Chapter 4. Environmental Consequences

4.1 Forest Vegetation and Fire, Fuels, and Air Quality

4.1.1 Summary of Effects

4.1.1.1 Alternative A (No Action)

- Under the no-action alternative, high stand densities would increase above the 55 percent threshold of relative density, and tree mortality due to drought, insects, and disease would be expected to occur. Species composition would be expected to gradually shift towards shade-tolerant species including fir and cedar species. The landscape would continue to be dominated by mid-seral closed canopy forests resulting in a homogeneous landscape with an increased susceptibility to large-scale drought, insects and diseases, and fires with high tree mortality.

- Under the no-action alternative, flame lengths would generally be at least 8 feet under 90th percentile weather conditions. Fire management's ability to safely suppress and contain fires, both in initial attack and extended fire suppression operations, would not be improved and would continue to decline over time from current conditions.

- The current predicted fire behavior would lead to high tree mortality in forested areas in the Project Area during a wildfire; these areas include Baker cypress stands, Riparian Habitat Conservation Areas (RHCAs), Protected Activity Centers (PACs), and Home Range Core Areas (HRCAs).

4.1.1.2 Alternatives B, C, D, and F

- Within treatments, stand densities would be reduced below the 55 percent relative density threshold, and tree densities would be reduced, particularly in the smaller diameter classes. This would result in more open canopy stands; these stands would promote conditions that would promote growth of residual trees and decrease susceptibility to adverse effects of drought, fire, insects, and disease. Group Selection, aspen, and Baker cypress treatments would favor the development and establishment of shade-intolerant species such as pine species, aspen, and Baker cypress. This would enhance species diversity on the landscape.

- The creation of mid- to later-seral open canopy stands and early seral stands would enhance forest structure and seral stage diversity across the landscape. The proposed treatments would promote fire-resistant stands, which would contribute to the development of a fire-resilient forest on the landscape level. This would contribute to landscape heterogeneity and begin to reduce susceptibility to large-scale drought, insects and diseases, and fires with high tree mortality.

- Alternatives that propose higher canopy cover retention criteria (50 percent canopy cover) result in higher stand densities that result in shorter timeframes for treatment effectiveness. Although alternatives B and C propose to treat the most acres, alternative D would result in lower stand densities and longer treatment effectiveness, but on relatively fewer acres.

Alternative F would implement the least amount of acres, with a moderate reduction in stand density.

- The retention of a 50 percent canopy cover in some prescriptions would decrease the effectiveness of fuel treatments with respect to retardant penetration through the canopy to surface fuels and may lead to retention of ladder fuels in the form of biomass, which would contribute to increased fire-related mortality.
- Overall, fuel treatments would result in an increased ability of fire managers to suppress and contain fires, leading to potential decreased suppression intensity and costs.
- Decreased suppression intensity could lead to a decreased potential for resource damage during a fire and lower the Burned Area Rehabilitation (BAER) costs after the fire is out. A decrease in fire intensity during a wildfire would increase firefighter and public safety, lead to lower mortality in forested areas, including Baker cypress stands, RHCAs, PACs, and HRCAs.

4.1.2 Guiding Regulations

The Diamond Project is designed to fulfill the management direction specified in the *National Forest Management Act of 1976* and the 1988 *Plumas National Forest Land and Resource Management Plan*, as amended by the 1999 Record of Decision on the Herger-Feinstein Quincy Library Group (HFQLG) final environmental impact statement (EIS) and the 2004 Record of Decision on the Sierra Nevada Forest Plan Amendment (SNFPA) final supplemental EIS. Fuel and vegetation management activities are designed to comply with the standards and guidelines as described in the 2004 Record of Decision on the SNFPA final supplemental EIS. Implementation of the Diamond Project, in combination with other projects on the Plumas National Forest, would aid in the implementation of the Plumas County Fire Plan (PCFSC 2005) that was approved by the Plumas County Board of Supervisors on April 19, 2005, and the Plumas County Hazardous Fuel Assessment Strategy (Callenberger and Lunder 2006).

4.1.3 Methodology for Assessing Impacts on Forest Structure, Species Composition, Fuels and Fire, Forest Health, and Air Quality

4.1.3.1 Geographic Area Evaluated for Impacts

The approximate 100,000-acre Diamond Project Area forms the geographic boundary of the Analysis Area used to analyze the direct, indirect, and cumulative effects on forest vegetation and fuels and fire. The Analysis Area is comprised of four watersheds: Antelope Lake, Upper Lights Creek, Middle Lights Creek, and Genesee Valley (see figure B-1 in appendix B). The analysis considers the four watersheds because, when combined, they represent the furthest measurable extent that effects on forest vegetation would occur as a result of implementing any of the proposed alternatives. With respect to fire, these watersheds, as a group, are geographically bounded by high-elevation ridgelines that are sparsely vegetated in places. Because of this, all of the fires that have occurred in these four watersheds have been contained within the watershed. Ecologically, the dynamics between vegetation and fire and fuels are inherently linked; vegetation treatments (and absence thereof) have a profound effect on fuels accumulations and fire behavior, and conversely, fire has a profound effect on vegetation establishment and development. The Analysis Area considers this relationship on the landscape level by including the vegetation and past large wildfires and contains all public lands available for and subject to proposed treatments under the Diamond Project, as well as the vegetation within the watersheds outside Treatment Areas. This allows for a congruent analysis of forest vegetation, fuels, and fire at the stand and landscape levels.

The direct, indirect, and cumulative effects analyses are based on a temporal scale. Documented past projects ranging as far back as 1971 were considered past actions within the Analysis Area. In a broader sense, current vegetation structure and composition reflects the historical management regimes prior to 1971. This vegetation structure and composition includes attributes of the current landscape including existing vegetation types, fuel treatments, burned areas, past sanitation harvest, and plantations.

For the purpose of the vegetation analysis, the temporal bounds include a 30-year horizon for future effects because modeling indicates that, within 30 years, the treated stands would approach current levels of stocking. Stand development modeling was extended beyond this timeframe as this allows for examining general trends and trajectories of stand development under no further management beyond those documented in “Appendix B: Past, Present, and Reasonably Foreseeable Future Actions,” which is located in this draft EIS. The potential fire behavior and effects of alternatives were modeled pre treatment and post treatment, with the latter reflecting treatments after completion. Fuel treatments are expected to remain effective for at least 10 years—this is based on experience with existing fuel treatments in the Diamond Project Area (North Antelope). Fuel treatments will likely require entry for burning and other maintenance prior to the 30-year horizon modeled for tree stand growth (see the 2004 HFQLG final supplemental EIS). Future maintenance activities are discussed in appendix B (Past, Present, and Reasonably Foreseeable Actions) of this document. With respect to air quality, the towns, National Parks, and major highways within 20 miles of the Project Area boundary are listed in section 3.1.3 “Air Quality” of chapter 3 (table 3-3). It is important to note that unknown or unanticipated future wildfires, disease outbreaks, or mortality may occur in the Project Area prior to completion of implementation of this project—these potential future disturbance events are not included as part of this analysis.

4.1.3.2 Measurement Indicators

Forest Vegetation. The effects of treatment on stand structure, compositional structure, and landscape structure of forest vegetation are evaluated for each alternative.

Stand Structure—Stand structure is analyzed using three measures of stocking and density: (1) trees per acre and their distribution by diameter class, (2) basal area per acre, and (3) relative stand density.

1. **Trees per acre and their distribution by diameter class:** Number and distribution of trees per acre by diameter class (see table 4-1) is an important unit of measure because it shows the effect of treatments on different size trees. High density stands also slow the rate of fire line construction by hand crews and mechanical equipment. The four diameter classes are based on diameter classes for forest products (biomass and sawlog products) and guidelines for reserve trees upon which silvicultural prescriptions are based. The sawlog-sized trees are split into two 10-inch diameter classes to analyze the effect of the alternative silvicultural prescriptions on forest structure.

Table 4-1. Diameter classes used for analysis.

Description by Product	Biomass Trees	Sawlog-Sized Trees		Reserve Trees
Diameter Class	0–10 inches dbh	10–20 inches dbh	20–30 inches dbh	>30 inches dbh

Notes: dbh = diameter at breast height.
> = greater than.

2. **Basal area per acre:** Basal area per acre is commonly used as a measure of stand density. This measure has been used by Oliver (1995) to describe the threshold for Ponderosa pine stands (150 square feet per acre), above which bark beetle related mortality is expected to occur. Basal area per acre has also been used by Landram (2004) to develop insect risk thinning guidelines for the eastside, transition, and westside zones of the Plumas National Forest.

3. **Relative stand density:** The concept of stand density index was first developed for even-aged stands by Reinecke (1933) to compare "the density of stocking of various stands." The relative density concept describes a stand's density relative to the maximum possible density and may serve as a simile for a stand density relation to its carrying capacity. In general, the concept of stand density as a measure has been further developed for forest management applications for both even-aged and uneven-aged stands (Curtis 1970; Drew and Flewelling 1977, 1979; Long 1985; Long and Daniel 1990; Helms and Tappeiner 1996; Jack and Long 1996; Powell 1999; Woodall et al. 2002).

   A relative density between 55 and 60 percent has been described as the lower limit of the "Zone of Imminent Competition Mortality" above which trees begin to die due to competition related stress (Drew and Flewelling 1977, 1979; Long 1985; Long and Daniel 1990; Smith et al. 1997; Powell 1999; Long 2005). For the purpose of this analysis, 55 percent was used as a conservative measure of the onset of competition-related mortality because stress induced by competition increases tree susceptibility to drought, insects, disease, and fire. This threshold serves as an appropriate measure for forest health because stands managed below this threshold are less likely to incur mortality due to the agents mentioned above.

   The desired relative densities immediately post treatment are between 25 and 45 percent. These levels are substantially below the 55 percent threshold of imminent competition mortality, and treatments within the desired range should have a reasonable "lifetime" before reaching densities at which mortality is expected to occur. Desired relative densities within the 20 to 30 years would be below the 55 percent threshold of imminent competition mortality (Blackwell 2004) as this longer time frame would be representative of a reasonable cutting or entry cycle.

   Reinecke (1933) described a maximum stand density of 750 for mixed conifer stands in California. The calculation of this maximum stand density is largely dependent on the mix of species. A more site-specific maximum stand density of approximately 680 was calculated using the Forest Vegetation Simulator (FVS), which calculates maximum stand density weighted by the “proportion of basal area each individual species represents in the stand” (Dixon 1994). This may be a more appropriate measure of maximum stand density as it considers site-specific species composition reflected in the existing condition. For the purpose of this analysis, relative density based on the maximum stand density index as calculated by FVS is used.

Compositional Structure—Compositional structure is measured by calculating the percent of species composition pre and post treatment. Percentage of species is also reported as a ratio of shade-intolerant to shade-tolerant species to display the relative proportion of species retention. Species composition is analyzed because silvicultural prescriptions may have an effect at the stand level on differing species dependent on shade tolerance and species biology. Residual species composition post treatment is an important measure because these trees represent the seed bank of the future, which is one factor that affects species diversity over time. Most importantly, species composition is analyzed at the landscape level because the effects of stand-level treatments on species composition may be highly localized and limited in area; however, species composition and their relative proportion at the landscape level show the cumulative effect of treatments on species composition over multiple forest vegetation types.

Landscape Structure—Landscape structure is measured by calculating the distribution of relative successional (seral) stages on the landscape. The percent change of seral stage and canopy density created by proposed treatments is calculated to measure change on the landscape structure. The distribution of seral stages on the landscape is an important indicator because it may be used as a measure of landscape diversity. The Forest stands were aggregated by California Wildlife Habitat Relationship (CWHR) size class because the proposed treatments, stand structure, and effects of treatments on stand structure would not substantially vary by forest vegetation type. The aggregation of stands by CWHR size class allows for landscape-level effects analysis by using size class as a proxy for seral stage and the corresponding stand-level effects by size class (seral stage). The CWHR size class and density class (Mayer and Laudenslayer 1988) is an effective proxy for seral stages to calculate the distribution of relative seral stages because it describes average tree size and canopy cover. In addition, this allows for a congruent analysis of effects on forest vegetation and wildlife habitat.

Fire and Fuels. The measurement indicators for potential treatment effects on potential fire behavior and severity include (1) flame length, (2) fire type, and (3) predicted percent mortality. These indicators are described below.

1. **Flame length (feet):** The length of flame measured in feet. Increased flame lengths can increase suppression intensity and likelihood of torching events and crown fires. Flame length is influenced in part by fuel type, potential for crown fire, and weather conditions. Fuel type and crown fire potential, in turn, influence the rates at which firelines can be constructed by different fire resources, including hand crews and mechanical equipment (see table 4-2). Flame lengths above 4 feet may present serious control problems—they are too dangerous to be directly contained by hand crews (Schlobohm and Brain 2002; Andrews and Rothermel 1982). Flame lengths over 8 feet are generally not controllable by ground-based equipment or aerial retardant and present serious control problems including torching, crowning, and spotting (see table 4-3).

Table 4-2. Sustained line production rates for common fuel models in the Diamond Project Area. Fuel Model 9 represents the desired condition.

Fuel Model (Rothermel 1983)	Resource Type		
	Type I[a] (chains per hour)	Type II[a] (chains per hour)	Type II Dozer[b,c] (chains per hour)
5–brush	6	4	105
9–representative of pine litter	28	16	85
10–timber (natural fuel accumulation)	6	4	20
11–logging slash, light	15	9	40

Notes:

a. Type I and Type II consist of 20-person crews.

b. Type II dozer is stationed at Mt. Hough Ranger District.

c. Type II bulldozer is used for construction, burnout, and holding; used on 26 to 40 percent slopes.

Table 4-3. Relationship between flame length and potential for success of active suppression.

Flame Length	Description
Less than 4 feet	Fires can generally be attacked at the head or flanks by firefighters using hand tools. A hand line should hold the fire.
4–8 feet	Fires are too intense for direct attack at the head with hand tools. A hand line cannot be relied on to hold the fire. Bulldozers, engines, and retardant drops can be effective.
8–11 feet	Fire may present serious control problems: torching, crowning, and spotting. Control efforts at the head will probably be ineffective.
Greater than 11 feet	Crowing, spotting, and major fire runs are probable. Control efforts at the head of the fire are ineffective.

Source: NWCG 2004.

2. **Fire type (surface or crown fire):** The predicted fire type (surface or crown fire) as predicted by FLAMMAP (Finney et al. 2005). Crown fire includes both active and passive crown fire (Stratton 2004). Fire type will affect the difficulty of controlling a fire, fire fighter and public safety, and fire-related tree damage and mortality. Generally speaking, it is more difficult and more expensive to safely contain crown fires because they tend to lead to more tree damage than surface fires. Surface fires, with flame lengths less than 4-feet, are more easy to safely contain and result in less tree damage than a crown fire (refer to table 4-3 above). For this reason, surface fires with flame lengths within 4 feet within treated stands are the desired post treatment condition.

3. **Predicted Percent Mortality:** The modeled percent probability of mortality for trees that may be killed by direct scorching of needles or cambial damage from a wildfire (Reinhardt et al. 1997) occurring under 90th percentile weather conditions. This information is displayed by the 10-inch diameter class for each alternative and prescription.

4.1.3.3 Analysis Methods

Forest Vegetation. Field inventories were conducted to measure attributes of existing vegetation in the Diamond Project Area. Stands in the Diamond Project Area were inventoried using the Forest Inventory and Analysis and Common Stand Exam protocols for the Pacific Southwest Region (U.S. Department of Agriculture [USDA] Forest Service Region 5). These stands are representative of the Project Area and the areas to be treated in all action alternatives. Data was collected on live and dead trees, understory vegetation layers, and fuels.

For analysis purposes, the stand data was typed by CWHR vegetation data and loaded into the Forest Vegetation Simulator, a forest growth model that predicts forest stand development (FVS 1997; Dixon 1994). The model was used to calculate existing stand conditions and to predict the effect of alternative treatments on stand development. Stand growth, mortality, regeneration, and development was simulated to predict the effects of treatments over time. The stand attributes analyzed include trees per acre, basal area, quadratic mean diameter, stand density index, canopy cover, and species composition. Stand attribute outputs were averaged and weighted by treatment and CWHR size class to examine stand level effects of treatment over the larger landscape scale. Model outputs have unknown variances that may sometimes be large; however, this is normal for modeling efforts, and outputs are best evaluated in a relative rather than an absolute sense.

A Geographic Information System (GIS) was used to analyze forest vegetation on the landscape scale by using CWHR data compiled by the VESTRA (2000) vegetation coverage for the Project Area. The distribution of CWHR size class and density was analyzed relative to the stand-level effects modeled by CWHR size class.

Fire and Fuels. The modeling of potential fire behavior was done under 90th percentile weather conditions (see table 4-4) that were calculated using Fire Family Plus (Main et al. 1990). The 90th percentile weather is defined as the severest 10 percent of the historical fire weather conditions occurring during the fire season. The Fuels Management Analyst software program (Carlton 2005) was used to model and assess the effects of different treatments on potential flame length and predicted tree mortality at the stand level. The Fuels Management Analyst program has been used to model potential stand-level fire behavior in published studies (Stephens and Moghaddas 2005a, b).

Table 4-4. Parameters used for stand-level modeling under 90th percentile weather conditions.

Weather Variable	Value	Weather Variable	Value
Weather Station Name and ID Number	Pierce (# 040915)	Herbaceous fuel moisture	30%
Time of Year	June 30 to September 15	Woody fuel moisture	70%
1-hour fuel moisture	1.9%	Probable maximum 1 minute 20-foot wind speed[a]	10 mph
10-hour fuel moisture	2.5%	Foliar (leaf) moisture content[b]	90%
100-hour fuel moisture	4.6%	Wind reduction factor—no treatment[c]	0.2
1,000-hour fuel moisture	6.1%	Wind reduction factor—DFPZ and area thinning treatments[c]	0.3
Relative Humidity	10%	Wind reduction factor—group selection openings[c]	0.4
Temperature (Fahrenheit)	91°		

Sources:

a. Crosby and Chandler 1966.

b. Stephens and Moghaddas 2005a, b; Agee et al. 2002.

c. Rothermel 1983.

Note: DFPZ = Defensible Fuel Profile Zone.

The software "FLAMMAP" (Finney et al. 2005) was used to predict fire type (surface or crown fire) spatially at a landscape scale. FLAMMAP has been used to assess landscape level fire hazard in published studies (Stratton 2004). It is important to note that results were based on outputs of an empirical fire model. The output data reflect fire modeling assumptions (weather, fuel model characteristics, and spatial variability) and variability within the Forest Inventory Analysis plots. Weather data used in fire modeling were obtained from the Pierce Weather Station, which is within the Analysis Area. Weather conditions at the station are recorded in a south-facing open area, reflecting "worst case" weather conditions within an area with virtually no canopy cover. For stand-level modeling in the Fuels Management Analyst program, wind speeds were modified using the wind speed adjustment factor (Rothermel 1983) to reflect the post-treatment effect of reductions in canopy cover on increased wind speeds. Gridded winds (Butler et al. 2004; Forthofer et al. 2003), which generate spatially explicit wind speeds based on local topography, were used for modeling in FLAMMAP. Gridded winds assume an approximately 10 mile per hour 20-foot ridge-top wind speed. Dead fuel moistures were adjusted within FLAMMAP based on the topography, shading, weather, and conditioning period length (Finney 2005). See the "Vegetation, Fire, Fuels, and Air Quality Specialist Report" for additional details on vegetation and fire modeling methodologies.

4.1.3.4 Design Criteria

Chapters 1 and 2 provide detailed information about the Design Criteria used for each alternative (also see appendix C in this document).

The harvest systems were determined by evaluating topography, slope, and access for each unit. Ground-based mechanical, skyline, and helicopter harvest systems are proposed (see chapter 2). All mechanical harvest operations would adhere to the standards and guidelines set forth in the timber sale administration handbook (Forest Service Handbook [FSH] 2409.15, including Region 5 supplements) and the Best Management Practices as delineated in the "Water Quality Management for Forest System Lands in California: Best Management Practices" (USDA 2000).

4.1.3.5 Type and Duration of Effects

Direct Effects. These are effects on forest vegetation and fuels that are directly caused by treatment implementation or, as with alternative A (no action), a lack of treatment.

Indirect Effects. These would be effects on forest vegetation and fuels and fire behavior that are in response to the direct effects of treatment implementation or, as with alternative A (no action), a lack of treatment.

Duration of Effects. Direct effects would likely be limited to the project implementation phase. Indirect effects would last beyond the implementation period and occur within the temporal bound of the cumulative effects analysis described above in section 4.1.3.1 ("Geographic Area Evaluated for Impacts").

4.1.4 Environmental Consequences: Forest Vegetation and Fire, Fuels, and Air Quality

4.1.4.1 Alternative A (No Action)

Under alternative A, no actions would be implemented to address the areas of concern identified in the Diamond Landscape Assessment (located in the project record) or objectives and desired conditions identified in the purpose and need sections in chapter 1.

Direct and Indirect Effects. Existing stand conditions would persist and develop unaltered by active management, with the exception of continued fire suppression activities. Wildfire, drought, disease, and insect-related mortality and recruitment would continue to occur. Stands would remain dense, particularly in the smaller diameter classes in terms of trees per acre and basal area. The high density of trees per acre that are less than 20 inches in diameter represents the effect of past management activities as described in "Chapter 3: Affected Environment." The stand-level surface, ladder, and canopy fuels (Scott and Reinhardt 2001) would not be modified from the existing conditions described in chapters 1 and 3.

These high tree densities would persist under alternative A, thereby reducing growth rates and tree vigor and increasing risk of mortality due to inter-tree competition and increased incidence of insect activity (Ferrell 1996; Oliver et al. 1996; Oliver 1995). High densities of small trees may cause competition for soil moisture and nutrients, which could contribute to increased stress on larger, older trees (Dolph et al. 1995). Over time, stand densities would increase beyond 55 percent of maximum density where trees begin to die from inter-tree competition; this threshold is referred to as the "lower limit of the zone of imminent competition mortality" (Drew and Flewelling 1977; Drew and Flewelling 1979; Smith et al. 1977).

Oliver (1995) observed that northern California even-aged ponderosa pine stands above Sartwell's (1971) basal area threshold of 150 square feet per acre were susceptible to *Dendroctonus* bark beetle attack. Currently, CWHR size classes 4 and 5 stands are over this threshold (see table 4-5), and pine stands within these CWHR types are at high risk of epidemic bark beetle mortality (Fiddler et al. 1989; Oliver 1995). True fir species (white and red fir) may exist at higher stand densities. However, at high stand densities, root disease and drought increase the susceptibility of true fir species to mortality caused by the *Scolytus* fir-engraver beetle (Oliver et al. 1996; Guarin and Taylor 2005; Ferrell 1996; Macomber and Woodcock 1994).

The increasing stand density and consequent mortality due to inter-tree competition and increased incidence of insect activity may have a major adverse effect on forest health by decreasing tree vigor and growth; increasing susceptibility to insects, disease, and drought; and increasing susceptibility to intense fire behavior. The resulting stand structure would be characterized by a very dense understory and midstory with interlocking crowns. These general trends, in relation to forest health and fire hazard, have been described by Powell (1999) and are shown in figure 4-1.

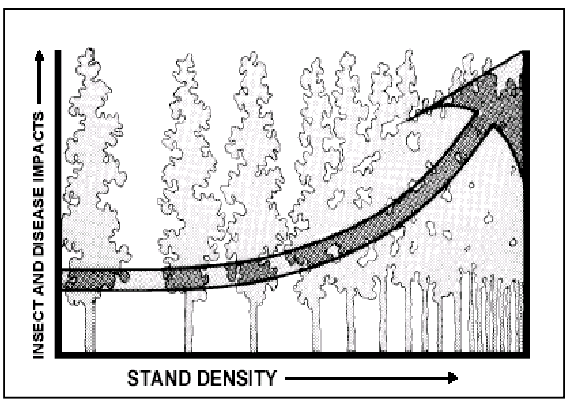
At the stand level, these trends would result in the continued persistence of high surface fuel loads, average height to tree crown base of less than 6 feet, and high stand densities across forested lands, including Baker cypress stands, RHCAs, PACs, and HRCAs in the Project Area. These conditions would result in flame lengths of at least 8 feet under 90th percentile weather conditions (see table 4-6). These flame lengths, when combined with current stand structure, would result in

Table 4-5. Existing and projected stand structure for alternative A.

