However, the presence of brook trout in this stream might prevent successful recolonization by bull trout in the near future.

ALTERNATIVE 1

Direct/Indirect Effects: Alternative 1 will have no effect on Mid-Columbia steelhead trout and Columbia River bull trout ("Threatened"), and will have no impact on redband trout or spring chinook salmon.

ALTERNATIVES 2-6

These alternatives "May Impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability" to **redband trout** and **spring chinook salmon**.

Preliminary determinations for "Threatened" species have been made in a draft Biological Assessment, which is currently in consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. A determination was made that most proposed projects "May Affect, but will not likely adversely affect" **mid-Columbia steelhead trout** and **Columbia River bull trout**. The instream fish habitat improvement projects were determined "May Affect, likely to adversely affect" in the short-term, but will be beneficial in the long-term.

Recreation

The scale considered for analysis was primarily the burned area itself, although analysis of trails took into consideration the entire Winom-Frazier OHV Complex. Recreation use (measured as Recreation Visitor Days) and predicted effects are based on observed use and use patterns; shifts in use as a result of past disturbances; informal interviews and comments from recreationists; registration at developed sites; permits for mushroom collection and hunting; and monitoring of trail use (traffic counters) and condition (through maintenance surveys). All known dispersed campsites have been marked in the field with tags and mapped, and monitoring has begun with regard to use and condition.

Dispersed and Developed Recreation

ALTERNATIVE 1

Direct/Indirect Effects: While overall Recreational Visitor Days within the analysis area would remain near the same levels as previous years under this alternative, traditional use patterns and recreational opportunities would be impacted as described in the following paragraphs.

The Forest Road 5506 crossing of Oriental Creek that was destroyed in the 1998 flood would not be repaired at this time, affecting recreationists in several ways. Currently, a user-made ford at this site is providing passage for high-clearance vehicles during low stream flows; however, motorists with trailers or low-clearance vehicles are not able to cross. There is no turn-around or parking area at the destroyed crossing, so vehicles that are unable to cross would have to back down the narrow road, causing a safety hazard for other motorists and posing a risk of backing into the stream itself. Forest Road 5506 has traditionally provided access into numerous dispersed campsites, as well as the Oriental and Big Creek trailheads, which are popular staging areas into the North Fork John Day Wilderness. Day use activities such as fishing, sight seeing and picnicking in the scenic portion of the North Fork John Day River corridor would also decrease due to inaccessibility. Based on past observations, motorists would likely create new parking and camping areas to replace the traditional use sites that are no longer accessible. This would increase ground disturbance along Forest Road 5506 and most sites would likely occur directly adjacent to the river due to limitations in terrain. Forest Road 5506-130 also provides vehicle access to the Oriental Creek and Big Creek trailheads; however, this road is in poor condition and is not suitable for low clearance vehicles or vehicles pulling trailers. Other wilderness trailheads may experience a moderate increase in use due to the inaccessibility of the Oriental and Big Creek trailheads. This would not degrade the alternate trailheads or associated trail systems, although it would increase crowding in those areas.

The 20 dispersed campsites identified as experiencing erosion, off-site vegetation damage, and reduced safety due to hazard trees would remain in their current condition and impacts to adjacent resources would continue. As a result, minor soil and vegetation degradation would continue to occur at these sites. As dead trees fall to the ground, some sites could be blocked from use, while other sites would not likely be used until revegetation occurs and a forested canopy is reestablished. Recreationists would also likely create new dispersed campsites to replace dispersed sites with undesirable conditions due to safety or visual quality. These could result in further impacts to riparian areas, fish, vegetation, or soil.

An interpretive opportunity would be missed for informing scenic byway travelers of the effects of the Tower Fire.

The Pearson Guard Station is scheduled for inclusion in the cabin rental program; however, the current condition of this site would make it ineligible for this program. Future maintenance of the cabin without funds from the cabin rental program would be difficult due to the projected decline in the facilities budget.

The two campsites and trailhead in Oriental Campground that were damaged in the 1998 flood (caused in part by conditions following the Tower Fire) would not be repaired. The campsites are currently not suitable for public use and would need to be closed, reducing camping opportunities in this area. The trailhead would also likely be closed due to accessibility limitations and poor soil conditions for parking. Since this is a popular entrance into the North Fork John Day Wilderness, ground disturbance would likely increase along Forest Road 5506 as wilderness users and other recreationists park their vehicles and trailers in any available space. If the campsites and trailhead remain open, their currently poor condition would continue to degrade since no corrective measures would occur.

Hazard trees along roads, trailheads, trail crossings, developed recreation sites and dispersed campsites would increase public safety risks and related government liability. Roads and developed recreation sites would be closed (as happened in 1998 on Forest Road 52 within the fire boundary). Use has already increased at the Frazier Campground because many OHV users prefer it to the Winom Campground, which was partially burned over in the Tower Fire. During the peak summer months and holiday weekends, the Frazier Campground would not have the capacity to accommodate users displaced by the closure of the Winom facility.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: The proposed low water ford at the destroyed Forest Road 5506 crossing of Oriental Creek would provide high clearance vehicle passage to allow access to Oriental Creek and Big Creek trailheads and numerous dispersed campsites, and low-clearance vehicles or vehicles pulling trailers would be able to cross the ford during low water flows. During periods of high flow, vehicles pulling trailers would have to back up for some distance in order to turn around, posing a safety hazard. The eventual proposed culvert installation at this site would allow vehicles to cross Oriental Creek throughout the year. Dispersed recreation activities, such as fishing, sight seeing and picnicking, in this scenic portion of the North Fork John Day River corridor would resume to pre-flood levels.

Since the Oriental Creek crossing on Forest Road 5507 would not be repaired, there would be less access and fewer dispersed camping options in this location than existed prior to the flood. Some traditional use dispersed camps (primarily associated with big game hunting activities) would remain inaccessible, which could result in soil disturbance at other locations as displaced users create new campsites. The improvement of Forest Road 5510 would not offset the reduction in options because dispersed camping and driving are already available on this road.

The proposed site hardening and removal of hazard trees at 20 dispersed campsites would reduce erosion and related sediment transport, cease off-site vegetation damage, and improve safety. Use of native materials (boulders, logs, gravel) in defining and hardening the 20 sites would help retain the natural appearance desired by dispersed campers. These improvements would encourage campers to continue using these sites versus creating new sites (which would increase soil and vegetation disturbance within the analysis area). Harvest and thinning activities could change the availability of adjacent dispersed campsites (not limited to the 20 identified for rehabilitation) and temporarily displace use, but this should be short-term. Harvest would reduce the hazards from falling trees wherever sites occur adjacent to proposed units and along haul routes. Displacement of campers should cease as soon as harvest and thinning activities are completed.

The proposed interpretive sign along the scenic byway would inform visitors of the effects of fire and restoration activities.

The proposed repair of the Pearson Guard Station would allow for administrative use of the site and prepare the guard station for inclusion in the cabin rental program. Inclusion in the rental program would provide funds to maintain this historical guard station and serve the public as a unique recreation experience.

The proposed repair of one toilet, two campsites, and the trailhead parking within Oriental Campground would provide needed facilities for recreationists. Although the trailhead is usable in its current condition, the proposed leveling of deposited sediment and removal of debris would improve access, while the placement of gravel would reduce erosion and provide a solid surface during wet soil conditions.

The proposed removal of hazard trees along roads, trailheads, trail crossings, and developed recreation sites would reduce risks to recreationists and their property. Hazard trees would be removed in the Winom Campground so it would remain open and use of the Frazier Campground would not exceed capacity.

ALTERNATIVE 4

Direct/Indirect/Cumulative Effects: This alternative would close a total of 18.5 miles of road that is currently open to public travel. The effects of this are discussed below under the affected road.

Barricading Forest Road 5445 at its junction with Forest Road 54 would eliminate use of four popular dispersed campsites along 1 mile of road currently open to the public. A large portion of recreationists on the North Fork John Day District prefer dispersed, undeveloped campsites, so the loss of access would likely result in the creation of other dispersed sites nearby to replace these popular hunting and OHV-related camps.

Closure and obliteration of 1.1 miles of Forest Road 5448 would eliminate access for full-sized vehicles to Three Culverts Camp, which serves as a trailhead and cluster of dispersed campsites that are used by

OHV enthusiasts. Disturbance of soil and vegetation would likely increase along the open portion of Forest Road 5448 as recreationists create new dispersed campsites and parking.

Closure of both Forest Road 5506-130 (1.7 miles) and Forest Road 5506 at the destroyed Oriental Creek crossing (3.1 miles) would exclude motorized access from 3.1 miles of the Wild and Scenic North Fork John Day River corridor, 10 high use dispersed campsites, parking for vehicles and trailers accessing the wilderness, and access to the Oriental Creek and Big Creek trailheads. These trailheads would no longer be functional. The closure would buffer the wilderness from vehicular disturbance; however, when Congress established the North Fork John Day Wilderness, Forest Road 5506 was specifically placed outside the designated wilderness boundary in order to retain access into this area, and this access would be eliminated. A new trailhead suitable for vehicles with trailers plus adequate space for vehicle turn around would be constructed prior to the crossing, but parking would be limited due to the close proximity of the North Fork John Day River and the narrow valley. A footbridge and horse ford would be constructed across Oriental Creek to maintain access to trails into the North Fork John Day Wilderness. Both the construction of a new trailhead/turn around and the footbridge/ford would be constrained by projected declines in the recreation budget. Additionally, some ground disturbance would likely occur along Forest Road 5506 as users create new parking and campsites to replace areas no longer accessible due to implementation of this project.

Repair of Forest Road 5507 would restore access to a popular and easy travel route through Oriental Basin. Some traditional use dispersed camps (primarily associated with big game hunting activities) would be displaced as a result of the closure of Forest Road 5510 (6.0 miles), but this would be offset by the restored access to sites would along Forest Road 5507 (which are more numerous). Some hunters would likely approve of closing Forest Road 5510 because it would reduce use in their preferred hunting area, while others would likely be upset that their favorite hunting camp is no longer accessible.

The proposed interpretive sign along the scenic byway, site hardening and of removal of hazard trees at 20 dispersed campsites, repair of the Pearson Guard Station, repair of two campsites and the trailhead parking within Oriental Campground, and felling of hazard trees would result in the same effects discussed under Alternative 2. In addition, Alternative 4 would include relocation of several developed and dispersed campsites within Big Creek Meadow Campground and the adjacent meadow. Parking would be improved so that a solid surface is provided during wet soil conditions. Traditional users could feel somewhat inconvenienced since the sites they normally occupy have been relocated; however, with proper signing and notification most users would recognize the need to protect the resources and comply with the changes to their camping experience.

Cumulative Effects: Based upon past, proposed, and foreseeable future activities described in Appendix A, the only cumulative effects on recreation resources would be associated with road closures (pleasure driving, access to recreation sites, dispersed camps). A number of roads and dispersed campsites were closed through implementation of the District Motorized Access and Travel Management Plan (which closed 60-70 percent of the roads across the District that were open in 1990). The road closures proposed under this project would further reduce dispersed campsites an estimated seven percent of the existing amount and close 18.5 miles of road.

ALTERNATIVE 5

Direct/Indirect/Cumulative Effects: This alternative would close a total of 12.9 miles of road that is currently open to public travel. Closure of Forest roads 5445 and 5448 would result in the same effects as described under Alternative 4. The Forest Road 5506 crossing of Oriental Creek would be repaired with a bridge or open arch to allow for vehicular use of the existing trailhead, and the road would be closed just beyond the trailhead. Closure of this road section and Forest Road 5506-130 would eliminate vehicle access to the Big Creek Trailhead and road-related recreation and camping opportunities would be reduced. The closure of Forest Road 5506-130 could also pose a safety concern for recreationists if future fires or flooding should occur in this area, since Forest Road 5506 would then provide the only entry and exit into the narrow canyon for approximately eight miles. Forest Road 5510 would be closed and Forest Road 5507 would be repaired, resulting in the same effects as described under Alternative 4.

The proposed interpretive sign along the scenic byway, site hardening and of removal of hazard trees at 20 dispersed campsites, repair of the Pearson Guard Station, repair of two campsites and the trailhead

parking within Oriental Campground, removal of hazard trees, and reforestation would result in the same effects discussed under Alternative 2. Harvest of dead and unhealthy trees and thinning would also result in the effects described under Alternative 2. Alternative 5 would also include the relocation of several developed and dispersed campsites associated with Big Creek Meadow Campground and improved parking as discussed under Alternative 4.

Cumulative Effects: Based upon past, proposed, and foreseeable future activities described in Appendix A, cumulative effects on recreation resources would be similar to those discussed under Alternative 4, except that 12.9 miles of road would be closed.

ALTERNATIVE 6

Direct/Indirect/Cumulative Effects: This alternative would close a total of 12.7 miles of road that is currently open to public travel. Forest Road 5448 would be closed at the north entry to the meadow, eliminating approximately ¾ of a mile of road. This would maintain some of the camping opportunities provided by the Three Culverts Camp and would provide a trailhead for OHV enthusiasts, while eliminating large vehicle access to the meadow and discouraging use of sites closer to the burn. Some campers would likely be displaced from their favorite location, but they would not need to relocate very far. Forest Road 5507-030 would be closed (5.6 miles) as would 6 miles of Forest Road 5510 (see effects described under Alternative 4).

Forest road 5445 would be repaired as described under Alternative 2 with the exception that the gated closure would be moved to allow access to a previously popular dispersed campsite. Forest Road 5506 would be repaired with a open arch or bridge and its entire length and Forest Road 5506-130 would remain open, providing the most accessibility of all the alternatives. Forest Road 5507 would be repaired resulting in effects described under Alternative 4.

Alternative 6 would include the relocation of several developed and dispersed campsites associated with Big Creek Meadow Campground and improved parking as discussed under Alternative 4.

Harvest of hazard trees would result in the effects described under Alternative 2.

Cumulative Effects: Based upon past, proposed, and foreseeable future activities described in Appendix A, cumulative effects on recreation resources would be similar to those discussed under Alternative 4, except that 12.7 miles of road would be closed.

OHV Trails

ALTERNATIVE 1

Direct/Indirect Effects: An education opportunity would be missed for informing trail users of the effects of the Tower Fire and involving them in protection of the affected resources.

The Cut-Across and Round Meadows trail crossings of Forest Road 52 (a major, paved, travel route) would not be improved, which could cause future safety problems if use of both the road and the OHV Complex increase as indicated by current trends. Both of these trails receive high use and form a popular loop. The Cut-Across Trail crossing currently has poor sight distance for OHV users and motorists alike and the approach to the road is steep with an inadequate area for stopping. The Round Meadows Trail crossing combines with a small dispersed campsite and a vehicle turnout on the north side of the road. This turnout is on a bend in the road and does not adequately provide the parking needed at this site.

The wet section of the River Trail would not be repaired, so rutting and sediment production would continue.

The lack of connection for 3- or 4-wheelers between the Winom and Frazier trail systems would continue under this alternative. Continued unauthorized use by 3- and 4-wheelers of the existing Roundaway Trail would increase the potential for serious accidents due to the steep, narrow trails. Unauthorized use would also increase maintenance costs because 4-wheelers require a tread of at least 50 inches, while the existing connecting trails have a tread of 12-24 inches. Use of Forest Road 5226 would continue to place OHV traffic with full-sized vehicles for approximately 6 miles. Most of this road is narrow and

winding so the potential for vehicle/OHV conflicts would remain high, particularly if use of the OHV complex continues to increase.

Closure of roads, trails, and developed recreation sites due to the presence of hazard trees would likely undermine partnerships formed over the past 10 years with local volunteer groups and the Oregon Department of Parks and Recreation to develop the Winom-Frazier OHV Complex. The Winom-Frazier OHV facilities that are not closed would experience an increase in use.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: Access to the Whoop-de-doo, Cable Creek, Round Meadows, and Short Cable trails would be reduced during repair of Forest Road 5448 and replacement of the three culverts with an OHV bridge. Replacement of the culverts would occur during the peak OHV season. A temporary crossing would be created to serve users during construction of the bridge.

The proposed educational signs at trailheads would inform trail users of the effects of fire and encourage their cooperation in protecting fragile soils and recovering vegetation within the burn area.

The sight distance on the Cut-Across Trail approach to Forest Road 52 would be improved to provide trail users with adequate view of the crossing at both the top and bottom of the steep bank. The dispersed site at the Round Meadows Trail crossing of Forest Road 52 would be improved to provide better visibility and parking off the road. This would enhance OHV user safety at this site, especially with the steady increase in use currently occurring in the OHV complex. Signing on both trails would be upgraded to better inform the users of the potential hazards associated with the road crossing.

The existing wet area on the River Trail would be hardened with either a puncheon-style bridge[12] or a turnpike[13] with suitable culverts for water flow. This would eliminate the damage to the trail tread and decrease the potential for sediment production from trail traffic.

A 6.5-mile OHV route would be constructed to provide a connection rated as “easy” for all types of OHVs between the Winom and Frazier trail systems. The new route would traverse gentler terrain (generally less than 10 percent grade as compared to the greater than 20 percent grade of the existing Roundaway Trail), which would accommodate the novice OHV rider, providing a safer route. The Roundaway, Chimney Rock, and Lookout trails would be officially closed to 3- and 4-wheeler use and a size restriction device would be installed to exclude all but motorcycles from the segment that is of highest concern. These trails would still be maintained to provide a challenging experience for advanced motorcycle riders. OHV use on Forest Road 5226 would be reduced, addressing safety concerns on this road.

Removal of hazard trees would allow all Winom-Frazier OHV facilities to remain open and use would continue to increase as indicated by recent use trends.

Harvest would re-open Forest Road 5506-100 (currently used as the River Trail #3043) and Forest Road 5200-440 (currently used as the Tower Loop Trail #3040) to haul out logs. These trails would be closed to OHV activity during logging due to safety concerns with logging equipment. Over the short-term this would have a major impact on the OHV complex because Trail #3040 is a popular loop trail that provides OHV access from the OHV Complex and Trail # 3043 provides access to the North Fork John Day River at Oriental Campground. Currently, suitable alternate routes for these trails are not available. The removal of trail bridges and clearing of existing down logs and young trees to allow access to large vehicles and equipment would destroy the existing standards of these trails. Mitigation is identified in Chapter 2 to return disturbed trails to pre-harvest conditions to meet OHV trail standards.

Cumulative Effects: Riding opportunities associated with the Winom and Big Creek Meadow campgrounds would increase, since the proposed Roundaway 4-wheeler trail would provide access to at least 31.5 additional miles of “Easy” trail. This would more evenly distribute use of both trails and campgrounds within the OHV complex. The foreseeable future trail relocation on the Round Meadow

[12]A puncheon is similar to a bridge in appearance. It consists of log supports that rest on the ground, topped by log beams that support the decking and bumpers.

[13]A turnpike is a simple trail tread elevated four to eight inches above ground level. It consists of poles that are staked in place, with the center filled with rock, Geo-block, or grass paver blocks and topped with soil.

Trail (which connects with the Roundaway Trail) would have little impact on the Winom trail system due to access to the Frazier trail system, although the Round Meadow to Whoop-de-doo to Cut-Across trail loop in the Winom area would temporarily be closed (one to two years).

ALTERNATIVE 4

Direct/Indirect Effects: Closure and obliteration of Forest Road 5448 would require that approximately 1.25 miles of OHV trail be rerouted. The three culverts would also be replaced with an OHV bridge suitable for horse travel. Use of this trail would be disrupted until construction of the new route and bridge is completed.

Forest Road 5506-100 shares the same tread with over half of the River Trail. Obliteration of this road would maintain a 50-inch trail tread.

The proposed educational signs at trailheads, improvement of the Cut Across and Round Meadows trail crossing of Forest Road 52, drainage improvement on the River Trail, and felling of hazard trees would result in the same effects discussed under Alternative 2.

The existing Roundaway OHV Trail would be closed to 3- and 4-wheeler traffic through use of a size restriction device, and no new trail connection would be provided between the Winom and Frazier systems. To reach the Winom trail system from the Roundaway Trailhead, a 4-wheeler would have to travel on 32 miles of trail one way (much of it rated as “More Difficult”). This would have a greater impact on occupants of the Winom Campground because riding opportunities for inexperienced drivers and families would be greatly reduced. Four-wheelers could use Forest Road 5226, which would shorten the travel distance, but the road is extremely busy with full-size vehicle traffic. Vehicle/OHV conflicts would increase as OHV use of the trail systems increases, and safety on this route would decline over time.

Cumulative Effects: Reduced riding opportunities associated with the Winom and Big Creek Meadow campgrounds would likely increase use of the Frazier Campground. This could result in crowding and increased maintenance costs. Similarly, trails in the Frazier portion of the OHV Complex would likely see an increase in use, which could decrease safety and degrade trail conditions. In addition, proposed relocation of the Whoop-de-doo Trail and foreseeable future trail relocation on the Round Meadow Trail (both connect with the Roundaway Trail) would temporarily eliminate most “Easy” trail access in the Winom system. Temporary closure (one to two years) of these trails would remove the “Easy” Round Meadow to Whoop-de-doo to Cut-Across trails loop, as well as the “Most Difficult” Roundaway to Whoop-de-doo to Cable Creek to Chimney Rock to Hidaway loop for motorcycles.

ALTERNATIVE 5

Direct/Indirect Effects: Proposed obliteration of Forest Road 5506-100 and Forest Road 5448 and replacement of the three culverts with an OHV bridge would result in the same effects discussed under Alternative 4.

The proposed educational signs at trailheads**,** improvement of the Cut Across and Round Meadows trail crossing of Forest Road 52, drainage improvement on the River Trail, and felling of hazard trees would result in the same effects discussed under Alternative 2. Harvest would also result in the effects described under Alternative 2, except that the Forest Road 5506-100 portion of the River Trail would not be used as a haul route, so associated effects from re-opening the road would not occur.

As described under Alternative 4, the existing Roundaway OHV Trail would be closed to 3- and 4-wheeler traffic using a size restriction device and no new trail connection would be provided between the Winom and Frazier trail systems. This would result in the same direct, indirect, and cumulative effects as Alternative 4.

ALTERNATIVE 6

Direct/Indirect Effects: This alternative would result in effects very similar to Alternative 2 with the following exceptions.

Although Forest Road 5448 would be closed at the north end of the meadow, access to the Whoop-de-doo, Cable Creek, Round Meadows, and Short Cable trails would remain. Approximately 1.25 miles of the OHV trail would be re-routed out of the meadow and the three culverts would be replaced with an

OHV bridge suitable for horse travel. Use of this trail would be disrupted until construction of the new route and bridge is completed. As in Alternative 2, Harvest would re-open Forest Road 5506-100 (currently used as the River Trail #3043) and Forest Road 5200-440 (currently used as the Tower Loop Trail #3040) to haul out logs.

Cumulative Effects: The proposed relocation of the Whoop-de-doo Trail and foreseeable future relocation on the Round Meadow Trail (both connect with the Roundaway Trail) would close access to the "Easy" trails in the Winom part of the OHV Complex for one to two years. Use of Frazier Campground would increase during the closure, resulting in crowding and increased maintenance costs. Similarly, trails in the Frazier portion of the OHV Complex would likely see an increase in use, which could decrease safety and degrade trail conditions. Temporary closure of these trails would remove the "Easy" Round Meadow to Whoop-de-doo to Cut-Across trails loop, as well as the "Most Difficult" Roundaway to Whoop-de-doo to Cable Creek to Chimney Rock to Hidaway loop for motorcycles.