CWHR Size Class	Time Frame	Total Trees per Acre	Trees Per Acre by Diameter Class <10 inches dbh	10–20 inches dbh	20–30 inches dbh	>30 inches dbh	Basal Area (square feet/acre)	Stand Density Index	Relative Stand Density (Percent of maximum)[a]
CWHR 3	Pretreatment	210	156	48	5	1	112	165	32
CWHR 3	10 years	206	136	62	7	1	139	241	38
CWHR 3	20 years	251	167	72	11	1	165	291	45
CWHR 3	30 years	287	193	75	18	1	189	333	52
CWHR 4	Pre	405	327	65	10	3	182	341	51
CWHR 4	10 years	375	283	77	11	4	209	376	56
CWHR 4	20 years	398	296	83	14	5	233	418	62
CWHR 4	30 years	418	309	87	17	5	255	455	68
CWHR 5	Pre	514	443	55	11	5	183	356	54
CWHR 5	10 years	478	398	62	13	5	208	389	59
CWHR 5	20 years	492	402	69	15	6	231	429	64
CWHR 5	30 years	499	401	74	17	7	252	463	70

Note: The values in this table were calculated using the Forest Vegetation Simulator (FVS).

a. Based on FVS (Dixon 1994) maximum stand density index for sierra mixed conifer weighted by species composition.



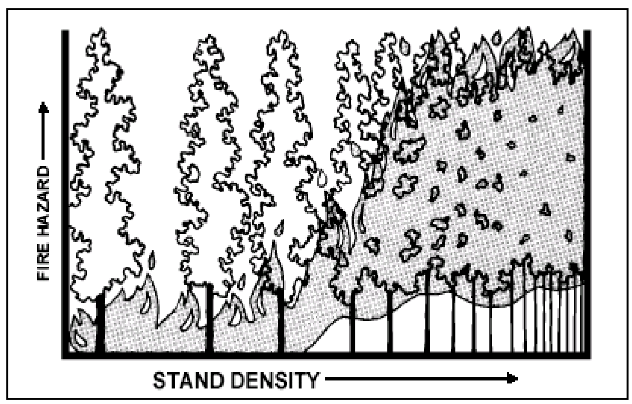


Figure 4-1. General effects of increasing stand density on (a) insect and disease impacts, and (b) fire hazard as described by Powell (1994, 1999).

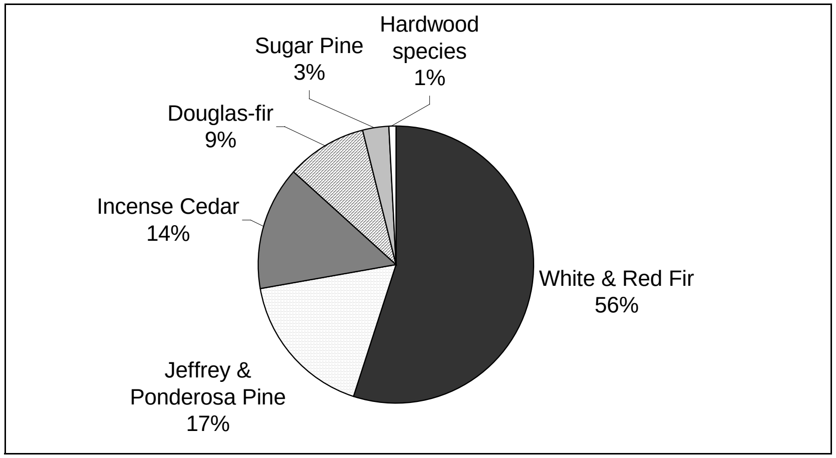
Table 4-6. Predicted flame length, fire type, height to live crown base, and mortality under alternative A.

CWHR Size Class	Treatment Stage	Predicted Percent of Trees That Would Be Directly Killed by Fire					Flame Length (feet)	Fire Type	Height to Live Crown Base (feet)
		<10 inches dbh	10–20 inches dbh	20–30 inches dbh	>30 inches dbh	All trees			
CWHR 3	No action	96	35	87	No trees in this class	98	8	Passive Crown	2
CWHR 4	No action	100	97	28	3	64	8	Passive Crown	5
CWHR 5	No action	100	69	25	5	72	8	Passive Crown	3
Baker Cypress Stands	No action	100	74	7	5	76	8	Passive Crown	4

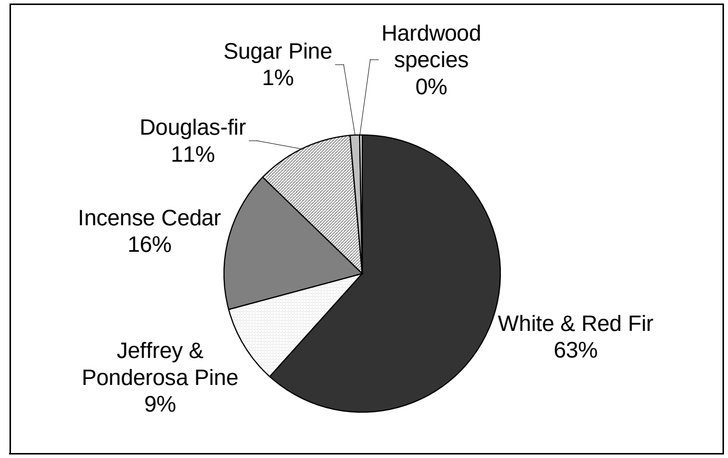
extensive high-intensity surface fires and torching with crown fire activity. This fire activity could result in up to 50 to 90 percent predicted direct mortality for trees up to 30 inches in diameter under current stand conditions (see table 4-6). The predicted direct mortality from scorch and cambial damage does not account for post-fire mortality to fire-damaged trees due to insect and disease activity.

Continued high density, high fuel load, and high flame length conditions would (a) reduce the production rates for line construction by hand crews and mechanical equipment (refer to table 4-3 above), (b) compromise the safety of fire fighters and the public, and (c) decrease the effectiveness of aerially applied retardant. In addition, burning embers from burning trees and standing dead trees could be blown to unburned areas outside the main fire—this could potentially increase the fire size. These direct and indirect effects do not reflect the influence of the fire itself on local weather conditions (Colson 1956; Cramer 1954). At the landscape level, these two factors (increased spotting and the fire's influence on local weather) tend to increase erratic fire behavior, resulting in increased fire size with higher tree mortality, especially when area weather patterns become warmer with increased winds and lower atmospheric stability (Schroeder and Buck 1974). The above factors would decrease the effectiveness of initial attack and extended fire suppression operations, leading to a greater potential for large, high-severity fires.

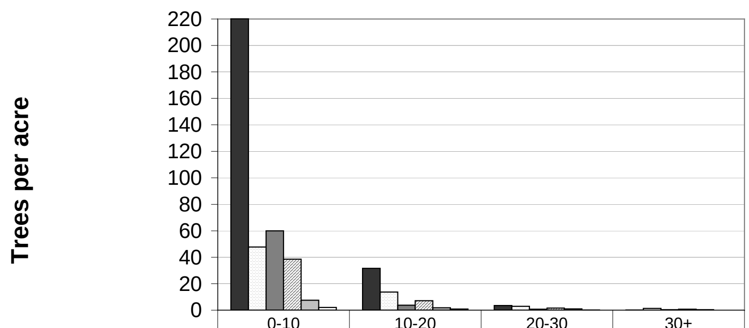
The existing stand structure promotes a low light environment, which strongly influences species composition by favoring the regeneration, growth, and development of shade-tolerant species such as white fir, incense-cedar, and, to a lesser degree, Douglas fir. Shade-tolerant species currently exist at high densities, particularly in trees less than 20 inches dbh (see figure 4-2c). Pine species (Jeffrey and ponderosa pines) dominate the overstory trees (greater than 30 inches dbh); however, the number of pines in the understory are much lower relative to shade-tolerant species. These large dominant overstory pines are "legacy" trees that may be indicative of species composition in historical reference conditions. However, existing stand structure and high densities clearly favor the regeneration, growth, and development of shade-tolerant species. Currently, stands in the Project Area are dominated by the shade-tolerant species mentioned above (see figure 4-2).



4-2a: Existing Condition: Pre-treatment species composition for CWHR size class 4.



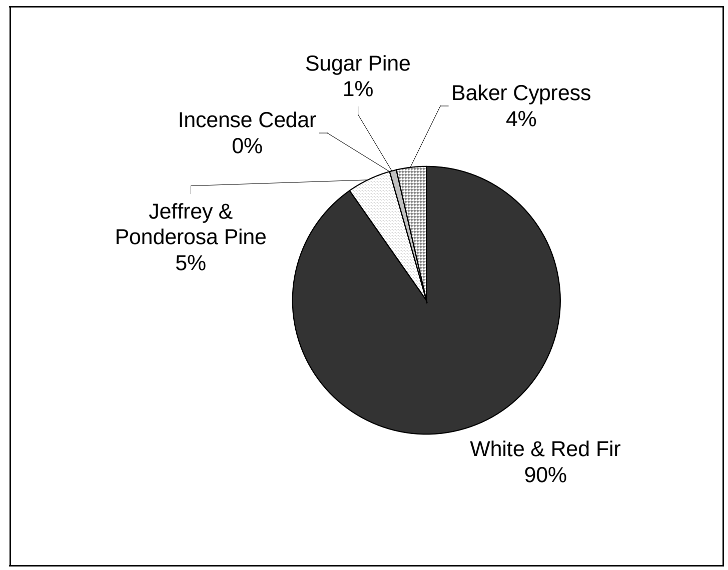
4-2b: Existing Condition: Pre-treatment species composition for CWHR size class 5.



	0-10	10-20	20-30	30+
White & Red Fir	220.1	31.6	3.6	0.2
Jeffrey & Ponderosa Pine	47.8	13.8	3.0	1.4
Incense Cedar	60.0	3.8	0.7	0.4
Douglas-fir	38.6	7.2	1.6	0.7
Sugar Pine	7.5	1.9	0.9	0.5
Hardwood species	2.1	0.9	0.1	0.0

Diameter Class

4-2c: Existing Condition: Species composition by diameter class pre-treatment stocking levels for CWHR size classes 4 and 5.



4-2d: Baker Cypress Existing Condition: Pre-treatment species composition for CWHR size classes 4 and 5.

Figure 4-2. Existing condition species composition.

Such high densities of shade-tolerant species compete with shade-intolerant species for resources (nutrients, light, and water), increase shade in the understory, and discourage the regeneration of shade-intolerant pine species (Oliver et al. 1996). Consequently, over the longer temporal scale, a shift in species composition would be expected to occur, giving preference to regeneration of shade-tolerant species over shade-intolerant species (Minnich et al. 1995; Ansley and Battles 1998; Oliver et al. 1996; McKelvey and Johnston 1992). Shade-tolerant species, white fir in particular, can be more susceptible to fire-related scorch mortality than shade-intolerant species such as ponderosa pine and Jeffrey pine (Skinner 2005; Stephens and Finney 2002; Mutch and Parsons 1998; Leiberg 1902). This susceptibility to mortality can lead to more trees being killed by wildfire-related scorch and damage to the cambium. A recent study (Hood et al., *In review*) has shown higher fire resistance in white fir less than 20 inches compared with published literature previously cited. Potentially contradictory results from various scientific studies are a normal part of the scientific process—results from one study may not represent scientific consensus.

A similar effect on species composition would be expected to occur in Aspen stands and Baker cypress stands. The high densities of conifer encroachment that would occur under alternative A would out-compete the shade-intolerant aspen regeneration and promote a shift in species composition from aspen to shade-tolerant species. The indirect effect would be a forest type change from aspen to mixed conifer forest.

The true fir species in the Baker cypress stands would continue to dominate the canopy, thereby perpetuating a low light environment in which Baker cypress would be unable to compete. In addition, the low light environment and the absence of fire would inhibit the regeneration, growth, and development of Baker cypress. This trend has been observed by Forest Service personnel since the 1960s. Consequently, the indirect effect would be the possible elimination of Baker cypress from this stand. See the “Botanical Resources and Noxious Weeds” sections in chapters 3 and 4 for additional discussion on Baker cypress.

Currently, relative stand density in CWHR size classes 4 and 5 is at or just below the 55 percent threshold thereby increasing the risk for competition-related mortality. Over time, diameter growth and an increase in trees per acre due to ingrowth would contribute to an increase in stand density. In the absence of treatment or naturally occurring disturbance, such as fire, stand density would continue to increase beyond the threshold of 55 percent relative stand density into the “zone of imminent mortality” (see figure 4-5a below). This would have an adverse effect on tree growth and vigor and resistance to insects, disease, drought, fire behavior, and fire-related tree mortality.

Under the no-action alternative, fire management’s ability to safely suppress and contain fires, both in initial attack and extended fire suppression operations, would not be improved and would continue to decline over time from current conditions due to continued stand densification and surface fuel buildup. Under 90th percentile weather conditions, flame lengths would generally be at least 8 feet (refer to table 4-6 above). The fireline handbook (NWCG 2004) notes that with 8-foot flame lengths, “Fire may present serious control problems: torching, crowning, and spotting; control efforts at the head will probably be ineffective.” As flame lengths exceed 11 feet, “crowning, spotting, and major fire runs are probable; control efforts at the head of the fire are ineffective” (NWCG 2004) (refer to table 4-3 above). Under current fuel loadings and stand densities, as represented by a Fuel Model 10 (refer to tables 4-2 and 4-5 above), the rates of line construction are relatively slow for both hand crews and tractors when compared with the post-treatment desired conditions (refer to table 4-3 above).

The current canopy cover can reduce the effectiveness of retardant penetration through tree crowns to surface fuels, in turn making it more difficult to contain large fires. A high percentage of retardant is intercepted by tree crowns before it reaches the ground and becomes less effective for suppressing and holding fires burning through surface fuels (Alexander 2000; Anderson 1974). This decreased penetration of retardant with higher canopy cover in untreated stands, when compared with an adjacent treated area, was witnessed on the Bell Fire in September 2005 (Craggs 2005; Moghaddas 2006). In addition, the use of aerial retardant is generally not effective at suppressing crown fires or fires with high flame lengths. The above factors result in a major negative effect on the overall ability of fire managers to safely suppress and contain fires, leading to increased suppression intensity and cost. This increased suppression intensity can lead to a greater potential for resource damage during the fire and higher Burned Area Rehabilitation (BAER) costs after the fire is out.

Implementation of alternative A would not establish a network of fuel treatments. Overall, the current predicted fire behavior for this alternative could lead to a greater potential for large, high-severity fires in forested areas, including Baker cypress stands, Riparian Habitat Conservation Areas, Protected Activity Centers, and Home Range Core Areas in the Diamond Project Area during a wildfire under 90th percentile or worse weather conditions.

4.1.4.2 All Action Alternatives (B, C, D, and F): All Treatments Involving Mechanical Harvesting

Direct and Indirect Effects. In general, the direct and indirect effects described below would be common to all action alternatives that propose mechanical harvesting as a treatment regardless of silvicultural prescription. The effects of the specific silvicultural prescriptions proposed under the action alternatives are described in the subsequent subsections. However, all treatments involving mechanical harvesting using ground-based, skyline, and helicopter logging systems would share similar effects that include the potential for damage to residual trees; incidental removal of snags and trees greater than 30 inches in diameter; the construction of skid trails, landings, and temporary roads to facilitate logging operations; and the creation of activity-generated slash. Implementation of mechanical treatments is expected to maintain current total volume of snags and woody debris greater than 10 inches in diameter (Stephens and Moghaddas 2005c).

Throughout all treatments, regardless of silvicultural prescription, trees greater than 30 inches in diameter would be retained in accordance with the 2004 Record of Decision on the SNFPA final supplemental EIS (see table 2 in that document). In general, trees in the 20- to 30-inch diameter classes and the greater than 30-inch diameter classes would be the favored tree sizes to retain. These larger trees have favorable attributes in terms of fire resistance, desired stand structure, and wildlife habitat. In pine-dominated mixed conifer forest types, shade-tolerant species (such as white fir, incense-cedar, and to a lesser degree, Douglas-fir) would be targeted for removal, particularly in the smaller diameter classes. Shade-intolerant species such as Jeffery pine, ponderosa pine, and sugar pine would be retained. In true fir-dominated forest types, species preference would be weighted towards maintaining naturally occurring shade-intolerant species such as Jeffery pine; however, species composition would be maintained at levels appropriate for that ecological forest type.

Damage to residual trees may occur during harvesting operations including damage to stems, bark scraping, wrenched stems, broken branches, broken tops, and crushed foliage (McIver et al. 2003). These effects are typical in logging operations, but care would be taken to minimize the potential for damage to residual trees. The Forest Service would inspect timber sales during harvesting to ensure that damage to residual trees is within reasonable tolerances.

Snags would be removed, particularly those under 15 inches in diameter. In accordance with the 2004 Record of Decision on the SNFPA final supplemental EIS (table 2, page 69), four to six snags per acre that are 15 inches in diameter or greater would be retained within Treatment Units dependent on forest type and treatment (see the "Design Criteria" section in chapter 2). Incidental removal of snags may occur for operability and safety; however, guidelines set forth in the Sierra Cascade Province Timber Theft and Detection Plan would be used to ensure that operability, safety, and minimum snag densities would be met. The snags to be retained would receive preference in locations where operability and safety are not anticipated to be issues. Snags within falling distances of roads, landings, and heavily used public areas would receive preference for removal. Where minimum snags densities do not currently exist, marking guidelines would provide for the retention of large live trees with wildlife habitat characteristics (such as multiple or broken tops, crooks, and/or bole cavities) to serve as future snag recruitment.

Existing skid trails, landings, and temporary roads would be used, when available, to facilitate the harvesting and removal of forest products (biomass and sawlogs). Skid trails, landings, and temporary roads could be constructed under all action alternatives to facilitate the removal of forest products when existing infrastructure does not exist. Under all action alternatives, about 20 miles of temporary road would be constructed, and any temporary roads constructed would be decommissioned after use. Construction of skid trails, landings, and temporary roads would require incidental removal of trees beyond those described for silvicultural purposes. This may include incidental removal of trees greater than 30 inches in diameter for operability. However, the location and size of skid trails, landings, and temporary roads, and the trees harvested for the construction of such facilities must be approved and agreed upon by the Forest Service. The removal of trees for operability would be incidental and therefore, would have negligible effects on stand structure.

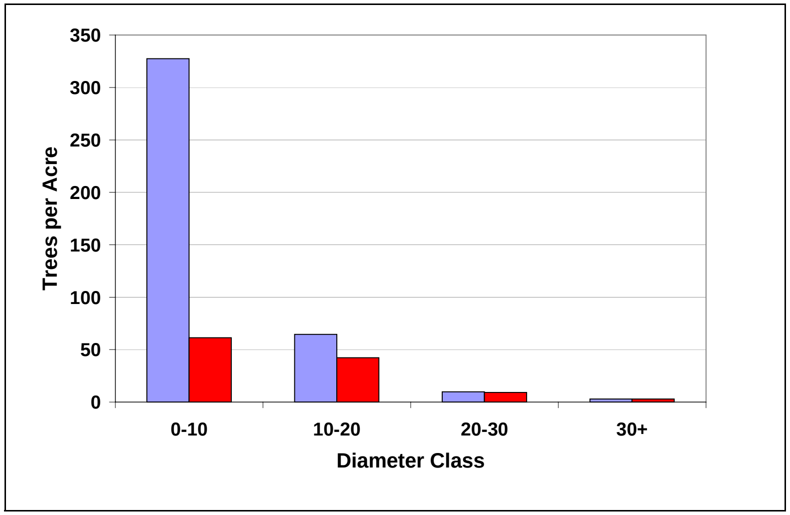
All action alternatives propose to use whole-tree yarding to treat slash generated by harvest activity. The removal of limbs and tops by such methods would greatly reduce activity-generated surface fuels (Agee and Skinner 2005). The majority of trees would be removed using whole-tree yarding, which would effectively reduce the potential for activity-generated fuel accumulation. Slash would be lopped and scattered to minimize fuel bed depth, continuity, and arrangement if whole-tree yarding is not feasible (such as when mechanical yarding of an individual large tree would result in excessive damage to a residual stand). The net effect may result in incidental activity-generated fuel accumulations. Underburning, pile burning, or other appropriate surface fuel treatment method would be used, as determined by post treatment evaluations, to reduce activity-generated and existing fuels.