Once the trail relocations are complete, riding opportunities associated with the Winom and Big Creek Meadow campgrounds would increase due to the increased access to the Frazier system provided by the Roundaway 4-wheeler Trail. Use of both trails and campgrounds would be more evenly distributed.

Roadless Area

The following factors were used to analyze effects to the South Fork-Tower Roadless Area: natural integrity, apparent naturalness, remoteness, opportunity for solitude, and opportunity for primitive recreation experience. These are some of the features and characteristics that were originally analyzed when making the decision to designate the area as roadless in the RARE II evaluation process.

> **Natural integrity** is the extent to which long-term ecological processes are intact and operating. Impacts to natural integrity are measured by the presence and magnitude of human-induced change to an area. This change includes physical developments as well as activity in the area.
>
> **Apparent naturalness** is an indicator of whether an area appears natural to most people who are using the area. There may be some human impact, but it is not obvious to the casual observer.
>
> **Remoteness** is the perceived condition of being secluded, inaccessible and "out of the way". Topography, vegetation screening, distance from human impacts, distance from sights and sounds of man, and difficulty of travel all contribute to remoteness.
>
> **Solitude** is defined as isolation from the sights, sounds, and presence of others and the developments of man.
>
> **Primitive recreation experience** is the opportunity to experience solitude along with a sense of remoteness, closeness to nature, serenity, spirit of adventure, and self-reliance through the application of woodsmen skills in an environment that offers a high degree of challenge and risk.

ALTERNATIVE 1

Direct/Indirect Effects: There would be little direct, indirect, or cumulative effect on the roadless resource. The natural integrity of the project area would not be disturbed by resource management activities, and the area would retain the current level of apparent naturalness. Most of the unroaded area would continue to provide only low to moderate opportunities for solitude due to existing topography. Within the burned area, a reduced sense of solitude would exist until new vegetation grows tall and dense enough to provide vegetative screening. Under Alternative 1, this may take four or more decades. This would indirectly result in reduced opportunities for experiencing solitude until understory vegetation grows back through natural processes. Once new tree seedlings and shrubs are established, the area would again provide moderate opportunities for achieving solitude. The density of improved roads and trails would not change and access to the area would stay at current levels. Any changes to the roadless character of the area would be through natural processes only.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: With the exception of spot herbicide application, all activities occurring within the South Fork-Tower Roadless Area in alternatives 2 and 3 are the same. Activities planned within the roadless area include:

- 139 acres of salvage harvest on the roadless area periphery
- 6,786 acres would be planted with tree seedlings. Vegetative control using spot applications of herbicide would occur in Alternative 2.
- Forest Road 5448 would be reconstructed from the 550 junction to the roadless area boundary. Three culverts would be replaced with an OHV bridge at the Three Culverts Camp. Several dispersed campsites located in this area would be rehabilitated.
- A fence would be constructed around one mile of the creek running through Round Meadows. In addition, 45 acres of Round Meadows would be fenced to exclude livestock.
- Riparian planting would occur along portions of South Fork Cable Creek, North Fork Cable Creek and Hidaway Creek.
- Grasses and shrubs would be planted along selected areas near Hidaway Creek.
- A 6.25-mile long, 300-foot wide shaded fuelbreak would be created within the South Fork-Tower Roadless Area along the ridge bounding (but outside) the northern edge of the North Fork John Day Wilderness.

A portion of four harvest units lie within the west and north periphery of the roadless area. However, there would be no road construction or reconstruction proposed within the roadless area in any of the alternatives. Thus, these alternatives are consistent with the Forest Service (2/11/99) 18-month moratorium on new road construction in unroaded areas. In addition, neither alternative will preclude implementation of the Forest Service proposed rules for protection of remaining roadless areas within the National Forest System; Federal Register (64 FR 56306). The potential for future designation of the roadless area as wilderness under the Wilderness Act would not be precluded.

Planting (and herbicide treatment in Alternative 2) would alter natural ecological processes. This would result in establishment of conifer cover and riparian vegetation many decades sooner than if the area was not planted. Planting could introduce slightly different genetic stock into the existing gene pool. However, planting a mix of seral species (grown from locally collected seed from the same elevational zone) would help return the area to historical conditions. Planting along riparian areas would accelerate the establishment of shade-producing shrubs and trees. The fencing in Round Meadows would encourage the recovery of natural vegetation.

Evidence of upland conifer planting and riparian plantings could be evident for many years. The proposed fencing in Round Meadows would introduce additional fabricated structures to the area. The planned fuelbreak is 6.25 miles long and would modify an area 300 feet wide along its entire length. Standing live and dead trees would be felled where necessary to eliminate contact between tree crowns. Trees in the understory that create a fuel ladder into the overstory would also be cut. Depending on tree size, spacing between trees would be a minimum of 20 feet, however, some level of tree cover would be maintained throughout the fuelbreak. Based on the Agricultural Handbook #701 scenic integrity examples, visual impacts from the fuel break would qualify as “retention” because the forest canopy would appear to thin as a result of being on a drier ridge and where the area was moderately to intensely burned there are few live trees remaining. In the future, where lodgepole pine regenerates thickly, this might fall to partial retention, as the wider spacing would not have as natural of an appearance. Since the fuelbreak would receive periodic maintenance, effects from this action would continue into the future.

Considering the existing condition of the roadless area, activities proposed in alternatives 2 and 3 would have little additional effect on remoteness. Approximately 19.8 miles of OHV trail are currently located within the roadless area. Because of the long, narrow shape of the roadless area, roads and timber

harvest activities to the north, west and southwest present nonconforming sights and sounds to nearly the entire roadless area. The destruction of forest vegetation by the Tower Fire has exacerbated this situation.

Destruction of existing vegetation by the fire has reduced the short-term opportunities for solitude and primitive recreation. The proposed planting and seeding would accelerate reestablishment of trees and shrubs, and once this occurs, the area would provide some additional opportunities for solitude. Harvest activities associated with alternatives 2 and 3 adjacent to the roadless area could result in indirect, short-term effects on solitude within the area. Proposed activities within the roadless area would also reduce solitude in the short-term. The increased sights and sounds of people and equipment during the construction of the shaded fuelbreak would result in direct, short-term effects on solitude. To a lesser extent, other projects such as planting, fence building, and seeding would also create short-term disturbance.

Cumulative Effects: No other projects that could affect roadless character in the South Fork-Tower Roadless Area are foreseen at this time. Since no timber harvest or road building would occur in any of the proposed alternatives, no major cumulative effects are anticipated.

ALTERNATIVE 4

Direct/Indirect/Cumulative Effects: The major differences between Alternative 4 and alternatives 2 and 3 that might affect the roadless character of the area are:

- Forest Road 5448 would be closed at the 550 junction and vehicle access to Three Culverts Camp would be eliminated.
- No timber harvest would occur in this alternative.
- Herbicides would not be applied within tree planting areas.
- The fuelbreak along the boundary of the North Fork John Day Wilderness and the roadless area would not be constructed.

The effects to the character of the South Fork-Tower Roadless Area would be similar to those described for alternatives 2 and 3, but slightly less. Vehicle access to Three Culverts Camp would be eliminated although there would be no change in OHV use in the roadless area. Since there would be no timber harvest associated with Alternative 4, solitude would not be affected by harvest activity disturbance. Construction of the fuelbreak between the roadless area and Wilderness would not occur. Thus, solitude would not be affected by the short-term disturbance associated with fuelbreak construction. The modifications to apparent naturalness associated with the fuelbreak would not occur.

ALTERNATIVE 5 AND 6

Direct/Indirect/Cumulative Effects: Most of the activities proposed in alternatives 5 and 6 that have the potential to affect the character of the South Fork-Tower Roadless Area are the same as those described for alternatives 2 and 3. The major differences are:

- 40 acres of harvest (only under Alternative 6) within the roadless area
- Forest Road 5448 would be closed at the 550 junction in Alternative 5 and at the north end of the meadow in Alternative 6 and vehicle access to Three Culverts Camp (which is along the edge of the roadless area) would be eliminated.
- 80% less harvest in Alternative 5 and 34% less harvest in Alternative 6.
- The fuelbreak along the northern boundary of the North Fork John Day Wilderness would not be constructed.

Effects would be similar to those discussed under alternatives 2 and 3. Only one harvest unit along Forest Road 52 would fall within the periphery of the roadless area boundary. The short-term disturbance from timber harvest would be less for Alternative 5 than Alternative 6.

Wild and Scenic River

The outstandingly remarkable values of wildlife and fisheries are discussed under sections that occurred earlier in this chapter. The outstandingly remarkable values of scenery, cultural, and recreation are described here.

ALTERNATIVE 1

Direct/Indirect Effects: The existing scenic conditions within the Wild and Scenic River corridor would remain unchanged, as would the current trends in the development of the scenic quality of the area. Unsightly conditions along Forest Road 5506 at the crossings of Sheep and Oriental creeks would remain. In these areas the roadbed has been either partially or completely washed out, resulting in an exposed and unstable roadbed, deposits of sediment, and woody debris within 100 feet of the river. This would not be consistent with Forest Plan direction to rehabilitate negative visual elements within Wild and Scenic River corridors. Over time, dense fir encroachment of historically open ponderosa pine stands (primarily on the north side of the river) would increase the risk of high levels of mortality due to unsustainable species compositions and stocking. As a result, stands would be more susceptible to insects and disease, and the older, larger trees would become more stressed due to competition for space, water, and nutrients.

The existing conditions of cultural resources within the Wild and Scenic River corridor would not change under this alternative.

Existing recreational opportunities would continue as they currently exist. Limitations on recreational opportunities and access to the Wild and Scenic River corridor that were caused by the flood would not be resolved. Several campsites and a bathroom at the Oriental Creek Campground that were damaged during the flood would not be repaired and so would remain unavailable for use. Additionally, damage of the Forest Road 5506 crossing of Oriental Creek would limit vehicle access and suitable parking for the trailhead does not exist. Recreationists wishing to access the Big Creek Trailhead at the end of Forest Road 5506 would continue to congest Oriental Campground with vehicles and trailers or use an unsafe, user-made ford pioneered over Oriental Creek.

ALTERNATIVES 2, 3, AND 6

Direct/Indirect Effects: Scenic quality would be improved through repair of unsightly conditions along Forest Road 5506 at the crossings of Sheep and Oriental creeks. Replacement of culverts would restore these areas to conditions similar to those that existed before the flood damage. Once the repairs were implemented, there would be no measurable change in visual conditions from those that existed in these areas prior to the damage. Selected stands along the north side of the river would be commercially thinned with a combination of helicopter, skyline, and ground based logging systems. This would enhance the visual quality of the area in the long-term by reducing risk of tree mortality and emphasizing large tree components. Of the total commercially thinned acres, approximately 51 acres would be within the Wild and Scenic River corridor, only 9 of which would be visible from the river. The proposed thinning would not dominate the landscape because stands proposed for treatment are located on the lower, gentler slopes adjacent to Forest Road 5506 and thinning would leave stands fully stocked. Thinning would promote development of large diameter trees and multi-aged stands and the existing large trees would be healthier and more likely to survive longer due to the reduced competition. Minor adverse affects on the visual quality of the river corridor could occur during harvest operations, but after the harvest is complete, the resulting stands would appear as part of the naturally appearing landscape.

The Wild and Scenic River corridor in the analysis area has been surveyed for cultural resources. Known sites would be protected from any ground disturbing activities, so there would be no effects to cultural resources.

Recreational opportunities would be restored to pre-fire and flood conditions. Repairs to Forest Road 5506 would allow access to the Wild and Scenic River corridor for most recreational users and their vehicles. A vehicle crossing at Oriental Creek would be reconstructed, allowing vehicle access to the Big Creek Trailhead. Campsites and the toilet at Oriental Campground would be restored so that all sites would be available for use.

Cumulative Effects: Scenic improvements achieved through the proposed thinning and road repair would add to recent restoration of about 8 miles of river floodplain that had been affected by dredge mining operations (known as the North Fork John Day Dredge Tailings Restoration Project). Ongoing and future activities within the Wild and Scenic River corridor include two mining claims with proposed increases in their level of exploration - Camp Creek Placers occurs within the analysis area on the edge of the burn, and Apache #3 is immediately downriver of the analysis area. The visual appearance of these claim sites would be altered during mining operations, but with mitigation measures and existing topographic and vegetative screening, they should not significantly affect the visual quality of the Wild and Scenic River corridor. The timing and duration of these two activities is not known, but since the commercial thinning that could be seen from the river would not occur near either claim, there would be no combination of effects on visuals. Removal of hazard trees is an ongoing activity that occurs as normal campground maintenance in two developed campgrounds located along the river. In the past this has had a minor affect on visuals because few trees are cut at a time and the campgrounds already appear as actively managed areas. Overall, the activities proposed under these alternatives would contribute to the cumulative enhancement of the corridor's visual quality.

The proposed repairs of the stream crossing and Oriental Campground would combine with ongoing campground and road maintenance to enhance the recreational experience of users of the Wild and Scenic River corridor.

ALTERNATIVE 4

Direct/Indirect/Cumulative Effects: Scenic quality would be improved through repair of unsightly conditions along Forest Road 5506 at the crossings of Sheep and Oriental creeks. Sheep Creek crossing would be repaired to conditions that existed before the road damage returning scenic quality to its pre-flood state. The conditions at Oriental Creek would be rehabilitated to create a more stable situation, but there would no be vehicle access across the creek. A footbridge would be constructed to provide access to the Big Creek Trailhead at the end of Forest Road 5506. An additional parking area would be constructed near Oriental Creek Campground. This parking area would be visible from the river and depending on the level of use could detract from the visual quality of the area.

Thinning of large trees would occur on 599 acres, but instead of harvesting the unwanted trees, they would be girdled or felled and left on site. The overall affect on scenic quality would be much the same as already discussed for alternatives 2, 3, and 6. There would be somewhat less visual impact on the 9 acres visible from the river since there would be no harvest activity, however, the dead standing trees resulting from girdling or the felled trees left on site may not appear natural to some forest visitors. Because of this, management activity would remain evident longer than with alternatives 2, 3, and 6.

The Wild and Scenic River corridor in the analysis area has been surveyed for cultural resources. Known sites would be protected from any ground disturbing activities, there would be no effects to cultural resources.

Recreation opportunities in the Wild and Scenic River corridor would be improved over existing conditions, but not restored to pre-flood levels. Access would be provided for recreation users and their vehicles up to Oriental Creek Campground, and the campsites and toilet would be restored and available for use. However, the Forest Road 5506 crossing of Oriental Creek would not be repaired. Instead, a small bridge would be constructed to provide access for foot traffic beyond Oriental Creek and the road would be closed to vehicles. A parking area for vehicles and trailers would be constructed near Oriental Creek Campground. This would change historic use of the area in that the Big Creek Trailhead at the end of Forest Road 5506 would not be accessible by vehicles. The final 2 miles of this road are an intrusion into the North Fork John Day Wilderness area and closing this stretch of road to vehicles would consolidate the wilderness.

Cumulative effects would be the same as those discussed under alternatives 2, 3, and 6.

ALTERNATIVE 5

Direct/Indirect/Cumulative Effects: The scenic effects of rehabilitating the road crossings at Sheep and Oriental creeks would be the same as described for Alternative 4. Commercial thinning under this alternative would result in less potential effects on scenery than under alternatives 2, 3, and 6 because

stands would be logged by helicopter. This would result in less ground disturbance and less short-term visual impacts as compared to alternatives 2, 3, and 6 for the 9 acres visible from the river.

The Wild and Scenic River corridor in the analysis area has been surveyed for cultural resources. Known sites would be protected from any ground disturbing activities, there would be no effects to cultural resources.

The effects on recreation opportunities in the Wild and Scenic River corridor would be the same as those discussed under alternatives 2, 3, and 6.

Cumulative effects would be the same as those discussed under alternatives 2, 3, and 6.

Visual Quality

ALTERNATIVE 1

Direct/Indirect Effects: A healthy forest environment setting is an important attribute that contributes to the overall recreation experience of visitors. While the Tower Fire created extensive views through its reduction of forest cover, the overall health and visual appearance of the affected forest has been reduced and would remain poor for a long period under this alternative. Based on Agriculture Handbook #701, visual integrity is currently unacceptably low because the fire caused extreme alteration of the valued landscape character (forest cover), particularly in terms of scale. Dead trees would remain a prominent feature in the landscape until they fall down, creating a tangled appearance in the foreground and middle ground of the Blue Mountain Scenic Byway, the Wild and Scenic River corridor, and developed recreation facilities. Large openings created by the most severe fire activity would remain until forest vegetation recovers through plant succession. Structural diversity, which contributes texture and form to visual quality, would not exist for decades within the areas of high tree mortality. The variety of crown sizes, textures, and colors provided by a mixture of tree species and ages was also lost where stands experienced high mortality. Where lodgepole pine regenerates prolifically, the resulting thick stands of small diameter, single species trees would provide a homogenous view, most likely resembling a thick “wall” of fine textured crowns with a uniform color. These types of stands do not produce large trees, so structural diversity in such areas would remain less than what existed before the fire. Because these conditions would not be changed under this alternative, visual diversity in the foreground, middle ground, and background would remain low for decades, if not centuries. While this would detract from the quality of the recreation experience, the availability of unique recreation settings (Wild and Scenic River Corridor, Scenic Byway, Wilderness Area, OHV Complex) within the Tower Fire would continue to attract recreationists to the area, regardless of forest condition.

ALTERNATIVES 2, 3, 5, AND 6

Direct/Indirect Effects: Harvest, thinning, and reforestation would facilitate a quicker return to a healthy forest setting than natural recovery (see Forest Vegetation discussion). Tree planting would establish seedlings more quickly than natural regeneration and would encourage growth of mixed species, which would allow the area to reach visual quality objectives more quickly than Alternative 1. Alternatives 2, 5, and 6 would result in timelier reestablishment of trees than Alternative 3 because competing vegetation would be controlled, improving seedling survival and growth. Where salvage harvest is to occur, removal of high densities of dead trees would make it possible to plant western larch, a species that requires open, sunny environments. Western larch would benefit visual quality by providing fall color and diversity in crown and bole structure, as well as add opportunities for larger trees. This would be especially important in areas dominated by lodgepole pine. Salvage harvest would remove 571 acres of dead trees from the foreground and middle ground of the Blue Mountain Scenic Byway (159 acres have already been salvaged under the Overlook Sale), which is allocated as A-3 Viewshed 1 in the Forest Plan. This allocation calls for a visual quality objective of retention in the foreground and partial retention in the middle ground. However, the Forest Plan also allows landscapes containing negative visual elements to be rehabilitated. Removal of large amounts of dead trees would reduce the undesirable visual effect (texture, color, reflectivity) of these trees in the foreground and middle ground, and reduce the potential for an unattractive tangle of downed trees in the future. Logging activity would be visible in the foreground. To mitigate this, landing sizes and slash piles would be kept small, with slash handpiled and

burned within 300 feet of the road. Given the scale of the fire, it is not possible to treat enough area through harvest or planting to fully rehabilitate the area. However, future textural and color diversity in the viewshed would be increased while the immediate effects would be mitigated by designing harvest to mimic natural openings; reducing visual dominance of slash, stumps, and skid trails; and planting seedlings within and outside harvest units at a broad enough scale and pattern so as to appear natural. Harvest in the middle ground and background along the scenic byway would likely remain visually subordinate to the fire as a whole, with landings and skid trails being the most likely impact. Slash would be spread on landings and skid trails to mitigate their appearance. Several overstocked stands would be thinned adjacent to the Wild and Scenic River corridor, improving their health and encouraging development of large trees that would increase structural diversity. All of the activities mentioned above would accelerate visual diversity throughout the fire area, although recovery would still likely take decades. Potential for future catastrophic fire would be reduced, increasing the likelihood of vegetation/visual recovery.

ALTERNATIVE 4

Direct/Indirect Effects: Thinning and reforestation would facilitate a quicker return to a healthy forest setting than natural recovery, however, reforestation would have a low success rate because competing vegetation would not be controlled (see Forest Vegetation discussion). Girdling or felling of trees otherwise proposed for harvest in Alternative 2 would not address the fire's deviation from visual integrity, and could actually increase the deviation in areas where green trees would be affected (such as along the Wild and Scenic River).

Wildlife Habitat

Analysis of wildlife habitat was begun for the proposed projects in 1997 and has been updated. Much of this report is based on information presented in the Tower Fire Ecosystem Analysis (1997). The scale used for analysis varies between the Tower Fire area (considered the analysis area) and the affected outlying subwatersheds, as appropriate to the topic. The quantity and quality of wildlife habitat was assessed using aerial photographs, district records, and field reconnaissance. Cumulative effects to wildlife were considered by developing a checklist of past, present, and foreseeable future activities, then diagramming cause/effect relationships of the proposed activities. This analysis is applied to categories of habitat as related to the wildlife issue. Where quantitative information is available, it is presented.

Effects of the proposed activities to wildlife are not considered significant in the context of the Tower Fire area, the Umatilla National Forest, and the Blue Mountains. Many wildlife species will not be affected at all, either because they no longer inhabit the area since the fire, or because they are well adapted to post-fire conditions. Those species that are well adapted to post-fire conditions should not be significantly impacted by projects that only affect a small portion of the fire and are limited in duration and intensity. No adverse effects are expected for any wildlife species listed as Sensitive by the Forest Service, nor those listed as Threatened, Endangered, or "of concern" by the U.S. Fish and Wildlife Service.

General Habitat

ALTERNATIVE 1

Direct/Indirect Effects: The Tower Fire created an abundance of early successional habitat over a large area. Wildlife species associated with this habitat type would thrive, but overall diversity would be low and recovery of forested habitats would take many years. A diversity of habitat types and conditions would still occur within the surrounding subwatersheds to support and maintain a variety of wildlife species.

Shrubs and grasses could out-compete natural tree regeneration, resulting in more shrub habitat and less forested habitat over a longer period. An increase in shrubs could also increase the frequency of wildfire across the area, further retarding the recovery of forested habitat. Overstocked stands would continue to be stressed and potentially at risk for insect and disease out breaks or stand replacement fire. Forage in the understory of these stands would become shaded out and decline in vigor. Areas with a high density of snags and down wood could be at high risk for wildfire. Where fuel densities are high, future fires

would burn regenerating seedlings and saplings, killing vegetation and extending the length of recovery for the site.

ALTERNATIVE 2

Direct/Indirect Effects: Thinning, treatment of root rot pockets, and planting would accelerate development of forested habitat and improve habitat diversity. Control of competing vegetation (outside of riparian areas) would increase the survival of planted seedlings, and allow forested habitat to develop at a faster rate. Herbicides proposed for use in treating competing vegetation are not toxic to wildlife when applied as directed on the label (USDA 1992; USDA 1996; and USDA 1997) and do not bio-accumulate if ingested. The main impact of this activity on wildlife would result from changes in vegetation. Since herbicides would be applied in spots around seedlings, rather than broadcast across an entire site, the impact on small mammals and other wildlife species would be negligible (USDA Forest Service 1998).

Proposed salvage and roadside hazard tree removal on 3,962 acres (8% of the fire area) would remove dead standing trees important to many wildlife species in the short-term. However, removal of dead trees would also reduce fuels, which in turn would reduce the risk of subsequent fires that could further degrade wildlife habitat. Commercial thinning would open the forest canopy on 843 acres. These activities would result in a short-term loss of green tree cover, but a long-term improvement in the health of those stands. Thinning would allow more sunlight to reach the forest floor and stimulate grass, forb and shrub germination and growth in the understory. The increase in herbage would provide forage and cover for many species of wildlife in the area. The structural integrity of the thinned stands would be maintained, and remaining trees should respond by increasing in size. These stands should reach the late structural class sooner and be in a healthier condition to resist insects and disease, ultimately providing habitat for species associated with older and larger trees. Special habitats such as meadows, scab habitats, and rock/talus slopes would be directly avoided and their boundaries further protected by the mitigation identified in Chapter 2.

Proposed prescribed burning would enhance forage for big game on 900 acres. Big game and other species would be attracted to this area, thereby dispersing herbivory activities over a broader area and reducing the potential for concentrated use on more sensitive sites. Prescribed burning could temporarily displace wildlife species associated with grass and shrub communities beneath a forested overstory, but species would reoccupy habitat within 3-5 years as vegetation regenerates on the site.

Proposed road projects (repair or obliteration of existing roads or construction of temporary roads) would have little or no effect on the quality or quantity of habitat in the fire area. No new permanent roads would be constructed for this proposal and temporary roads would be obliterated and re-vegetated after harvest activities are completed.

Cumulative Effects: The Tower Fire overshadowed the effects of many past activities by changing wildlife habitat structure and composition over a large portion of the analysis area, however some activities still have a residual effect within the burn. Timber and fuel wood harvest reduced tree densities and down wood in many areas, which have been further decreased by the fire. Livestock grazing and fire suppression changed species and structural compositions, while installation of range improvements (fences, water developments, etc.) still affects distribution of livestock and wildlife. Road construction increased human disturbance of wildlife and increased vulnerability of big game to hunting. This has been intensified by the consumption of vegetation across large areas by the Tower Fire.

Species which favored open stands of old ponderosa pine have likely declined as these stands have grown in with more shade-tolerant species. Based on the forest vegetation analysis, the proposed activities would immediately accelerate development of historic species compositions, structure, and stand densities on 17 percent of the fire area, with reintroduction of fire where fuels are reduced moving an 2 percent of the fire area toward historic trends in the long-term. Foreseeable future thinning within and adjacent to the fire area, ongoing and future prescribed burning adjacent to fire area, and future reintroduction of fire within the burn would further return the area to historic habitat conditions. Wildlife species would respond in kind to these habitat shifts.

ALTERNATIVE 3

Direct/Indirect Effects: Effects to wildlife habitat in general would be similar to that described in Alternative 2. Reforestation efforts without herbicide treatments would be less successful, so it would take longer for many wildlife habitats to recover from the fire.

Cumulative Effects: Cumulative effects would be similar to those discussed under Alternative 2 except that immediate movement toward historic habitat and species compositions would occur on only 10 percent of the fire area and proposed planting would only have a 35 percent survival rate, so renewal of forest habitat would be limited.

ALTERNATIVE 4

Direct/Indirect Effects: Effects to wildlife habitat in general would be similar to that described in Alternative 2 with the following exceptions. This alternative would close the most miles of currently open road and no new trail would be constructed for off-road vehicles, which would be the most beneficial to wildlife security. Restricting prescribed burning to the fall would be more difficult to accomplish due to weather constraints, and could result in delayed implementation. Girdling commercial-sized trees as a method of thinning would provide additional snags and down wood in the short term, while still reducing competition from overstocking and promoting late and old structure. While eliminating harvest and commercial thinning would result in more cover and habitat structure than in other action alternatives, it would be at the risk of supplying fuel for potential future fires. Reforestation efforts without herbicide treatments would be less successful, so it would take longer for many wildlife habitats to recover from the fire.

Cumulative Effects: Cumulative effects would be similar to those discussed under Alternative 2 except that immediate movement toward historic habitat and species compositions occur on only 9 percent of the fire area, accelerated renewal of forest habitat would be limited by a 35 percent survival rate of planted trees, and fire would not be reintroduced inside the burn in the future due to high fuel loads. This alternative would close 18.5 miles of open road in addition to those already closed under the District Motorized Access and Travel Management Plan, which would be the most beneficial to wildlife security than any other alternatives.

ALTERNATIVE 5

Direct/Indirect Effects: Effects to wildlife habitat would be similar to that described for Alternative 4. The prescribed burn would not be implemented in order to protect soil cover, which would result in fewer acres of forage enhancement for big game. Helicopter logging to the exclusion of all other methods could result in higher snag losses due to down drafts from helicopter rotors. These effects could be relatively minor and localized, depending on particular site conditions. Since some logging and fuels treatments would occur, fuels would not be as high in this alternative as in Alternative 4, and the fuel break would also be created to reduce future fire risk.

Cumulative Effects: Cumulative effects would be similar to those discussed under Alternative 2 except that long-term acceleration of movement toward historic habitat and species compositions would increase only 0.2 percent over the short-term improvement in historic habitat and species compositions. This alternative would close 12.9 miles of open road in addition to those already closed under the District Motorized Access and Travel Management Plan, and would be nearly as beneficial to wildlife security as Alternative 4.

ALTERNATIVE 6

Direct/Indirect Effects: Effects to wildlife habitat would be similar to that described for Alternative 2 except that timber harvest is reduced by nearly ½ (45%), fuels reduction treatments are proposed on 740 acres, and 12.7 miles of currently open road would be closed. The reduced amount of salvage harvest and commercial thinning in combination with the relatively large number of open road miles closed would result in more wildlife cover, habitat structure, and security areas than in other action alternatives. Additionally, fuels reduction projects should reduce the risk of future fire and therefore protect wildlife habitat in the long term.

Cumulative Effects: Cumulative effects would be similar to those discussed under Alternative 2 except that long-term acceleration of movement toward historic habitat and species compositions would be a little greater than 1 percent above the short-term improvement due to the smaller area of fuel reduction. This alternative would close 12.7 miles of open road in addition to those already closed under the District Motorized Access and Travel Management Plan, which would be more beneficial to wildlife security than Alternative 2.

Riparian Habitat

ALTERNATIVE 1

Direct/Indirect Effects: Riparian habitat would recover slowly, and in some areas remain unsuitable for species associated with riparian hardwoods and shrubs for a long period. Sensitive wetland and riparian habitats within Donut, Long, Round and Pearson meadows and vegetation at two springs and three ponds could be degraded by potential future livestock use and dispersed camping.

ALTERNATIVES 2-6

Direct/Indirect Effects: Proposed riparian planting and fish habitat restoration projects would maintain or enhance wetland habitats in the fire area. Proposed fencing of the three ponds, two springs, and four meadows would protect them from potential future livestock grazing. This would allow wetland vegetation to recover fully with minimal utilization and provide wetland wildlife species with quality habitat. The repair of the three ponds would help maintain wetlands and provide habitat for aquatic insects, amphibians and a watering source for wildlife. Alternative 5 would expand the no harvest zone around Class 3 streams, resulting in more dead and down trees in the riparian habitat. This would be beneficial, particularly for species that use cavities in riparian areas, but would also create a higher fuel load and risk for future intensive fires.

Cumulative Effects: The Tower Fire was the primary influence on the condition of riparian habitat. Many riparian restoration projects have already been completed in the affected subwatersheds, improving habitat conditions for fish and wildlife. Riparian areas in the affected subwatersheds would not be affected by most ongoing and future activities, which comply with the amended Forest Plan (which incorporates PACFISH standards and guidelines for Riparian Habitat Conservation Areas). All activities on the District are currently being reviewed for compliance with the Endangered Species Act regarding listed fish. Any adverse conditions for listed fish species would not likely be allowed to continue, and as such, riparian habitat for wildlife species would not be degraded. The Tower Fire area is currently being rested from grazing, but livestock use may be proposed in the future. The cumulative effects of livestock and big game utilization of riparian areas could degrade riparian habitat if areas have not recovered fully from the fire.

Old Growth Habitat

ALTERNATIVE 1

Direct/Indirect Effects: Remaining green patches of old growth would continue to exist, and no dead trees would be removed from old growth stands killed in the fire. Forest Plan designated C1 - Dedicated Old Growth stands that were killed by the fire would not be replaced at this time and potential green old growth stands outside the burn would not be protected from future harvest. Overstocked green stands within the fire boundary could take longer to reach the late or old structural stage that is currently deficient throughout the fire area. Species dependent on mature forest would not likely occupy much of the fire area for 100-200 years (the length of time estimated for development of mature forest).

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: No timber salvage would occur in C1 - Dedicated Old Growth, but salvage would occur in approximately 178 acres of inventoried old growth that burned. Since these areas have burned and no longer function as old growth, the effects of harvest would be negligible. All live trees would remain, and the largest snags available would remain at levels described in the mitigation section in Chapter 2.

Commercial thinning would occur on 11 acres of green overstocked stands containing trees averaging 10 to 12 inches diameter at breast height. This treatment would be designed to maintain canopy cover and move the stands toward a late and old structural stage faster than if left alone.

New areas to designate as C1 - Dedicated Old Growth have been identified outside the fire perimeter. Replacement acres would approximate those that were lost to the fire, however large contiguous blocks of old growth habitat are not available. The new designations of these remaining patches of old growth forest would provide protection from woodcutting, recreational developments, road building, and timber harvest.

Cumulative Effects: Previous harvest activity on the District removed substantial amounts of old growth habitat. Several recent large fires, including the Tower, Summit, and Bull Fires, also contributed greatly to a reduction in old growth forest and connectivity between old growth stands. Replacement stands would be identified for the C1 stands that were lost in the fire under all action alternatives, but the loss of these habitats would not be recovered in the short term. Foreseeable future thinning adjacent to the fire would accelerate development of late and old stand characteristics in surrounding areas. Any future harvest proposed would adhere to the Forest Plan Amendment #11 intent to maintain and promote late and old structural stands.

ALTERNATIVES 4 AND 5

Direct/Indirect/Cumulative Effects: Effects will be similar to Alternatives 2 and 3 except that no salvage would occur within fire-killed inventoried old growth stands. This would provide more large-diameter snags than other alternatives, and in turn provide more cavity excavator habitat over the long-term. Thinning the overstocked green stands through girdling or felling excess trees and leaving them would move stands toward a late and old structure and provide down wood habitat. Cumulative effects would be the same as described under Alternatives 2 and 3.

ALTERNATIVE 6

Direct/Indirect/Cumulative Effects: Effects would be similar to those discussed under Alternatives 2 and 3 with the exceptions that only 28 acres of fire killed inventoried old growth would be salvaged, and fuels treatments are planned on 87 acres. About 14 acres of inventoried old growth that experienced nearly complete mortality would be treated by removing or fragmenting the standing dead material, and using a full suspension ground based harvest system to remove stems 5-15” in diameter, which would be decked for sale or burning. A slashbuster-type machine may also be used to disperse material. Approximately 15 acres of burned inventoried old growth near roads would be sold as firewood. These salvage and fuels treatments will not negatively impact the old growth resources in the area, since these areas are burned over and affect only a fraction (4%) of the total burned old growth habitat in the area.

In 58 acres of inventoried old growth with a healthy overstory of Ponderosa pine and/or western larch, proposed fuels treatments include felling the understory mortality, then underburning in the fall or spring. Reducing the fuels in these stands will aid in the retention and development of old growth characteristics.

Dead and Down Wood Habitat

ALTERNATIVE 1

Direct/Indirect Effects: Dead standing tree habitat would be abundant in the short-term, however, virtually all burned trees would fall in the next 30 years, resulting in an abundance of down wood habitat but a shortage of snags (Gobar 1996). The actual rate of fall-down would be dependent on the intensity of fire scorching, tree species and diameter, pre-fire condition of trees, and location. In general, trees in wind prone areas, such as ridge tops, would fall sooner than trees in protected areas, such as stream bottoms. Some trees would be uprooted entirely while others would break off at various heights providing a diversity of structures for wildlife. As this occurs, vertical cover would decrease and coarse woody debris, which provides horizontal screening cover, would increase. The large amounts of down wood could also create conditions conducive to intense fires that could sterilize soil. A reoccurrence of high intensity wildfire would set back the vegetative recovery that has occurred after the Tower Fire, which would delay creation of snags in the long-term. The fall-down process began during the autumn of 1996

and is expected to continue for the next few decades. Natural regeneration could take 50-75 years (or longer where natural reforestation is delayed) for large green trees and snag habitat to develop across the landscape**.** This could be further delayed due to the fire's consumption of nearby seed sources.

ALTERNATIVES 2-6

Direct/Indirect Effects: Salvage operations associated with Alternatives 2 and 3 would result in an immediate reduction of snag habitat on 3,299 acres, while Alternative 5 would reduce snag habitat on 998 acres and Alternative 6 would reduce snag habitat on 2,106 acres. Under Alternative 5, the exclusive use of helicopter logging could result in higher snag losses due to down drafts from helicopter rotors. These effects could be relatively minor and localized, depending on particular site conditions. Alternative 4 would not salvage dead trees and, in fact, would increase their abundance for a short period due to girdling of large trees within thinned stands. Unharvested areas would contain relatively high levels of snags, depending on the pre-fire condition. Regardless of harvest activity, most dead trees are expected to fall in the next few decades.

In salvage harvest units that experienced heavy tree mortality, all green trees would be left and these trees would be available in the future as snag habitat. Mitigation measures modified from *Guidelines for Post-fire Restoration Projects* (Gobar 1996) would ensure that the largest and most sound snags would be left in each harvest unit. The original snag guidelines were based on population requirements of those cavity excavator species expected to occur after a fire. The snag retention criteria were tied to the plant association group, but differed from many previous standards by suggesting that all snags retained be the largest available in the unit to help preclude wind throw. Modifications to these criteria resulted from review of the in-depth snag analysis for the Summit Fire Recovery FSEIS (Knotts 1998), as well as recent publications developed by Forest Service Research Stations (Saab and Dudley 1998; Bull et al. 1997). This modified guidance would be applied to all harvest alternatives in the Tower EIS. Leaving the recommended snag levels is expected to provide adequate snag habitat for 20-30 years in heavy mortality stands, and longer in stands that have larger diameter trees (>24 inch diameter at breast height) and green trees to contribute to future snag habitat.

In some harvest units, many green trees remain, and these would provide an important source of future snags within the fire, while existing snags would continue to be abundant. Therefore, areas which meet green tree replacement requirements for future snag habitat would be excluded from the higher snag retention standard, though leaving the largest snags in the unit would still be a requirement (see scenarios A and B under snag mitigation in Chapter 2).

Since down wood will be plentiful as dead trees begin to fall, retention standards for this component would follow the existing District guidance (letter of 3/22/96).

The proposed snag enhancement project would remove tops from scattered large trees to reduce wind resistance, which should extend the length of time snags remain standing. This would maintain nesting and roosting habitat for a longer period. (See Management Indicator Species section for discussion of the effects on primary cavity excavators and secondary cavity nesters.)

Cumulative Effects: Post-fire harvest associated with Lone, Dragon, Hairy Hazard, and Overlook sales reduced snag habitat on 3,135 acres, while harvest on private lands reduced snag habitat on an additional 360 acres. This, coupled with the proposed reduction in dead trees would affect between 9 and 14 percent of the burned area. Areas not salvaged would retain high levels of snags in the short-term, as described in Alternative 1.

Management Indicator Species

ALTERNATIVE 1

Direct/Indirect Effects: A variety of conditions would be available, such as unlogged areas with high tree densities, lightly burned areas with green trees remaining, and some previously logged areas, providing for optimal woodpecker use (Saab and Dudley 1998). The ***northern three-toed woodpecker*** occurs in the analysis area and is expected to increase its presence, due to its attraction to large stands of dead trees. Other ***primary cavity excavators*** expected to do well for the next 15-20 years are:

Lewis's woodpecker, hairy woodpecker, black-backed woodpecker, northern flicker, and the downy woodpecker. These species tend to prefer large, dead, standing trees for construction of nesting and roosting cavities. In addition, they forage primarily on dead standing trees, on down logs, or on the ground. However, not all primary cavity excavators benefit from post-fire conditions because many are dependent on live "green" trees and uncharred logs for habitat (such as ***pileated woodpecker***).

Dead standing trees would be susceptible to wind throw and natural fall rates. The greatest loss in snag habitat could occur within 10 years. With the increasing amount of down material, snags and down wood could be at risk if future fire occurs in the area. This would ultimately limit the distribution and density of primary cavity excavator and secondary nesters in the burn area. While current habitat conditions limit the number and type of management indicator species occurring within the fire area, habitat for all Forest Plan management indicator species occur outside the burn in the adjoining subwatersheds.

The ***American marten***, which depends on mature forest, may not occur in the area for many years. Natural recovery would lengthen the time to develop conditions that could support these and other species that are dependent upon mature forests and well-developed riparian areas.

Summer and winter foraging habitat for ***Rocky Mountain elk*** should be abundant throughout the fire area. Summer forage quality should diminish within 3 to 5 years after the Tower Fire when nutrient levels normalize and shrubs begin to dominate the site. Winter forage should be abundant and could dominate the area for many years. Big game could concentrate grazing in potentially undesirable areas. A large number of elk would be attracted to micro sites that are "greening up" after the fire, and would subject these sites to compacting, conifer elimination, and reduced vigor for grasses and shrubs. Excessive utilization in riparian areas and tree plantations could impede riparian and conifer habitat recovery in the area. Damage to crops and forage on private lands adjacent to the fire could be a perpetual problem.

Hiding and thermal cover for elk would not be well distributed and would develop slowly. Cover developing in the area would occur in small patches rather than the large stands of dense cover. Some marginal cover would be available in the lightly burned areas, and hiding cover could quickly develop in lodgepole pine areas that tend to naturally regenerate prolifically. All trees would remain to serve as screening to obscure the view of elk, but eventually the dead trees would fall. Based on the discussion under the Forest Vegetation section, marginal cover would likely develop in 50-70 years while effective suitable cover would require 70-100 years, particularly since tree seed sources were consumed in a large portion of the fire.

Road densities would remain at the current level and public recreation activities on and adjacent to roads are expected to increase in the near future (particularly OHV use). Because stands are now more open, human disturbance of all wildlife would be greatest in the spring and autumn during mushroom harvesting and hunting seasons. With the combined loss of cover and potential increase in human activities, big game disturbance and displacement in the general area would increase and would vary in intensity throughout the year.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: Dead standing tree habitat for the ***northern three-toed woodpecker*** and ***primary cavity excavators*** (hairy woodpecker, black-backed woodpecker, Lewis's woodpecker, northern flicker, and downy woodpecker) would be in abundance for several years after the fire. Mitigation to retain snags in harvest units (4,805 acres) would ensure adequate levels of large snags and down logs remain in units, and ample short-term snag habitat would be available in unharvested areas. A variety of conditions will be available, such as unlogged areas with high tree densities, lightly burned areas with green trees remaining, and some previously logged areas, providing for optimal woodpecker use (Saab and Dudley 1998). Mitigation requiring retention of the largest dead trees available should lengthen the time the proposed harvest areas are suitable for nesting (Saab and Dudley 1998). Once the majority of dead trees fall, these management indicator species would not likely occupy the majority of the areas. Proposed snag enhancement which would remove tops from large, sound trees would extend the longevity of some snag habitat by reducing the likelihood of wind throw.

Proposed activities would maintain or improve ***Rocky Mountain elk*** summer and winter foraging habitat. Forage enhancement (prescribed burning), commercial thinning, salvage harvest, and road obliteration

activities would improve or maintain the availability of grasses and shrubs in the fire area. The forage component would increase in quality and quantity across the fire area within the next three to five years. Competing vegetation treatments around seedlings (1,740 acres) would not measurably decrease the availability of grasses and shrubs, due to the wide distribution of grasses and shrubs in the fire area. The remaining activities (fish habitat projects, wetland protection, snag enhancement, etc.) would not greatly change the quantity or quality of forage in the burned area, and so would not directly or indirectly affect forage for elk.

Some proposed activities would decrease hiding and thermal cover for elk in the short-term. The commercial thinning would maintain canopy cover between 45 and 60%, retaining marginal cover and, in some places, satisfactory cover for elk. Dead standing trees (which provide some hiding cover) would be reduced through harvest and this would increase exposure of big game to human disturbance under these alternatives. Pre-commercial thinning and the shaded fuel break would also decrease hiding cover. Altogether, the salvage, Armillaria treatment, commercial and non-commercial thinning, and fuel break would reduce hiding cover over approximately six percent of the burned area. Hiding cover in the fire area would eventually improve through conifer and riparian plantings and natural regeneration. Under Alternative 2, competing vegetation treatments (herbicide and scalping) would increase seedling survivability, and potential cover habitat would develop at a quicker and more efficient rate than with natural regeneration.

Proposed road projects would not result in a net increase in open road densities. Temporary roads would be constructed to facilitate harvest activities, but these roads would be closed and obliterated after harvest is completed so associated disturbance would last only as long as they remain open (estimated three to five years). Road densities would remain at the current level and public recreation activities on and adjacent to roads are expected to increase in the near future (particularly OHV use). Because stands are now more open, human disturbance of all wildlife would be greatest in the spring and autumn during mushroom harvesting and hunting seasons. With the combined loss of cover and potential increase in human activities, big game disturbance and displacement in the general area would increase and would vary in intensity throughout the year.

Cumulative Effects: Past timber harvest and associated roads on both private and National Forest lands have cumulatively reduced wildlife snags and big game cover in the short-term. Several large fires on the North Fork John Day Ranger District (Tower, Summit, Bull) have further reduced big game thermal and screening cover**.** Harvest proposed under Alternative 2 or 3 would remove some additional hiding and thermal cover; however, tree planting on 11,594 acres (including upland and riparian planting) would offset these reductions in the long-term by initiating the recovery of cover associated with conifer species more quickly than natural reforestation.

Ongoing activities that would add to disturbance or loss of habitat within and adjacent to the Tower Fire area include campground tree thinning and maintenance along the North Fork John Day River, active mining claims (Camp 1 and 2, Apache 3), grazing and fence maintenance on privately owned lands and portions of National Forest lands which burned at a low intensity, mushroom harvesting, hunting, dispersed camping, OHV trail use and maintenance, road maintenance, and firewood cutting. While the effects would be short-term and intense at times, long-term effects are not expected. The ongoing tree planting of past harvest units (Junewood and Placer sales) which burned during the fire would offset cumulative effects to big game cover habitat by restoring cover more quickly than natural means.

Reasonably foreseeable actions and associated disturbances likely to occur within and adjacent to the fire area over the next five years include the salvage harvest of insect damaged stands, additional thinning of ponderosa pine on National Forest and private lands, reopening of the entire burned area to grazing, Turner/Otter Larch Resale, reforestation, and prescribed fire. The effects of these actions would be time specific and more pronounced early on in the fire recovery process, but would decrease over time as cover develops.

ALTERNATIVE 4

Direct/Indirect/Cumulative Effects: Dead standing tree habitat for the ***northern three-toed woodpecker*** and ***primary cavity excavators*** would be in abundance in the short-term. Snag enhancement would result in the same effects described under Alternatives 2 and 3. No harvest would

occur, so ample short-term snag habitat would be available throughout the fire area. A variety of conditions will be available, such as unlogged areas with high tree densities, lightly burned areas with green trees remaining, and some previously logged areas, providing for optimal woodpecker use (Saab and Dudley 1998). Once the majority of dead trees fall, these management indicator species would not likely occupy the majority of the burned area.