4.1.4.3 All Action Alternatives (B, C, D, and F): Fuel Treatments (DFPZ, Underburn, Pile Burn, and Mastication)

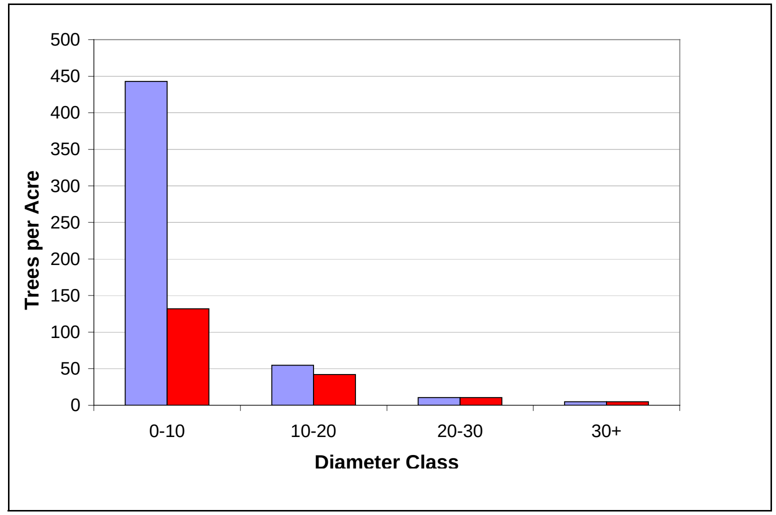
Direct and Indirect Effects. The proposed fuel treatments (DFPZ, underburn, pile burn, and mastication) under alternatives B, C, D, and F would implement basic principles of fuel reduction, which integrate reduction of surface fuels, thinning from below, and retention of large fire-resistant dominant and codominant trees (Agee and Skinner 2005; Peterson 2005; Graham et al. 2004). The removal of saplings and pole-sized trees would reduce stand density, ladder fuels, and shade-tolerant species, while increasing canopy base height. These basic principles of fuel reduction have reduced flame lengths and tree mortality under modeled (Stephens and Moghaddas 2005a) and real fire conditions both on the Plumas National Forest and on wild fires in conifer-dominated vegetation types (Skinner et al., *In press*; Moghaddas, *In review*; Tonto National Forest 2005; Plumas National Forest 2003; Beckman 2001; Hood 1999). Treatments would reduce fire hazard in approximately 350 acres of extended Wildland Urban Interface along Diamond Mountain Road. Both the strategic DFPZ network of fuel treatments along with non-network fuel treatments follow past forest-level (Olson et al. 1995) and more recent scientific recommendations for fuel treatments (Hessburg et al. 2005; Agee et al. 2000). Specifically, Hessburg et al. (2005) note:

> Currently, dry forest landscapes of the Inland Northwest exhibit high landscape connectivity of conditions that support large and severe fires. To buy time for more thoughtful and carefully planned forest restoration, it makes sense to begin restoration by designing and developing networks of shaded fuel breaks throughout the dry forests (Agee et al. 2000; Arno and Allison-Bunnell 2002). These networks would provide the advantage of breaking large fire-prone landscapes into smaller and more manageable pieces, which would be of significant benefit, both for restoration and fire suppression efforts. It would be useful to position fuel breaks adjacent to existing roads so that the fuel breaks could be revisited at regular intervals, and re-treated to maintain a widely scattered cover of medium- and large-sized ponderosa pine (where available) with only light fuels. (page 132)

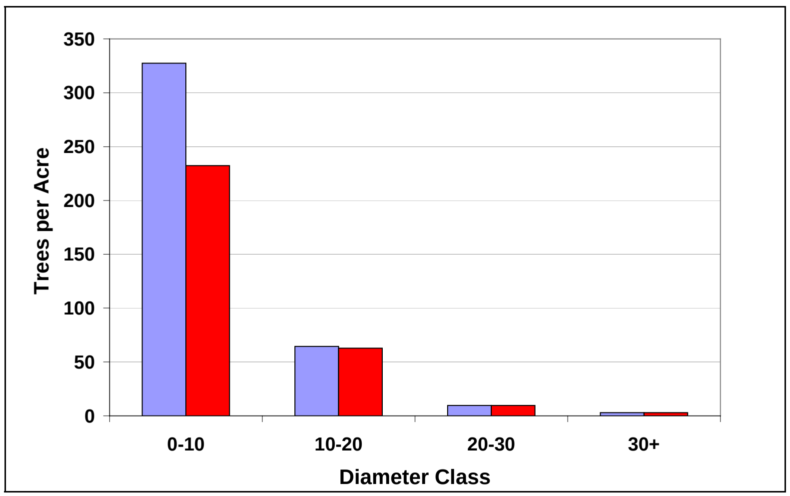
Direct and Indirect Effects of DFPZ Fuel Treatment Prescription 1: CWHR Size Classes 3 and 4 – Thin to 35–40 Percent Canopy Cover; CWHR Size Class 5 – Thin to 40–45 Percent Canopy Cover, 30-inch Upper Diameter Limit. Fuel treatments that implement the lower canopy cover (35 to 45 percent canopy cover) guidelines in all CWHR types would have a major beneficial effect on residual stand structure. The low thinning would reduce trees per acre, particularly in trees less than 10 inches in diameter, and crown thinning would reduce trees per acre primarily in the 10- to 20-inch diameter class (see figures 4-3a and 4-3b below). Within CWHR size classes 4 and 5, approximately one tree per acre on average would be harvested in the 20- to 30-inch diameter class. The larger trees that would be removed would be those impacted by insects and disease. Mechanical fuel treatments would increase the average height to live crown base, resulting in surface fires with less potential for torching and crowning, leading to lower overall predicted mortality than pretreatment stands (see table 4-7 below). This reduction in flame length and potential for crown fire would increase the ability of fire managers to suppress and contain fires in both initial and extended operations within and adjacent to fuel treatment units. In addition, a reduction of canopy cover would allow better penetration of retardant to surface fuels when compared with current conditions under the no-action alternative. Overall, fuel treatments are less effective in moderating tree mortality in CWHR size class 3 stands. This is because trees in this size class have a smaller average diameter, have thinner bark, and are less fire resistant than larger-diameter dominant and codominant trees in CWHR size classes 4 and 5.



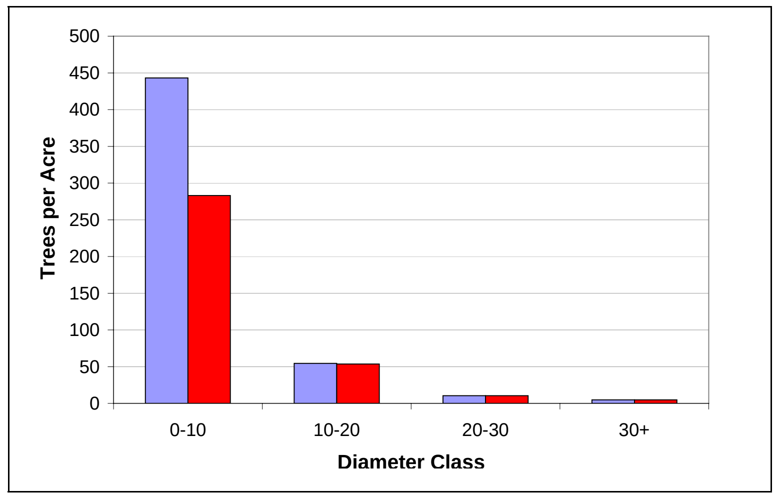
4-3a. Fuel Treatment: Thin to 35%–40% canopy cover, 30-inch upper diameter limit, pre- and post-treatment stocking levels by diameter class for CWHR size class 4.



4-3b. Fuel Treatment: Thin to 40%–45% canopy cover, 30-inch upper diameter level, pre- and post-treatment stocking levels by diameter class for CWHR size class 5.



4-3c: Fuel Treatment: Thin to 50% canopy cover, 20-inch upper diameter limit, pre- and post-treatment stocking levels by diameter class for CWHR size class 4.



4-3d: Fuel Treatment: Thin to 50% canopy cover, 20-inch upper diameter limit, pre- and post-treatment stocking levels by diameter class for CWHR size class 5.

Figure 4-3. Trees per acre pre and post fuel treatments by diameter class for CWHR size classes 4 and 5.

Table 4-7. Predicted flame length, fire type, height to crown base, and mortality for the fuel treatments under alternatives B, C, D, and F.

CWHR Size Class	Treatment Stage	Predicted Percent of Trees Directly Killed by Fire by Diameter Class					Flame Length (feet)	Fire Type	Height to Live Crown Base (feet)
		<10 inches dbh	10–20 inches dbh	20–30 inches dbh	>30 inches dbh	All Trees			
Alternatives B, C, D, and F: CWHR Size Class 3 DFPZ Fuel Treatment – Thin to 35–40% Canopy Cover, 30-inch Upper Diameter Limit, Mastication									
CWHR 3	Pretreatment	96	35	87	No trees	98	8	Passive Crown	2
CWHR 3	Treatments complete	95	35	9	No trees	70	4	Passive Crown	4
Alternatives B, C, D, and F: CWHR Size Class 4 DFPZ Fuel Treatment – Thin to 35–40% Canopy Cover, 30-inch Upper Diameter Limit									
CWHR 4	Pretreatment	100	97	28	3	64	8	Passive Crown	5
CWHR 4	Treatments complete	78	20	8	3	29	3	Surface Fire	29
Alternatives B, C, and D: CWHR Size Class 5 DFPZ Fuel Treatment – Thin to 40–45% Canopy Cover, 30-inch Upper Diameter Limit									
CWHR 5	Pretreatment	100	69	25	5	72	8	Passive Crown	3
CWHR 5	Treatments complete	87	17	6	2	43	3	Surface Fire	6
Alternative F: CWHR Size Classes 4 HRCA/DFPZ Fuel Treatment – Thin to 50% Canopy Cover, 20-inch Upper Diameter Limit									
CWHR 4	Pretreatment	100	97	28	3	64	8	Passive Crown	5
CWHR 4	Treatments complete	78	20	8	3	29	3	Surface Fire	25
Alternative F: CWHR Size Classes 5 DFPZ Fuel Treatment – Thin to 50% Canopy Cover, 20-inch Upper Diameter Limit									
CWHR 5	Pretreatment	100	69	25	5	72	8	Passive Crown	3
CWHR 5	Treatments complete	87	17	6	2	43	3	Surface Fire	6
Alternatives B, C, D, and F: CWHR Size Classes 4 and 5 Baker Cypress Fuel Treatment									
Baker Cypress Stands CWHR 4 and 5	No action	100	74	7	5	76	8	Passive Crown	4
Baker Cypress Stands CWHR 4 and 5	Treatments complete	0	18	7	3	6	3	Surface Fire	42
Alternatives B, C, D, and F: Group Selection, 30-inch Upper Diameter Limit									
CWHR 4 and 5	Pretreatment	100	97	28	3	64	8	Passive Crown	5[a]
CWHR 4/5	Treatments complete and replanted	100	—	—	3	—	4	Passive Crown	1[a]

Note:

a. The value reflects planted trees only—the residual trees in Group Selection Units would have a height to crown base greater than 30 feet.

The vast majority of the large dominant and codominant trees would be retained, while most trees harvested would be the small understory and midstory trees that represent the ladder fuels. The net beneficial effect would be a reduction in stand density (see table 4-8 below), which would improve tree vigor and growth and improve residual tree resistance to insects, drought, disease, and fire-related mortality. Basal area per acre would be at or below the 150 square feet per acre threshold as described by Oliver (1995) for ponderosa pine stands and would meet the insect risk thinning guidelines determined for the transition zone for the Plumas National Forest (Landram 2004).

The resulting stand structure would be characterized by an open understory. The horizontal arrangement of tree crowns would be spatially diverse, and crowns in the residual stand would be spaced at a distance that reduces the potential for crown fire spread. This spacing would be achieved by leaving clumps of the largest fire-tolerant trees with a network of intermingled openings between the clumps. The vertical arrangement of tree crowns would be discontinuous from the understory into the middle and overstory tree canopy. Treatments in CWHR size classes 3 and 4 would result in a CWHR density class of poor, and treatments in CWHR size class 5 would result in a CWHR density class of moderate; however, it would not alter the existing CWHR size class. This stand structure would promote a higher light environment that would strongly influence species composition by favoring the growth and development of shade-intolerant species tree species, as well as understory grasses, forbs, and shrubs. This would have a moderate beneficial indirect effect by maintaining and perpetuating shade-intolerant species, thereby enhancing species composition diversity, and decreasing potential scorch-related mortality (Stephens and Finney 2002) within these stands (see figures 4-4a and 4-4b).

Immediately following treatment, relative stand density would be reduced 27 to 38 percent relative density. This range in relative density would be well below (17 to 28 percent below) the 55 percent threshold for the lower limit of the zone of imminent competition mortality. These treatments, in general, would meet the desired condition for reducing stand densities. Treatments implementing a 35 percent canopy cover would result in relative densities below the lower limit of full site occupancy (35 percent relative density) as described by Powell (1999); however, this would still be congruent with fuel reduction and forest health objectives by maintaining open canopy stands with little inter-tree competition.

Over time, the diameter growth of residual trees and increase in trees per acre due to ingrowth would contribute to an increase in stand density. Fuel treatments that implement lower canopy cover retention guidelines would have a longer beneficial effect on the reduction of stand density below the threshold of 55 percent relative stand density (see figure 4-5b below). This beneficial effect would contribute to the longevity of the fuel treatments and, over time, enhance stand resistance to insects, drought, disease, and fire.

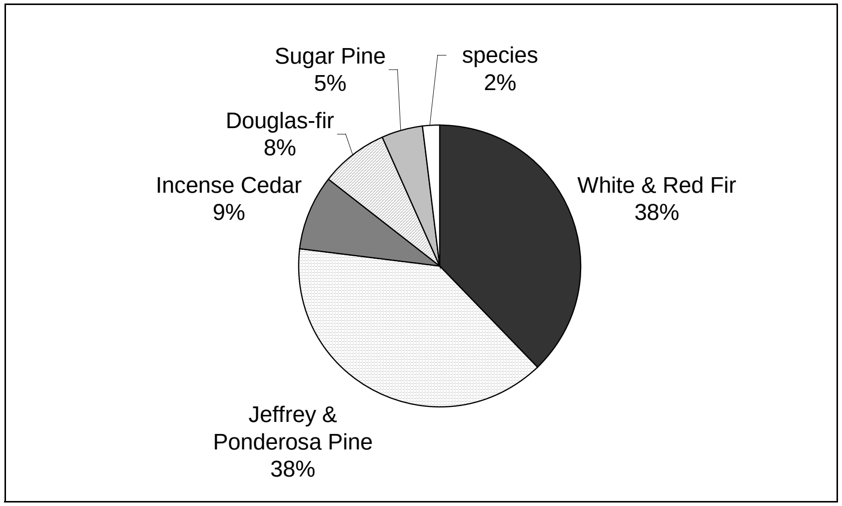
Direct and Indirect Effects of DFPZ Fuel Treatment Prescription 2: CWHR Size Classes 4 and 5 – Thin to 50 Percent Canopy Cover, 20-inch Upper Diameter Limit. Fuel treatments that implement higher canopy cover (50 percent) guidelines in CWHR size classes 4 and 5 would have a minor beneficial effect on residual stand structure. The low thinning would reduce trees per acre, primarily in trees less than 10 inches in diameter; however, on average, 60 to 70 percent of trees in this diameter class would be retained after treatment. A reduction in trees per acre in the 10- to 20-inch diameter class would be minimal. Consequently, all trees over 20 inches in diameter would be retained, as would over 90 percent of trees in the 10- to 20-inch diameter class (see figures 4-3c and 4-3d below).

Table 4-8. Effects of fuel treatments on stand structure under the action alternatives.

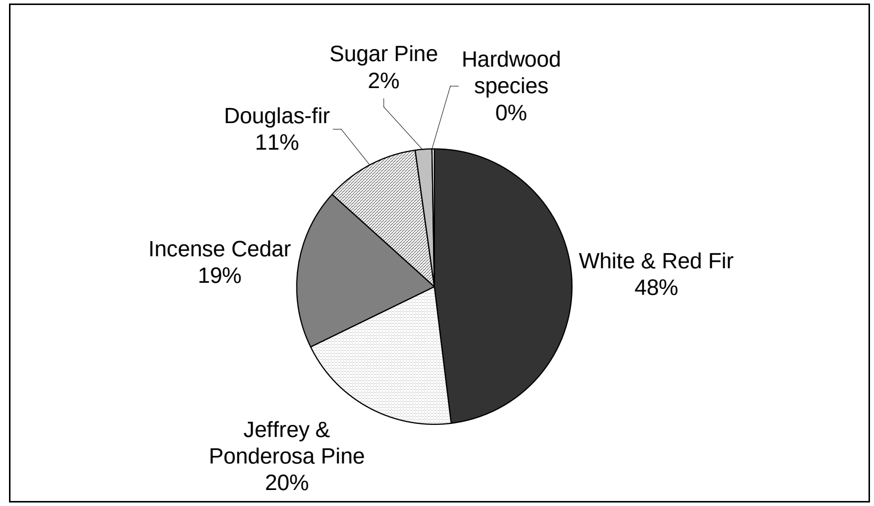
CWHR Size Class	Time Frame	Trees Per Acre by Diameter Class: Total Trees per Acre	<10 inches dbh	10–20 inches dbh	20–30 inches dbh	>30 inches dbh	Basal Area (square feet per acre)	Stand Density Index	Relative Stand Density (percent of maximum)[a]
Alternatives B, C, D, and F DFPZ Fuel Treatment – Thin to 35–40% Canopy Cover, 30-inch Upper Diameter Limit, Mastication									
CWHR 3	Pre	210	156	48	5	1	112	165	32
CWHR 3	Harvest	68	64	4	0	0	15		
CWHR 3	Post	142	92	44	5	1	97	169	27
CWHR 3	10 years	140	80	52	7	1	117	195	31
CWHR 3	20 years	168	99	57	11	1	140	234	37
CWHR 3	30 years	166	91	56	18	1	162	263	42
Alternatives B, C, and D Alternative F: CWHR size class 4 outside of HRCAs DFPZ Fuel Treatment – Thin to 35–40% Canopy Cover, 30-inch Upper Diameter Limit									
CWHR 4	Pre	405	327	65	10	3	182	341	51
CWHR 4	Harvest	289	266	22	1	0	56		
CWHR 4	Post	116	61	43	9	3	126	202	31
CWHR 4	10 years	119	53	51	11	4	144	224	34
CWHR 4	20 years	147	75	54	13	5	164	261	40
CWHR 4	30 years	144	65	57	16	6	184	285	44
Alternatives B, C, and D: Alternative F: Prescription would not be implemented DFPZ Fuel Treatment – Thin to 40–45% Canopy Cover, 30-inch Upper Diameter Limit									
CWHR 5	Pre	514	443	55	11	5	183	356	54
CWHR 5	Harvest	323	311	12	1	0	37		
CWHR 5	Post	191	132	33	10	5	146	248	38
CWHR 5	10 years	187	121	48	13	5	164	272	42
CWHR 5	20 years	212	139	52	15	6	184	307	47
CWHR 5	30 years	203	125	54	17	7	204	331	51
Alternatives B, C, D, and F: RHCAs DFPZ Fuel Treatment – Thin to 50% Canopy Cover, 20-inch Upper Diameter Limit									
CWHR 4	Pre	405	327	65	10	3	182	341	51
CWHR 4	Harvest	97	95	2	0	0	9		
CWHR 4	Post	308	232	63	10	3	173	311	46
CWHR 4	10 years	295	205	74	12	4	197	343	51
CWHR 4	20 years	313	212	82	14	5	223	384	57
CWHR 4	30 years	297	189	85	18	5	247	411	61
Alternatives B, C, and D: RHCAs Alternative F: RHCAs and all CWHR size class 5 DFPZ Fuel Treatment – Thin to 50% Canopy Cover, 20-inch Upper Diameter Limit									
CWHR 5	Pre	514	443	55	11	5	183	356	54
CWHR 5	Harvest	161	160	1	0	0	8		
CWHR 5	Post	353	283	54	11	5	175	320	48
CWHR 5	10 years	335	255	62	13	5	197	350	53
CWHR 5	20 years	346	256	69	15	6	219	387	58
CWHR 5	30 years	323	225	74	17	7	241	412	62

Note: The values in this table were calculated by the Forest Vegetation Simulator (FVS).

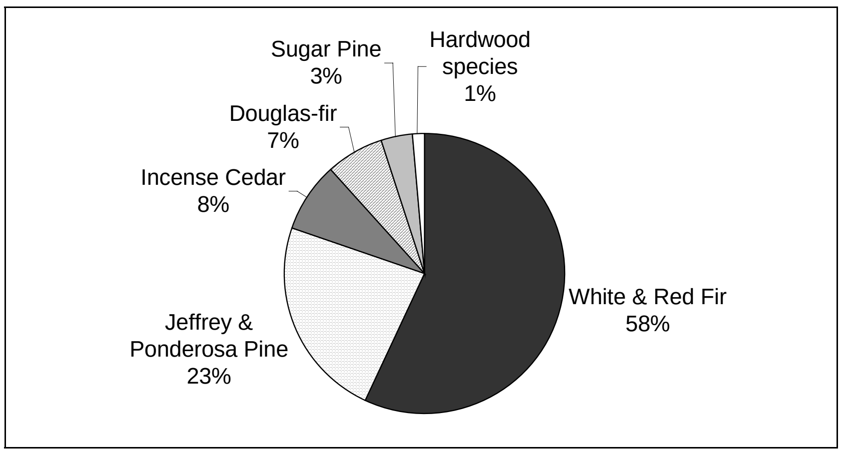
a. Based on the FVS (Dixon 1994) maximum stand density index for Sierra mixed conifer weighted by species composition.



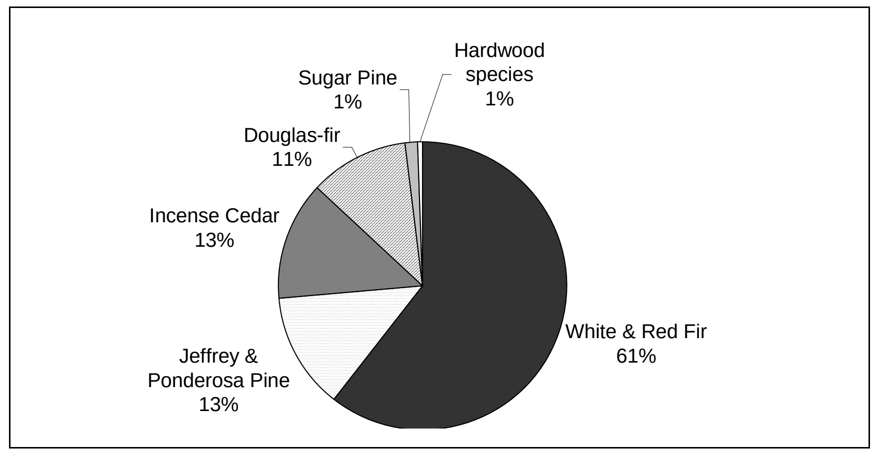
4-4a: Fuel Treatment: Thin to 35%-40% canopy cover, 30-inch upper diameter limit, post-treatment species composition for CWHR size class 4.



4-4b: Fuel Treatment: Thin to 40%-45% canopy cover, 30-inch upper diameter limit, post-treatment species composition for CWHR size class 5.

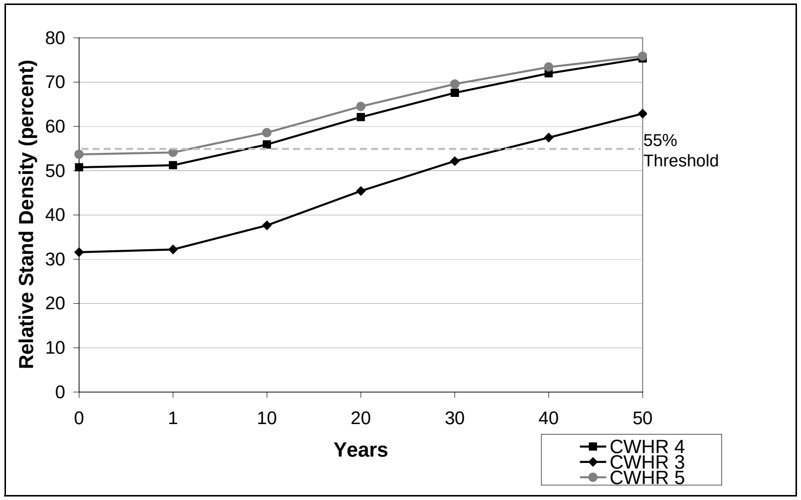


4-4c: Fuel Treatment: Thin to 50% canopy cover, 20-inch upper diameter limit, post-treatment species composition for CWHR size class 4.

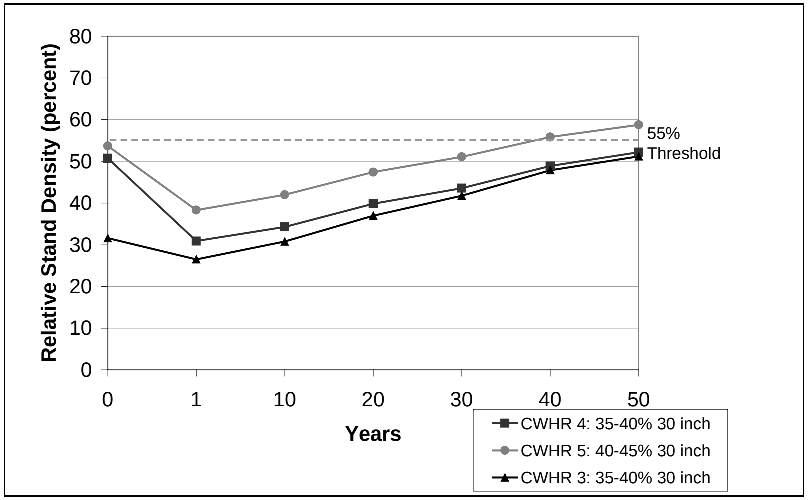


4-4d: Fuel Treatment: Thin to 50% canopy cover, 20-inch upper diameter limit, post-treatment species composition for CWHR size class 5.