Forage enhancement projects to maintain or improve ***Rocky Mountain elk*** summer and winter foraging habitat would be implemented as described under Alternatives 2 and 3, except that restricting prescribed burning to the fall would be more difficult to accomplish due to weather constraints. Thinning (by girdling or felling and leaving) would decrease hiding cover for elk in the short-term only where trees are felled, but would maintain existing canopy cover since thinned stands would not be expected to detract from the value of the existing canopy cover. Overall, cover in the fire area would eventually improve through conifer and riparian plantings and natural regeneration. Cover would develop a quicker rate than natural recovery because of reforestation; however, the survival rate of seedlings would be low due to competition from existing vegetation so cover would not develop very efficiently. This alternative would close the most miles of currently open road (18.5 miles) and no new trail would be constructed for off-road vehicles, therefore Alternative 4 would be the most beneficial to big game security.

Cumulative effects would be similar to that described for Alternatives 2 and 3, with the exception that no removal of dead trees would occur, and therefore no removal of short term cavity excavator and big game habitat would occur. This alternative would close 18.5 miles of open road in addition to those already closed under the District Motorized Access and Travel Management Plan

ALTERNATIVES 5 AND 6

Direct/Indirect/Cumulative Effects: Effects to management indicator species would be similar to Alternative 2 with the following exceptions. Fewer acres would be enhanced for big game forage in Alternative 5 (no prescribed burning); however, the amount of harvest activity would be reduced by 65 percent under Alternative 5 and 45 percent under Alternative 6. In addition to the roads already closed under the District Motorized Access and Travel Management Plan, Alternatives 5 and 6 include between 12.5 and 13.0-mile reduction in open roads, which would be nearly as beneficial to elk security as Alternative 4.

Threatened, Endangered, Proposed, and Sensitive Species

The Endangered Species Act requires protection of all species listed as “threatened” or “endangered” by federal regulating agencies (Fish and Wildlife Service and National Marine Fisheries Service). The Forest Service furthermore maintains, through the Federal Register, a list of species which are proposed for classification and official listing under the Endangered Species Act, species which appear on an official State list, or that are recognized by the Regional Forester as needing special management to prevent their being placed on Federal or State lists. The most recent update to the Regional Forester’s list occurred on November 15, 2000 for fish and wildlife and May 1999 for plants.

The sections of chapters 3 and 4 that deal with threatened, endangered, proposed, and other species listed on the Regional Forester’s Sensitive Species List constitute the Terrestrial Wildlife Biological Evaluation for the proposed projects. Based on local studies, surveys and monitoring, as well as published literature regarding distribution and habitat use, the following Threatened, Endangered, Proposed, and Sensitive wildlife species have the potential to occur in or adjacent to the fire area: ***northern bald eagle, Canada lynx, gray wolf, peregrine falcon, and spotted frog***. A determination has been made that none of the proposed activities would negatively affect any of these species potentially occurring in or near the analysis area.

ALTERNATIVE 1

Direct/Indirect Effects: ***Northern bald eagles*** (Threatened) are known to winter within the Tower Fire area, mostly within one mile of the North Fork John Day River and on the ridgeline south of the river. Yearly mid-winter eagle counts and other monitoring indicates that typically 5 to10 bald eagles use the river corridor between US 395 and Oriental Creek (15 miles from Highway 395). Roost trees, which are the primary habitat feature within the analysis area, would continue to exist along the North Fork John

Day River, because this area burned at low intensity, therefore, Alternative 1 would have no effect to bald eagles.

Canada lynx (Threatened) have not been documented within the Tower analysis area or on the District since the 1920's, although several recent but unconfirmed sightings have been reported in the Blue Mountains. Potential lynx habitat occurs in the Tower Fire area, but this habitat was nearly completely burned over in 1996. Since suitable habitat for foraging and denning is not currently present within the burned area, Alternative 1 would have no effect to lynx. The area could provide denning habitat in the future as large trees fall, particularly if foraging habitat is nearby. Lodgepole pine stands that were burned could have the potential to support snowshoe hare populations (and thus lynx foraging habitat) in 20 years when regeneration reaches a height that will provide forage above deep snow (Koehler 1990).

Gray wolf (Endangered) are currently expanding from the Idaho population into the Blue Mountains. Individuals have been documented in the Ukiah area, but are presumed to be dispersers. No pairs or reproduction have been identified. Since no management activities have been proposed, Alternative 1 would have no effect on individuals or the quality or quantity of habitat.

Peregrine falcon, California wolverine*, *and Columbia spotted frog, listed as "Sensitive" by the Regional Forester, would not be negatively impacted under this alternative, although habitats for sensitive species could recover at a slower rate than under other alternatives, postponing increased distribution of these species in the subwatersheds. Peregrine falcons are not known to nest on the North Fork John Day District. The wolverine has not been documented on the North Fork John Day District and natal denning habitat for this species does not exist within the fire area. Potential foraging habitat for the wolverine was greatly reduced by the Tower Fire, but potential habitat within the subwatersheds remains. Populations of spotted frog are currently stable within the analysis area, but could decline if habitat for the species is not protected. Without protection of wetlands from grazing, habitat for the frog could deteriorate through livestock utilization of vegetation and the potential for disturbance of key habitats.

ALTERNATIVES 2-6

Direct/Indirect Effects: ***Northern bald eagles*** Activities listed under Alternatives 2-6, as mitigated, would not affect northern bald eagles or their habitat. This determination is based on surveys that indicate nesting and/or breeding eagles do not occur within or adjacent to the fire area, and summer and winter foraging activity is relatively infrequent. Mitigation identified in Chapter 2 would limit potential disturbance from noise and human activity. The majority of the proposed activities would take place between April and October to protect wintering eagles from direct disturbance; harvest of units that are within a half-mile of the river would not be allowed from December through March. The level of noise within harvest units would be relatively low and of short duration, so commercial thinning and salvage outside the half mile river corridor would have no direct or indirect effects on potential eagle activity in the area. Helicopter logging (particularly in Alternative 5), could disturb foraging bald eagles near the river, so this activity would also be restricted near the river during the season of bald eagle use. A long-term change in bald eagle movement patterns would not likely occur.

Proposed activities are expected to maintain or improve potential nesting and foraging habitat along the North Fork John Day River corridor. Some commercial thinning is proposed within a half mile of the North Fork John Day River, however, this activity would not alter potential perching or nesting structures, because all trees greater or equal to 21 inches in diameter would be retained and canopy cover would not be reduced. Snags would be retained as described under the mitigation section of Chapter 2.

Prey species are expected to continue to occur along the river corridor and proposed activities (such as road obliteration, road improvements, large wood placement, reforestation, fish passage improvements, and fencing) would improve or maintain water quality and habitat for these species. Herbicide spot treatments would not directly impact bald eagles or their habitat because the three herbicides proposed for use are not toxic to eagles or their prey species, and do not persist in the environment for an extended period of time (USDA 1988, USDA 1992, USDA 1996, and USDA 1997).

Potential eagle perch trees would be avoided where prescribed burning would occur within the river corridor. Since the prescribed burning would not take place in the next year, consultation with U.S. Fish

and Wildlife Service would need to be initiated prior to implementation of the burning to reassess baseline conditions for the eagles.

Canada lynx or its habitat would not be adversely affected by any of the actions listed under Alternatives 2-6. Consultation with the U.S. Fish and Wildlife Service led to the conclusion that road improvements, timber salvage, and fuels treatments in the Tower Fire area "may affect, but are not likely to adversely affect" lynx. All other proposed projects were determined to have "no effect" to lynx. All proposed projects comply with the Canada Lynx Conservation Assessment and Strategy (USDA et al. 2000). No suitable lynx habitat will be altered. No pre-commercial thinning is proposed in potential lynx habitat. Ample areas (over 90% of fire area) will be left untreated and should eventually provide future denning habitat.

Only a small percentage of the proposed road improvement projects occur within potential, but unsuitable, lynx habitat. No roads will be upgraded, and many currently closed roads will be obliterated. About 8 road miles of the 13 miles proposed for hazard tree removal pass through potential, but currently unsuitable lynx habitat (233 acres) under all action alternatives. Timber salvage and fuels reduction projects would not reduce the suitability of any lynx habitat. Salvage is proposed in approximately 1,083 acres of currently unsuitable lynx habitat under Alternatives 2 and 3, none in Alternatives 4 and 5, and 758 acres under Alternative 6. Alternative 6 also includes fuels treatments (slash/deck, fell/burn, firewood) in about 90 acres of unsuitable lynx habitat. Other salvage units do not occur in lynx habitat, and no commercial thinning is proposed in lynx habitat. Ample potential denning habitat and foraging habitat will be available and well distributed in the Tower Fire area as large tracts of burned trees start falling and provide future denning structure. Down wood will be maintained in salvage harvest units, along riparian corridors and in adjacent unharvested areas (90% of the fire area will not be salvaged or treated for fuels in any alternative).

Proposed recovery projects such as reforestation would promote additional vegetative development, which could ultimately provide potential denning and foraging habitat. Tree species planted will be appropriate for site conditions (plant association group), and will help return the area to historic conditions. Much of the 50,000 acre Tower Fire is recovering naturally with lodgepole pine and will become snowshoe hare foraging habitat in the future (10-15 years). The 675 acres of planting within potential, but unsuitable, lynx habitat will include western larch inter-planted among existing lodgepole regeneration, as well as grand fir, spruce, Douglas-fir, and western white pine. Herbicide application would primarily occur within ponderosa pine and mixed conifer stands, and will not be applied to any trees. These treatments would not lead to a loss of potential foraging habitat in the fire area, because the herbicides would control competing vegetation and improve the survivability of regenerating conifers. When applied at the recommended rate, the three herbicides proposed for use are not toxic to mammals (USDA 1988, USDA 1992, USDA 1996, and USDA 1997). Other proposed actions would not affect the Canada lynx or its habitat because potential denning or foraging habitat would not be affected.

Activities proposed in Alternatives 2-6 would have no effect on ***Gray wolves***. A reduction in open road miles could be considered beneficial if a known wolf population, rendezvous area, or den site were found, however this is not the case. Areas with low open road densities may be key to wolf survival when dispersing wolves are adjusting to new environments (Thiel 1985). The proposed reduction in road densities could benefit potential future wolf habitation. The remaining proposed management activities would have no effect on individuals, nor the quantity or quality of habitat.

Peregrine falcons are not expected to be impacted by any actions listed under Alternatives 2-6. Surveys in 1992, 1993, and 1997 at potential nest sites failed to detect any peregrine falcons on the District. Potential nesting habitat is greater than ten miles from the analysis area, generally too far for foraging falcons during the nesting season. Proposed activities would generally improve foraging habitat by accelerating forest recovery.

California wolverine or its habitat would not be impacted by any actions listed under Alternatives 2-6. Several snow track surveys have been conducted across the District and within the analysis area in the past decade, and no wolverine or their tracks have been found. Wolverine may pass through or skirt the edge of the fire to take advantage of wintering ungulate populations. Natal denning habitat for this species does not occur within the burned area and the majority of proposed activities would occur in

areas relatively unsuitable for foraging. The proposed commercial thinning in the south portion of the fire area would reduce tree densities, but canopy cover and forest structure would be maintained, providing suitable habitat for foraging. Alternative 4 proposes the highest number of road closures and no new trail construction for off-road vehicles, which would be the most beneficial to wolverine. Proposed herbicide spot treatments would not impact the wolverine or its habitat because it would occur in areas that are unlikely to be frequented by wolverine (burned over areas), and when applied at the recommended rate, the three herbicides proposed for use are not toxic to mammals (USDA 1988, USDA 1992, USDA 1996, and USDA 1997).

Columbia spotted frog potential habitat within the burned area would be maintained or improved by proposed activities. Salvage and thinning would not enter Riparian Habitat Conservation Areas so these activities should not affect spotted frog habitat. Fencing two springs, four meadows, and three ponds would restrict potential livestock use and maintain the quality of riparian habitat. Currently known populations of these species in the fire area would be expected to increase as the area recovers and regenerates into healthy forest and riparian habitat.

Cumulative Effects: ***Northern bald eagle*** populations (residents and migrants) have been increasing in Oregon over the last 15 years. Currently, one eagle nest is known approximately 30 miles downstream from the fire area and numerous large trees (greater than 30 inches diameter at breast height) are available for potential roosting and nesting within the analysis area. Effects of past activities on bald eagle populations and habitat along the North Fork John Day River would be reduced by some of the proposed activities. Nesting sites could expand throughout the river system as habitat along and adjacent to the river corridor continues to recover from mining activities (river dredging) that occurred within the last 30 years. Proposed activities such as fish habitat improvements, road closures and obliteration, and reforestation in riparian areas would continue to improve habitat for the eagle's prey, which should indirectly improve foraging habitat for eagles.

Canada lynx or its habitat would not be affected by the cumulative addition of proposed actions with past, ongoing and reasonably foreseeable future activities. Since lynx have been listed as "Threatened", specific conservation measures have been developed to ensure that all ongoing and future projects would not negatively impact lynx or lynx habitat (USDA et al. 2000). Ongoing activities occurring in potential lynx habitat in the Meadow Creek Lynx Analysis Unit include 3 cattle allotments, suction dredging, 2 miles of potential snowmobile route, and several fire camp locations. After consultation with the U.S. Fish and Wildlife Service, it was determined that none of these activities would adversely affect lynx.

No cumulative effects to ***peregrine falcon*** have been identified. Riparian areas, particularly when near nesting sites, may be key peregrine foraging habitat. Riparian areas affected by ongoing and future projects in adjoining areas should maintain riparian habitat, since they follow the amended Forest Plan and therefore incorporate PACFISH standards and guidelines for Riparian Habitat Conservation Areas.

Potential foraging habitat for ***California wolverine*** was greatly reduced by the Tower Fire, which superseded the effects of past activities. Some proposed activities such as reforestation and road closures would maintain or enhance habitat for wolverine.

Columbia spotted frog potential habitat would be maintained or improved by proposed and future projects. Riparian Habitat Conservation Areas and other riparian habitats where spotted frogs would occur have specific management guidelines in place to protect and enhance habitat.

Species of Concern

The U.S. Fish and Wildlife service requested that we consider the following wildlife species of concern: northern goshawk, Pacific fisher, olive-sided flycatcher, and several bat species.

ALTERNATIVE 1

Direct/Indirect Effects: Forest habitat for the ***northern goshawk*** would be slow to recover in the burned area. ***Pacific fisher*** are not expected to occur on the Umatilla National Forest. The ***olive-sided flycatcher*** will likely use the fire area for breeding, particularly where tall snags remain. An abundance of snag habitat is currently providing temporary roosting habitat for foraging ***bats***.

ALTERNATIVES 2-6

Direct/Indirect Effects: ***Northern goshawk*** potential habitat within the fire area would be maintained or improved by proposed activities. A small portion of the former Oriental Creek post-fledging area is proposed for harvest since this area completely burned and is no longer inhabited by goshawk. Salvage of dead trees, thinning, fuels treatments, reforestation, and herbicide application is not proposed in or near existing potential goshawk nesting habitat. Commercial thinning would retain all live trees 21 inches in diameter at breast height or larger, and move stands toward a late and old structural condition that is typical of goshawk nesting habitat. Exclusion of salvage in Alternative 4 may increase the risk of future intense fires due to higher fuel loads. Conifer and riparian planting would create potential habitat for prey species and ultimately future habitat (> 100 years) for nesting goshawks. Since Alternatives 3 and 4 would result in much lower reforestation success, it could take longer for goshawk habitat to recover from the fire. Potential goshawks in the area are not expected to forage extensively in the burn away from forested areas, but rather would likely forage along forest edges and adjacent forest interior. Proposed big game forage enhancement projects would indirectly improve or maintain potential goshawk habitat by maintaining or increasing grasses and shrubs, which provide habitats (forage and cover) for goshawk prey species such as small birds and mammals. Snag enhancement activities adjacent to forested habitat would improve foraging habitat for goshawk by extending snag availability for primary cavity excavators and secondary cavity nesters. Some of these species would become prey species for the northern goshawk. The remaining activities (fish passage, stock ponds, fencing, etc.) would not have a direct or indirect effect on goshawk or their habitat, because proposed activities would not change the quantity or quality of habitat in the analysis area.

Pacific fisher are not expected to occur on the Umatilla National Forest. If an individual happened to travel through the area, it would likely move along the North Fork John Day River rather than through burned areas where projects are proposed.

Olive-sided flycatchers will likely use the fire area for breeding, particularly where tall snags remain. An abundance of this type of habitat would remain throughout the fire area, until snags are blown down naturally in the next few decades. Lightly burned stands around the perimeter of the Tower Fire will provide habitat over a longer period.

Big-eared bat, small-footed myotis, long-eared myotis, long-legged myotis, and Yuma myotis would not be negatively impacted by any actions listed under Alternatives 2 through 6. No suitable hibernacula or colonial roosting habitat are known within the fire area. An abundance of snag habitat is currently providing temporary roosting habitat for foraging bats and this would not be altered by the proposed actions to the degree that bat populations would be affected. Thinning, reforestation, and forage enhancement would encourage vegetative development and ultimately provide habitat for insect populations sooner than if the fire area were left to recover naturally. Snag retention guidelines for primary cavity excavators, and additional mitigation requiring the retention of hollow snags in harvest units would provide potential day roost habitat for bats within harvest units. Snag enhancement activities could extend the length of time dead standing trees would remain standing, extending potential use by bats. The use of herbicides would not change overstory canopies, so foraging habitat and insect populations would not be reduced. When applied at the recommended rate, the three herbicides proposed for use are not toxic to insects or small mammals (USDA 1988, USDA 1992, USDA 1996, and USDA 1997).

Cumulative Effects: Past timber harvest and associated activities have changed the habitat for ***northern goshawk*** in the area. By far the Tower Fire caused the biggest reduction in goshawk nesting and foraging habitat. Proposed and reasonably foreseeable future projects such as future commercial thinning and timber sales in the area would maintain habitat conditions for goshawk since Forest Plan guidelines, as amended to promote late and old forest structure and riparian habitat (USDA 1995), would be followed.

Potential foraging and travel habitat for the ***Pacific fisher*** was greatly reduced by the Tower Fire, which superseded the effects of past activities. Some proposed activities such as reforestation and road closures would maintain or enhance habitat that fisher could potentially use, although the likelihood of occupancy is low.

Past, ongoing, and proposed activities would not cumulatively impact potential ***olive-sided flycatcher*** populations in the area. Salvage of burned trees could reduce the amount of habitat, but in the context of the Tower Fire and the large amount of snag habitat available, this would be a small impact.

Past, ongoing, and proposed activities would not cumulatively impact potential ***bat*** populations in the area. Salvage of burned trees could reduce the amount of habitat, but in the context of the Tower Fire and the large amount of snag habitat available, this would be a small impact.

Economics/Social

The social and economic effects of the various proposed management alternatives were assessed in terms of viability of harvestable timber, potential payments to counties, employment supported by the alternatives, and the economic efficiency for relative comparison between alternatives. Analysis was conducted using the TEA_ECON model to predict advertised bid rates for the timber harvest portion of the project, the IMPLAN model to predict employment impacts to the region of influence, and an economic efficiency analysis to quantify overall present net values to maximize net public benefits.

The affected area or impact zone for the Umatilla National Forest consists of Grant, Morrow, Umatilla, Union, Wallowa and Wheeler counties in Oregon and Asotin, Garfield, Columbia and Walla Walla counties in Washington. These counties are encompassed within the Pendleton and Spokane Bureau of Economic Analysis regions. Many communities in the impact zone are closely tied to the Forest in both work activities and recreation. Three principle uses of the area—recreation, timber harvesting, and domestic livestock grazing—were primarily affected by the Tower Fire.

Table 4.13: **Summary of economic effects**

Measure	Alternative					
	1	2	3	4	5	6
Potential Advertised Bid Rate	0	$-14/ccf	$-14/ccf	0	$-28/ccf	$-16/ccf
25% payment to Counties	0	$ 48,557	$ 48,557	$ 0	$ 15,277	$ 28,700
Employment	0	137	137	0	29	76
Net Value		$-7.7 million	$-6.6 million	$-7.9 million	$-6.2 million	$-6.8 million
Discounted Benefits	0	$ 179,574	$ 179,574	$ 0	$ 58,563	$ 108,237
Discounted Costs	0	$ 7.9 million	$ 6.8 million	$ 7.9 million	$ 6.2 million	$ 6.8 million

Viability of Timber Harvest

The area proposed for commercial thinning and salvage logging within the Tower Fire was analyzed to determine the economic viability of harvesting timber by determining the tentative advertised bid rates per hundred cubic feet ($/ccf). This estimate was based on estimates of volume, species, amount of sawtimber and nonsaw material, logging systems costs, haul costs, road maintenance costs, contractual costs, erosion control and other developmental costs, temporary road costs, and specified road construction costs, and the value of timber proposed for removal. The preliminary value of the timber was based on the prices for the same species and material of all sales actually sold within Appraisal Zone 3 (primarily Blue Mountain forests) within the last 12 months. An initial bid rate was determined by subtracting the costs associated with logging from the base period prices adjusted for the quality of the material and current market conditions. Adjustments were made to the volume of estimated sawtimber to

account for deterioration in material over the last few years. This rate was further reduced per current appraisal methods (Transaction Evidence Appraisal) to allow for competition between bidders to determine the tentative advertised bid rate. The computer software program, TEA_ECON was used for this analysis.

ALTERNATIVES 1 AND 4

Direct/Indirect Effects: Alternatives 1 and 4 would not involve timber harvest and therefore, would not produce any direct costs to wood products industries (Figure 4.2). Revenues to the Forest Service would likely be generated in the future through small sales (post/pole, firewood, etc.), but these would be minor and unpredictable.

ALTERNATIVES 2, 3, 5, AND 6

Direct/Indirect Effects: All alternatives that harvest timber would produce negative advertised bid rates indicating that the project would not provide a viable harvest proposal (Figure 4.2). Based on this analysis, alternatives 2 and 3 provide the least negative tentative advertised bid rates at $-14/ccf. Alternative 6 bid rate is slightly more negative at $-16/ccf due to a mixture of helicopter and ground-based logging systems followed by the most negative bid rate, $-28/ccf, in Alternative 5. Alternative 5 would provide the least viable option of all alternatives that harvest timber due to logging the entire sale area with helicopter logging systems, which is more expensive than ground-based systems.

Cumulative Effects: Estimates for tentative advertised bid rates for alternatives 2, 3, 5, and 6 are within the range of rates experienced by the three Blue Mountain forests (Malheur, Umatilla, and Wallowa-Whitman) within the last two. Advertised bid rates have fluctuated over the last few years reflecting the volatility of the market for timber. Changes to prices would likely occur in the future at the time of the appraisal depending on actual market conditions at that time.

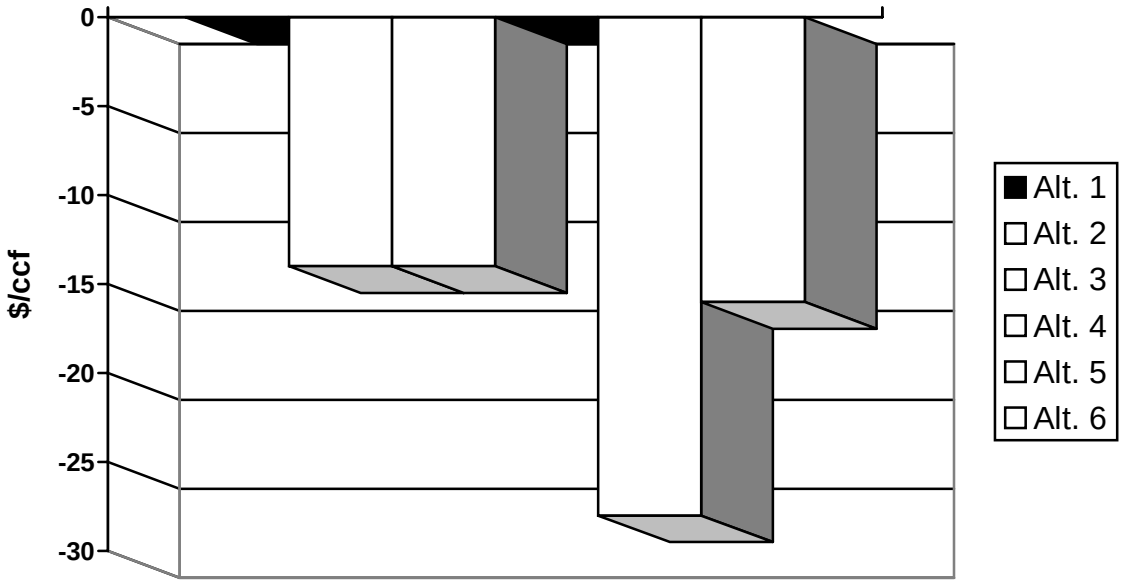


Figure 4.2: **Tentative advertised bid rates (negative) by alternative.**

Payments to Counties

By law, 25 percent of the gross receipts collected by the Forest Service from the use of National Forest System lands and resources (timber sales, grazing permits, and other deposits) are returned to the counties as a source of funds for schools and roads. Payments to counties are based on the amount of National Forest System lands within a county and comprise an important element of local county budgets.

ALTERNATIVES 1 AND 4

Direct/Indirect Effects: Alternatives 1 and 4 would not harvest timber, and therefore, would not contribute toward payments to counties (Figure 4.3).

ALTERNATIVES 2, 3, 5, AND 6

Direct/Indirect Effects: Based on the minimum base rates that would be required from the sale and the subsequent gross revenue from harvesting timber, payments to counties from the project over the two-year period total approximately $48,557 under alternatives 2 and 3 (Figure 4.3). Alternative 6 would provide 41 percent less at $28,700, and Alternative 5 would provide 69 percent less with $15,277 in payments to counties. All monetary figures are in terms of 2001 dollars.

For alternatives 2, 3, 5, and 6, payments to counties would be distributed to counties within the boundary of the Umatilla National Forest as follows: Umatilla (27 percent), Grant (22 percent), Columbia (11 percent), Wallowa (9 percent), Union (7 percent), Garfield (7 percent), Asotin (4 percent), Wheeler (3 percent), Walla Walla (1 percent) and Baker (less than 1 percent).

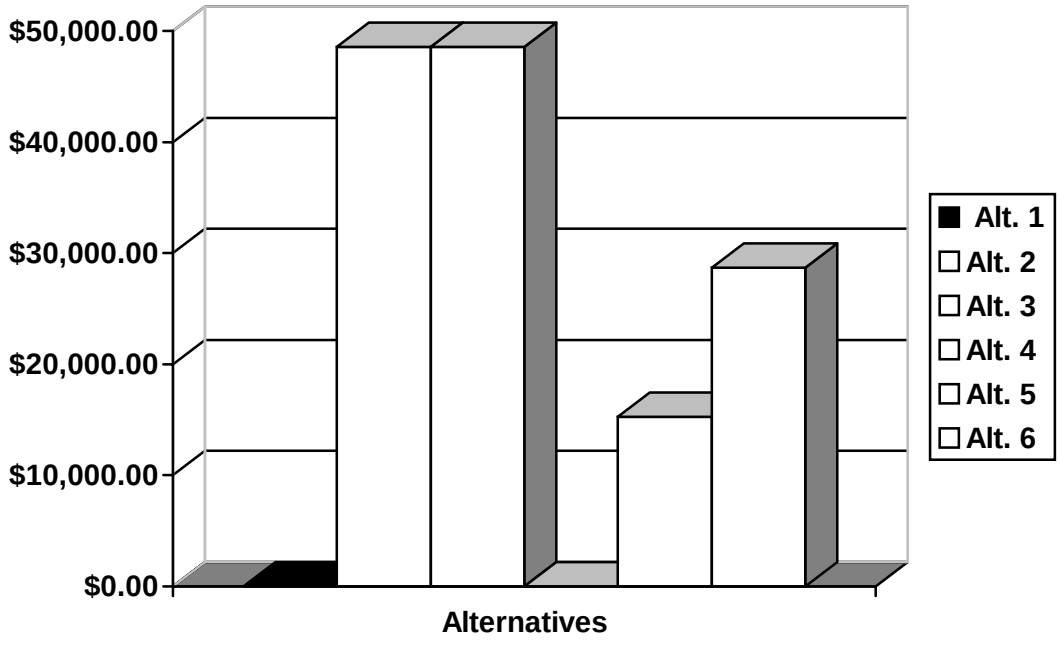


Figure 4.3: Payments to counties by alternative.

Cumulative Effects: Payments to counties from activities occurring on the Umatilla National Forest totaled $2.6 million (2001$) during fiscal year 1997 (USDA 1998). Payments to counties from the proposed commercial thinning and salvage harvesting in alternatives 2, 3, 5, and 6 would comprise less than one percent of the total Forest payments compared to the 1997 annual total. Payments to counties associated with grazing fees have also been reduced since the fire. Domestic livestock have been

excluded from burned pastures (Pearson and Texas Bar) of the Texas Bar C&H Allotment since the fire. This resulted in a reduction of total numbers of livestock grazed on that allotment and an associated reduction in grazing fees associated payments to counties. Numbers of livestock grazed on the Texas Bar C&H Allotment and subsequent payments to counties could potentially increase in the future when the burned pastures are reopened to grazing. Other activities that contribute payments to counties include recreation receipts and other special use receipts across the Forest.

Employment

The major effect on employment from the alternatives would occur from the level of commercial thinning and salvage logging. Levels of harvest by alternative would affect employment in several ways:

- directly - (effects attributable to employment associated with harvesting, logging, mills and processing plants for sawtimber, pulp, chips, veneer and plywood)
- indirectly - (effects attributable to industries that supply materials, equipment, and services to these businesses)
- induced - (effects attributable to personal spending by the business owners, employees, families, and related industries).

Employment effects were derived from estimates predicted with the input-output model, IMPLAN, for the Umatilla National Forest impact zone (USDA 1998) and updated for the Timber Sale Program Information Reporting System (TSPIRS) in 1994. Job estimates include temporary and permanent full-time and part-time employment. The estimates do not include unpaid family workers or sole-proprietors. This analysis assumes that all harvesting would occur over the next two years. Employment effects from recreation and domestic-livestock grazing activities were not analyzed because the level of use was not expected to change by alternative. The estimates provide a relative comparison of jobs supported by the alternatives to communities and counties within the regional impact zone and not necessarily to any one county.

ALTERNATIVES 1 AND 4

Direct/Indirect Effects: These alternatives would not harvest any timber and, therefore, would not support direct, indirect, or induced employment associated with timber harvesting in the impact zone.

ALTERNATIVES 2, 3, 5, AND 6

Direct/Indirect Effects: Alternatives 2 and 3 would support 137 jobs over the two-year period. Alternative 6 would support less with 76 jobs, followed by 29 jobs supported under Alternative 5 (Figure 4.4).

Cumulative Effects: Annual timber-related employment supported by timber harvested from the Umatilla National Forest for the years 1995-97 averaged 394 jobs. Employment supported by commercial thinning and salvage harvesting in Alternatives 2 and 3 would support approximately 17 percent toward the annual total. Alternative 6 would contribute approximately 10 percent toward the annual employment total based on the total volume harvested. Alternative 5 would contribute approximately 4 percent toward the annual employment supported by timber harvesting on the Forest in the past.

Other employment would continue to occur because of other timber sales in progress, domestic-livestock grazing, and recreation activities, and other special use receipts across the Forest. Commercial collection of special forest products such as mushrooms could continue to occur, although the quantity of harvest is unknown. In addition, other employment opportunities would also be provided by restoration and enhancement activities outlined in this EIS and would depend on the level of funded projects.

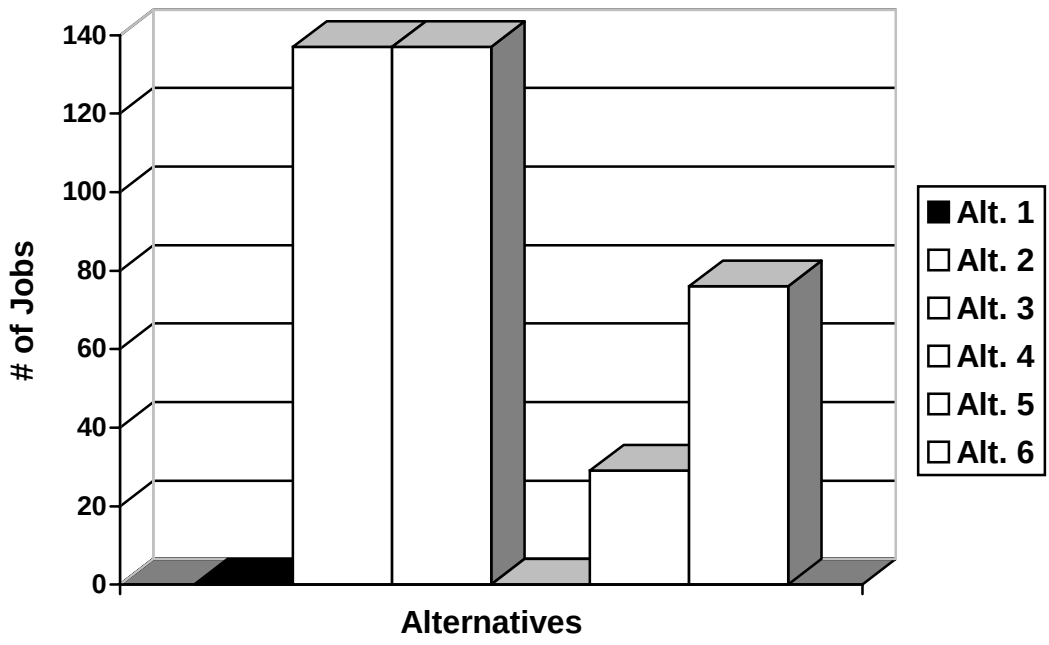


Figure 4. 4: Employment effects from timber harvesting by alternative.

Economic Efficiency

An economic efficiency analysis was completed that focused on identifiable and quantifiable ecosystem benefits and costs for each alternatives in terms of the present net value (benefits minus costs) to assess which alternative comes nearest to maximizing net public benefits (36 CFR 219.2). Ecosystem functions provide a broad set of ecosystem services such as clean water or native forest stands that are valuable to both human and nonhuman components of the ecosystem. These ecosystem values may be assessed in economic and non-economic terms. Economic valuation provides a partial measure of the full range of ecosystem values in commensurate terms for assessing economic tradeoffs. Non-economic values are necessarily assessed in terms relevant to other disciplines such as ecology or ethics. Changes in ecosystem services must be measurable and quantifiable in like terms, preferably monetary measures, in order to assess a relevant change in economic value (Bergstrom and Loomis).

Measurable and quantifiable economic market benefits related to proposed activities include revenue from timber volume proposed for harvest. Revenue is derived from the tentative advertised bid rate for the timber multiplied by the total cubic-feet proposed for harvest. Other economic non-market benefits that may occur as a result of the proposed restoration activities include changes in recreational fishing through reductions in sediment and improvements to fisheries habitat, improvements in the quality of the recreation experience, and increases in forage to wildlife species. In addition to use values, existence values (otherwise referred to as preservation values) or nonuse values may capture important economic value to the public (Swanson and Loomis 1996). Although these benefits are important components of the ecosystem services provided to humans, the production relationship between ecosystem functions and ecosystem services is not well defined or measurable at the project level in terms that provide comparison of commensurate dollar values. Refer to the recreation and biologic sections on environmental consequences in this EIS for a discussion of non-economic benefits to human and biological and physical resources by alternative.

Dollar-quantified costs that were measurable and quantifiable at the project level include costs to the Forest Service for preparing and administering the commercial thinning and salvage sales and implementing the restoration activities by alternative (refer to Chapter 2 for a complete list of restoration

activities). Other opportunity or externalized costs that could potentially occur include damage to soils from harvest operations resulting in long-term losses in soil productivity and potential timber harvest, losses in wildlife habitat as a result of reduced large snags or increases in wildfire risk, or increases in sedimentation of downstream fish habitat from erosion in the fire area. These costs are not well defined or measurable at the project level in terms that provide comparison of commensurate dollar values. Refer other sections on environmental consequences in this EIS for a discussion of non-economic benefits to human and environmental resources for a relative comparison between alternatives.

This analysis is based on identifiable and quantifiable economic benefits and costs and is more typically a financial comparison between revenues and costs. The objective of the economic efficiency analysis is to show a relative measure of difference between alternatives based on direct costs and values used. All dollar values have been discounted in terms of the present (2001 dollars). Discounting is a process whereby the dollar values of costs and benefits that occur at different times are adjusted to a common time period so that they can be compared. The real (exclusive of inflation) discount rate of four percent was used in this analysis. Refer also to the Umatilla National Forest, FEIS, Appendix B, for a comprehensive quantification of the net public benefits for the Forest Plan. The socioeconomic reports on file for both the South Tower and Big Tower Environmental Assessments provide further discussion of the limitations and cost-effectiveness of restoration methods conducted as part of the economic analysis for the project.

ALTERNATIVE 1

Direct/Indirect Effects: The present net value for Alternative 1 would be zero due to the data limitations described for quantifying economic benefits and costs beyond those identified at the project level.

ALTERNATIVES 2, 3, 4, 5, AND 6

Direct/Indirect Effects: All action alternatives illustrate a negative present net value due to project-related costs and restoration costs that are greater than the revenue from commercial thinning and salvage harvesting. Alternative 2 has the highest restoration costs ($6.8 million) followed by Alternative 6 ($6.5 million), Alternative 5 ($6.4 million), and Alternative 4 ($5.7 million). Alternative 3 has the lowest restoration costs ($5.6 million).

Alternative 5 would have the least negative present net value (-$6.2 million) due to the least amount of timber harvesting that would contribute costs toward a deficit sale and a below-cost project. Alternative 3 would have a present net value of $-6.6 million, Alternative 6 would have -$6.8 million, and Alternative 2 would have -$7.7 million. Alternative 4 would result in the most negative present net value (-$7.9 million).

Potential benefits that were not quantified in economic terms due to the limitations of measuring the production relationship between ecosystem functions and ecosystem services at the project level include improvements to soil productivity, reduced erosion, water quality improvements in temperature, and terrestrial and aquatic habitat improvement. A potential quantitative economic effect of improved fish habitat would be subsequent changes in smolt survival rates and overall fish population levels. Two measures of potential economic effects would be the changes related to commercial and sport fishing in terms of the economic value of harvested fish. Fish species most at risk in the analysis area include bull trout, Chinook salmon, steelhead trout, and resident trout (USDA 1996). Sport values quantified for fish range from an average net value per fish (the economic trade-offs an angler would make for access to a given fishing experience) of $55 for salmon and $160 (1999$) for steelhead in the Columbia River Basin depending on the location and size of the catch (Olsen et al. 1991). Depending on the level of change from the restoration activities in the project area, the net economic value of fish (for example) may or may not be affected. Changes in sport fishing would also have an affect on recreation expenditures and potential economic impacts. Refer to the Aquatics section of this EIS for further discussion of effects to fish habitat.

Other potential qualitative economic benefits or costs from the alternatives include changes to the diversity, quality and quantity of wildlife habitat for both game and non-game terrestrial species. With respect to big-game populations, the economic value of hunting would depend on how changes in population levels and spatial distribution of game animals affect either the quality or intensity of the hunting experience. Consequently, the overall level of hunting could change with corresponding

economic impacts from hunting-related expenditures. Changes in non-game population levels and diversity could affect wildlife viewing, photography, and other non-consumptive uses of the area. Refer to the Recreation and Wildlife sections of this EIS for further discussion of effects to these resources.

Cumulative Effects: Other actions that have already occurred within the analysis area that contributed toward the cost of restoration include the restoration treatments immediately following the fire such as seeding for erosion control, culvert removals, cross drain construction, reconstruction of damaged OHV trails, planting of shrubs on Oriental and Texas Bar creeks, and conifer planting.

Off-site effects could potentially occur in the long-term, such as decreases in downstream water quality, increases in risk of wildfire impacts on private timberland property values, or changes in alternative forest products harvesting and businesses. For example, future wildfires in or adjacent to the fire area could potentially decrease downstream water quality due to increased erosion. The amount would depend on the timing, size, intensity, magnitude, and location of the fire. Refer to other sections in this EIS for a discussion of the potential risks of these effects occurring. These effects, depending on the event and the location, could also negatively or positively affect property values. In examples where forest management activities benefited the environment and improved the local natural amenities, adjacent property values increased (Niemi and Whitelaw 1997). Adjustments in terms of local or regional affects on alternative forest products businesses would depend upon timing and local employment conditions. For example, increased wildfire risk would potentially benefit certain species such as mushrooms that are commercially harvested in large quantities following fires, thereby providing increased employment locally. However, tourism and recreation employment that relies on amenity values and scenic values produced in the area would likely decrease in the short-term until the burned area recovers or activities are implemented to mitigate negative effects.

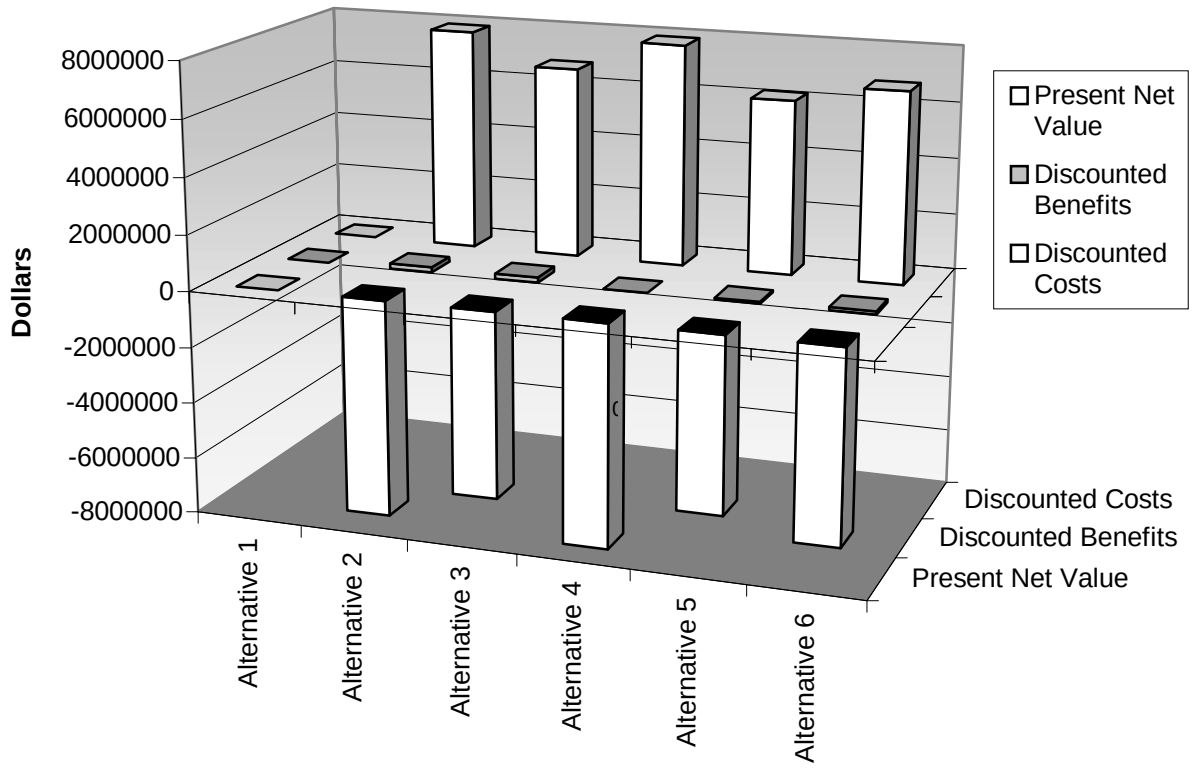


Figure 4.5: Benefits, costs, and present net value by alternative.

Non-Forest Vegetation

Noxious Weeds

ALTERNATIVE 1
Direct/Indirect/Cumulative Effects: Introduction of noxious weeds into the proposed analysis area through harvest-related activities would not occur. However, noxious weeds would likely increase within the analysis area due to natural mechanisms (wind, water, wildlife), ongoing projects, public and administrative use of existing roads, and as a result of the fire creating a desirable seedbed.

ALTERNATIVES 2 - 6
Direct/Indirect/Cumulative Effects: In addition to the weed spreading mechanisms identified under Alternative 1, logging machinery and other vehicles associated with harvest operating along roadways could also spread noxious weeds, especially where soil is disturbed. The timber harvest and temporary road construction proposed in alternatives 2, 3, 5, and 6 would increase the likelihood of spreading noxious weeds along roadways and establishing new populations in proposed harvest units. Alternative 5 would not construct temporary roads and would have approximately 3,810 fewer acres susceptible to invasion than alternatives 2 and 3, fewer landings, and no temporary road construction. Alternative 6 would have about 1,643 fewer acres than Alternatives 2 and 3, and 3 fewer miles of temporary road construction susceptible to invasion. Mitigation measures described under Prevention Strategies in Appendix E of the Umatilla National Forest Management of Noxious Weeds EA would reduce the possibility of noxious weed establishment and spread under both action alternatives. Post-project surveys would be used to determine if existing infestations spread because of project activities or if new infestations become established. If problem areas are found they would be analyzed and treated using the procedures outlined in the above-mentioned EA.

Threatened, Endangered, or Sensitive Plants

A Biological Evaluation was completed for “Sensitive” species in February 2001.

Silene spaldingii has been proposed for federal listing as “Threatened” on December 3, 1999. Since there is no potential habitat present within or adjacent to the planning area, the finding for *Silene spaldingii* is “No Effect”.

Botrychium minganense occurs within the big game forage enhancement underburn and one of the commercial thinning units. The population was found on an old road that is not within the Forest transportation system. A spring burn after plants emerge or burning in heavy fuels could kill plants, therefore a finding of “may impact individuals or habitat, but will not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species” has been given for *Botrychium minganense*. Prescribed fire will not be ignited within the Riparian Habitat Conservation Area for Sheep Creek during any time of year. Vehicles will not use the abandoned road, nor will fire line be constructed on or near the road within the vicinity of the population. Harvest will not use the road containing *B. minganense* for skidding or a landing, vehicles will not use the road for access, and no other disturbance will occur along or near the affected portion of road where *B. minganense* occurs.

Carex crawfordii and ***Carex interior*** could occur within the Tower Fire area. Mitigation to observe Riparian Habitat Conservation Area requirements will reduce impacts to these species. In addition, slash will not be piled in wet areas. With this mitigation, proposed projects would result in a finding of “May impact individuals or habitat, but will not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species.

Fire Management

Proposed projects and fire history information were analyzed at the subwatershed scale. Specific fire behavior, fuel loading, and particulate (smoke) emissions information was completed for the areas within the burned perimeter of the Tower Fire (1996).