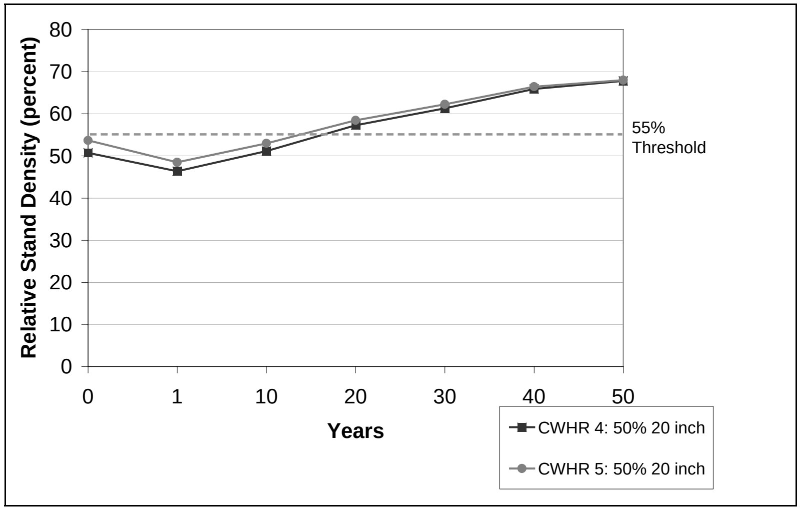
Figure 4-4. Species composition post fuel treatment for CWHR size classes 4 and 5.



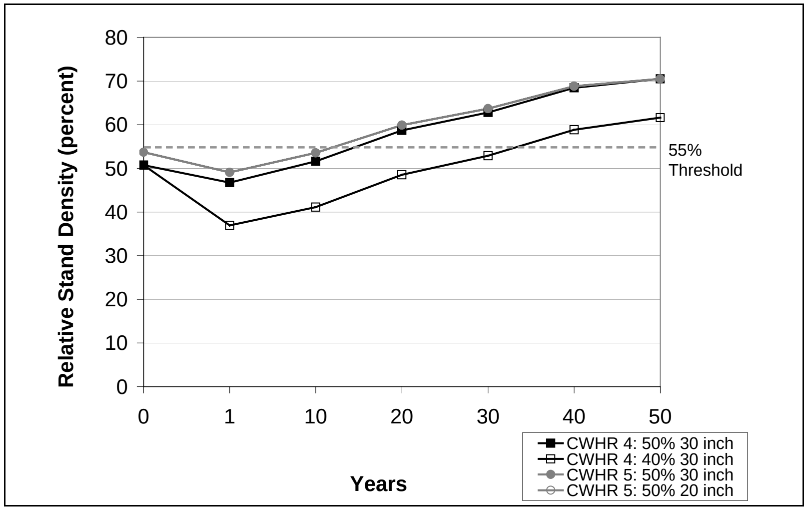
4-5a: Alternative A (No Action): Relative stand density over time.



4-5b: Relative stand density over time; fuel treatment prescriptions – thin to 35%–45% canopy cover, 30-inch upper diameter limit.



4-5c: Relative stand density over time; fuel treatment prescriptions – thin to 50% canopy cover, 20-inch upper diameter limit.



4-5d: Relative stand density over time; area thinning treatment prescriptions – thin to 50% canopy cover, 20- and 30-inch upper diameter limit, and thin to 40% canopy cover, 30-inch upper diameter limit.

Figure 4-5. Relative stand density over time.

The vast majority of trees harvested would be small understory trees that represent ladder fuels. The net effect would be a minor beneficial reduction in stand density in trees less than 10 inches in diameter. The effects on residual tree vigor and growth and resiliency to insects, drought, disease, and fire would be minor because stand density, particularly in the 10- to 20-inch trees, would be maintained at relatively high levels. On average, the basal area per acre would be maintained above 150 square feet per acre, and pine stands would be susceptible to bark beetle induced mortality. However, basal area per acre for mixed conifer and true fir stands would be within the middle range of the insect thinning guidelines for the transition zone as determined by Landram (2004) for the Plumas National Forest.

The residual stand structure would be characterized by a moderately dense understory with gaps and a dense mid-story with interlocking crowns. The horizontal arrangement of tree crowns would be moderately dense and homogeneous with minor crown separation and gaps. The vertical structure would be relatively continuous. Treatments in CWHR size classes 4 and 5 would result in a CWHR density class of moderate; however, it would not alter the existing CWHR size class. This residual stand structure would promote a moderately low light environment that would favor shade-tolerant tree species and forbs. The existing shade-intolerant species would be maintained, and enhanced growth and development of these species would occur in gaps where higher light conditions would exist; however, this would be minor compared to the other fuel treatment prescriptions. This would have a negligible beneficial effect by maintaining shade-intolerant species within these stands; however, this effect would be tempered by the relatively fewer trees removed (refer to figures 4-4c and 4-4d above).

Immediately following treatment, the relative stand density would be reduced 46 to 48 percent relative density. This range in relative density would be slightly below (7 to 9 percent below) the 55 percent threshold for the lower limit of the zone of imminent competition mortality. These treatments, in general, would result in stand densities that may be slightly higher than the desired condition. The consequences, therefore, would be shortened longevity in terms of stand density reduction over time.

Over time, the diameter growth of residual trees and increase in trees per acre due to ingrowth would contribute to an increase in stand density. Fuel treatments that implement a higher canopy cover retention guideline would have a shorter effect on the reduction of stand density below the 55 percent threshold of relative stand density. These fuel treatments would maintain higher stand densities after treatment which would be expected to have a shorter lifetime relative to those fuel treatments that implement lower canopy cover (40 percent canopy cover) retention guidelines (refer to figure 4-5c above).

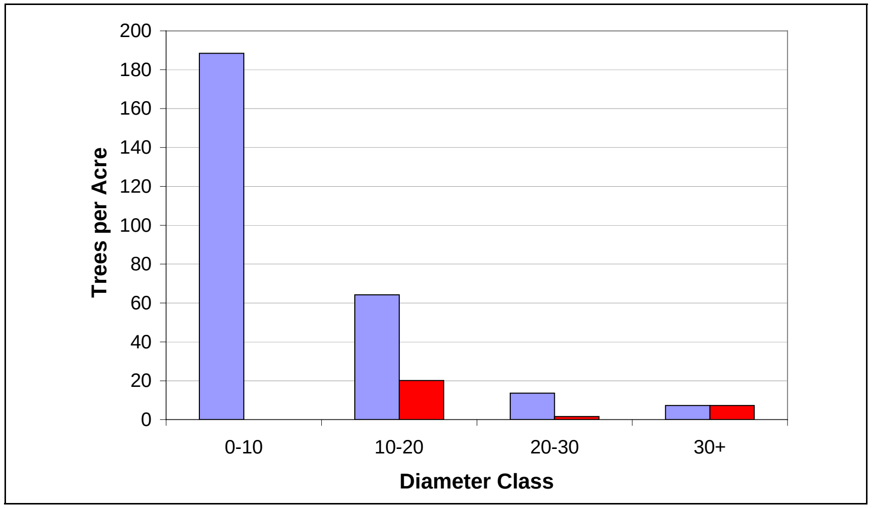
Fuel treatments in CWHR size classes 4 and 5, which would maintain 50 percent canopy cover, would likely lead to higher retention of biomass (trees less than 10 inches dbh) to meet canopy cover requirements. The greater the proportion of biomass retained to meet canopy cover requirements, the less effective these treatments would be in facilitating retardant penetration. This in turn would lead to decreased ability of fire managers to contain and control fires within and adjacent to these stands.

Direct and Indirect Effects of Baker Cypress Fuel Treatment Prescription 3: CWHR Size Class 4 – Thin to 30 Percent of the Existing Basal Area, 30-inch Upper Diameter Limit; CWHR Size Class 5 – Thin to 40 Percent Canopy Cover, 30-inch Upper Diameter Limit. The Baker cypress fuel treatment would use low thinning to remove ladder fuels in the suppressed and intermediate crown classes, which would remove the vertical continuity between surface and canopy fuels. This fuel treatment would use crown thinning to remove codominant trees to reduce the horizontal continuity of canopy fuels. This fuel treatment is necessary to facilitate the reintroduction of fire to promote the regeneration, growth, and development of Baker cypress stands. Fire plays a crucial role in cypress regeneration by opening the cones and creating post-fire conditions, such as exposed mineral soil and direct sunlight to the ground (Vogl et al. 1977). All Baker cypress would be retained regardless of size. Jeffrey pine would receive secondary preference for retention to meet basal area guidelines. True fir species under that are 30 inches in diameter would receive preference for removal.

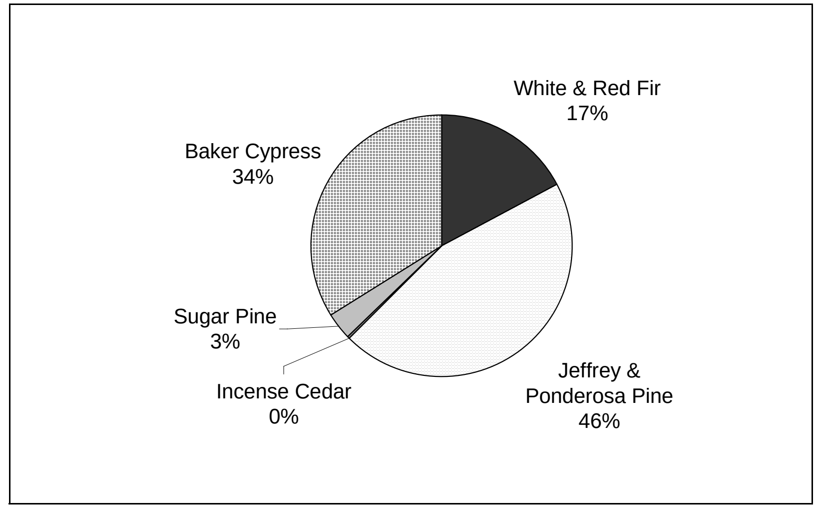
Fuel treatments in all CWHR types would have a major beneficial effect on shifting residual stand structure towards desired conditions where prescribed fire could be safely used to promote the regeneration, growth, and development of Baker cypress stands. Treatments in CWHR size class 4 stands would substantially reduce trees per acre in all diameter classes with the exception of those trees greater than or equal to 30 inches in diameter (see figure 4-6a below). Treatments in CWHR size class 5 stands would reduce nearly all trees per acre less than 10 inches in diameter in species other than Baker cypress and would reduce approximately 25 percent of all trees in the 10- to 20-inch diameter class (see figure 4-6c below).

In CWHR size class 4, the net beneficial effect would be a major reduction in stand density and canopy cover, which would allow the safe use of moderate-intensity fire to create light and seedbed conditions favorable for the regeneration of Baker cypress. In CWHR size class 5, the net beneficial effect would be a moderate reduction in stand density relative to the CWHR size class 4 prescription. This treatment would also facilitate the safe use of lower-intensity fire to create favorable seedbed conditions for Baker cypress regeneration. In both treatments, there is a minor risk that some individuals may be killed or damaged by fire as a result of mechanical and prescribed fire fuel treatments; however, overall, these treatments would have a net beneficial effect for Baker cypress regeneration, growth, and development (see table 4-9 below).

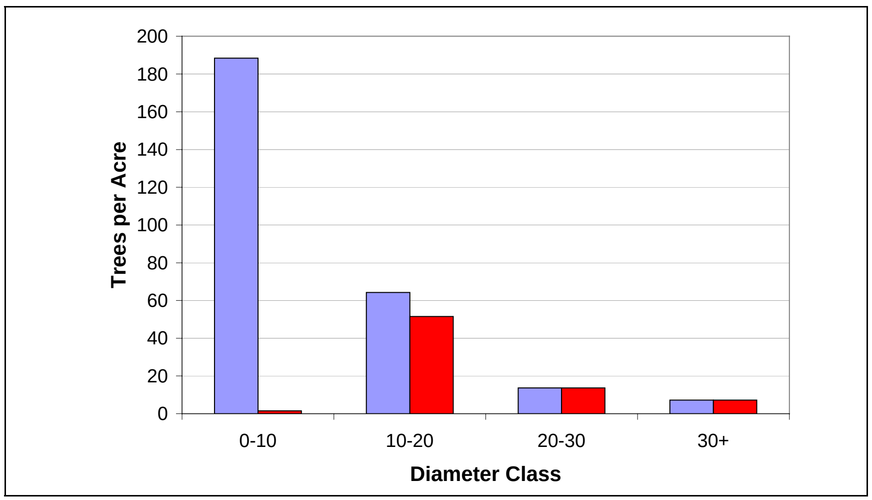
In CWHR size class 4, the residual stand structure would be a very open canopy and high light environment. The horizontal and vertical arrangement of mid and overstory trees would be discontinuous and characterized by substantial crown separation. Treatments in CWHR size class 4 would result in a CWHR density class of sparse; however, it would not alter CWHR size class. In CWHR size class 5, the residual stand structure would be characterized by an open understory where the horizontal and vertical arrangement of trees would be heterogeneous and discontinuous. Treatments in CWHR size class 5 stands would result in a CWHR density class of moderate; however, it would not alter CWHR size class. These stand structures (CWHR sizes classes 4 and 5) would allow for the safe reintroduction of fire of moderate to low intensity, respectively, to create a seedbed suitable for the regeneration and establishment of Baker cypress.



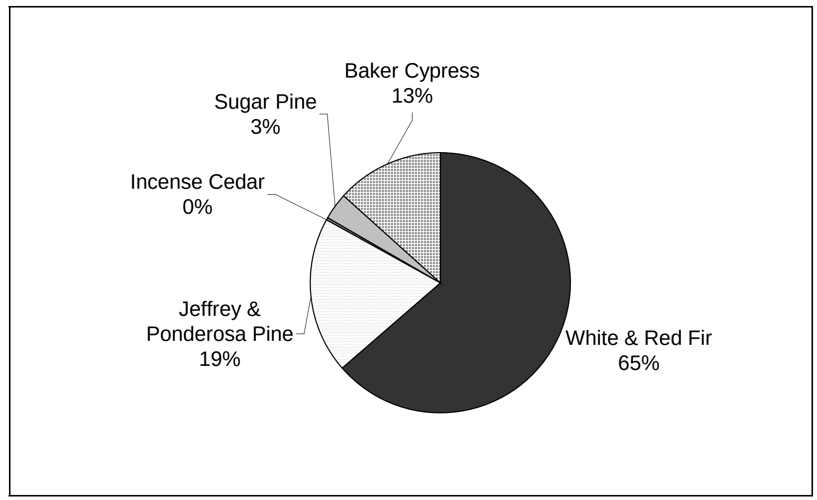
4-6a: Baker Cypress Fuel Treatment: Thin to 30% basal area, 30-inch upper diameter limit, pre- and post-treatment stocking levels by diameter class for CWHR sized class 4.



4-6b: Baker Cypress Fuel Treatment: Thin to 30% basal area, 30-inch upper diameter limit, post-treatment species composition for CWHR size class 4.



4-6c: Baker Cypress Fuel Treatment: Thin to 40% canopy cover, 30-inch upper diameter limit, pre- and post-treatment stocking levels by diameter class for CWHR 5.



4-6d: Baker Cypress Fuel Treatment: Thin to 40% canopy cover, 30-inch upper diameter, post-treatment species composition for CWHR size class 5.

Figure 4-6. Trees per acre pre and post Baker cypress fuel treatments and corresponding species composition post treatment.

Table 4-9. Effects of Baker cypress fuel treatments on stand structure under the action alternatives.

CWHR Size Class	Cycle	Total Trees per Acre	Trees Per Acre <10 inches dbh	Trees Per Acre 10–20 inches dbh	Trees Per Acre 20–30 inches dbh	Trees Per Acre >30 inches dbh	Basal Area (square feet per acre)	Quadratic Mean Diameter (inches)	Stand Density Index	Relative Density (% of maximum)[a]
Alternatives B, C, D, and F: CWHR Size Classes 4M and 4D Baker Cypress Fuel Treatment – Thin to 30% Basal Area, 30-inch Upper Diameter Limit										
CWHR 4	Pre	264	188	55	13	8	204	11.9	346	48%
CWHR 4	Harvest	244	188	44	12	0	123			
CWHR 4	Post	20	0	11	1	8	81	27.6	99	14%
CWHR 4	10 years	19	0	10	1	8	85	28.6	103	15%
CWHR 4	20 years	51	32	10	1	8	89	18.0	129	18%
CWHR 4	30 years	49	31	8	3	7	94	18.8	135	19%
Alternatives B, C, D, and F: CWHR Size Classes 5M and 5D Baker Cypress Fuel Treatment – Thin to 40% Canopy Cover, 30-inch Upper Diameter Limit										
CWHR 5	Pre	264	188	55	13	8	204	11.9	346	48%
CWHR 5	Harvest	200	187	13	<1	0				
CWHR 5	Post	54	1	42	13	8	172	22.2	231	32%
CWHR 5	10 years	63	0	39	16	8	183	23.2	241	33%
CWHR 5	20 years	93	32	34	19	8	194	19.7	273	37%
CWHR 5	30 years	91	31	26	25	9	207	20.5	285	39%

Note: The values were calculated by the Forest Vegetation Simulator (FVS).

a. Based on the FVS (Dixon 1994) maximum stand density index for Sierra mixed conifer weighted by species composition.

These stand structures would favor early seral and shade-intolerant species, such as the Baker cypress. Baker cypress composition in the midstory would be improved by preferential retention of all Baker cypress to maintain a mature seed source for regeneration (refer to figures 4-6b and 4-6d above). Little is known about Baker cypress regeneration; however, in other fire-adapted cypress species, such as Sergeant's cypress, as many as 12,000 seedlings per square foot have been observed after fire occurrence (Ne'eman et al. 1999). Baker cypress regeneration was not modeled because current models are not developed to handle such high regeneration rates. However, literature on other fire-adapted cypress species suggests that mineral soil seedbeds and high light environments created by fire occurrence promote conditions favorable for cypress regeneration, growth, and development (Ne'eman et al. 1999). These fuel treatments would represent a larger goal of restoring fire on the stand level to create conditions favorable for Baker cypress regeneration and increase the potential for maintaining Baker cypress stands on the landscape level.

Direct and Indirect Effects of Prescribed Fire Fuel Treatments: Underburning and Pile Burning. The effects of these treatments in all action alternatives are expected to be the same. Underburning is nonselective, and it may kill some dominant and codominant trees that may have otherwise been retained in mechanical treatments. Implementation of prescribed burning treatments would have a negligible to minor effect on species composition in underburn units. According to the HFQLG final supplemental EIS (page 19), overall, the overstory canopy would not be affected by underburning, although torching of individual or small groups of trees would occur on up to 10 percent of the burn area where high surface fuel concentrations and ladder fuels can occur together. Torching may result in gaps in the canopy typically less than 0.5 acre in size. Localized torching from underburning would occur, thereby creating small openings in the overstory where shade-intolerant species may become established and grow, depending on size. The effects of pile burning treatments would be highly localized and dispersed. These effects would include scorch and subsequent mortality of individual trees; however, this would be a negligible effect due to the relative scale and dispersion associated with the nature of these treatments. These treatments would reduce understory vegetation and would result in incidental mortality in the midstory but would not be expected to change CWHR size class or density class.

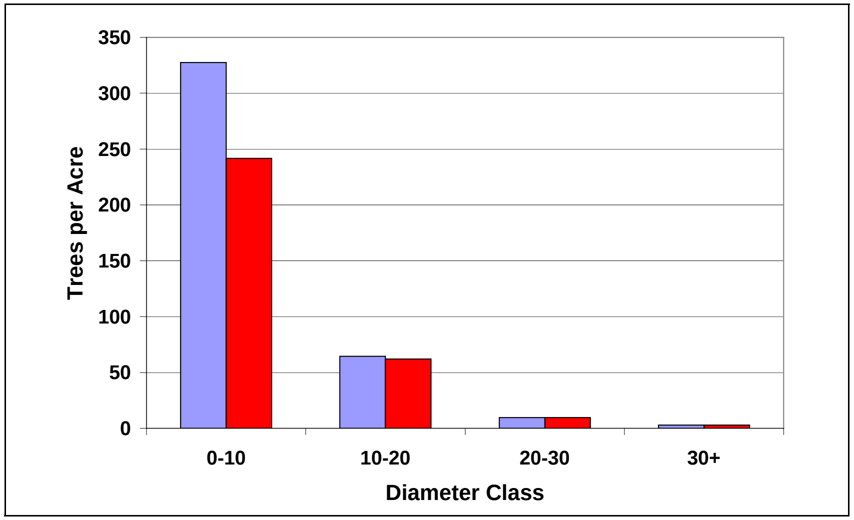
Implementation of prescribed burning is expected to reduce existing rotten woody debris but overall would maintain the current total volume of snags and woody debris greater than 10 inches in diameter (Stephens and Moghaddas 2005c). Prescribed burn-only treatments are expected to result in standing dead snags (Stephens and Moghaddas 2005c; Brown et al. 2003) that will likely fall to the ground within 5 to 10 years, thereby maintaining surface woody debris. Fire-only treatments may need to be treated sooner than mechanical fuel treatments (Fernandes and Botelho 2003). Based on observations on the 2001 Stream Fire, hand thinning treatments would not be as effective as mechanical treatments in modifying ladder and crown fuels and resulting fire behavior or tree mortality (Beckman 2001).

4.1.4.4 All Action Alternatives (B, C, D, and F): Area Thinning Treatments

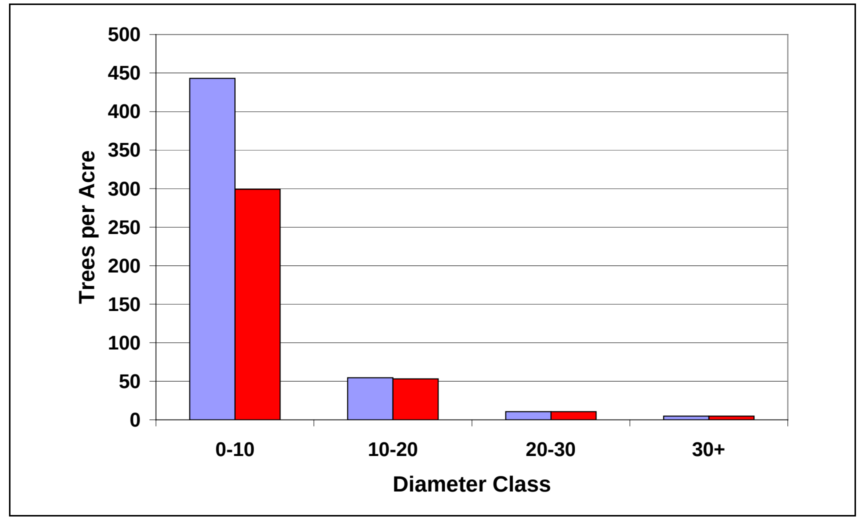
The area thinning treatment can be described as a combination of low (“thinning from below”) and crown thinning (Smith et al. 1997) where individual trees are selected for removal in order to meet forest health objectives while maintaining forest structure and improving species composition. The forest health objectives are designed to improve vigor of residual trees by reducing stand density and competition and capturing mortality and diseased/dying individual trees. The area thinning treatment is an intermediary thinning of the “matrix” around group selections to reduce stand density and improve forest growth and health. The largest, most vigorous dominant and codominant trees would be retained to create a residual stand comprised of larger fire-resistant trees. Suppressed and intermediate trees would receive preference for removal. Group selection would be used for meeting regeneration objectives.

Direct and Indirect Effects of Area Thinning Treatment Prescription 1: CWHR Size Classes 4 and 5 – Thin to 50 Percent Canopy Cover, 30-inch Upper Diameter Limit; CWHR Size Class 5 – Thin to 50 Percent Canopy Cover, 20-inch Upper Diameter Limit. Area thinning treatments that implement higher canopy cover guidelines in CWHR size classes 4 and 5 would have a minor beneficial effect on residual stand structure. The low thinning would reduce trees per acre primarily in trees less than 10 inches in diameter; however, on average, 70 percent of trees in this diameter class would be retained after treatment. The reduction in trees per acre in the 10- to 20-inch diameter class would be minimal. The 30-inch upper diameter limit prescription would allow for removal of trees between 20 and 30 inches in diameter; however, given the silvicultural mechanics of the low thinning, and that retention of 50 percent canopy cover would be the constraining factor, the removal of these trees would be incidental and negligible in effect.