Fire behavior predictions were made utilizing the BEHAVE System, a series of interactive fire behavior computer programs for estimating wildland fire potential under various fuels, weather and topographic situations. Fuel models, where described, were based on the thirteen standard fuel models utilized in the BEHAVE System. Estimates of fall-down rates for trees killed by the Tower Fire and associated rates of decay of downed trees were based on professional judgment and conditions observed on other stand replacement events on the North Fork John Day Ranger District within the past twenty years. Estimates of fuel accumulation were based on tree fall-down rates combined with pre-cruise volumes (determined for sales associated with Cable Environmental Assessment and Tower EIS), cruised volumes from the Dragon and Overlook sales, and standard topwood (non-merchantable volume) tables for Douglas-fir and white fir (DEBMOD6 1985). Background fuel loadings were based on General Technical Report PNW-105.

Effects of prescribed burning for big game forage enhancement and salvage harvesting (with associated piling and burning of slash at landings) would have a significant, beneficial effect on fuel loading and associated fire risk within the Tower Fire area in alternatives 2, 3, 5, and 6, though to varying degrees based on the amount of area treated. Thinning would have a short-term adverse effect, but it would add to the significant, beneficial effect in the long-term. Overall, proposed activities could reduce fuels on approximately 10 percent of the fire area. At a larger scale, such as the Umatilla National Forest or Blue Mountain Province, effects of these projects would not be significant.

ALTERNATIVE 1

Direct/Indirect Effects: Under this alternative, fuel loads would not be reduced and existing fuel continuity would remain unchanged. Fine fuel loadings would continue to build through 2001 as remaining needles, small branches (1-6 inches in diameter), and trees up to 9 inches in diameter fall to the ground (see Table 4.15). Where the fire burned at low intensities, the primary fire carrier for the next couple of years would be grasses and some needle cast (Northern Forest Fire Laboratory fuel model 2). As a result, low to moderate rates of fire spread would be expected with relatively low fire intensities (flame length less than 4 feet).

The primary fuel carrier for the first 10 years would be needles, fine twigs from the dead overstory, and grass (Northern Forest Fire Laboratory fuel model 8). Low rates of spread and fire intensities would be expected until the overstory further deteriorates and adds to the surface fuels. Fires in this fuel type could be controlled through direct and indirect means, burnout operations, water application, and retardant. Under ideal weather conditions, fires could reach several hundred acres in size due to the abundance of flashy fuels, but control and mop-up efforts should be effective, especially where roads and natural barriers exist. However, the large number of standing dead trees would slow mop-up operations and pose an extreme risk to firefighters for the next 50 years.

Approximately 10 to 20 years after the Tower Fire, fuel load compositions would transition from a grass type to a mixture of grasses, accumulated down fuels, and needles. By Year 20, 10 percent of the trees larger than 9 inches in diameter would be on the ground. These fuel accumulations would burn with intensities in excess of hand crew control limits (4-foot flame lengths). BEHAVE fire spread modeling shows rates of fire spread would likely be moderate to high in all areas burned by the Tower Fire, with an increase in fire intensities in the heavy accumulations of larger fuels. Fires under these conditions would have a significant risk of growing to a large size and burning with intensities that would be lethal to the developing vegetation. Consumption of the accumulated large fuels would result in high soil temperatures, significant mineral soil exposure, and similar visual conditions that existed following the Tower Fire (without the dead overstory material).

Between 20 and 40 years, fuel accumulations of heavier material from fire-killed trees would begin to contribute to the intensity of wildfires, particularly on cool moist sites. While fires that occur during this time would not begin as crown fires (the overstory would be pole-sized), they would exhibit intensities that

would limit the effectiveness of a direct attack. In addition, burnout of fuels after passage of the flaming front would likely be intense, which would result in high mortality to new regeneration and expose mineral soil. Fire control measures such as bulldozers, indirect burnout, and retardant would be required to control well-established fires during this time. Mop-up could be expensive and time consuming due to the number of snags and heavy down fuels that would be present.

Table 4.14: Estimated rate of fuel accumulation.

Years	Fuels accumulated on the ground	Fuel composition
0-5	needles, small branches (1-6 inches in diameter), and smaller trees	grass type
<10	majority of trees less than 9 inches in diameter	grass type
<20	10% of the trees larger than 9 inches in diameter	mixed grass, needles, and large down fuels
<40	over 90% of the trees larger than 9 inches diameter	down and decaying logs, limbwood, needles, and developing forest vegetation

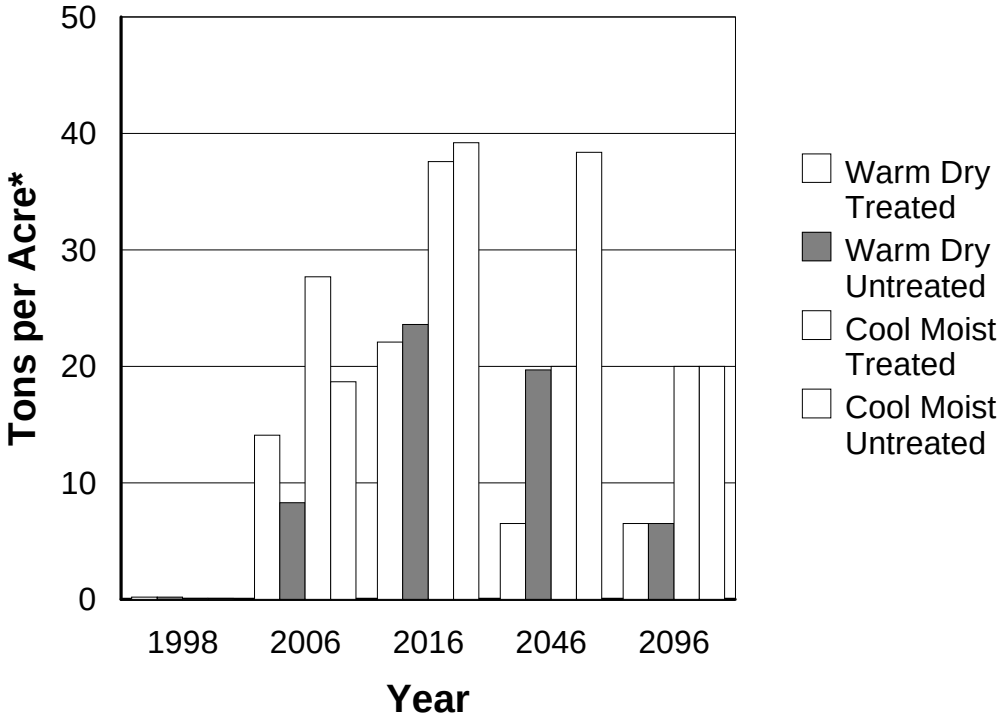
Beyond 40 years, the heavier fuels that fell following the Tower Fire would show significant decay and the fuel profile would begin to resemble a typical profile for the stand type present on the site. Fuel conditions on cool, moist and cold, dry plant association group sites, as well as within riparian areas, would begin to revert to similar conditions as seen on the analysis area prior to the Tower Fire (continuous overstory canopies, dense fuels, and ladder fuels which connect surface and aerial fuels). Summer fires occurring in these stands would exhibit fire behavior that would present serious control problems, result in high levels of stand mortality, and pose a risk to the safety of suppression personnel. Where foreseeable future prescribed underburning occurs in dry-site ponderosa pine stands, fuel levels would be relatively low and expected fire behavior should not present significant control or mortality problems. If dry sites do not receive fuel treatment, fuels would increase far beyond historic levels, and a fire occurring during summer conditions would cause control challenges for suppression and result in mortality to the involved stand.

The fuel type connecting the North Fork John Day Wilderness and the rest of the burned area characteristically sustains fires that primarily spread by crown fire and long range spotting. The horizontal continuity of fuels in this area would increase as dead trees fall and vertical continuity (ladder fuels) would also increase as a new stand of lodgepole regenerates (see Forest Vegetation discussion). As a result of these factors, prescribed natural fire opportunities within the Tower Unit of the North Fork John Day Wilderness would be limited and large, continuous blocks of fuel would rebuild over time. In addition, no control points exist adjacent to the eastern boundary of the analysis area that could effectively stop the spread of a wildfire from the east or west. All these factors would present serious challenges to control efforts and pose high safety risk to suppression personnel for 50 years or more.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: Figure 4.6 shows the projected effects of harvest on fuel accumulation through time, which would occur on 3,299 acres in alternatives 2 and 3. Also, landing piles associated with the Dragon, Lone, Overlook, and Hairy Hazard sales that were not treated prior to the court injunction would be burned as described under their associated plans. Proposed harvest would move non-merchantable tops and branches from the forest canopy to the ground at a rate of 6 tons of fuel per acre on dry sites and 9 tons of fuel per acre on wet sites. This increase in ground fuels would occur 10 to 20 years sooner than if the areas were not harvested. Overall, fuel loading would increase for approximately 10 years following harvest; however, removal of wood fiber would result in a long-term reduction in fuel loading over the next 100 years. Associated fire intensity would increase following harvest until fuels decay. Long-term anticipated fire intensities would be reduced due to the removal of heavy fuels that would

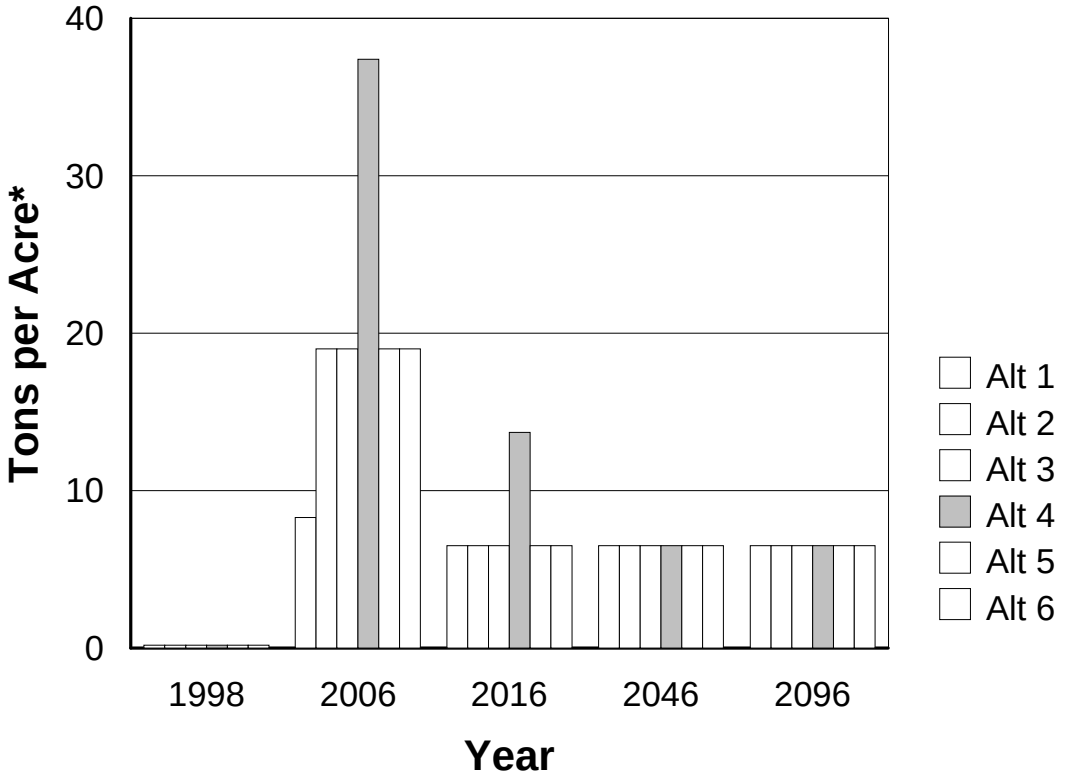
otherwise increase in the fuelbed over the next 40 to 50 years. Removal of the dead trees would also reduce falling tree hazards for firefighters during wildfire suppression or prescribed burning activities. Areas outside of harvest units (including Riparian Habitat Conservation Areas, the South Fork-Tower Roadless Area, and the North Fork John Day Wilderness) would continue to pose hazards to firefighters and create control problems during fire suppression efforts as discussed under Alternative 1. Affects on air quality are discussed later in this chapter under the section that addresses compliance with the Clean Air Act.



*Not including precommercial & commercial thinning

Figure 4.6: Comparison of expected fuel loading between harvest and no treatment.

Non-commercial and commercial thinning would immediately add approximately 19 tons of fuel per acre over approximately 1,026 acres at the time of implementation. Figure 4.7 displays the projected effect of this on fuel accumulation through time. Slash created from the commercial thinning would increase the risk of higher intensity fires in the short-term, but this should be reduced through scheduled underburning, either associated with wildlife forage enhancement or the ongoing maintenance burns within the Juniper/Oriental Underburn. Where prescribed burning would not occur, slash would start to decay within 2-3 years and fuel loads would eventually decrease. Thinning would reduce future large-diameter fuels, remove ladder fuels, increase the percentage of fire-resistant tree species, and open up the stand canopy, all of which would reduce the future potential for crown fire spread. Removal of large-diameter and ladder fuels would create conditions that would allow fuel levels to be more easily maintained at manageable levels through the use of prescribed fire. This would result in wildfires that are easier to suppress and of less severity so less damage is likely to occur.



*Desired Future Fuel Loading = 6.5 TPA

Figure 4.7: Comparison of expected fuel loading between harvest commercial thinning and no treatment.

The proposed 6.25-mile-long shaded fuelbreak would reduce surface and ladder fuels and increase crown spacing, which would stop or significantly slow the surface spread of wildfires and provide a control point for initiating a burnout operation (under suitable winds) when faced with a crown fire moving from east to west or vice versa. Due to the topographical location and fuel type, the fuel break would be most effective when adjacent areas are periodically treated with a controlled underburn prior to fire start. The variable width of the fuel break should allow for the creation of safety zones for use by suppression personnel during either prescribed fire or wildfire management operations. However, the greatest benefit posed by the fuel break, would lie in its use for initiating prescribed fire within the roadless area. The fuel break would disrupt fuel accumulations and continuous canopy conditions. Over time, the wider tree spacing would increase stand health, which would result in lower accumulations of fuels. The roadless area is relatively inaccessible, so by reducing fuels through regular application of prescribed fire, control of future wildfires in this area would be more likely, and fire intensities would be reduced. Also, the combined fuel break and prescribed fire treatments within the roadless area would create a reasonable holding line that would improve opportunities for the use of prescribed natural fire within the Tower unit of the North Fork John Day Wilderness Area. However, the lack of accessibility to the fuel break would make maintenance costly and difficult.

Prescribed underburning to enhance big game forage would occur across 900 acres within the Tower Fire area. Underburning would reduce fuels, which would make wildfires easier to suppress and less damaging. Past and proposed road closures and decommissioning could eventually slow suppression response times because such roads would no longer be maintained. Down trees and debris would

eventually block these roads to quick access. This could greatly increase the size that wildfires would burn prior to initial attack actions.

Cumulative Effects: Fire management direction continues to evolve as more is learned about the effects of fire and its influence on the development of vegetation found in the Blue Mountains of northeast Oregon. However, the majority of naturally occurring fires and all human-caused fires not prescribed for management reasons would likely continue to be suppressed due to complex resource issues (i.e. protection of structures, private inholdings, or threatened fish species habitat). This policy would limit fire's role in the ecosystem to areas where prescribed fire can be effectively managed or wildfires that escape suppression. Fuels would be maintained at levels which would allow for reasonable control of fire where prescribed fire is proposed to improve wildlife forage on 900 acres of dry sites, on another 1,200 acres presently approved for burning over the next 20 years, and additional areas under consideration for future burning. Where prescribed burning does not take place and fire is excluded, an abnormal buildup of fuels would continue to result, particularly on dry sites, which could allow the development of fuel and vegetative conditions similar to those which were found prior to the Tower Fire. In all alternatives, fire suppression effectiveness would be dependent upon the involved fuels and the types of suppression resources that can be applied to suppression efforts.

Several proposed actions would act cumulatively with past, ongoing, and foreseeable future actions to reduce fuel loads and affect future abilities to control or suppress fire. Areas that were harvested in the past 10 years that then burned in the Tower Fire (5% of the fire area) now have little to no larger fuels to sustain future wildfire. In the long-term (>10 years), proposed hazard tree removal, salvage, harvest of dead and *Armillaria*-infected, thinning, and the fuelbreak would further decrease large-diameter fuel loads over an additional 10 percent of the area. Foreseeable future prescribed fires and thinnings are also being considered in proposals for the Oriental Juniper Underburn, Camas Underburn, Camas Restoration projects, Farley Diggins projects, Retex projects, an additional unnamed underburn in the Oriental Juniper area planned in 2000, and potential prescribed burning within the North Fork John Day Wilderness (see Appendix A for details). Also, the proposed thinning would occur in an area that was underburned once prior to the Tower Fire and burned again in the fire. These past events reduced fine fuels so that the proposed thinning would result in lower fuel loads related to this type of activity. The long-term effect of harvest and thinning would result in future wildfires that burn with less intensity and duration, resulting in less damage to soils. Wildfires would be easier to control, increasing the ability to successfully protect planted trees and untreated riparian areas within the Tower Fire area. Future fuels treatments designed to maintain early seral species and low fuel loadings would be easier to implement. However, the proposed road obliteration, coupled with roads previously closed under the District Motorized Access and Travel Management Plan, would result in a cumulative decrease in access, which would make fire suppression more difficult and increase its cost.

ALTERNATIVE 4

Direct/Indirect Effects: Under Alternative 4, trees killed by the Tower Fire would not be removed so effects detailed under Alternative 1 would apply. While 599 acres of thinning would occur, all of the boles and slash would remain on site adding 37 tons of fuel per acre within thinned stands that contain commercial-sized trees at the time of implementation. The areas proposed for thinning currently have low fuel loadings, primarily due to past fuels treatment that resulted in lower fire intensities and less tree mortality during the Tower Fire. Leaving larger diameter fuels in the thinning slash would create a fuel profile typically associated with cool, moist sites, even though the stands to be thinned occur on a dry site. This would negate the short-term fuel reduction produced by past fuels treatments and the Tower Fire. The large-diameter slash would increase future fire intensities and durations (prescribed or wild), which would result in greater exposure of mineral soil. The increase in fire intensities within thinned areas of both commercial and non-commercial-sized material would also make control of prescribed and wild fires more difficult, because expected flame lengths would exceed direct control options for hand crews, would require significant mop-up time, and would result in high levels of mortality to the surrounding stands. Such risks could delay the prescribed fire for big game forage enhancement as well as future fuel treatments until desired burn intensities could be achieved, which would result in even greater accumulations of fuel within the thinned area. Without fuels treatment, these effects could be expected for at least 20 years until downed wood sufficiently decays. Wildfires that occur following thinning and

prior to treatment or decay of thinning slash would have a much higher probability of resulting in a stand replacement fire similar in effect to the Tower Fire. After decay or effective treatment of the slash, the reduced large diameter and ladder fuels, increased number of fire-resistant tree species, and open stand canopies created by thinning would reduce the severity of future fires, making control easier and less damaging to the remaining stand.

Obliteration of 42.5 miles and decommissioning of another 6.4 miles of roads closed to public travel would reduce fire suppression abilities in some areas, although critical fire access routes would be retained. For instance, obliteration of Forest Road 5506-100 would remove an alternate "escape route" currently identified for initial attack crews fighting fire on the west side of Oriental Creek below Forest Road 5507. As long as the Oriental Creek crossing on Forest Road 5507 is repaired, obliteration of Forest Road 5506-100 would not reduce control effectiveness or firefighter safety in this area. Obliteration of 5507-270 would limit fire engine access to some of the Oriental Basin, which could slow initial attack resulting in larger fire sizes. The effect of this closure would depend upon where a wildfire starts. Fires are most effectively suppressed by fire engines, so obliteration would greatly reduce the ability to control fires that start close to Forest Road 5507-270. Fires starting more than ¼ mile from this road would also be affected by its closure due to a greater reliance on aerially delivered firefighters and/or an increased delay in ground response.

Cumulative Effects: Ongoing and foreseeable future prescribed underburns within or adjacent to thinned stands would likely be delayed due to the high risk posed by the heavy fuel loads associated with thinning trees and leaving them on site. This would delay the return of fire to its role in the ecosystem.

ALTERNATIVE 5

Direct/Indirect Effects: Salvage harvest associated with this alternative would have similar effects to those discussed under alternatives 2 and 3, although only 399 acres would be treated. Results of the 598 acres of commercial thinning and 180 acres of precommercial thinning would again mimic those discussed under alternatives 2, and 3. Areas outside of harvest or thinning units would continue to pose hazards to firefighters and create control problems during fire suppression efforts as discussed under Alternative 1.

Obliteration of 24.3 miles of closed roads would reduce fire suppression abilities as described in Alternative 4, though not to as great an extent.

Cumulative Effects: When coupled with past salvage (5 percent of the burned area) and foreseeable future actions, effects of thinning and salvage would have similar results as those discussed under alternatives 2 and 3; however, salvage and thinning under this alternative would only affect 2 percent of the fire area.

ALTERNATIVE 6

Direct/Indirect Effects: Reduction of large-diameter fuels would occur using several methods. Salvage harvest would occur on 1,528 acres, with the same effects on fuels as described for alternatives 2 and 3.

In the Cable Creek drainage, many trees have deteriorated beyond the point of merchantability, but treatment of fuels is still a priority. Salvage harvest would most likely take the form of commercial firewood or post and pole sales, which would occur on 162 of the acres mentioned above. On 371 acres, standing fuels up to 15 inches in diameter at breast height would be felled, with logs 9 to 15 inches in diameter skidded to the nearest road where they would be piled for later sale or burning. The fuels that remain on the ground would be reduced using a "slash buster" mounted on a tractor or rubber-tired skidder. This machine would drive on top of the slash to avoid compacting the soil, and break or chip fuels into smaller pieces that would decompose more quickly. The amount of fuels reduced in this manner would be similar to the amount reduced via harvest. Treatment on another 207 acres would involve felling then underburning standing fuels up to 15 inches diameter at breast height. Underburning would occur in stands with fewer accumulated fuels and is expected to reduce fuel loadings by 5-8 tons per acre. Burning would result in a long-term reduction in fuel loading over the next 100 years.

Results of the 599 acres of commercial thinning and 180 acres of precommercial thinning would again mimic those discussed under alternatives 2, and 3. Areas outside of harvest or thinning units would

continue to pose hazards to firefighters and create control problems during fire suppression efforts as discussed under Alternative 1.

Obliteration of 33.1 miles and decommissioning of 6.4 miles of closed roads would reduce fire suppression abilities as described in Alternative 4, though not to as great an extent.

Cumulative Effects: When coupled with past salvage (5 percent of the burned area) and foreseeable future actions, effects of hazard tree removal, thinning, salvage, fuel treatments in the Cable Creek area would have similar results as those discussed under alternatives 2 and 3 on just under 10 percent of the fire area.

Transportation System

Analysis displayed here was based on field reconnaissance of road conditions and known maintenance costs.

ALTERNATIVE 1

Direct/Indirect Effects: Roads would remain in their current condition and sediment would continue to occur due to poor drainage. Plugged culverts on Forest Road 5506 at the Sheep Creek crossing and Forest Road 5507 at milepost 10.2 would probably wash out, closing these roads. Forest Road 5510 would be the main access through Oriental Basin. Where hazard trees occur along roads, the roads would have to be closed until trees fall or are removed.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: Proposed projects would occur only as funding becomes available. These alternatives would repair conditions on many open and closed roads, decreasing the potential for sediment production on 50 miles of road. Maintenance would also be reduced because improved drainage structures would be less likely to fail or cause major damage if they do become plugged. Access on Forest roads 5506, 5510, and 5448 improve and Forest Road 5510 would serve as the main access through Oriental Basin. However, even with the planned improvements to Forest Road 5510, it would be very expensive and hard to maintain. Inherent site conditions would result in a much lower standard of road than Forest Road 5507, which previously provided primary access to the Oriental Basin (see discussion of repair of Forest Road 5507 under Alternative 4). Safety would be improved where hazard trees adjacent to roads are removed, washed out crossings on Forest Road 5506 are repaired, and some of the narrow sections of Forest Road 5510 are widened. However, the proposed high water overflow dips over pipes and water bar construction on roads used by OHV traffic could cause safety problems.