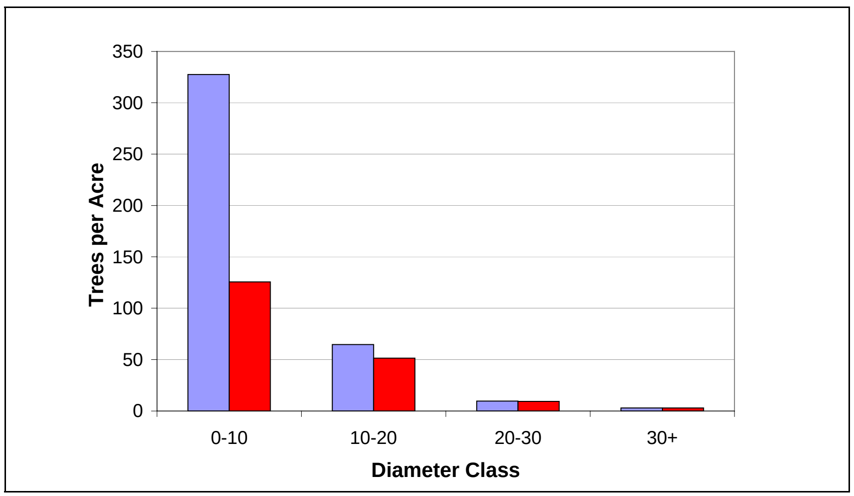
Under the 20-inch upper diameter limit prescription, all trees over 20 inches in diameter would be retained. Under all prescriptions, over 90 percent of trees in the 10- to 20-inch diameter class would be retained (see figures 4-7a, 4-7b, and 4-7d).



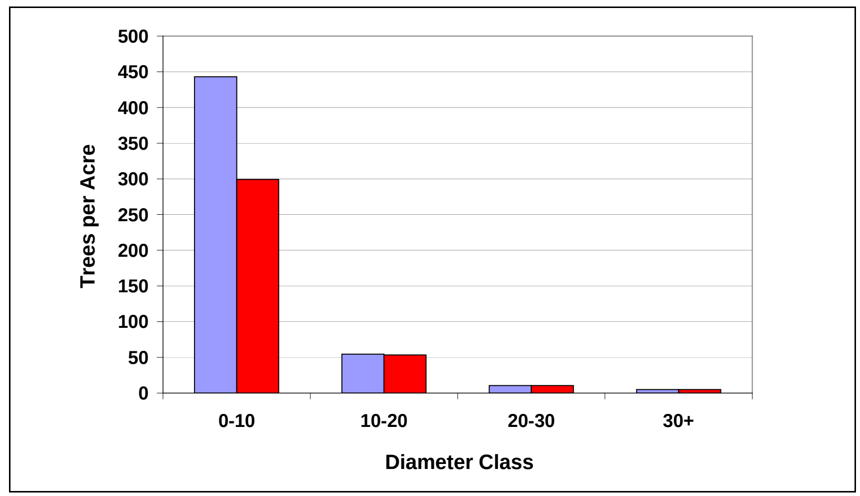
4-7a: Area thin to 50% canopy cover, 30-inch upper diameter limit, pre- and post-treatment stocking levels by diameter class for CWHR size class 4.



4-7b: Area thin to 50% canopy cover, 30-inch upper diameter limit, pre- and post-treatment stocking levels by diameter class for CWHR size class 5.



4-7c: Area thin to 40% canopy cover, 30-inch upper diameter limit, pre- and post-treatment stocking levels by diameter class for CWHR size class 4.



4-7d: Area thin to 50% canopy cover, 20-inch upper diameter limit, pre- and post-treatment stocking levels by diameter class for CWHR size class 5.

Figure 4-7. Trees per acre pre and post area thinning treatment by diameter class for CWHR size classes 4 and 5.

The vast majority of trees harvested would be small understory trees that represent ladder fuels. The net effect would be a minor beneficial reduction in stand density in trees less than 10 inches in diameter. The effect on residual tree vigor and growth and resiliency to insects, drought, disease, and fire effects would be minor because stand density, particularly in the 10- to 20-inch diameter trees, would be maintained at relatively high levels. On average, basal area per acre would be maintained above 150 square feet per acre, and pine stands would be susceptible to bark beetle induced mortality (see table 4-10 below). However, basal area per acre for mixed conifer and true fir stands would be within the middle range of the insect thinning guidelines for the transition zone as determined by Landram (2004) for the Plumas National Forest.

Table 4-10. Effects of area thinning treatments on measurement indicators for stand structure.

CWHR Size Class	Cycle	Total Trees per Acre	Trees Per Acre: <10 inches dbh	Trees Per Acre: 10–20 inches dbh	Trees Per Acre: 20–30 inches dbh	Trees Per Acre: >30 inches dbh	Basal Area (square feet per acre)	Quadratic Mean Diameter (inches)	Stand Density Index	Relative Density (% of maximum)[a]
Alternatives B and C: CWHR Size Classes 4M and 4D Area Thin to 50% Canopy Cover, 30-inch Upper Diameter Limit										
CWHR 4	Pre	405	327	65	10	3	182	9.7	341	51
CWHR 4	Harvest	89	86	3	<1	0	9			
CWHR 4	Post	316	241	62	10	3	173	10.5	313	47
CWHR 4	10 years	304	214	74	12	4	198	11.4	346	52
CWHR 4	20 years	350	250	81	14	5	223	11.1	394	59
CWHR 4	30 years	330	223	85	17	5	247	12.0	422	63
Alternatives B, C, and D: CWHR Size Classes 5M and 5D Area Thin to 50% Canopy Cover, 30-inch Upper Diameter Limit										
CWHR 5	Pre	514	443	55	11	5	183	9.0	356	54
CWHR 5	Harvest	145	144	1	<1	0	8			
CWHR 5	Post	369	299	54	11	5	175	10.1	324	49
CWHR 5	10 years	349	270	61	13	5	197	10.9	354	54
CWHR 5	20 years	388	299	68	15	6	219	10.6	397	60
CWHR 5	30 years	360	264	72	17	7	241	11.4	422	64
Alternatives D and F: CWHR Size Classes 4M and 4D Area Thin to 40% Canopy Cover, 30-inch Upper Diameter Limit										
CWHR 4	Pre	405	327	65	10	3	182	9.7	341	51
CWHR 4	Harvest	216	202	13	1	0	37			
CWHR 4	Post	189	125	52	9	3	145	12.3	245	36
CWHR 4	10 years	189	113	61	11	4	166	13.3	272	41
CWHR 4	20 years	247	161	67	14	5	190	12.3	321	49
CWHR 4	30 years	240	146	72	17	5	213	13.2	351	53
All Action Alternatives; RHCAs and Alternative F: CWHR Size Classes 5M and 5D Area Thin to 50% Canopy Cover, 20-inch Upper Diameter Limit										
CWHR 5	Pre	514	443	55	11	5	183	9.0	356	54
CWHR 5	Harvest	145	144	1	0	0	8			
CWHR 5	Post	369	299	54	11	5	175	10.1	324	49
CWHR 5	10 years	349	270	61	13	5	197	10.9	354	54
CWHR 5	20 years	388	299	68	15	6	219	10.6	397	60
CWHR 5	30 years	360	264	72	17	7	241	11.4	422	64

Note: The values were calculated by the Forest Vegetation Simulator (FVS).

a. Based on FVS (Dixon 1994) maximum stand density index for Sierra mixed conifer weighted by species composition.

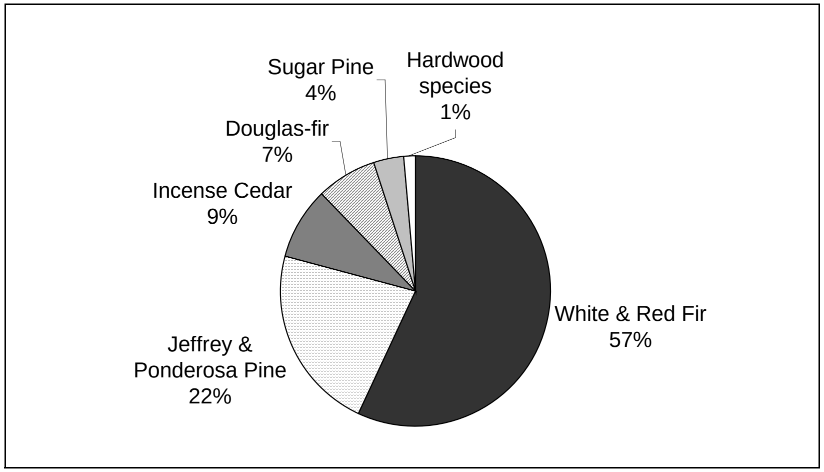
The residual stand structure would be characterized by a moderately dense understory with gaps and a dense midstory with interlocking crowns. The horizontal arrangement of tree crowns would be moderately dense and homogeneous with minor crown separation and gaps. The vertical structure would be relatively continuous. Treatments in CWHR size classes 4 and 5 would result in a CWHR density class of moderate; however, it would not alter the existing CWHR size class. This residual stand structure would promote a moderately low light environment that would favor shade-tolerant tree species and forbs. Existing shade-intolerant species would be maintained and enhanced growth and development of these species would occur in gaps where higher light conditions exist, but this would be minor compared to the other fuel treatment prescriptions. This would have a negligible beneficial effect by maintaining shade-intolerant species within these stands; however, this effect would be tempered by the relatively fewer trees removed (see figures 4-8a, 4-8b, and 4-8d below).

Immediately following treatment, relative stand density would be reduced 47 to 49 percent relative density. This range in relative density would be slightly below (6 to 8 percent below) the 55 percent threshold for the lower limit of the zone of imminent competition mortality. These treatments, in general, would result in stand densities that are slightly higher than the desired condition. The consequences, therefore, would be shortened longevity in terms of stand density reduction over time and treatment effectiveness.

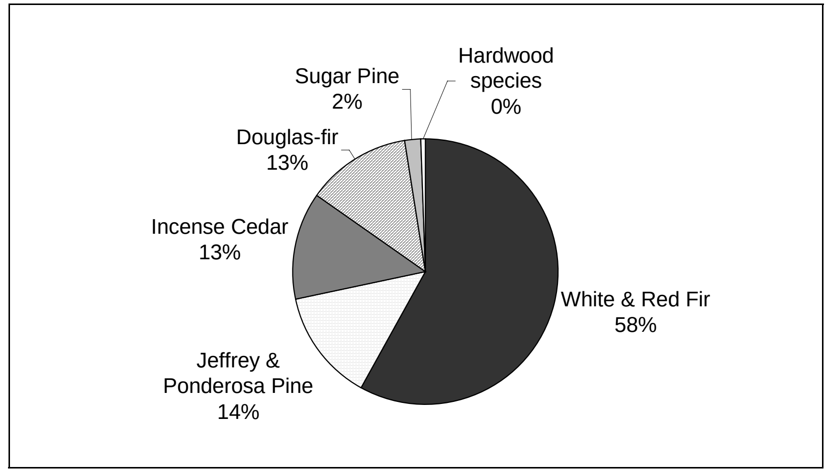
Over time, diameter growth of residual trees and increase in trees per acre due to ingrowth would contribute to an increase in stand density. Area thinning treatments that implement a higher canopy cover (50 percent) retention guideline would have a shorter effect on the reduction of stand density below the 55 percent threshold of relative stand density. Within 20 years, stand densities are expected to be above the 55 percent threshold and above desired conditions. These area thinning treatments would maintain higher stand densities after treatment, which would be expected to have a shorter lifetime relative to those area thinning treatments that implement lower canopy cover (40 percent) retention guidelines (refer to figure 4-5d above).

While area thinning is not specifically designed as a fuel treatment, area thinning treatments would provide moderate improvement in potential fire behavior and tree mortality where treatments result in a canopy dominated by larger-diameter trees. In areas where canopy cover requirements restrict removal of biomass, area thinning treatments are expected to perform similarly to untreated stands.

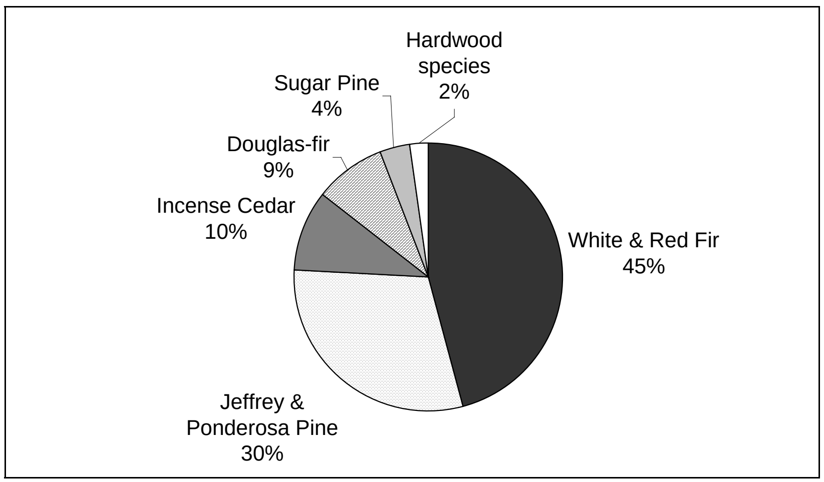
Direct and Indirect Effects of Area Thinning Treatment Prescription 2: CWHR Class Size 4 – Thin to 40 Percent Canopy Cover, 30-inch Upper Diameter Limit. Area thinning treatments that implement lower canopy cover (40 percent) guidelines in CWHR size class 4 would have a moderate beneficial effect on residual stand structure. The low thinning would reduce trees per acre, particularly in trees less than 10 inches in diameter, and crown thinning would reduce trees per acre primarily in the 10- to 20-inch diameter class. On average, approximately one tree per acre would be harvested in the 20- to 30-inch diameter class; the larger trees removed would be those impacted by insects and disease. The area thinning prescription that would thin to 40 percent canopy cover is very similar to the fuel treatment prescription; however, more understory would be retained in the area thinning prescription in order to maintain forest structure. The pre- and post-treatment levels of trees per acre for area thinning to 40 percent canopy cover are shown in figure 4-7c above.



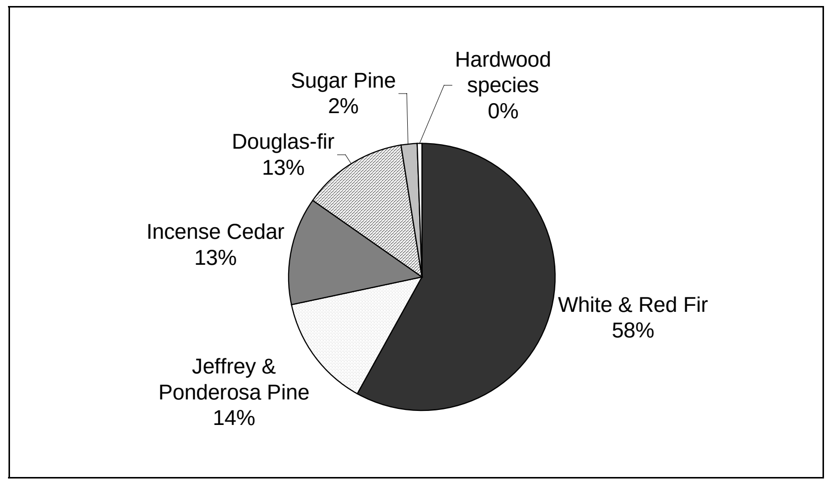
4-8a: Area thin to 50% canopy cover, 30-inch upper diameter limit, post-treatment species composition for CWHR size class 4.



4-8b: Area thin to 50% canopy cover, 30-inch upper diameter limit, post-treatment species composition for CWHR size class 5.



4-8c: Area thin 40% canopy cover, 30-inch-upper diameter limit, post-treatment species composition for CWHR size class 4.



4-8d: Area thin to 50% canopy cover, 20-inch upper diameter limit, post-treatment species composition for CWHR size class 5

Figure 4-8. Species composition post area thinning treatments for CWHR size classes 4 and 5.

Large dominant and codominant trees would be retained while most trees harvested would be the small understory and midstory trees that represent the ladder fuels. The net beneficial effect would be a reduction in stand density to approximately 36 percent (refer to table 4-10 above), which would improve tree vigor and growth and improve residual tree resistance to insects, drought, disease, and fire effects. On average, the basal area per acre would be just below 150 square feet per acre—the threshold for susceptibility to bark beetle mortality in pine stands and within the insect risk thinning guidelines for mixed conifer and true fir stands within the transition zone (Landram 2004) (refer to table 4-10 above).

The residual stand structure would be characterized by a moderately open understory and midstory with gaps and clumps of trees scattered within the stand. The horizontal arrangement of tree crowns would be spatially diverse, and crowns in the residual stand would be spaced at a distance that reduces the potential for crown fire spread. This spacing would be achieved by leaving clumps of the largest fire-tolerant trees with a network of intermingled openings between the clumps. The vertical arrangement of tree crowns would also be variable and diverse. Denser clumps would maintain continuity from the understory into the mid and overstory tree canopies, while gaps and widely spaced trees would have very little vertical crown continuity or fuel ladders. Treatments in CWHR size class 4 would result in a CWHR density class of moderate; however, it would not alter the existing CWHR size class. This stand structure would promote a variable light environment that would promote a diverse mix of shade-intolerant and shade-tolerant understory species. This would have a moderate beneficial indirect effect on residual species composition by maintaining and perpetuating shade-intolerant species and enhancing species composition diversity within these stands (refer to figure 4-8c above).

The relative stand density immediately after treatment would be reduced 36 percent relative density. This range in relative density would be well below (19 percent below) the 55 percent threshold for the lower limit of the zone of imminent competition mortality. These treatments would meet the desired condition for reducing stand densities. Treatments implementing a 40 percent canopy cover would result in relative densities just above the lower limit of full site occupancy (35 percent relative density) as described by Powell (1999). This is representative of a fully stocked stand with an open canopy having little inter-tree competition and crown spacing, which would reduce the potential for crown fire spread.

Over time, the diameter growth of residual trees and increase in trees per acre due to ingrowth would contribute to an increase in stand density. Area thinning treatments that implement a lower canopy cover (40 percent) retention guideline would have a longer beneficial effect on the reduction of stand density below the threshold of 55 percent relative stand density (refer to figure 4-5d above). This beneficial effect would contribute to the longevity of the area thinning treatment and, over time, enhance stand resistance to insects, drought, disease, and fire.

Area thinning prescriptions 1 and 2 are not specifically designed as fuel treatments in terms of placement and treatment intensity. Area thinning treatments in the Diamond Project Area would incorporate some of the basic principles of fuel reduction described in the fuel treatments section, though at a lower intensity as seen in fuel treatments. Overall, area thinning treatments would provide moderate improvement in potential fire behavior and tree mortality where treatments result in a canopy dominated by larger-diameter trees. In areas where 50 percent canopy cover requirements restrict removal of biomass, area thinning treatments may be less effective at reducing likelihood of crown fire.

Direct and Indirect Effects of Aspen Treatments. Fire exclusion has permitted conifers to encroach into aspen stands, thereby competing with existing aspen and creating shade conditions unfavorable for aspen regeneration, growth, and development. This conifer ingrowth has also contributed to fuel ladders within aspen stands, which increases its susceptibility to severe fire. Aspen stands would be mechanically thinned and hand thinned per the Design Criteria described in chapter 2. All conifers under 30 inches in diameter would be removed to eliminate conifer encroachment. This would have a major beneficial effect on aspen regeneration, growth, and development by creating open light conditions and disturbed soil. Maintenance and perpetuation of aspen stands would have a major beneficial effect in terms of enhancing species composition diversity across the landscape. These beneficial effects of thinning on regeneration, growth, and development of aspen stands are evident in past treatments in the Boulder Creek area of the Diamond Project.

Direct and Indirect Effects of RHCA Treatments. Stand conditions in RHCAs are similar to those in adjacent uplands. Accumulations of surface, ladder, and canopy fuels due to drought-related mortality and conifer encroachment have left many riparian areas vulnerable to the effects of severe wildfire. RHCAs would be mechanically thinned and hand thinned per the Design Criteria described in chapter 2. Mechanically harvested RHCAs would be thinned to 50 percent canopy cover with a 20-inch upper diameter limit. The effects of the proposed treatments in RHCAs within DFPZs and Area Thinning Units would correspond with those shown for the 50 percent canopy cover and 20-inch upper diameter limit prescription within the respective treatment units (refer to tables 4-8 and 4-10 above).

Thinning would improve riparian habitat within RHCAs by reducing conifer encroachment and competition with riparian-associated species. The reduction in stand density of conifer ingrowth would also correspond with a reduction in ladder and canopy fuels, thereby reducing the vulnerability of RHCAs and associated vegetative cover to adverse effects of severe wildfire.

4.1.4.5 All Action Alternatives (B, C, D, and F): Group Selection

The action alternatives would implement group selection harvest as directed by the *Herger-Feinstein Quincy Library Group Forest Recovery Act* (HFQLG Act) to "test the effectiveness of an uneven-aged silvicultural system in achieving an uneven-aged, multistory, fire-resilient forest; provide an adequate timber supply that contributes to the economic stability of rural communities; and improve and maintain ecological health of the forest."

The group selection method would create openings in the canopy to mimic gaps caused by natural agents, thereby emulating regeneration of a multicohort (multiple age classes) system across the landscape (York et al. 2003; Helms and Tappeiner 1996). Bonnicksen and Stone (1981, 1982) describe the southern mixed conifer forest of the Sierra Nevada as consisting of "mosaic aggregations in a space-time system." The aggregations (collections) of cohorts (groups of individuals commonly consisting of trees of similar age [Helms 1998]) created using the group selection system may be used to increase diversity in forest structure on the landscape scale (McDonald and Abbot 1994), as well as promote the regeneration, growth, and development of shade-intolerant species (Leak and Filip 1977).

The ability of group selection to promote the regeneration, growth, and development of shade-intolerant conifer species is largely dependent on the size of the opening (York et al. 2004; McDonald and Reynolds 1999). “Seedlings of very shade-intolerant species such as ponderosa pine require a minimum of 30 percent full sunlight to survive in the understory” (Oliver and Larson 1996). The amount reaching the group is a function of group size relative to the surrounding codominant and dominant tree height on the edge of the group. Consequently, those trees in the center of the group selection receive the most amount of light and water, while those trees near the edge receive partial shade and must compete with surrounding codominant trees for water resources (York et al. 2003).

Throughout all action alternatives, a range of group selection sizes would be used to most appropriately “fit” the site requirements to encourage the regeneration, growth, and development of shade-intolerant species. Group selection openings would range in size from 0.5 acre to 2 acres, averaging 1.5 acres in size. The group selection silvicultural system is designed to create a regulated, uneven-aged stand over time comprised of a balanced distribution of different age classes. The combination of area thinning and group selection harvest methods would strive to emulate gap dynamics of an uneven-age forest system. This system focuses on maintaining forest structure while providing openings that encourage regeneration, growth, and development of shade-intolerant species, and it may be effective in enhancing structural and compositional diversity, which contributes to the ecological health of the forest.

Direct and Indirect Effects of Group Selection. Within the 2-acre maximum Group Selection Units, all trees less than 30 inches in diameter would be harvested. Incidental healthy, undamaged, shade-intolerant trees less than 10 inches in diameter could be retained as advanced regeneration; however, nearly all trees under 30 inches in diameter would be removed. The resulting stand structure and seral stage would be characterized by CWHR size classes 1 and 2. The openings in forest canopy created by group selection would allow sunlight to reach the forest floor, creating favorable conditions for the regeneration, growth, and development of planted shade-intolerant, fire-adapted species. Natural regeneration from trees and shrubs in the surrounding stand would also be expected to occur within the group selection openings.

Site preparation and regeneration needs would be evaluated after harvest. Those Group Selection Units requiring natural and activity slash treatment would undergo “site preparation” via machine piling, brush raking, hand piling, and/or underburning to clear any activity slash and debris that would prevent site regeneration.