Cumulative Effects: The open or closed status of roads would not change and temporary roads constructed to access harvest units would be obliterated after harvest is complete, so open road density would not change. Reductions in sediment production through the proposed treatments of 50 miles of road would reduce long-term, cumulative sediment yield caused by past road construction.

ALTERNATIVES 4 AND 5

Direct/Indirect Effects: Alternative 4 would repair 43 miles of open and administrative use roads, close 18.5 miles of open road (all of Forest Road 5506-130 and portions of Forest roads 5445, 5448, 5506, 5507-030, and 5510), and obliterate or decommission another 48.9 miles. Alternative 5 would repair 36.2 miles of open and administrative use roads, close 12.9 miles of open road (all of Forest Road 5506-130 and portions of Forest roads 5445, 5448, 5506, and 5510), and obliterate or decommission another 24.3 miles. Forest roads 5506 and 5506-130 currently provide a transportation loop for the public that is highly used, closing this would force drivers of the remainder of Forest Road 5506 to backtrack quite a distance and would make fire suppression or evacuation of the area very difficult. The open bottomed arch pipe that would be installed on Forest Road 5506 at the Sheep Creek crossing would have a higher risk of failure than other alternatives. The drop from the outlet of the pipe to the river is so great that soil would likely erode back into the open bottom arch causing it to fail. In these alternatives, 1.7 miles of Forest Road 5507 would be reopened by installing an open-bottomed arch pipe or a bridge at the crossing of

Oriental Creek, which was destroyed by the 1998 flood. Forest Road 5510 would be closed and partially obliterated, with Forest Road 5507 serving as the main access route through Oriental Basin. Forest Road 5507 would have 4.1 fewer miles of road within Oriental Basin than Forest Road 5510 and 37 fewer drainage pipes with 12 less stream crossings (class III and IV streams). Road 5507 is a higher standard road than Forest Road 5510 with a wider running surface, many turnouts, and better sight distance. Along much of Forest Road 5510, drivers must back down the road when oncoming traffic is met. Potholes are prolific on Forest Road 5510 and the narrow, outsloped sections cause a hazard when the road is covered with snow or ice. Both roads cut through highly erodible, granitic sand that does not revegetate easily and results in frequent cleaning and maintenance of ditches and cross drains. However, Forest Road 5507 does not cut through landslide deposits, so it has not experienced the mass failures that have occurred in the past along Forest Road 5510. The proposed reductions of fill heights and construction of sags over pipes, and armoring of cut and fill slopes should greatly reduce the risk of future damage from plugged culverts.

Proposed projects would occur only as funding becomes available, spreading implementation and effects across several years. This is particularly pertinent to road obliteration, as it is unlikely that all of the proposed miles of obliteration and decommissioning would be funded at the same time. The road closures, obliterations, and decommissioning would reduce public and administrative access to large portions of land. As a result, activities such as tree planting, thinning, cone collection and fire suppression would be much more difficult and expensive to administer, and future logging would require new road construction or expensive helicopter systems.

Cumulative Effects: Approximately ¾ of the roads on the District were closed under the District Motorized Access and Travel Management Plan and the existing road density is already below the 2 miles per square mile listed as a forest-wide management objective in the Forest Plan. Closing the 18.5 miles of road under Alternative 4 would reduce the current open road density from 0.96 miles per square mile to 0.80 miles per square mile. Under Alternative 5, 12.9 miles would be closed, reducing open road density to 0.85 miles per square mile.

ALTERNATIVE 6

Direct/Indirect Effects: Alternative 6 would repair 52.4 miles of open and administrative use roads, close 12.7 miles of open road (Forest roads 5448, 5507-030, and 5510), and obliterate or decommission another 39.5 miles. Proposed projects would occur only as funding becomes available, spreading implementation and effects across several years. This is particularly pertinent to road obliteration, as it is unlikely that all 39.5 of the proposed miles for obliteration and decommissioning would be funded at the same time. Forest Road 5448 (1.1 miles) would be closed at the northern edge of the meadow and completely obliterated. This would reduce access to the most popular campsites at Three Culverts Camp, but still maintain camping options in the meadow. Forest Road 5510 would be closed, but not until Forest Road 5507 was fully functional as an alternate route into Oriental Basin. The road closures, obliterations, and decommissioning would reduce public and administrative access to large portions of land. As a result, activities such as tree planting, thinning, cone collection and fire suppression would be much more difficult and expensive to administer, and future logging would require new road construction or expensive helicopter systems.

Cumulative Effects: Approximately ¾ of the roads on the District were closed under the District Motorized Access and Travel Management Plan and the existing road density is already below the 2 miles per square mile listed as a forest-wide management objective in the Forest Plan. Closing 12.7 more miles of road would reduce the current open road density from 0.96 miles per square mile to 0.85 miles per square mile. Repair, decommissioning, or obliteration on 91.9 miles of road would reduce long-term, cumulative sediment yield caused by past road construction.

Compliance with Other Laws, Regulations, & Policies

This section describes how the action alternatives comply with applicable State and Federal laws, regulations, and policies.

National Historic Preservation Act

As identified in Chapter 3, 25 heritage properties exist within the analysis area. Before project implementation, State Historic Preservation Office consultation will be completed under the *Programmatic Agreement among the United States Department of Agriculture, Forest Service, Pacific Northwest Region (Region 6), The Advisory Council on Historic Preservation, and the Oregon State Historic Preservation Officer regarding Cultural Resource Management on National Forests in the State of Oregon*, dated March 10, 1995, pursuant to stipulated Forest Archaeologist review dated November 15, 1996. Identified sites will be protected by prohibiting any disturbance within 300 feet of the site perimeter. This mitigation resulted in a determination of no effect on cultural heritage sites.

Endangered Species Act and Regional Forester's Sensitive Species

The Endangered Species Act requires protection of all species listed as "threatened" or "endangered" by federal regulating agencies (Fish and Wildlife Service and National Marine Fisheries Service). Biological Evaluations for "Endangered", "Threatened", and "Sensitive" plant, wildlife, and fish species have been completed. Determinations were made that none of the proposed projects would adversely affect, contribute to a trend toward Federal listing, nor cause a loss of viability to the listed plant and animal populations or species. Details regarding the actual species found within the Tower Fire area and the potential effects of proposed activities on those species and their habitat are contained under the Non-Forest Vegetation, Wildlife Habitat, and Fish and Aquatic Habitat sections.

Plants

There are no known populations of "threatened" or "endangered" plant species within the fire area, although one species, *Silene spaldingii,* is proposed for federal listing as "Threatened." See the Non-Forest Vegetation section of this chapter for more detailed discussion of the predicted effects on sensitive plant species.

Terrestrial Wildlife

All of the proposed actions in this EIS were included in the "Biological Assessment of the Effects of Ongoing Activities and Existing Projects on the Canada Lynx, Umatilla National Forest." The U.S. Fish and Wildlife Service concurred that none of the proposed projects will adversely affect lynx [Log no. 1-7-00-I-430]. Consultation regarding the gray wolf and bald eagle is not necessary since a determination has been made that the proposed activities will have no effect to those species. See the Wildlife Habitat section for more detailed discussion of the predicted effects on wildlife species.

Aquatic Wildlife

A Biological Assessment (BA) for listed fish species has been presented to the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, and consultation is pending. Preliminary determinations have been made that most of the proposed projects "May Affect, but will not likely adversely affect" listed fish species, and several projects will have "No Effect" to listed fish species. Restoring the Texas Bar stream channel where it was constricted by a landslide and removing fish passage barriers by replacing culverts or creating step weirs in the stream is predicted to cause short-term negative effects, but long-term benefits. A preliminary determination has been made that these fish habitat improvement projects "May Affect, and will likely adversely affect" steelhead trout. The Record of Decision for this EIS will not be signed, and the proposed projects will not be implemented until concurrence and/or a Biological Opinion from the above-mentioned regulatory agencies is received. See the Fish and Aquatic Habitat section for more detailed discussion of the predicted effects on fish species.

Wild and Scenic River Act

Based on analysis displayed in the Recreation section of this chapter, proposed projects would fully comply with the Wild and Scenic River Act.

Clean Air Act

Assessments of potential impacts on air quality related to proposed activities were completed under the Big Tower Salvage and Revegetation Project EA and the South Tower Fire Recovery Project EA

(numbers discussed here have been updated to reflect the most current information). Analysis indicates that none of the alternatives would violate Federal Clean Air Act PM-10 Emission standards (Table 4.16), due to the quantity of expected emissions and the proximity of the nearest “special protection zone” (LaGrande, Oregon, which is approximately 23 air miles from the Tower area). All burning would comply with the State of Oregon's Smoke Management Implementation Plan (OAR 629-43-043) and, for greater specificity, the memorandum of understanding between the State of Oregon, Bureau of Land Management, and the Forest Service.

Table 4. 15: **Estimated Emissions (tons)**

Alternative	PM 10	PM 2.5
2	129	103
3	129	103
4	131	104
5	18	15
6	97	78

ALTERNATIVE 1

Direct/Indirect Effects: This alternative would not produce any emissions, although ongoing and foreseeable future activities (i.e. prescribed burning, thinning) would still add to emissions within the analysis area over the next 10 years.

ALTERNATIVES 2 AND 3

Direct/Indirect Effects: Under this alternative, approximately 163 landing piles (associated with harvest) and 225 acres of hand piles (associated with the fuelbreak) would be burned, and 900 acres would be underburned for big game forage enhancement. Together, this would result in consumption of approximately 8,922 tons of material during fuel treatment, producing an estimated 129 tons of PM-10 emissions[14]. The majority of the pile burning would be conducted during the fall under fairly wet conditions. By monitoring weather conditions, and taking advantage of seasonal use and smoke dispersal patterns, the projected emissions should have a minimal effect on forest users and the surrounding communities. Smoke associated with the proposed management activities would be short-term and restricted to individual dwellings within the immediate area (including the communities of Ukiah, Dale, and Meadowbrook, as well as Forest campgrounds and dispersed camp sites within and near the analysis area). The community of Dale, Oregon, would experience some impact, particularly in the early morning hours following the ignition of the 900 acres of underburning. Conditions would be expected to clear by midmorning and should not violate state and federal standards. There would be little impact on "Special Protection Zones" or Class I Wilderness areas due to the remote location of the analysis area.

ALTERNATIVE 4

Direct/Indirect Effects: This alternative would only reduce fuels on the 900 acres proposed for fall underburning to enhance wildlife forage. This fall burning, together with leaving commercial-sized fuels on the ground in the proposed thinning units, would result in consumption of about 9,000 tons during fuel treatment. This would result in 131 tons or more of PM-10 emissions. This alternative could potentially impact local communities and forest users because all burning would occur in the fall, when the number of forest users is greatest and frequent high air pressure events reduce smoke dispersal and create stronger inversions.

ALTERNATIVE 5

Direct/Indirect Effects: Harvest would create an estimated three helicopter landings resulting in consumption of approximately 24 tons of material during fuel treatment, generating less than 1 ton of PM-10 emissions. By monitoring weather conditions, taking advantage of seasonal use and smoke dispersal

[14]PM-10 is a measurement of particulate matter (smoke) that is 10 micrometers or less in size.

patterns, this projected emission should have minimal effect on forest users and the surrounding communities.

ALTERNATIVE 6

Direct/Indirect Effects: Harvest would produce approximately 71 landing piles, and 1,107 acres would be underburned (big game forage enhancement and fuels treatment in the Cable Creek area). As a result, approximately 6,714 tons of material would be consumed during the treatment of these fuels, generating 97 tons of PM-10 emissions. During consideration of treatment options in the Cable Creek area, alternatives other than burning were considered, including chipping, slash busting, and falling and lopping. Use of a slash buster and commercial firewood harvest was selected where feasible to reduce emissions and meet treatment objectives. By monitoring weather conditions, taking advantage of seasonal use, and smoke dispersal patterns, this projected emission should have minimal effect on forest users and the surrounding communities.

Clean Water Act

The Clean Water Act of 1977 focuses on the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters. This was amended in 1987 to protect waters against pollution from both point and non-point sources. As part of the implementation of this act, the State of Oregon maintains an inventory of water quality limited streams, based on standards developed by the Oregon Department of Environmental Quality.

Beneficial uses of the Tower analysis area (Table 4.17), as defined by the State of Oregon for the John Day River Basin, include public and private domestic water supply, industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, and aesthetic quality. The following table shows the water quality parameters associated with these beneficial uses.

Table 4.16: Beneficial uses and associated water quality parameters for North Fork John Day Subbasin.

Beneficial Use	Associated Water Quality Parameter
Public Domestic Water Supply	Turbidity, Chlorophyll a
Private Domestic Water Supply	Turbidity, Chlorophyll a
Industrial Water Supply	Turbidity, Chlorophyll a
Irrigation	None
Livestock Watering	None
Anadromous Fish Passage	Biological Criteria, Dissolved Oxygen, Flow Modification, Habitat Modification, pH, Sedimentation, Temperature, Total Dissolved Gas, Toxics, Turbidity
Salmonid Fish Rearing	Dissolved Oxygen, Flow Modification, Habitat Modification, Sedimentation, Temperature
Salmonid Fish Spawning	Same as Salmonid Fish Rearing
Resident Fish and Aquatic Life	Same as Anadromous Fish Passage
Wildlife and Hunting	None
Fishing	Aquatic Weeds or Algae, Chlorophyll a, Nutrients
Boating	None
Water Contact Recreation	Aquatic Weeds or Algae, Bacteria, Chlorophyll a, Nutrients, pH
Aesthetic Quality	Aquatic Weeds or Algae, Chlorophyll a, Nutrients, Turbidity

Land disturbing activities such as roads and timber harvest can result in non-point sources of pollution. Beneficial uses most likely to be affected by the Tower Fire and proposed actions are: salmonid fish

rearing, salmonid fish spawning, and resident fish and aquatic life. Water quality standards most affected by the fire and proposed actions are: habitat modification, temperature, and sedimentation.

Standards for individual parameters are established by the State; for example, the standard for water temperature is as follows:

> *"Seven (7) day average of the daily maximum shall not exceed the following values unless specifically allowed under a Department-approved basin surface water temperature management plan:*
>
> - *64° F*
> - *55° F during times and in waters that support salmon spawning, egg incubation, and fry emergence from the egg and from the gravels*
> - *50° F in waters that support Oregon Bull Trout*
>
> *{except when the air temperature exceeds the 90th percentile of the 7-day average daily maximum air temperature for the warmest 7-day period of the year}"*

Four streams within or near the Tower project area are not meeting water quality standards, as listed on the State of Oregon 1998 303(d) list:

- Hidaway Creek (mouth to headwaters) for habitat modification and temperature
- Cable Creek (mouth to headwaters) for habitat modification and temperature
- Big Creek (mouth to headwaters) for temperature
- North Fork John Day River (Middle Fork to Granite) for temperature

A draft Water Quality Restoration Plan has been developed for the federally managed portions of the Hidaway and Cable watersheds. This plan has been shared with the Confederated Tribes of the Umatilla Indian Reservation and will be submitted to the State of Oregon. Several actions proposed under the Tower Fire Recovery FEIS would contribute to improvement of water quality in these watersheds. Specifically, riparian planting to accelerate recovery of stream shade, and fencing to exclude livestock from Round Meadow, along the South Fork Cable Creek. Big Creek was not included in the water quality restoration plan because almost its entire length is within the North Fork John Day Wilderness and is likely functioning at potential. A Total Maximum Daily Load, or TMDL, is scheduled by the State of Oregon for the North Fork John Day subbasin in 2003.

Executive Orders 11988 and 11990: Floodplains and Wetlands

Executive Order 11988 requires government agencies to take actions that reduce the risk of loss due to floods, to minimize the impact of floods on human health and welfare, and to restore and preserve the natural and beneficial values served by floodplains. The proposed road repair and obliteration projects would reduce the risk of loss to infrastructure and fish habitat and help preserve the values provided by floodplains. Other sediment reduction projects (riparian planting, fencing, dispersed campsite treatments, etc.) would do the same. Harvest would not occur within 100-year floodplains due to mitigation measures detailed in Chapter 2 (see Riparian Habitat Conservation Area measures). Some restoration projects could occur within 100-year floodplains, however, the identified mitigation measures are sufficient to comply with the requirements of this executive order.

Executive Order 11990 requires that government agencies take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. Streamside riparian areas, seeps, springs, and other wet habitats exist within the analysis area. These areas would be avoided according to Riparian Habitat Conservation Area boundaries defined in PACFISH and mitigation measures identified in Chapter 2. These measures are judged to meet the intent of Executive Order 11990.

Executive Order 12898: Environmental Justice

Executive Order 12898 requires that federal agencies adopt strategies to address environmental justice concerns within the context of agency operations. With implementation of any of these alternatives, there would be no disproportionately high and adverse human health or environmental effects on minority or low-income populations. The actions would occur in a remote area and nearby communities would mainly be affected by economic impacts as related to timber harvest or contractors implementing rehabilitation activities. Herbicide application could affect mushroom or cultural plant collectors, which often consist of low income or minority groups. This would be mitigated by the timing of herbicide application, a warning included with all applicable collection permits, and posting of treated areas. Racial and cultural minority groups could also be prevalent in the work forces that implement prescribed fire, tree planting, herbicide application, or thinning activities. Contracts contain clauses that address worker safety, and additional measures regarding herbicide application have been detailed in mitigation measures in Chapter 2 and in Appendix C (which is an excerpt from the Regional Competing and Unwanted Vegetation FEIS and Mediated Agreement).

National Forest Management Act Compliance

All proposed harvest units are planned on suitable land, and will be capable of re-stocking within 5 years of harvest by either natural or artificial means. All units were considered for potential uneven-aged management. The effects of the fire (direct tree mortality, secondary insect damage) and pre-existing incidence of disease have limited the options available for the current stands. Proposed harvest activities and vegetation manipulation will meet direction of CFR 36 219.27.

Forest Plan Consistency

Current Forest Plan direction identifies desired fuel conditions by management area across the forest. Within the analysis area it is expected that these levels can be met through a natural fuels underburning program on drier sites, primarily south of Forest Road 52 on southern aspects. It is expected that fuel accumulations within the South Fork-Tower Roadless Area, Riparian Habitat Conservation Areas, on cool moist, and on cold dry plant association groups will exceed the levels recommended by the Forest Plan, primarily due to limitations on management or the exclusion of fire in the future.

The interdisciplinary team reviewed Forest Plan standards and guidelines as they pertain to the proposed actions. The catastrophic results of the fire preclude attainment of several standards and guidelines, such as forest stand structure and species diversity, visual quality within designated viewsheds, satisfactory cover for big game, etc. However, the Forest Plan also contains wording to allow for deviations from the standards and guidelines under catastrophic conditions. The interdisciplinary team determined that the proposed management activities and their alternatives would not further detract from the standards and guidelines. As a result, the proposed action and all the developed alternatives would be consistent with the Forest Plan.

The required screening process (as found in Forest Plan Amendment #11) for timber sales was applied to this analysis. Under the riparian screen, PACFISH Riparian Habitat Conservation Areas are designated for class 1-4 streams, ponds, springs, and other riparian areas. Salvage harvesting within Riparian Habitat Conservation Areas is an option; however, this was not pursued due to the presence of listed fish species and sediment concerns related to the fire. Under the ecosystem screen, the subwatersheds within the analysis area are below their Historic Range of Variability for all but the earliest seral stages. It is anticipated that thinning in densely stocked areas (through commercial or other means) together with reforestation where mortality predominates would initiate a movement within the subwatersheds towards Historic Range of Variability for vegetation structure and species composition, shortening the time to recovery. There would be no net loss of Late Old Structure within the analysis area, since only fire-killed trees would be removed. Salvage harvest and other fuel reductions would indirectly aid achievement of Historic Range of Variability for vegetation structure and species composition by reducing future fire intensities within the treated areas. Under the wildlife screen, downed wood and snags needed to meet wildlife requirements would be retained. Salvage harvest would occur within the portion of Oriental Creek goshawk Post Fledging Area that was severely burned by the fire.

The Post Fledging Area and nest core area were originally established under the Oriental/Juniper analysis conducted during 1993.

Lands acquired by the Umatilla National Forest through the 1988 exchange with Louisiana Pacific Corporation would be allocated to management areas by extending existing management area boundaries from adjacent National Forest System Lands. The interdisciplinary team found that these allocations would be consistent with the values and resources associated with the acquired lands and the surrounding National Forest.

Parallels with Governor Kitzhaber's 11-point strategy

This project addresses several of the items proposed by Governor Kitzhaber for restoration of Eastside ecosystems. The Washington Office of the Forest Service has given a strong commitment to supporting the Governor's strategy, so the relationship of this project to each point is discussed here.

There are broad areas of potential agreement about goals for restoration of ecosystem health to the forest of Eastern Oregon. The actions proposed for the Tower Fire Recovery Projects were designed to fall within the bounds of broad public support, however, the proposals did generate a heated public debate about harvesting fire-killed trees in a burned area. Timber industry representatives were very disappointed that the EIS proposed to salvage trees from less than 20% of the burned area. They felt that far more of the dead trees should be harvested to reduce the risk of future wildfires and to support the struggling wood products industry in northeast Oregon. On the other hand, environmental advocates were very disappointed that the EIS proposed to harvest any trees from the burned area and risk damaging soils, water, and wildlife habitat. The project was designed to represent a moderate approach to salvage harvest balanced with environmental enhancements, such as riparian planting, recreation site rehabilitation, removal of fish passage barriers, and obliteration of damaging roads.

Ecosystem health includes the health of forests, streams, and watersheds." The proposed projects, while posing potential impacts to streams in the short-term (2-3 years), would show an improvement in water quality in the long-term due to road obliteration, road repair, and remediation of some past management activities. The proposed fuels treatments (including salvage) and reforestation would help protect the future forest from high intensity fire, improve tree cover where seed sources are lacking, and increase the diversity of tree species.

Ecosystem health may be improved through active management in overstocked stands, which have suffered from fire exclusion and highgrading of large trees. Many stands within the Tower Fire perimeter were considered overstocked before the fire due to fire suppression. In some overstocked stands, the fire burned cool and the stands remain stressed. The commercial thinning proposed as part of the Tower Fire Recovery Projects would reduce stocking to a healthy level, with the goal of maintaining large, old ponderosa pine. Another proposed action would reduce stocking on 198 acres, which contain trees that are not of a commercial size.

Thinning of small diameter green trees is an important component of active management for forest health and will help make sales economically viable. The dead timber proposed for salvage has greatly decreased in value due to decay. However, the commercial thinning mentioned under Point 3 would address this point as well.

Plan and implement operations first in less controversial areas. In the short run, avoid operating in roadless areas, near fish habitat and old growth areas. The Tower Fire Recovery Projects were designed from the beginning with this point firmly in mind. One of the reasons that less than 20% of the burned area is proposed for salvage harvest is that the South Fork/Tower Roadless Area, old growth, and riparian areas were removed from consideration for ground disturbing activities. All alternatives include a 300-foot buffer on all fish-bearing streams, 150-foot buffer on perennial non-fish-bearing streams, and 100-foot buffer on ephemeral streams; Alternative 5 would protect riparian areas even more by extending the buffer on non-fish-bearing perennial streams to 300 feet. Designated old growth stands that were burned in the Tower Fire were avoided and stands to replace the killed designated old growth were identified outside the fire area. Harvest of trees in the burned area is the primary area of controversy that was unavoidable.

For ecosystem health restoration activities to truly succeed, monitoring and learning from these efforts is essential. Monitoring of fire recovery and rehabilitation projects began immediately following the fire in 1996 and several research studies have also been initiated. This research has been a partnership with National Forest System (management), Forest Service Research, and various universities. Monitoring has also been identified to track implementation and consequences of the activities proposed in the Tower Fire Recovery Projects EIS.

Cumulative effects analysis should include all ownerships within a watershed, where possible. One of the primary reasons that the Ninth Circuit Court required an EIS for the Tower area was so the cumulative effects of the array of salvage and rehabilitation projects would be considered more comprehensively and together with the effects of the fire itself. This has been completed and a description of the processes used is incorporated at the beginning of this chapter. The cumulative effects themselves are described in various subsections of this chapter in association with the pertinent alternatives. Information regarding private lands within the affected subwatersheds has also been included where available.

Active management includes more than cutting trees. Riparian area planting, reforestation, road obliteration, and stream rehabilitation are all key components. The Tower Fire Recovery Projects EIS proposes many projects besides harvest. In addition to the items above, proposed actions would remove barriers to fish passage, increase longevity of snags, improve wildlife forage, reduce soil compaction from past activities, stabilize eroding soils, protect and enhance riparian habitat.

Use of low impact cost effective equipment is an important element in effective restoration. The Forest Service, federal government, and the state should provide incentives that encourage the use of such equipment. Alternatives within the Tower EIS looked at various ways to incorporate low impact and cost effectiveness into salvage. Harvester/forwarder equipment is one of these ways, within the constraints of topography. In Alternative 2, 38 percent of the area proposed for harvest would occur using harvester/forwarder equipment, 24 percent would rely on helicopters (lower impacts, more costly), and 38 percent would be harvested via tractor (lower cost, higher impacts). In Alternative 6, no tractors would be used in order to limit soil disturbance, 78 percent of the harvest would use harvester/forwarder equipment, and 22 percent would rely on the more costly helicopter methods. Alternative 5 would rely entirely on helicopters for harvest, limiting the amount of area harvested due to the high cost.

Timber salvage may be an important component of ecosystem health restoration and fuel reduction strategies to the extent that it promotes ecosystem health goals. The stated need for timber salvage within the Tower Fire area is to reduce future fire intensity and duration 20+ years from now. This is critical for the survival of currently regenerating stands. It would also allow for easier application of prescribed fire, which is essential for maintaining ecosystem health.

Where costs of ecosystem health restoration efforts are not paid for by timber sale proceeds, funds should be made available to finance these activities on a priority basis. The North Fork John Day Ranger District has made and will continue to make fire recovery a priority. Many ecosystem health restoration projects had already occurred before the court injunction through funds not related to timber sales, such as reforestation outside of harvest areas, riparian planting, road obliteration, and exclusion of livestock. This would continue as funds for such projects are made available by Congress or through grants from organizations such as Bonneville Power Administration, Rocky Mountain Elk Foundation, etc.

Parallels with the Upper Grande Ronde River Anadromous Fish Habitat Protection, Restoration, and Monitoring Plan

The Upper Grande Ronde Plan was prepared in 1992 in cooperation with the Oregon Department of Fish and Wildlife, Columbia River Inter-Tribal Fish Commission, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, and Oregon State University. It was drafted in response to concerns over continuing declines of Snake River anadromous fisheries stock and the degraded condition of habitat in the Grande Ronde Sub basin. While the proposed Tower projects would not occur within the Grande Ronde Sub basin, the area does contain Snake River anadromous fisheries stock and there are similar concerns regarding degraded habitat. The Confederated Tribes of the Umatilla Indian Reservation and Columbia River Inter-Tribal Fish Commission have requested that the Tower Fire Recovery Projects EIS

be considered with regard to this plan. This section will review how the proposed actions for the Tower area respond to the elements, objectives, and standards contained within the Upper Grande Ronde Plan.

Element 1: Floodplain/Riparian Vegetation

In summary, the objective for this element is to manage floodplains to be fully occupied by natural plant communities that have structural and functional properties that promote stability, resiliency, and aquatic diversity. The floodplains should have a high capacity for water storage during floods and provide for long-term stability of summer base flows. The floodplains should also store organic material and sediment to maintain high quality fish habitat through time. The Tower projects would accomplish the three associated standards by planting riparian vegetation where it is still deficient and by observing riparian buffers where timber harvest would occur. The Upper Grande Ronde Plan identifies a minimum 300-foot buffer on each side of fish bearing and perennial streams. This buffer width was included in Alternative 5 of the Tower EIS. Alternatives 2, 3, and 6 propose PACFISH buffers of a minimum 300 feet on each side of fish-bearing streams and 150 feet on non-fish bearing perennial waters. Some non-harvest projects would cause disturbance within these buffers (road repair or obliteration and removal of fish barriers caused by roads), but they would provide long-term improvement in fish habitat and would be mitigated to limit the amount of short-term sediment production. Protection of meadow ecosystems would occur through fencing to exclude livestock and planting of riparian vegetation appropriate to the site.

Element 2: Channel Morphology

In summary, the objective for this element is to manage for natural channel forming and maintenance processes without substantial long-term or subwatershed-wide modifications. There should be numerous, persistent large pools, and frequent well-distributed complexes of woody debris. In meadow ecosystems, large, stable communities of streamside vegetation should be present to provide bank stability. Alternatives 2 and 3 in the Tower EIS propose additions of large instream wood to increase pool frequency and depth, as well as the function it serves for habitat. This would correspond with the first two standards under this element. However, upon further field reconnaissance the District fish biologist determined that many fire-killed snags have fallen into area streams since the proposal was first made, and that the trade-offs of soil disturbance and compaction associated with felling and moving wood into streams out-weighed the need for placement of instream wood. As a result, this project was dropped from alternatives 4, 5, and 6. The third standard regarding a width to depth ration ranging from 7:1 to 10:1 would be addressed indirectly through various Tower proposals, such as road repair or obliteration, soil stabilization plantings, riparian planting, fencing, and rehabilitation of dispersed campsites. Some projects (harvest, road repair and obliteration, removal of fish barriers) could potentially produce sediment. Mitigation measures have been identified in Chapter 2 to limit production of sediment, and though some sediment could still reach streams, the predicted amount does not indicate a change in width-to-depth ratios.

Element 3: Sediment/Substrate

The objective for this element is to manage for channel and substrate conditions that will not limit spawning and rearing. An analysis of sediment was completed for both the short-term and long-term and a baseline recovery curve was predicted. This is discussed extensively in Chapter 4 under the Water and Soil and Fish and Aquatic Habitat sections.

Element 4: Water Quality/Quantity

The objective for this element is to moderate summer and winter stream temperatures to provide highly favorable conditions for the production of spring chinook, summer steelhead, and other aquatic organisms. Standards under this objective address production of cool water temperatures in summer and greater than 32° F in winter. Projects associated with the Tower EIS were designed to maintain and, where possible, improve water temperatures. Removal of stream shade could potentially occur under road obliteration, removal of barriers to fish passage, or where bridges are proposed on Forest roads 5507 or 5506. These same projects would improve long-term stream health and fish habitat. Projects that would improve water temperatures include riparian planting and fencing. Harvest, temporary road construction, and prescribed fire projects were designed to avoid removal of stream shade (and thus maintain stream temperatures).

In addition to addressing the elements in the Upper Grande Ronde Plan, a water quality restoration plan was developed for the Tower area, which was one of the tasks recommended in the Upper Grande Ronde Plan. The Tower EIS also contains monitoring recommended in the Upper Grande Ronde Plan and would implement Best Management Practices (which would be monitored for implementation and effectiveness as recommended

Livestock management in riparian areas was addressed indirectly through fencing of sensitive areas; overall management of livestock was not considered under the Tower EIS.

Many roads within the Tower burn were proposed for obliteration; this would address both obliteration of many draw-bottom roads and reduction of general road density as recommended in the Upper Grande Ronde Plan. This would increase short-term risk of sediment due to soil disturbance, but reduce long-term risk of sediment flushes from road or stream crossing failures. Road repair would address reduction of road-caused sediment sources as described in the Upper Grande Ronde Plan.

Other Jurisdictions

There are a number of other agencies responsible for management of resources within the Tower Fire area. The Oregon Department of Fish and Wildlife is responsible for management of fish and wildlife populations, whereas the Forest Service manages the habitat for these animals. The Oregon Department of Fish and Wildlife has been contacted regarding this EIS and has provided information used in the development of alternatives and analysis. The USDI Fish and Wildlife Service and National Marine Fisheries Service are responsible for the recovery of species listed under the Endangered Species Act. Any Forest Service activities that have the potential to affect such species must be approved by the responsible agency. Consultation with those agencies regarding the proposed Tower Fire Recovery Projects is ongoing and would be completed before any activities related to this EIS could be implemented.

The Environmental Protection Agency is responsible for enforcement of environmental quality standards, such as those established for water resources, while the Oregon Department of Environmental Quality sets standards, identifies nonpoint sources of water pollution, and determines which waters do not meet the goals of the Clean Water Act. The Environmental Protection Agency has certified the Oregon Forest Practices Act as Best Management Practices. Oregon State compared Forest Service practices used to control or prevent non-point sources of water pollution with the Oregon Forest Practices Act and concluded that Forest Service practices meet or exceed State requirements (Forest Service 1988c). These are periodically reviewed as practices change. The Forest Service and Oregon Department of Environmental Quality have signed a Memorandum of Understanding (2/12/79 and 12/7/82) outlining this. The Oregon Department of Environmental Quality listed Hidaway Creek, Big Creek, the forks and mainstem of Cable Creek, and North Fork John Day River as water quality limited for 1998. A water quality restoration plan has been developed concurrently with this EIS to satisfy State requirements. Permits for any instream work would be required from the Oregon Division of State Lands.

Oregon Department of Environmental Quality and the Oregon Department of Forestry are responsible for regulating all prescribed burning operations. The USDA Forest Service Region 6 has a Memorandum of Understanding with Oregon Department of Environmental Quality, Oregon Department of Forestry, and the USDI Bureau of Land Management regarding limits on emissions, as well as reporting procedures. All burning will comply with the State of Oregon's Smoke Management Implementation Plan and, for greater specificity, the memorandum of understanding mentioned above.

The Umatilla National Forest has filed cultural resource site reports conducted within the Tower Fire area with the State Historic Preservation Officer.

Energy Requirements and Conservation Potential

Some form of energy would be necessary for proposed projects requiring use of mechanized equipment: road repair or obliteration, fish weir construction, subsoiling, forage enhancement prescribed fire, snag enhancement, dispersed campsite rehabilitation, hazard tree removal, harvest, and thinning. Precommercial thinning would involve small machines, while projects such as rehabilitation of dispersed campsites, snag enhancement, or fish weir construction could require heavy machinery for a small amount of time. Both possibilities would result in minor energy requirements. High fuel requirements are associated with helicopter operations (harvest or prescribed fire for forage enhancement), however, helicopters are more productive and do not need to be operated for as long as more conventional ground-based machines. Harvest using helicopters would also avoid the need to consume fuel for temporary road construction.

Alternatives that harvest trees would create supplies of firewood as a by-product. Such material would be of relatively low quality due to charred bark, deterioration, and many lower quality fuelwood species. These products, however, contribute to the local supply of energy for home space heating.

Urban Quality, Historic, and Cultural Resources

The Tower Fire area contains no urban areas. The goal of the Forest Service's cultural resource management program is to preserve significant historic and cultural resources in their field setting and ensure they remain available in the future for research, social/cultural purposes, recreation, and education. One proposed project in particular - the repair of Pearson Guard Station - would improve the opportunities for preserving this historic landmark by restoring facilities that would make it eligible for the cabin rental program which would directly provide funds for its upkeep. The remainder of the proposed activities could inadvertently expose prehistoric cultural resources through ground disturbance. This possibility is addressed through mitigation described in Chapter 2. The cultural resource report determined that there are adequate standards, guidelines, and procedures to protect cultural resources and to meet the goals of the cultural resource management program. This is discussed further in the "Cultural Resource" section of this chapter.

Prime Farmland, Rangeland, and Forestland

No prime farmland, rangeland, or forestland occurs within the analysis area.

Consumers, Minority Groups, & Women

The effects on civil rights, including those of minorities and women, are expected to be minimal. Alternatives 2 through 6 would be governed by Forest Service contracts, which are awarded to qualified purchasers regardless of race, color, sex, religion, etc. Such contracts also contain nondiscrimination requirements. While the activities identified here would create jobs and the timber harvest would provide consumer goods, no quantitative output, lack of output, or timing of output associated with these projects would affect the civil rights, privileges, or status quo of consumers, minority groups, and women.

Unavoidable Adverse Effects

Implementation of any of the alternatives would inevitably result in some adverse environmental effects. The severity of the effects can be minimized by adhering to the direction in the management prescriptions and Standards and Guidelines in Chapter IV of the Forest Plan and additional mitigation proposed in Chapter 2 of this document. These adverse environmental effects are discussed at length under each resource section.

Short-term Use and Long-Term Productivity

The relationship between short-term uses of man's environment and the maintenance and/or enhancement of long-term productivity is complex. Short-term uses are generally those that determine the present quality of life for the public. In the Pacific Northwest, this typically includes: timber harvest, livestock grazing, recreation, transportation, utility corridors, and wildlife habitat. Long-term productivity refers to the land's capability to support sound ecosystems producing a continuous supply of resources and values for future generations. Management activities associated with short-term uses (i.e. burning,

use of machinery, or removal of wood fiber) could reduce the productivity of some portions of the National Forest. The magnitude that long-term productivity would be reduced is not known because investigations of these effects have only recently begun. However, general comments can be made regarding potential effects caused by the proposed activities. For purposes of this analysis, the duration of this project would be at least five years. Under all alternatives, the long-term productivity of the Forest lands and resources would be protected from unacceptable degradation by the standards and guidelines in the Forest Plan, specific project design, and mitigation measures for the alternatives described in Chapter 2 of this document.

Structural improvements contribute towards the opportunity to use the potential productivity of the analysis area. Roads and trails provide necessary access, and roads are considered as long-term improvements that provide for continued use over time. While no new construction would occur, between 36 and 60 miles of road would be repaired (depending on the selected alternative) and about 2 miles of trail would be improved. Proposed road repair would improve accessibility of roads to the public, while repair of stream crossings damaged in the 1998 flood would reopen some major roads that were closed by the flood. Road closures in Alternative 4 (18.5 miles on Forest roads 5445, 5448, 5506, 5506-130, 5507-030, and 5510), Alternative 5 (12.9 miles on Forest roads 5445, 5448, 5506, 5506-130, and 5510) and Alternative 6 (12.7 miles on Forest roads 5448, 5507-030, and 5510) would reduce public accessibility. Wildlife use the created openings resulting from the presence of roadways. Animals that use roads open to the public or OHV trails are at risk of hunting, harassment, and injury or death by vehicular collision during their life cycle. Proposed road and trail improvements could modify future population levels, with a greater affect on non-game species, since game species have regulated population levels.

Preserving long-term soil productivity is essential for maintaining a healthy ecosystem and allowing the sustained yield of timber and other renewable resources from the Forest. Proposed subsoiling and road obliteration would reduce long-term soil compaction that resulted from past management, and soil stabilization plantings would retain soil on site, which would benefit soil productivity. Conclusive evidence relative to short-term impacts of timber harvest and prescribed fire adversely affecting long-term site productivity does not exist. Considerable research suggests, however, that nitrogen reserves, organic residues, and soil physical properties are critical elements of the ecosystem that must be carefully managed to ensure long-term productivity (Little and Klock, 1985; Sachs and Sollens, 1986; Harvey et. al., 1987; Powers and Weatherspoon, 1984; and Amaranthus and Perry, 1987). These researchers suggest that the various components of the site should be maintained to ensure that potential losses of nutrients and changes in soil physical and biological properties do not occur. This is addressed through mitigation in Chapter 2 that relates to designation and location of skid trails and retention of slash and down wood.

No long-term effects to water or its beneficial uses are expected from the proposed management activities under any alternative. However, the physical characteristics of one or more stream channels could be temporarily or permanently altered as a consequence of short-term direct or indirect effects of management (i.e., road crossings, erosion, reestablishment of riparian vegetation, deposition of sediments, etc.).

Effective fire prevention and suppression, while minimizing damage to existing timber stands and other resources, resulted in long-term changes in vegetative composition and reduced timber productivity, altering the overall ecosystem. The Tower Fire reduced site productivity as a result of excessive fuel buildups. Removal of wood fiber and disposal of slash, if done through a proper prescription, would have little effect on long-term productivity. However, productivity could be adversely affected if large wood is not removed (as under alternatives 1 and 4), or slash resulting from harvest is not treated or is inadequately treated. Burning at the wrong time or allowing for a high intensity, long duration fire would result in loss of soil fertility. Most other effects of slash disposal would be short-term and have little effect on productivity.

Unnatural fuel accumulations have developed due to fire exclusion and could result in unacceptable impacts on air quality, as witnessed during the Tower Fire. Harvest, thinning, and prescribed fire can be utilized both effectively and efficiently to reduce fuel loadings and otherwise manipulate the various fuel complexes in the analysis area. This would greatly reduce the consequences of a wildfire within and

adjacent to the manipulated fuels complexes. It would also enhance the long-term productivity of wildlife habitat, increase stream flows, provide more visual diversity, and provide the disturbance necessary for the perpetuation of important plant species. The temporary impacts of smoke from prescribed fire under alternatives 2, through 6 would have minor effects on the short-term use of Forest resources such as recreation sites, visual resources, and Wilderness. The use of prescribed fire to reduce the flammability of activity fuels and the construction of a shaded fuel break under alternatives 2, 3, and 6 would affect long-term forest productivity by reducing the risks and consequences of a major wildfire. The long-term benefits of prescribed fire in natural fuels more than outweigh the short-term impact to air quality.

The Tower Fire created conditions which, coupled with public use, are currently resulting in decreased long-term productivity through erosion on approximately 26 dispersed campsites. Under Alternative 1, the vegetation and soils on much of each site would continue to experience trampling, soil compaction, and disturbance due to a lack of site definition and barriers. Alternatives 2 through 6 would construct barriers and define the sites with gravel so that use is better contained and vegetation has an opportunity to recover from the fire. The short-term use (construction or improvement) of trails and trailheads to enhance the dispersed recreation experience would have long-term effects on productivity similar to those described for dispersed campsites under Alternative 1. Such effects would be very limited in extent (area).

Irreversible and Irretrievable Effects

An **"Irreversible"** commitment of resources refers to a loss of future options with nonrenewable resources. An **"Irretrievable"** commitment of resources refers to loss of opportunity due to a particular choice of resource uses.

Where roads traverse steep slopes, they become permanent features on the landscape. No new construction of permanent roads is planned, however construction of temporary roads would pose an irretrievable loss of uninterrupted underground water flows and soil productivity. Decommissioning would restore much of the temporary road to productivity, particularly where compaction is reduced through subsoiling. However, only recontouring of the road to the previous slope would begin to restore prior drainage patterns or underground flows. As a result, temporary road construction would result in some irretrievable losses in hydrologic function and site productivity. Temporary roads and log landings would produce irreversible changes in the natural appearance of the landscape as well. This would be greatly reduced where actual obliteration would occur. Rock used to surface roads or harden campsites or trails would be an irreversible commitment of mineral resources.

There is an inherent risk of accelerating landslides, erosion, and other changes in soil physical and biological properties when harvesting timber, constructing temporary roads, repairing or obliterating permanent roads and subsoiling in steep, rugged terrain, particularly where soils consist of landslide deposits. Debris avalanches, when they occur, often scour to bedrock. Surface and channel erosion, severe soil compaction and displacement, damage to proper functioning of soil biological processes, etc., could lead to either a limited or total loss of site productivity. Productivity, once lost, requires a long time for natural processes to restore. However, road obliteration and subsoiling of past harvest units would also restore somewhat the otherwise irreversible effects of past harvest and road construction. The soil and water protection measures identified in the Forest Plan Standards and Guidelines and mitigation measures in Chapter 2 are designed to avoid or minimize the potential for irreversible losses from the proposed management practices.

Concerning threatened and endangered plant, wildlife, and fish species, a determination has been made that the proposed actions will not result in irreversible or irretrievable commitment of resources that foreclose formulation or implementation of reasonable or prudent alternatives.

Any losses in fish habitat and fish production would be expected to increase as a function of increased, chronic sediment. Some of the proposed rehabilitation projects that would increase short-term sediment would actually decrease sediment over the long-term or immediately increase the amount of accessible fish habitat (i.e. road obliteration or fish barrier removal). This would provide for healthier fisheries in the future as long as they are able to survive the short-term sediment increases. Mitigation in Chapter 2 was designed to minimize impacts of sediment on fish.

Forested habitats within the Tower Fire, particularly old growth habitats, were greatly diminished by the fire. Proposed activities which would plant trees would initiate reestablishment of these habitats more quickly, shortening the time that dependent wildlife species are extirpated from the area or are stressed due to less ideal habitats. Planting would also reestablish biotically valuable white pine stands, which were unique in this area and extirpated by the fire. Replacement of killed old growth would maintain the highest quality adjacent habitat to help sustain dependent species until old growth is restored within the burned area. As a result, some of the restoration activities would offset otherwise irreversible effects from the Tower Fire.

Under Alternative 1, retention of dense accumulations of dead and injured trees, continued mortality from Armillaria, continued overstocking, and reliance on natural reforestation would slow tree recovery in severely burned areas of the fire and result in a combined overall decline in established green stands. Alternative 4 would have similar results, given that the tree planting would only achieve an estimated 30% success due uncontrolled, competing vegetation. As a result, tree growth and productivity would be irretrievably lost in both alternatives. Herbicide application under alternatives 2, 5, and 6 would result in an irretrievable loss of growth of affected grasses, ferns, and shrubs for approximately 2 to 3 years. However, this would be minor because herbicide would be applied in small spots surrounded by a large matrix of untreated vegetation. Also the vegetation growth lost would be somewhat offset by the tree growth gained through control of competing vegetation. Trees that have regenerated since the fire would be irretrievably lost where skid trails and landings would occur within harvest units. However, most of these trees are lodgepole pine, which has regenerated at high densities that would eventually result in lost growth and forest health. Many lodgepole pines would remain outside the skid trails and landings and would utilize the resources made available by the killed trees to increase growth. In a number of units, planting would also occur, which would include the skid trails and landings.

There has already been an irretrievable loss of timber value due to decay and a total loss of value would occur in the absence of salvage. Fungi infect the fire-killed trees, resulting in wood discoloration and decay. All the alternatives preclude tree removal on at least part of the burned area. This represents a commitment of the land to uses other than timber harvest and an irretrievable loss of the economic value of those trees. Tree removal also constitutes an irretrievable loss of the value of removed trees for wildlife habitat, soil productivity, and other values.

Wilderness potential (characteristics) within the roadless area where the fuel break occurs would be irretrievably lost. However, this could be reversed since vegetation within the fuelbreak could be allowed to return to previous densities.