Both artificial and natural regeneration would be used to reforest Group Selection Units. Group Selection Units within the true fir forest type may be naturally regenerated. In all other forest types, a combination of natural and artificial would be used to achieve desired stocking levels, with an emphasis on regenerating shade-intolerant species. Those units requiring artificial regeneration would be planted with a mix of species native to the ecological forest type. Species to be planted would include Jeffrey pine, ponderosa pine, rust-resistant sugar pine, and Douglas-fir. Natural regeneration would be used for incense cedar, white fir, and red fir species. This regeneration method would have a major beneficial effect on enhancing desired species composition on both the stand and landscape scales.

After establishment of regeneration, release treatments (grubbing, pre-commercial thinning, and/or mastication) would be used to reduce competing vegetation to favor the growth and development of desired species. Without release treatments, shrub and naturally regenerated tree species would likely compete with desired species and slow the growth and development into subsequent seral stages. Over time, these treatments would contribute to the development from seral stages CWHR 1 and 2 to CWHR 3, represented by a quadratic mean diameter greater than 6 inches (see table 4-11).

The Group Selection Units would have lower flame lengths after site preparation and replanting than the untreated forested areas. Residual trees greater than 30 inches in diameter within the groups would have a low chance of mortality during fires due their high average crown base height and relatively low fuel loads in areas that have been prepared for planting (see table 4-11). Planted trees would remain vulnerable to scorch-related mortality several years after initial planting due to their small size. Groups imbedded within Fuel Treatment and Area Thinning Units would be less vulnerable to damage by wildfire than those groups established outside of Area Thinning and Fuel Treatment Units (Weatherspoon and Skinner 1995).

Table 4-11. Effects of group selection on attributes of stand structure.

CWHR Size Class	Cycle	Total Trees per Acre	Trees Per Acre				Basal Area (square feet per acre)	Quadratic Mean Diameter (inches)	Stand Density Index	Relative Density (percent of maximum)[a]
			<10 inches dbh	10–20 inches dbh	20–30 inches dbh	>30 inches dbh				
Alternatives B, C, D, and F: Group Selection, 30-inch Upper Diameter Limit										
CWHR 4/5	Pre	470	396	60	10	4	185	9.3	354	53
CWHR 4/5	Harvest	466	396	60	10	0	154			
CWHR 4/5	Post	4	0	0	0	4	31	35.7	34	6
CWHR 4/5	10 years	201	197	0	0	4	33	5.0	73	12
CWHR 4/5	20 years	277	273	0	0	4	41	5.0	94	15
CWHR 4/5	30 years	274	270	0	0	4	57	6.1	125	21

Note: The values in this table were calculated by the Forest Vegetation Simulator (FVS).

a. Based on FVS (Dixon 1994) maximum stand density index for Sierra mixed conifer weighted by species composition.

4.1.4.6 All Action Alternatives (B, C, D, and F): Borax Treatments

All action alternatives propose to apply Borax (trade name, Sporax®) to all harvested conifer stumps 14 inches in diameter and greater in Fuel Treatment Units, Area Thinning Units, and Group Selection Units (as specified in chapter 2, section 2.2.6 "Design Criteria Common to All Action Alternatives") to minimize residual tree susceptibility to *annosum* root rot. *Annosum* root disease (*Heterobasision annosum*) is spread by airborne spore colonization of freshly cut stumps. The direct effect of timber harvesting would be the creation of an unnaturally large number of freshly cut stumps, which would increase the potential for spread of *annosum* root disease. A common silvicultural practice to minimize the spread of *annosum* root disease is to apply a layer of Borax to freshly cut stumps soon after harvest in order to prevent new infection centers. This method is effective at mitigating the spread of *annosum* spores (Kliejunas 1989; USDA Forest Pest Management

Handbook 1994; Goheen and Otrosina 1998; Schmitt et al. 2000; Adams 2004; Kliejunas and Woodruff 2004; Information Ventures 2005; Woodruff and Kliejunas 2005).

There is the potential for new infection in any harvest area because airborne spores can travel far distances, up to 100 miles (Goheen and Otrosina 1998; Adams 2004) and *H. annosum* is known to occur throughout the forests of northern California and southern Oregon (Schmitt et al. 2000). The occurrence of *annosum* has been confirmed in true fir and is suspected to occur in pine stands in the Diamond Project Area (Woodruff and Kliejunas 2005). *Annosum* has been documented in both pine and fir stands on the Mt. Hough Ranger District (Kliejunas 1993), on the eastside of the Plumas National Forest in ponderosa and Jeffrey pine stands (Kliejunas 1989), and on the neighboring Lassen National Forest to the north of the Project Area (Woodruff 2006).

Infection by *annosum* root disease may become more wide spread if stumps are not treated. This would make the long-term control of the disease more difficult and may impact previously unaffected stands on National Forest lands, as well as adjacent landowners. In addition, harvesting without treating stumps would leave the potential for adverse effects on future species composition across the landscape. The consequences of not treating stumps with Borax application may include increased infection rates, mortality of desired large dominant and codominant residual trees, reduced canopy cover to below desired levels as a result of mortality, and an increase in fuel loads beyond desired conditions as a result of mortality (Goheen and Otrosina 1998). In areas where stumps were left untreated, infection rates ranged from 12 to 34 percent on the eastside of the Plumas National Forest (Kliejunas 1989). "Past studies on the Shasta Trinity and Modoc National Forests have found between 3 and 17 percent of untreated 18- to 22-inch ponderosa pine stumps and between 8 and 35 percent of untreated 22- to 26-inch ponderosa pine stumps infected with *H. annosum* decades after the stumps were exposed" (Woodruff 2006).

Once *annosum* infests a site, it resides in the soil for up to 50 years as a saprophytic (an organism that obtains food from dead or decaying organic matter) agent. Once established, the disease creates infection centers where trees of like species begin to display effects ranging from reduced individual tree vigor, root and bole decay, windthrow, root mortality, and in the worst case scenario, tree mortality. The infection centers create localized pockets of dead and down trees that contribute to higher surface fuel accumulation in the future. The Borax treatments are expected to reduce potential stand-level mortality, resulting in decreased contributions to surface fuel loads from trees killed by *annosum*. *Annosum* root disease is also known to increase susceptibility of infected trees to adverse effects of drought and insect attack, particularly in true fir (Ferrell 1996).

Other methods for controlling *annosum* have been suggested. Many of these alternative methods have been developed for forests in the southeastern United States. Several treatment strategies (prescribed burning, manipulation of season of cutting to avoid dispersion of spores, and treatment with a competitive nontoxic fungus [*Phlebiopsis gigantea*]) have been recommended in the southeastern region by the Mississippi State University Extension and others (Ammons and Patel 2000; Annesi et al. 2005). Intensive prescribed burning before and after treatment, as suggested by Ammons and Patel, may not be a viable option due to prohibitive cost and inherent risk associated with pre-treatment burning. Cutting when *annosum* spores are at their lowest levels has been suggested, but there are no data or studies to support the effectiveness of such a treatment. The competitive fungus, *Phlebiopsis gigantean*, is not available or registered for use in California and may not be a viable treatment due seasonality and concerns regarding the introduction of a nonnative organism into the ecosystem. The treatment strategies discussed above were developed for forests in the southeastern United States, and the effectiveness of these practices has not been established in forests in the western United States.

Direct and Indirect Effects of Borax Treatments. The projected levels of Borax application (in pounds per acre) for each treatment and prescription are displayed in table 4-12. The suggested application rate of 1 pound per 50 square feet of stump surface would be applied to freshly cut stumps (Wilbur Ellis 2001); this application rate and projected levels of Borax application (in pounds per acre) is consistent and well within those analyzed in the Human Health and Ecological Risk Assessment for Borax (Sporax®) Final Report (USDA 2006).

Table 4-12. Projected amounts of Borax application for each treatment and prescription.

Treatment	Prescription	Projected Pounds of Borax Application (per acre[a])		
		CWHR 3	CWHR 4	CWHR 5
Fuel Treatment	Thin to 35–40% canopy cover, 30-inch diameter limit	0.03	0.46	n/a
	Thin to 40–45% canopy cover, 30-inch diameter limit	n/a	n/a	0.20
	Thin to 50% canopy cover, 20-inch diameter limit	n/a	0.03	0.01
Area Thinning	Thin to 50% canopy cover, 30-inch diameter limit	n/a	0.04	0.02
	Thin to 50% canopy cover, 20-inch diameter limit	n/a	0.04	0.02
	Thin to 40% canopy cover, 30-inch diameter limit	n/a	0.28	n/a
Group Selection	30-inch diameter limit	n/a	1.92	1.92

Note:

a. Based on FVS calculation of the basal area of harvested trees greater than 12 inches dbh. Trees greater than 12 inches dbh were used as a proxy for trees with a stump diameter of 14 inches.

All Borax applications would follow safety and resource protection measures. The proposed Borax application would comply with all applicable state and federal regulations for the safe use of pesticides (including the Sporax® label requirements). For example, applicators would be adequately trained, medical aid would be available, wash water and eye wash water would be on site or nearby, and personal protective equipment would be used (eye protection, gloves, long-sleeved shirt, and long pants). Best Management Practices for pesticide application, including a spill contingency plan, would be implemented. Borax applications would not occur within 25 feet of stream courses and would not be applied during sustained rainfall.

The Syracuse Environmental Research Associates, Inc. (SERA) Human Health and Ecological Risk Assessment for Borax (2006) addresses the effects and ecological risk of Borax applications to tree stumps and reports:

> Boron is an essential trace element for terrestrial plants. The amount of boron required to produce optimal growth and development varies tremendously between species and even between strains of species…While there are many studies evaluating the phytotoxicity of boron compounds, few provide useful data that are

> useful in a quantitative assessment of the risk of boron toxicity. Data are available for a limited number of terrestrial plants…According to the product label for Sporax (Wilbur-Ellis company, no date), borax spilled or applied to crops may retard plant growth or kill plants. The label does not specify which plants species are at greatest risk for borax-induced phytotoxicity…There also does not appear to be a risk to terrestrial plants exposed to boron through runoff of Sporax applied to tree stumps. Although risk to insects and soil microorganisms was not characterized, since borax is used effectively in the control of fungi and insects, adverse effects of environmental exposures to insects and nontarget microorganisms are possible. However, given the atypical application method for Sporax, widespread exposures are not likely.

"Borax as used in forestry is identical to the material sold throughout North America as a household cleaning agent and also used for control of household insects" (Dost et al. 1996). Borax has even been recommended as an "environmentally friendly" household cleaning solution and a "safe alternative to common household products" (Wilmington College 2003; AEHA 1998). These household applications are in much closer proximity to humans than tree stump applications.

The SERA risk assessment Final Report (USDA 2006) concludes, "the use of Sporax® in Forest Service programs will not substantially contribute to boron exposures in humans" and "will not typically or substantially contribute to concentrations of boron in water or soil." In addition, the SERA report concludes, "the use of Sporax® in the control of annosum root disease does not present a significant risk to humans or wildlife species under most conditions of normal use, even under the highest application rate. For workers and the general public, none of the other exposure scenarios considered yield hazard quotients that exceed the level of concern" (USDA 2006).

The application of Borax to freshly cut stumps would be effective at mitigating the spread of *H. annosum* spores (Smith 1970; Graham 1971; Kliejunas 1989; Schmitt et al. 2000; Kliejunas and Woodruff 2004; Information Ventures 2005; Woodruff 2006). Borax application would minimize the risk of infection and creation of new infection centers, thereby maintaining and improving individual tree vigor and reducing susceptibility to other mortality agents, including drought, insects, and fire (Ferrell 1996; Woodruff 2006). A reduction of tree mortality related to *annosum* would result in a minor to moderate beneficial effect on surface fuels and resulting flame lengths by reducing the amount of woody material contributed by dead and dying trees.

4.1.4.7 All Action Alternatives (B, C, D, and F): Air Quality

Direct and Indirect Effects on Air Quality. Burning may potentially occur in Fuel Treatment, Group Selection, and Area Thinning Units, which are depicted on project maps. A combination of biomass removal and chipping would be used to minimize potential surface and ladder fuels that would be underburned. Emissions factors, fuel load, and consumption variables are listed in the "Fire and Fuels Report" located in the Diamond Project record. Total emissions by alternative are listed in table 4-13. Underburn and pile burn implementation would occur over five to seven years as weather conditions and resource availability permit. The maximum emissions from all of the potential burning in the Diamond Project Area would be equivalent to approximately 7,500 acres of wildfire. For comparison, the 2001 Stream Fire burned approximately 3,500 acres in just eight days.

Table 4-13. Predicted emissions for all burned acres in the Diamond Project Area.

Alternative	Total PM_{10} Emissions	Total $PM_{2.5}$ Emissions	Total PM CH_4 Emissions	Total CO Emissions	Total PM CO_2 Emissions	Total NMHC Emissions	Total VOC Emissions	Total Vehicle Emissions[a]
	(tons)							
A (no action)[b]	2,460	2,256	1,536	24,120	379,800	1,176	2,880	—
B, C	2,416	2,209	1,605	23,329	378,611	1,207	2,864	114
D	2,195	2,008	1,452	21,224	343,687	1,093	2,601	116
F	1,789	1,637	1,170	17,345	279,247	883	2,114	80

Notes: PM = particulate matter
CH_4 = methane
CO_2 = carbon dioxide
NMHC = nonmethyl hydrocarbon
VOC = volatile organic compound

a. Vehicle Emissions = emissions (dust) from vehicles used during implementation. Assumes an 80 percent reduction in emissions from road surfaces (1.2 pounds per vehicle mile) through implementation of standard road watering procedures. Vehicle miles assumes 20-mile average round trip on dirt roads per load; number of trips determined by data contained in the economic analysis.

b. Alternative A assumes emissions for a 7,500-acre wildfire in the mixed conifer forest type.

During underburn and pile burn activities, smoke would likely be visible from Indian Valley, Genesee Valley, and Antelope Lake but would move east towards Highway 395, Susanville, and the Honey Lake Valley during the day. At night, inversion could reduce visibility in Genesee, North Arm, and Indian Valley until late morning when the inversion layer typically lifts (Schoeder and Buck 1974). All burning would be completed under approved burn and smoke management plans. Piles would be constructed to minimize mixing of soil and burned under weather conditions that would allow efficient combustion. In conjunction with mechanical fuel treatments, underburn activities are expected to reduce accumulated fuels and reduce the “unacceptable risk of wildfire” and related uncontrollable emissions as described in U.S. Environmental Protection Agency (2006). In terms of actual acres of underburn and pile implemented, all treated units would be evaluated after treatment to determine if surface fuels were meeting desired conditions. The units meeting desired conditions may not be burned, thereby decreasing total burned acres and emissions.

Dust emissions would be spread out during the mechanical treatment implementation period of approximately five years. Dust would be mitigated by road watering and other standard management practices described in contracts (sections T-806 and B-5.3). No known serpentine based soils are in the Project Area would be disturbed by project implementation activities. Alternative F would have the lowest overall dust emissions when compared to alternatives B, C, and D. Harvesting, biomass removal, and road work would be completed primarily with diesel-powered equipment, including feller bunchers, skidders, tractors, graders, and trucks. This equipment would be inspected to determine equipment (spark arresters, fire extinguishers, and firefighting equipment) compliance with fire safety standards. The condition of emissions control systems of various pieces of equipment would vary by age, maintenance, manufacturer, and past use.

4.1.4.8 Cumulative Effects Common to All Alternatives (A, B, C, D, and F)

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

This cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. Focusing on individual actions would be less accurate than looking at existing conditions because there is limited information on the environmental impacts of individual past actions, and it is not reasonably possible to identify each and every action over the last century that has contributed to current conditions. By looking at current conditions, the Forest Service is sure to capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects. The Council on Environmental Quality issued an interpretive memorandum on June 24, 2005, regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." For these reasons, the analysis of past actions in this section is based on current environmental conditions.

The cumulative effects of past management practices, fire exclusion, and high-mortality fires (as detailed in appendix B) have largely shaped the forest that exists in the Project Area today. These past projects and events are reflected in the VESTRA (2000) vegetation layer used to characterize the existing conditions (the baselines for analysis) in the Project Area. Changes in vegetation structure as a result of fires and recent past projects since the baseline data were collected have been incorporated into the Diamond Project's existing conditions, with the exception of approximately 87 acres of even-aged regeneration harvest on private land. Such activities have had major impacts at the stand level by converting mid to later seral forest to early seral structure; however, on the landscape scale, this has had a negligible impact due to the dispersed nature of these projects and their size relative to the Project Area.

On public and private lands, past harvest activities focused on removal of dominant and codominant trees and retention of biomass and even-aged management. These harvest systems often used lop and scatter techniques for limb wood and tree tops. The results of these practices were high-density stands of small trees with relatively high fuel loads. Many of these stands continue to be conducive to high-mortality fire today. Since 1996, commercial thinning from below, with and without prescribed fire, has been the principal silvicultural treatment implemented on public lands in the Diamond Project Area. This silvicultural treatment has been used to establish several fuel treatments adjacent to the Diamond Project Area (Green Flat, Hungry, North Antelope, and Lucky S Projects). These treated areas currently meet desired conditions in terms of potential fire behavior and tree mortality. The North Antelope fuel treatment was impacted by the Stream Fire of 2001 and was successfully used to help contain this fire (USDA 2003; Beckman 2001; Raley 2001).

Herbicides have been used to control competing brush in conifer plantations on private lands within the Diamond Project Area. A reduction of competing brush generally reduces stand-level flammability in plantations and increases rates of tree growth. These factors can shorten the length of time that planted trees remain vulnerable to scorch-related mortality. Past high-mortality fires in the Diamond Project Area were typically replanted, and many of these areas are now dominated by young trees that are 25 to 60 feet in height.

Watershed and wildlife projects are not generally implemented at a scale or location to have an influence on landscape-level vegetation or fire behavior and related tree mortality. In general, wildlife and watershed projects listed in “Appendix B: Past, Present, and Reasonably Foreseeable Future Actions,” have a negligible effect on stand- and landscape-level fire behavior and related tree mortality. Small burn projects (such as the Genesee burn) and projects that increase riparian vegetation and soil moisture in meadows (grazing exclosures) or riparian areas (check dams) may have a minor beneficial effect by decreasing fire behavior where higher soil moisture and corresponding fuel moistures occur. In general, current road conditions and past road closures to benefit wildlife have had a negligible impact on the ability of fire managers to suppress and contain fires in the Diamond Project Area. Fine grasses and palatable shrubs may generally be less abundant in grazing allotments, leading to decreased flame lengths and rates of spread where grazing occurs.

The abandonment and closure of mine shafts is expected to increase public and firefighter safety because many of these shafts are difficult to see under wildfire conditions—this can lead to potential injury or loss of life. The establishment of test wind energy sites may increase the amount of infrastructure requiring protection during a wildfire event. There is the potential for ignitions from construction and maintenance activities. Proposed land conveyance, if implemented, could have varied potential effects on fire behavior and related tree mortality. Development of conveyed parcels may increase the amount of Wildland Urban Interface in the Diamond Project Area.

Other present and proposed future projects in the Project Area include wildlife, botanical, watershed, and recreation/special use projects. These projects would not be expected to have a measurable effect on forest structure in the Project Area due to the nature of such projects, with the exception of the Plumas National Forest Integrated Noxious Weed Control Program. This program would have a major beneficial effect by controlling the invasion and spread of noxious weeds and maintaining native understory vegetation in the Project Area. The removal of noxious weeds by any mechanical or chemical method would have a negligible effect on stand- and landscape-level fire behavior and related tree mortality. The target weed species are found in small, isolated populations and are not generally considered unusually flammable.

Present and proposed future fuels and vegetation management projects in the Diamond Project Area include hazardous fuels reduction in the form of mastication, grapple piling and burning, or underburning. These activities would have a major beneficial effect on the stand level by maintaining an open understory in these stands, thereby reducing high stand densities of small trees, ladder fuels, and fire risk. However, these activities would have a negligible impact on overall landscape structure because they are not likely to affect seral stage (as represented by CWHR size class) or overstory canopy (as represented by CWHR density class).

Christmas tree cutting and firewood collection would likely have an adverse effect on regeneration and snag levels, particularly within localized areas around main roads. Christmas trees and fuel wood cutting have a negligible effect on stand- and landscape-level fire behavior. Levels of regeneration and snags outside of the main road corridors are unlikely to be affected due to recruitment in untreated areas and lack of access. Due to the seasonal and dispersed nature of these activities, there would be a negligible effect across the Project Area. The primary (moderate) adverse effect of past recreation activities, with respect to fire, is increased ignition sources from campfires, vehicles, and other intentional or unintentional ignitions from forest users during summer months.

Future DFPZ maintenance is not proposed in the Project Area at this time but is included in the cumulative effects analysis as a possible future event. The 2003 HFQLG final supplemental EIS and Record of Decision, in combination with the original HFQLG Act final EIS and Record of Decision, provide programmatic guidance for DFPZ construction and maintenance in the HFQLG Pilot Project Area. The predicted maintenance treatments are described in “Appendix B: Past, Present, and Reasonably Foreseeable Future Actions.” These maintenance activities could occur at least 10 years after implementation. The direct and indirect effect of such maintenance activities would maintain an open understory with reduced amounts of brush, tree regeneration, and naturally accumulating slash. These activities may reduce incidental numbers of snags but may also induce snag recruitment through incidental tree mortality, particularly in prescribed fire treatments. Another cumulative effect of DFPZ maintenance would be a reduction in tree regeneration and decreased recruitment of another age class of trees at the stand level; however, these treatments would maintain forest canopy and residual tree size. This, in turn, would retain stand structure and composition and would have a moderate beneficial effect on the long-term effectiveness of fuel treatments in terms of reducing understory establishment and development.

The cumulative effects of HFQLG Pilot Project actions, such as the proposed Diamond Project and other vegetation management actions in the Sierra Nevada, were assessed in the SNFPA final supplemental EIS (2004) and the HFQLG final EIS (1999). The fuel treatments constructed in the proposed Diamond Project Area would constitute approximately 2 percent of the total acreage of fuel treatments to be constructed under the Pilot Project (up to 300,000 acres). The group selection proposed for the Diamond Project alternatives accounts for less than 13 percent of the annual group selection planned for the Pilot Project (8,700 acres per year) as analyzed under the HFQLG final EIS (1999).

4.1.4.9 Cumulative Effects: No-Action Alternative (A)

The no-action alternative would rely on “natural” disturbance, such as density-dependent mortality and fire occurrence (or lack thereof), to shape overall landscape structure. The maintenance of early seral stand structure would rely on areas of disturbance. The current landscape is dominated by mid-seral closed forests as represented by CWHR size classes 4M and 4D (see table 3-1 in the “Forest Vegetation and Fire, Fuels, and Air Quality,” section 3.1 in chapter 3) This would favor shade-tolerant species and would likely perpetuate a lower ratio of shade-intolerant to shade-tolerant species (approximately one shade-intolerant to six shade-tolerant species).

Alternative A would maintain this landscape by contributing to the development of mid-seral closed canopy forests (represented by CWHR 4M and 4D) (see table 4-16 in section 4.1.4.11 below). No treatments would occur to enhance the development of mid-seral open-canopy forests. This would result in overall landscape homogeneity. Stand densities would be expected to increase with time beyond the 55 percent threshold, thereby incurring competition-related mortality. Within a 10-year time frame, an estimated 95 percent of the acres proposed for treatment under the action alternatives would have relative stand densities over the 55 percent threshold under the no-action alternative.

The maintenance of high stand densities across the landscape would result in the potential for adverse major impacts such as beetle outbreaks beyond endemic levels, widespread susceptibility to drought, and increased risk for high-mortality fire. These high stand densities and closed-canopy forests would favor a gradual shift in species composition toward shade-tolerant species, which would have an adverse effect on species diversity across the landscape. Such high-density stand structure is susceptible to forest health and fire hazard issues, and a homogeneous occurrence of these mid-seral closed canopy forests across the landscape would be unstable (McKelvey and Johnston 1992). Alternative A would not provide for spatially variable, diverse stand structures across the landscape as described by Skinner (2005), Skinner and Chang (1996), Weatherspoon (1996), and the HFQLG final EIS (1999), and it would not meet the desired conditions identified in the Diamond Landscape Assessment or the desired conditions identified in the purpose and need sections in chapter 1 of this document.

By taking no action, fire behavior is expected to continue to result in high-mortality fires such as the Stream Fire of 2001 (Plumas National Forest 2003; Raley 2001). This fire burned over 3,500 acres, with tree mortality exceeding 75 percent on 2,300 acres of the burned area. Over the long term, mortality occurring in high-density stands would continue to increase surface fuel load through deadfall of standing dead trees. This increase in mortality and related deadfall has been witnessed in the Project Area and other parts of the Sierra Nevada range as a result of region-wide drought in the late 1980s (Guarin and Taylor 2005). These increased surface fuels, combined with continuous ladder and canopy fuels, would continue to hinder suppression effectiveness and would likely maintain stands susceptible to high-mortality fires such as the Stream Fire (see table 4-14). Increased flame lengths during a wildfire could lead to high mortality in forested areas, including Baker cypress stands, RHCAs, PACs, and HRCAs in the Project Area. In turn, this may result in continued high fire suppression and rehabilitation costs for the indefinite future in the Diamond Project Area.

Table 4-14. Alternative A acres of potential surface fire and crown fire (passive and active) for all public lands, private lands, PACS, and HRCAs in the Diamond Project Area.

Fire Type	Acres of Public Land	Acres of Private Lands	Total Public and Private Acres[a]	All PACs and HRCAs on Public Lands in the Project Area[a]
	Diamond Project Area[a]			
Surface Fire	25,990	2,295	28,286	9,202
Crown Fire (active and passive)	52,533	15,590	68,123	23,191
Grand Total	**78,523**	**17,885**	**96,409**	**32,393**

Note:

a. Acres exclude unburnable areas such as lakes, rock outcrops, and other barren areas in the Diamond Project Area.

The no-action alternative would not improve firefighter and public safety, which could lead to potential future injuries during fire events. The no-action alternative would also not reduce potential tree mortality or protect rare species and associated habitat from the major adverse effects of severe wildfire (Stephens and Moghaddas 2005a; Agee 2002). Reasonably foreseeable fuel treatment projects (see appendix B) would be implemented at the stand level although they would mostly remain geographically separated. Alternative A would not provide continuity between existing and future fuel treatments, thereby decreasing their overall effectiveness at the landscape level. At the landscape level, the current Fire Regime Condition Class would not be modified over the short term. Modifications over the long-term would be primarily caused by high-mortality fires and drought and insect-related mortality, none of which would trend the landscape-level Fire Regime Condition Class towards Condition Class I (see the "Glossary" for a definition of *Fire Regime Condition Class*). The no-action alternative would allow stands to continue to develop under the influence of the legacy of past management practices and fire suppression (Skinner 2005; Agee 2002). Overall, the no-action alternative would trend conditions for fire behavior and predicted mortality away from the desired conditions described in chapter 2.

4.1.4.10 Cumulative Effects Common to All Action Alternatives (B, C, D, and F)

The cumulative effects of past projects may be characterized by the existing conditions that exist on the landscape today. Present and future projects may be characterized by a shift in land management values and practices that emphasize forest structure (including the retention of large dominant and codominant trees), the role of fire as a process, and their relationship to landscape diversity and healthy, resilient ecosystems.

Due to the nature of the proposed treatments and silvicultural prescriptions, cumulative effects would include the maintenance and development of large trees throughout the Project Area. Upper diameter limits maintain the component of large trees that exist in the Project Area, and thinning from below treatments would create conditions favorable for growth and development of large trees. Preference in thinning prescriptions for retaining shade-intolerant species in Sierra Mixed conifer and Jeffrey and Ponderosa pine-dominated stands and preferential regeneration of shade-intolerant species in Group Selection Units would enhance the regeneration, growth, and development of shade-intolerant species. These treatments would contribute to a higher ratio of shade-intolerant species in treated areas immediately post treatment (approximately one shade-intolerant to four shade-tolerant species). This ratio would be substantially lower for higher elevation white fir and red fir stands where species preference would maintain shade-tolerant species native to the ecological forest type.

Snag levels would be reduced in current, proposed, and future fuel reduction projects, therefore the cumulative effect would be the reduction of snags in treated areas. However, across the Project Area, snag recruitment would continue to occur, particularly in untreated areas where high stand densities would continue to contribute to mortality.

Stand density would be reduced particularly in the smaller diameter classes through all action alternatives. This effect differs by alternative due to the differences in amount of acres treated under differing canopy cover retention guidelines. Ten years following treatment, approximately 94 percent of the treated area in alternatives B and C would result in stand densities that meet desired conditions (below the 55 percent relative stand density threshold described above in section 4.1.3.2, "Measurement Indicators"). However, 20 to 30 years following treatment, only 32 percent of the treated acres would result in desired stand densities. In alternatives D and F, approximately 94 percent of the treated area would result in stand densities that meet desired conditions; however, 20 to 30 years following treatment, approximately 56 percent of the treated area in alternative D and 47 percent of the treated area in alternative F would result in stand densities that meet desired conditions. The lower canopy cover retention guidelines implemented in alternatives D and F would provide for a longer reduction in stand densities relative to alternatives B and C.

Stand structure within treated stands would have lower stand densities and would be characterized by mid- to later-seral open canopy stands, particularly in the understory. Within all action alternative, approximately 2.2 to 2.8 percent of the mid-seral closed canopy stands would be converted to mid- to late-seral open canopy with gaps (created by group selection) characterized by early seral open canopy structure. The horizontal and vertical structure of these stands would be diverse and would be comprised of clumps of trees, gaps in the canopy, and intermingled openings. This stand structure would enhance species composition diversity by providing for a range of conditions that would favor regeneration of shade-intolerant species and maintenance of shade-tolerant species according to native ecological forest type.

Stand-level treatments would reduce potential fire behavior, fire-related tree mortality, and spotting in Fuel Treatment and Area Thinning Units. These treatments would increase the ability of fire management personnel to suppress and contain wildfires during initial and extended operations while increasing firefighter and public safety. At the landscape level, these treatments would provide connectivity between existing fuel treatments and break up the continuity of surface and crown fuels. With completion of the Diamond Project, over 35 percent of public lands in the Diamond Project Area would have the desired surface fire type under 90th percentile weather conditions. The proposed fuel treatments would provide connectivity between existing treatments within and adjacent to the Project Area, including the North Antelope, Hungry, and Green Flat fuel treatments. Based on FLAMMAP outputs, these areas are concentrated in the central and eastern portions of the Project Area. In these areas, crown fire potential would still exist, but susceptible areas would generally be adjacent to or in relatively close proximity to treated stands.

In conjunction with proposed RHCA and aspen treatments, the Diamond Project would have a moderate beneficial effect on reducing landscape-level fire-related tree mortality when combined with existing and future fuel treatments. A reduction landscape-level fire-related tree mortality would help maintain stand structure in Baker cypress stands, aspen stands, RHCAs, PACs, and HRCAs in the Project Area. Borax treatments are expected to reduce potential stand-level mortality, resulting in decreased contributions to surface fuel loads from trees killed by *annosum* root disease. In terms of overall effectiveness for potential fire behavior, alternatives B and C would result in the greatest number of acres meeting desired conditions. Alternatives D and F would result in approximately 1,800 and 800 acres less, respectively, of area meeting desired conditions of surface fire when compared to alternatives B and C (see table 4-15).

On the landscape level, all action alternatives would contribute to landscape diversity by converting homogeneous stands of mid-seral closed canopy forest to a mosaic of both early seral structure and mid- to later-seral open canopy forest. Consequently, on the landscape scale, there is little difference between the alternatives.

Throughout all action alternatives, the only change in CWHR size class would be due to group selection treatment converting mid and later-seral size classes represented by CWHR size classes 4 and 5 to early seral size classes represented by CWHR size classes 1 and 2. This effect would be similar in alternatives B, C, and D due to similar acres in group selection treatment, but it is much more reduced in alternative F due to reduced acres in group selection (see table 4-16).

Table 4-15. Alternatives B and C – acres of surface fire and crown fire (passive and active) for all public lands, private lands, PACs, and HRCAs in the Diamond Project Area.

Alternative	Fire Type	Acres of Public Land	Acres of Private Lands	Total Public and Private Acres[a]	All PACs and HRCAs on Public Lands in the Project Area[a]
		Project Area[a]			
B and C	Surface Fire	33,501	2,305	35,806	11,310
B and C	Crown Fire (active and passive)	45,021	15,580	60,601	21,085
B and C	**Grand Total**	**78,522**	**17,885**	**96,407**	**32,395**
D	Surface Fire	31,683	2,305	33,988	9,956
D	Crown Fire (active and passive)	46,839	15,580	62419	22,439
D	**Grand Total**	**78,522**	**17,885**	**96,407**	**32,395**
F	Surface Fire	32,669	2,305	34,974	10,303
F	Crown Fire (active and passive)	45,853	15,580	61,433	22,092
F	**Grand Total**	**78,522**	**17,885**	**96,407**	**32,395**

Note:

a. Acres exclude unburnable areas such as lakes, rock outcrops, and other barren areas in the Project Area.

Within CWHR size classes, a change in density class would be more apparent. The general trend of these fuel and forest health projects would result in more acreage of mid- to later-seral open canopy stands characterized by CWHR density classes moderate and poor (see table 4-16). The intensity of this effect would be limited by the number of acres treated over time and tempered by the development of mid-seral closed-canopy forests in untreated stands. Although the canopy cover density classes do not vary substantially by alternative, alternative D would provide for the greatest reduction in stand density on the stand level and create more open canopy stands that would be more resistant to the effects of fire, drought, insects, and disease. These open canopy stands would also promote conditions favorable for shade-intolerant species to establish and develop. This would enhance the health of stands dominated by pine species, aspen, and Baker Cypress and contribute to species diversity across the landscape.

Future fuels and forest health-driven projects (see appendix B) would likely maintain this trend of creating open canopy stands represented by poor canopy cover. The net cumulative effect would be an increase in diversity compared to existing conditions that are dominated by mid-seral closed canopy stands represented by CWHR size classes 4M and 4D. This effect would be maintained by future actions, such as DFPZ maintenance.

Future maintenance activities (as described in appendix B) would increase the longevity of fuel treatments established under the Diamond Project. Future prescribed burn activities would likely have lower smoke emissions because much of the existing surface fuel would have been removed during initial underburn and pile burn treatments.

Table 4-16. Cumulative effects on the landscape structure from all alternatives.

CWHR Size Class	CWHR Tree Sizes (average)	CWHR Density Class	CWHR Canopy Cover (%)	Alternative A		Alternatives B and C				Alternative D				Alternative F			
				Existing Acres	Existing Percent	Proposed Acres	Change in Acres	Proposed Percent	Change in Percent	Proposed Acres	Change in Acres	Proposed Percent	Change in Percent	Proposed Acres	Change in Acres	Proposed Percent	Change in Percent
1	<1 inch dbh		Total	217	0.2%	1,346	1,129	1.4%	1.1%	1,171	954	1.2%	1.0%	825	608	0.8%	0.6%
2	1–6" dbh		Total	2,118	2.1%	2,118	0	2.1%	0.0%	2,118	0	2.1%	0.0%	2,118	0	2.1%	0.0%
3	6–11" dbh	Dense	>60	127	0.1%	126	-1	0.1%	0.0%	126	-1	0.1%	0.0%	126	-1	0.1%	0.0%
		Moderate	40-59	1,630	1.6%	1,610	-20	1.6%	0.0%	1,610	-20	1.6%	0.0%	1,610	-20	1.6%	0.0%
		Poor	25-39	1,895	1.9%	1,913	18	1.9%	0.0%	1,914	19	1.9%	0.0%	1,914	19	1.9%	0.0%
		Sparse	10-24	950	1.0%	950	0	1.0%	0.0%	950	0	1.0%	0.0%	950	0	1.0%	0.0%
			Total	4,603	4.6%	4,600	-3	4.6%	0.0%	4,601	-2	4.6%	0.0%	4,601	-2	4.6%	0.0%
4	11–24" dbh	Dense	>60	2,891	2.9%	2,722	-169	2.7%	-0.2%	2,723	-168	2.7%	-0.2%	2,736	-155	2.8%	-0.2%
		Moderate	40-59	42,785	43.2%	40,558	-2,227	40.9%	-2.2%	40,613	-2,172	41.0%	-2.2%	40,862	-1923	41.2%	-1.9%
		Poor	25-39	9,246	9.3%	10,843	1,597	10.9%	1.6%	10,846	1,600	10.9%	1.6%	10,733	1487	10.8%	1.5%
		Sparse	10-24	2,434	2.5%	2,524	90	2.5%	0.1%	2,524	90	2.5%	0.1%	2,524	90	2.5%	0.1%
			Total	57,355	57.9%	56,646	-709	57.2%	-0.7%	56,705	-650	57.2%	-0.7%	56,854	-501	57.4%	-0.5%
5	>24 inches dbh	Dense	>60	4,440	4.5%	4,244	-196	4.3%	-0.2%	4,286	-154	4.3%	-0.2%	4,341	-99	4.4%	-0.1%
		Moderate	40-59	21,142	21.3%	20,930	-212	21.1%	-0.2%	20,996	-146	21.2%	-0.1%	20,850	-292	21.0%	-0.3%
		Poor	25-39	4,274	4.3%	4,265	-9	4.3%	0.0%	4,272	-2	4.3%	0.0%	4,272	-2	4.3%	0.0%
		Sparse	10-24	435	0.4%	435	0	0.4%	0.0%	435	0	0.4%	0.0%	435	0	0.4%	0.0%
			Total	30,291	30.6%	29,874	-417	30.1%	-0.4%	29,989	-302	30.3%	-0.3%	29,898	-393	30.2%	-0.4%
			Nonforest Total	4,519	4.6%	4,519	0	4.6%	0.0%	4,519	0	4.6%	0.0%	4,519	0	4.6%	0.0%
			Grand Total	99,103	100.0%	99,103	0	100.0%	0.0%	99,103	0	100.0%	0.0%	99,103	0	100.0%	0.0%

The Diamond Project is not intended to reduce all hazards on all acres in a single project. The proposed action alternatives should be considered the first step toward creating desired conditions on the landscape scale. Fuel treatments and maintenance would be needed to augment these treatments into the future as stands develop. Treatments in the Diamond Project Area would help move areas in Fire Regime Condition Classes 2 and 3 toward Fire Regime Condition Classes 1 and 2, respectively. These treatments would promote fire-resistance and forest health at the stand level, enhance the diversity of forest structure across the landscape, and contribute to landscape heterogeneity, which may be more resilient to fire hazard and forest health issues in the future. Collectively, vegetation and fuel treatments would trend the Diamond Project Area towards fire- and vegetation-related desired conditions described in chapters 1 and 2 of this document.

Overall, the Design Criteria listed in chapter 2 ("Design Criteria Common to All Action Alternatives," tables 2-17 to 2-27), and any mitigations under alternative D associated with watershed objectives, would have a net negligible or beneficial effect on forest vegetation, fuels, fire behavior, and air quality.

4.2 Soils and Hydrology

4.2.1 Summary of Effects

4.2.1.1 Alternative A – No Action

- The lack of fuel treatment in alternative A would leave soil productivity and watershed values vulnerable to the damaging effects of future severe wildfires.

- The three subwatersheds that are currently over the Threshold of Concern (TOC) would be allowed to recover with time and drop below the TOC.

- No road decommissioning would occur, so associated long-term beneficial watershed effects would not be realized.

- The lack of noxious weed treatments would leave the diversity and productivity of native and desired nonnative plant communities in the riparian areas at risk for decline.

4.2.1.2 Alternatives B (Proposed Action) and C

- The enhanced ability of fire management to suppress, control, and contain fires that impact or start in Fuel Treatment Units under 90th percentile weather conditions would produce long-term benefits to soil productivity and watershed values that would otherwise remain more vulnerable to the damaging effects of future severe wildfires.

- Actions are proposed in this alternative that would take place in one subwatershed that is currently over the TOC and that would cause the cumulative Equivalent Roaded Acre (ERA) values to exceed the TOC in six additional subwatersheds, placing them all at a high risk for cumulative effects.

- Large ERA increases, approaching or reaching the TOC, would place two additional subwatersheds at a high risk of cumulative effects.

- There would be a moderate risk that soil productivity could be impaired—this is based on the standards contained in the 1988 *Plumas National Forest Land and Resource Management Plan* (the "Forest Plan"), as amended, and USDA Forest Service Region 5 soil standards. Alternatives B and C propose the greatest amount of mechanical treatments, so there would be the greatest amount of ground disturbance from equipment, skid trails, and landings. The direct, indirect, and cumulative effects on soil productivity from alternatives B and C would be greater than alternatives A, D, and F.

- The decommissioning of 9.6 miles of roads would result in long-term benefits to watershed resources.

- No significant adverse cumulative watershed effects associated with herbicide applications are expected. The applications of herbicide would protect the diversity and productivity of native and desired nonnative plant communities in the riparian areas (this only applies to alternative B because alternative C does not propose herbicide use; therefore, alternative C would incur the same effects as alternative A with regard to noxious weeds).

4.2.1.3 Alternative D

- The enhanced ability of fire management to suppress, control, and contain fires that impact or start in Fuel Treatment Units under 90th percentile weather conditions would produce long-term benefits to soil productivity and watershed values that would otherwise remain more vulnerable to the damaging effects of future severe wildfires.

- This alternative proposes actions that could cause the cumulative ERA values to exceed the TOC in five subwatersheds. Large ERA increases would be incurred in two or more subwatersheds, causing them to approach or reach the TOC. However, additional hillslope and stream channel treatments within these subwatersheds and their drainage networks would mitigate the high risk of cumulative effects suggested by the ERA values. As a result, stream channel integrity would be enhanced, and subwatershed susceptibility to adverse cumulative watershed effects would be reduced. Due to these mitigation measures, the risk of adverse watershed effects would be reduced to moderate levels in the subwatersheds of concern.

- There would be a moderate risk that soil productivity could be impaired—this is based on the standards contained in the 1988 Forest Plan and USDA Forest Service Region 5 soil standards. Alternative D proposes a moderate amount of mechanical treatments, so there would be a moderate amount of ground disturbance from equipment, skid trails, and landings. The direct, indirect, and cumulative effects on soil productivity would be less than alternatives B and C and greater than alternatives A and F.

- The decommissioning of 9.6 miles of roads would result in long-term benefits to watershed resources.

- No significant adverse cumulative watershed effects associated with herbicide applications are expected. The applications of herbicide would protect the diversity and productivity of native and desired nonnative plant communities in the riparian areas.

4.2.1.4 Alternative F

- The enhanced ability of fire management to suppress, control, and contain fires that impact or start in fuel treatment units under 90th percentile weather conditions would produce long-term benefits for soil productivity and watershed values that would otherwise remain more vulnerable to the damaging effects of future severe wildfires.

- The cumulative ERA values would not exceed the TOC in any subwatershed due to actions proposed in this alternative.

- Large ERA increases, approaching or reaching the TOC, would place five subwatersheds at a high risk of cumulative effects.

- There would be a moderate risk that soil productivity could be impaired—this is based on the standards contained in the 1988 Forest Plan and USDA Forest Service Region 5 soil standards. Of the action alternatives, alternative F proposes the least amount of mechanical treatments, so there would be the least amount of ground disturbance from equipment, skid trails, and landings. The direct, indirect, and cumulative effects on soil productivity would be less than alternatives B, C, and D and greater than alternative A.
- The decommissioning of 9.6 miles of roads would result in long-term benefits to watershed resources.
- No significant adverse cumulative watershed effects associated with herbicide applications are expected. The applications of herbicide would protect the diversity and productivity of native and desired nonnative plant communities in the riparian areas.

4.2.2 Guiding Regulations

Clean Water Act of 1972, as Amended. Section 208 of the *Clean Water Act* requires states to prepare nonpoint source pollution plans that are to be certified by the state and approved by the U.S. Environmental Protection Agency (EPA). In response to this law, and in coordination with the State of California Water Resources Control Board (SWRCB) and EPA, Forest Service Region 5 began developing Best Management Practices (BMPs) in 1975 for water quality management planning on National Forest System lands in the state of California. This process identified the need to develop a BMP for addressing the cumulative off-site watershed effects of forest management activities on the beneficial uses of water.

Clean Water Act and Best Management Practices—Land management activities have been recognized as potential sources of nonpoint water pollution. By definition, nonpoint pollution is not controllable through conventional treatment plant means. Nonpoint pollution is controlled by containing the pollutant at its source, thereby precluding delivery to surface water. Sections 208 and 319 of the federal *Clean Water Act*, as amended, acknowledge land treatment measures as being an effective means of controlling nonpoint sources of water pollution and emphasize their development.

The most effective means to control nonpoint source pollution is through implementation of BMPs, which are defined as "methods, measures, or practices selected by an agency to meet its nonpoint source control needs. BMPs include, but are not limited to, structural and nonstructural controls, operations, and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters." BMPs are usually applied as a system of practices rather than as a single practice. BMPs are selected on the basis of site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility. BMPs are basically a preventive rather than an enforcement system. BMPs are a whole management and planning system in relation to sound water quality goals, including both broad policy and site-specific prescriptions.

Executive Orders 11988 and 11990. These two orders provide for the protection of floodplain and wetland areas, respectively. These orders are intended to preserve the natural and beneficial values served by floodplains and wetlands.

California Regional Water Quality Control Board Conditional Waiver of Waste Discharge. In January of 2003, the Regional Water Quality Control Board—Central Valley Region adopted Resolution No. R5-2003-005, which provides for a conditional waiver of the requirement to file a report of waste discharge and obtain waste discharge requirements for timber harvest activities on Forest Service lands within the Central Valley Region. Additional provisions were added in the 2005 Resolution No. R5-2005-0052. To receive a waiver for a timber harvest activity, the Forest Service must comply with specific conditions established by the Water Quality Control Board.

U.S. Forest Service Soil and Water Conservation Handbook. Chapter 20 of the Soil and Water Conservation Handbook provides policy, direction, standards, and guidelines to guide cumulative watershed effects analysis, monitoring, and model modification.

Forest Service Soil Management Handbook. The Region 5 Supplement to the Soil Management Handbook (USDA Forest Service 1995) provides threshold values for soil properties and conditions to use as indicators of significant change in soil productivity, soil hydrologic function, and soil buffering capacity, and in turn, to maintain or restore ecosystem health diversity and productivity and water quality. Detrimental soil disturbance is the resulting condition when threshold values are exceeded. The components of soil productivity addressed by these standards are soil cover, soil porosity, and organic matter.

Plumas National Forest Land and Resource Management Plan (Forest Plan). The 1988 Forest Plan provides standards and guidelines for protecting the soil resource. The Forest Plan provides specific guidelines for soil productivity measures, such as soil cover and compaction.

Sierra Nevada Forest Plan Amendment. The 2004 Sierra Nevada Forest Plan Amendment Record of Decision management direction for the Herger-Feinstein Quincy Library Group (HFQLG) Pilot Project Area is to apply the Scientific Analysis Team guidelines (as set forth in the HFQLG EIS and Record of Decision) to vegetation management actions that are proposed for fuels reduction, timber management, area thinning, prescribed fire, and salvage harvest within the Pilot Project Area for the life of the Pilot Project.

4.2.3 Methodology for Assessing Impacts on Soils and Watershed

4.2.3.1 Watershed Analysis Area – Spatial and Temporal Boundaries

The Watershed Analysis Area consists of 48 subwatersheds, which comprise about 112,200 acres. This area is described in chapter 3—section 3.2.2 and figure 3-2. To determine cumulative watershed effects, the impacts of timber harvest activities were expected to last 35 years. Impacts from high-intensity fire events were limited to 15 years, and impacts from low or moderate intensity fires were limited to 10 years. These values reflect the period of time required for site recovery following these types of activities and events. Beyond this timeframe, vegetation has generally had ample opportunity to reestablish and develop adequate canopy cover to provide organic material to the soil. Together, canopy and litter cover provide physical protection against soil erosion. In addition, roots have reoccupied the soil mantle, and most effects from compaction have been negated except along established travel ways. These factors tend to moderate peak flows and thus diminish adverse effects on channel condition and water quality. A linear recovery coefficient was incorporated into the analysis to reduce the disturbance coefficients over the 10-, 15-, or 35-year recovery period. Figure 4-9 shows the disturbance model for a harvest activity.

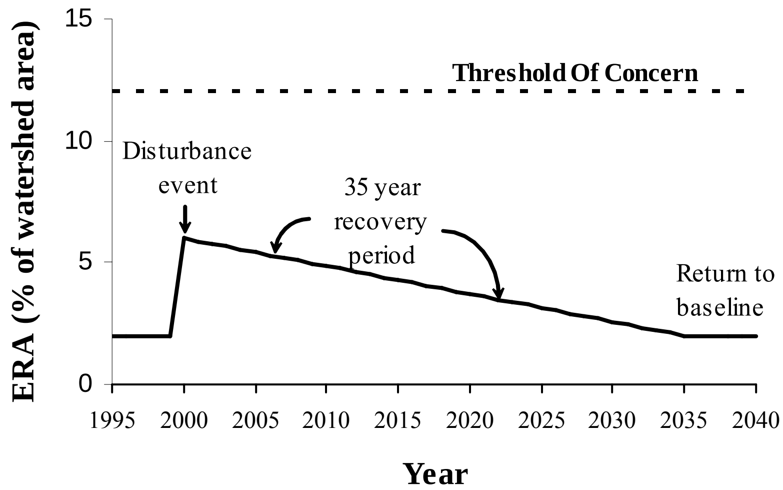


Figure 4-9. Conceptual disturbance and recovery model for a harvest activity.

4.2.3.2 Soils Analysis Area – Spatial and Temporal Boundaries

The Soil Analysis Area consists of the DFPZ Fuel Treatment Units and Area Thinning Units, as shown in figure 3-1 in chapter 3. The effects on soil productivity are expected to be limited to the units in which the proposed treatments would occur. The soils analysis does not incorporate a time limit for considering past activities. The current soils condition reflects the cumulative effects of past activities, regardless of when they took place. For example, if multiple activities have occurred in a given treatment unit over the past 50 years, it is not necessarily possible to separate the effects of older treatments from more recent ones. As a result, it is not practical to set a time constraint on those effects. The effects on soils may extend until the resource has recovered from the impact of the proposed activities. The persistence of soil effects into the future can vary widely. For example, ground cover may recover within one to two years following a treatment. Soil compaction, however, may last for decades. Thirty-five years was chosen as a future timeframe for soil effects. After this time, the degree and variability of soil conditions are expected to be similar to the no-action alternative.

4.2.3.3 Indicator Measures and Terminology

The specific measures used to examine the cumulative soil and watershed effects are shown below in table 4-17. These are generally quantitative assessments that are used to make comparisons with threshold values, which are defined in the guiding regulatory documents.

“Equivalent Roaded Acres” is a conceptual unit of measure used to assess ground-disturbing activities. One acre of road surface equals one “Equivalent Roaded Acre” or ERA. Numeric coefficients are used to convert acres of timber harvest and other disturbance activities to ERA values. The ERA serves as a “common currency” to describe effects from a wide range of management activities. For example, 1 acre of underburning equals 0.05 ERA. In a given watershed, disturbances are added together to determine a cumulative ERA for that watershed. This value is often expressed as a percentage of the TOC.

Table 4-17. Summary of environmental indicators and measures examined in this assessment.

Key Ecosystem Element	Environmental Indicators	Variable Assessed
Water Quality	Chronic sedimentation, accelerated hillslope erosion	Equivalent roaded acres (ERA)
Soil Productivity	Organic matter losses Soil loss Detrimental compaction	Surface fine organic matter Effective soil cover Skid trails, landings, soil bulk density

The TOC is an indicator used to assess the risk of cumulative watershed effects. The TOC is generally expressed as a percentage of watershed area. When the total ERA in a watershed exceeds the TOC, susceptibility for significant adverse cumulative effects is high. The cumulative ERA in a watershed is often expressed as a percent of the TOC. For example, in a 1,000-acre watershed where the TOC is 12 percent of the watershed area, 100 percent of the TOC represents a condition where the amount of disturbance is similar to 120 acres of road surface.

Organic matter loss, accelerated erosion, and detrimental compaction are used as indicators of reduced soil productivity. Organic matter losses are assessed by measuring the surface fine organic matter and large woody material. Surface fine organic matter should cover at least 50 percent of the activity area. The organic matter includes plant litter, duff, and woody material less than 3 inches in diameter. Large woody material is composed of logs at least 20 inches in diameter and 10 feet long. Five logs per acre, representing the range of decomposition classes, should be present. Fine organic matter and large woody material may be reduced to meet fuel management objectives, except when needed for essential erosion control. Effective soil cover is used to evaluate the potential for accelerated erosion. Effective soil cover consists of material that impedes rain drop impact and overland flow of water, including organic residues 0.5-inch thick, exposed roots, stumps, surface gravels more than 0.75 inch, and living vegetation. Minimum effective ground cover is prescribed at 40, 50, 60, or 70 percent on areas with maximum Erosion Hazard Ratings of low, moderate, high, and very high, respectively. To avoid impacts due to detrimental compaction, soil porosity should be at least 90 percent of total porosity found under natural conditions. Reductions in soil porosity correspond with increases in soil bulk density. To avoid land base productivity loss due to soil compaction, dedicate no more than 15 percent of timber stands to landings and permanent skid trails.

4.2.3.4 Analysis Methods

Cumulative Watershed Effects Analysis Methods and Assumptions. There are numerous methods for assessing the effects of land use activities on the landscape (Berg et al. 1996; USDA Forest Service 1988a; Reid 1998). For the purpose of this cumulative watershed effects (CWE) analysis, the effects of past, present, and reasonably foreseeable future actions were assessed using the Region Five Cumulative Off-site Watershed Effects Analysis (USDA Forest Service 1988a). Under this approach, the effects of land management activities were evaluated on the basis of ERA. These ERA values serve as a “common currency” to describe effects from a wide range of management activities. The wide use of this model in Region 5 allows for comparisons among projects across both space and time.

Within each subwatershed in the Watershed Analysis Area, past management activities were analyzed to account for the cumulative amount of land disturbance that has occurred within each subwatershed. The area of land manipulated by each past management activity was converted to an area of road surface, resulting in a measure of ERA. Numeric disturbance coefficients were used to convert these management effects to ERA effects in terms of the pattern and timing of surface runoff. Coefficients vary by management activity, silvicultural prescription, site preparation methods, type of equipment utilized, and fireline intensity.

Dividing the total ERA by the size of the watershed yields the percent of the watershed in a hypothetically roaded condition. This value can serve as an index to describe effects on downstream water quality. An increase in the road density of a watershed can result in greater effects on water quality downstream. Watersheds and their associated stream systems can tolerate some level of land disturbance, but there is a point at which land disturbances begin to substantially affect downstream channel stability and water quality. This upper estimate of watershed “tolerance” to land use is called the Threshold of Concern, or TOC. For this analysis, the TOC was assessed for each subwatershed in terms of the percent of the area in a hypothetically roaded condition. As disturbances approach the TOC, there is an increased probability that soil productivity and water quality values would be impaired. Above the TOC, water quality may be degraded to the point that the water is no longer available for established uses, such as municipal water supplies or irrigation, or no longer provides adequate habitat for fisheries. In addition, stream channels can deteriorate to the extent that riparian and meadowland areas become severely damaged.

As a guide to the CWE assessment, when planned activities within forest watersheds result in increases in ERA of 25 to 30 percent of the TOC, relatively small increases in peak flows are generally realized. Given that the ERA threshold for the subwatersheds in this analysis is 12 percent of the watershed area, this would likely result from an ERA increase of 3 to 4 percent of the watershed area. In watersheds where streams are stable and ERA values (watershed disturbances) are not approaching threshold, such increases generally do not stress the system. However, a closer look at the activities planned within the watershed would be important where increases in ERA could approach 40 to 50 percent of the TOC (5 to 6 percent of the watershed area), stream channels are in poor condition, or ERA values are approaching the TOC.

In calculating the ERA contribution by the proposed harvest activities, all areas of the Treatment Units were assumed to be treatable. For example, no compensations were made for rock outcrops, roaded areas, or small-scale slope limitations that would restrict harvest activities. In most cases, such site-specific information was not available. Coefficients were applied to similar activities regardless of soil type, slope conditions, season of operation, or specific equipment characteristics. In calculating ERA contributions due to roads, all roads were considered equally, regardless of surface material (pavement, gravel, or native soil surface). Acres of roads were calculated by assuming that all roads are 25 feet wide. The linear recovery curve used in this analysis is not necessarily reflective of recovery patterns on the ground. Linear recovery models tend to under-predict effects in the very early stages of recovery, and over-predict effects in later stages of disturbance recovery.

Soil Assessment Analysis Methods and Assumptions. In the summer of 2005, the watershed field crew, under the direction of the District soil scientist, assessed soil productivity measures in the proposed Treatment Units. The Fuel Treatment Units and Area Thinning Units were sampled using similar methods. Due to the potential ground disturbance, units proposed for mechanical harvest treatment were given the highest priority for soil assessment. Soil-related information was collected in 54 of the proposed Defensible Fuel Profile Zone (DFPZ) Units and 12 of the Area Thinning Units described in the proposed action (refer to chapter 2). The Fuel Treatment Units were sampled more intensively because the proposed treatments are expected to affect a larger proportion of each Treatment Unit. The proposed treatments in the Area Thinning Units are expected to be more dispersed. Site-specific treatment locations in Area Thinning Units, such as placement of group selection harvest sites, are currently unknown, which prevented soils assessment in the specific locations where treatment would occur. A detailed description of sampling methods can be found in the "Cumulative Watershed Effects and Soil Assessment Report" in the project record.

Skid trails have not yet been laid out for the Diamond Project, so skid trail densities from the "HFQLG Soils Monitoring Report," written by Wayne Johannson in 2005, were used as a proxy. This report monitored projects on the Plumas, Lassen, and Tahoe National Forests with prescriptions that were similar to the proposed Diamond Project. The monitoring report revealed an average skid trail density for DFPZ Units of 10 percent. This does not account for the reuse of existing skid trails (from past projects estimated to be 20 percent), nor does it account for subsoiling the skid trail approaches to the landings. With these changes incorporated into the monitoring data, the skid trail density would be reduced to 6 percent. The Fuel Treatment Units proposed in the Diamond Project consist primarily of DFPZs, so it was reasonable to use the DFPZ Unit monitoring report data. The Fuel Treatment Units are also expected to have the greatest skid trail density for this project, so the conservative approach for this analysis was to extend the 6 percent skid trail density to all Treatment Units.

4.2.3.5 Design Criteria

Chapters 1 and 2 provide detailed information about the Design Criteria used for each alternative. Additional measures, which were incorporated in the design of the action alternatives, would further reduce the risk of cumulative and local impacts on water quality and channel stability. These are found in appendix C.

All mechanical harvest operations would adhere to standards and guidelines set forth in the timber sale administration handbook (Forest Service Handbook [FSH] 2409.15, including Region 5 supplements) and the Best Management Practices as delineated in the "Water Quality Management for Forest System Lands in California: Best Management Practices" (USDA 2000). Timber sale contracts contain many standard provisions that help ensure protection of soil and water resources. These include provisions for an erosion control plan, road maintenance, and skid trail spacing.

Management activities in RHCAs must contribute to improving or maintaining watershed and aquatic habitat conditions described in the Riparian Management Objectives (RMOs). RHCA widths are consistent with the Scientific Analysis Team (SAT) guidelines set forth in appendix L of the final EIS for the HFQLG Forest Recovery Act. Where RHCAs would be treated, prescriptions and protection measures have been designed to address the RMOs. Where RHCAs would be mechanically treated, ground-based equipment would only be used on slopes less than 25 percent and on stable soils. To provide a buffer between streams and mechanically treated areas, an equipment exclusion zone would be established. The buffer width would vary by stream type and the steepness of the side slope, as shown in table 4-18. For example, all mechanical equipment would be excluded from within 100 feet (horizontal) of perennial fish-bearing streams with side slopes of 0 to 15 percent, and 150 feet from perennial fish-bearing streams with side slopes between 15 and 25 percent. These streamside zones (which include mechanical exclusion, riparian buffers) would serve as effective filter and absorptive zones for sediment originating from upslope treatment areas. The removal of vegetation in these equipment-exclusion zones would be allowed and would be determined on a site-by-site case to protect the sensitive attributes associated with the riparian area.

Table 4-18. Equipment restriction zones and burn pile restriction zones in RHCAs.

Stream Type	Equipment Restrictions by Slope Class			Burn Pile Restrictions by Slope Class[a]	
	0–15%	15–25%	>25%	0–15%	>15%
Perennial, fish bearing	100 feet	150 feet	No mechanical treatment	25 feet	40 feet
Perennial, no fish	50 feet	100 feet	No mechanical treatment	25 feet	40 feet
Intermittent	50 feet	100 feet	No mechanical treatment	15 feet	25 feet
Ephemeral	25 feet	50 feet	No mechanical treatment	15 feet	15 feet

Note:

a. Where feasible, burn piles would not be placed any closer to streams than the distances shown. The distances shown would apply to each side of the stream channel and are based on stream type and slope steepness.

4.2.4 Environmental Consequences: Watershed and Soil Resources

4.2.4.1 Past, Present, and Reasonably Foreseeable Future Actions

The existing conditions reflect the aggregate impact of prior human actions and natural events, such as wildfire, that have affected the environment and might contribute to cumulative effects. The ERA model attempts to accurately account for the cumulative effects of past, present, and reasonably foreseeable actions and combine such effects into a single aggregate ERA value that represents the current condition of each subwatershed. Appendix B of this document contains a detailed description of past, present, and reasonably foreseeable future actions. The following discussion does not attempt to recount all possible factors that contributed to the cumulative water effects (CWE) ERA analysis or list all human or natural impacts that occurred in the Soil Analysis Area during the analysis timeframe (35 years). Instead, the discussion simply focuses on some of the major contributing factors used to calculate the current condition ERA values and assess future effects. The current conditions in the analysis subwatersheds have been impacted by many actions over the last century—these main actions were mining, grazing, and timber harvesting. Many streams were affected by historic mining, especially Lights Creek and its tributaries, as well as Indian Creek and its tributaries.

Tractor logging during the 20th century left noticeable effects on the composition of the timber stands that remain today, including effects on tree species composition, age, and diameter classes. From 1974 to 2005, scheduled timber harvests and associated activities on public lands treated approximately 31,500 acres in the analysis subwatersheds. In some cases, individual stands were treated multiple times, so the actual number of affected acres is slightly less. Silvicultural prescriptions included clear cutting, overstory removal, group selection, sanitation, shelter wood, and area thinning, as well as associated activity fuel burning. Between 1982 and 2005, proposed harvest activities on private lands called for harvests on approximately 9,369 acres of timberland in the analysis subwatersheds.

There are 5,109 acres in the analysis subwatersheds that were burned in wildland fires between 1977 and 2001. Large wildfires (like the Stream Fire) have resulted in severe impacts on soil productivity and subwatershed condition in these areas, but conditions may continue to improve as soil cover and organic matter accumulates.

Historically, livestock grazing occurred throughout a large portion of the Soil Analysis Area, especially within meadows and stringer meadows. Many areas around Antelope Lake and the upper portions of Pierce, Middle, Lights, and Indian Creeks were grazed extensively. Today, there are still five active allotments with less than 1,000 head of cattle, and the majority of private grazing in this area occurs in the Upper Lights Creek area.

Historic logging, mining, and grazing have also influenced the hydrologic and vegetative characteristics of the analysis watersheds. Such historic legacy effects are common to many of California's forested watersheds (CDF 2003). More recent forest activities, including fire suppression and development of the transportation system, continue to affect the watershed conditions in this area. Unpaved roads are often considered the primary source of sediment to stream channels.

Generally, recreational activities occur throughout the entire Diamond Project Area, but the majority of use is around the Antelope Lake area, and as a result, dispersed recreational impacts of undeveloped camping areas and user-created roads and trails are evident. Off-highway vehicle (OHV) use may contribute to compacted soil conditions where these activities occur. The locations of many user-created features are unknown, but the national OHV route designation process is currently underway, and upon completion of the process, these routes will be incorporated into the ERA assessment for future projects. Other activities (such as woodcutting, Christmas tree cutting, and hunting) have negligible effects on the soils or ERA assessment.

Data obtained from the California Department of Pesticide Regulation identified approximately 860 acres in the Watershed Analysis Area that were treated with herbicides (at varying application rates) between 2000 and 2004, and an additional 1,235 acres in the cumulative effects Analysis Area.

Past watershed improvement projects were implemented during the 1980s through early 2000s. These include bank stabilization treatments, fish ladders, and headcut and gully repairs. These improvements were not accounted for in the ERA analysis. However, they have generally contributed to improving watershed conditions by maintaining or improving stream channel form and function.

Future activities planned in the Watershed Analysis Area during 2006 largely include salvage and fuel treatment projects such as Greenflat and Lucky "S" and DFPZ maintenance. The Hungry Fuel Reduction Project is scheduled for completion in 2006. The associated underburning for all these projects is expected to last for 3 to 5 years. These activities are not expected to result in appreciable increases in ERA and were included in the public harvest assessment in the cumulative watershed effects. DFPZ maintenance would occur once watershed recovery begins.

4.2.4.2 Alternative A (No Action): Cumulative Watershed Effects—Riparian Management Objectives

Under alternative A, no actions would be implemented to address the areas of concern identified in the Diamond Landscape Assessment (located in the project record) or objectives and desired conditions identified in the purpose and need sections in chapter 1.

Riparian and aquatic ecosystems on the Plumas National Forest are managed to achieve specific Riparian Management Objectives (RMOs) (HFQLG EIS, appendix L). These objectives address riparian vegetation, stream condition, water quality, water table levels in meadows, and riparian habitat. Under the no-action alternative, riparian and aquatic ecosystems would not be altered by management activities. However, this does not mean that riparian systems would remain unchanged. As described in “Soils and Hydrology” section (3.2) in chapter 3, stream conditions in the Diamond Project Area range from poor to good, based on physical stream characteristics. Generally, these surveyed streams have shown improvements in condition over previous years’ surveys. However, about 30 percent of the stream miles surveyed in DFPZ units showed evidence of bank instability. In addition, 11 headcuts were identified. Unstable banks can undermine riparian vegetation and reduce water quality by contributing large amounts of sediment into the stream. Headcuts lower the level of the channel bottom and often move upstream, eroding the channel as they migrate. In meadows, headcuts can lower the level of the water table. As the area affected by unstable banks and headcuts increases, water quality and channel conditions are reduced. Under the no-action alternative, these erosive processes may continue unchecked, thereby degrading riparian conditions and habitat. Boulder and Thompson Creeks, and their tributaries, are more affected by unstable channel conditions, compared with other surveyed areas. Thompson Creek flows into Boulder Creek, which drains into Antelope Lake. These unstable channel conditions may be accelerating sediment inputs into the lake. Water quality is further addressed under the ERA discussion below.

Historically, fire has been an integral disturbance agent in riparian systems (Dwire and Kauffman 2003; Everett et al. 2003; Skinner 2003). However, fire suppression has reduced the influence of fire, resulting in fuel accumulation and increased likelihood of large, severe wildfires (Taylor and Skinner 1998). During wildfires, drainages can behave like chimneys, rapidly directing fire upslope through the drainage area. In alternative A, surface, ladder, and crown fuels would not be treated on upslope areas or in RHCAs, and as a result, watersheds would remain vulnerable to the effects of a future severe wildfire.

Noxious weeds would not be treated in alternative A, and as a result, the weeds may spread over time. As described in chapter 3, many occurrences of the noxious weed, Canada thistle, are located in RHCAs and pose a potential threat to biological plant diversity in riparian communities. The spread of Canada thistle could decrease the diversity and productivity of native and desired nonnative riparian plant communities.

4.2.4.3 Alternative A: Cumulative Watershed Effects, ERA Analysis

Direct Effects. Under the no-action alternative, all subwatersheds would continue to recover, and ERA values would slowly decline to a baseline level over time. Road decommissioning activities would not occur, so watershed benefits and reductions in ERA values due to road decommissioning would not be realized. Fuel treatment activities would not occur. A future severe wildfire could greatly increase ERA values within and across subwatersheds.

Indirect Effects. In the short term, water quality and downstream beneficial uses would remain unchanged. As watersheds recover from past management activities, there may be small improvements in water quality. However, in the absence of road improvements, decommissioning, or obliteration, the transportation system would continue to be a large contributor of sediment to the stream network. The high density of roads and road/stream crossings would continue to affect the hydrologic regime in these subwatersheds.

Cumulative Effects. Table 3-10 in chapter 3 shows the current ERA values for all 48 subwatersheds in the Watershed Analysis Area. These values reflect the current cumulative effects on ERA from past, present, and reasonably foreseeable projects. Table 4-19 below shows the current ERA values under alternative A, for those watersheds that are placed most at risk by the action alternatives. Private harvests are expected to continue in the overall Watershed Analysis Area, though it is difficult to predict the location, type of harvest treatments, or number of acres that would be affected. In the event of a future severe wildfire, affected areas may be highly susceptible to erosion and generate large pulses of sediment to stream channels (Elliot and Robichaud 2001). Sediment may be stored in channels for many years until peak flows mobilize the materials and move them downstream. Large runoff events often follow severe wildfires, resulting in increased peak flows.

Table 4-19. Predicted subwatershed disturbance in ERA for each alternative.

Subwatershed[a]			ERA (Percent of the TOC) by Alternative[b]				
No.	Name	Size (acres)	A	B	C	D	F
10	East Branch Lights	3,476	83	109	109	97	88
21	Pierce	2,508	58	115	115	115	98
22	Upper Boulder – west tributary	848	43	98	98	98	97
24	Mid Boulder - east	848	50	127	127	113	95
25	Mid Boulder - west	969	42	107	107	107	89
28	Indian above Antelope - middle	894	58	119	119	118	100
32	Lower Lone Rock[c]	1,149	136	136	136	136	134
34	Upper Boulder east tributary	2,377	58	111	111	112	97
35	Boulder - top	1,699	42	91	91	89	69
42	Cold[c]	1,699	133	186	186	133	133
43	Indian below Antelope - dam to Cold[c]	1,638	177	179	179	177	177

Notes:

a. Only the subwatersheds exceeding the TOC or at high risk for cumulative effects based on ERA are shown.

b. ERA is shown as the percent of the TOC for each subwatershed. For example, a subwatershed that is above the TOC will have a total value greater than 100. Total ERA contributions less than 100 are below the TOC. As disturbance approaches and exceeds the TOC, the risk of detrimental watershed effects increases.

c. The 2001 Stream Fire burned with high intensity in these subwatersheds.

4.2.4.4 Alternative A: Soil Assessment—Soil Cover and Organic Matter

Direct Effects. Under the no-action alternative, soil cover and organic matter can be expected to increase as organic materials accumulate on the forest floor.

Indirect Effects. As a result of increased soil cover, the risk of soil erosion may decline on forested hill slopes. Soil cover dissipates the energy of falling raindrops by intercepting them before they strike the soil surface. Reduced soil erosion would help retain soil nutrients and a favorable growth medium on site. The continued accumulation of organic matter on the forest floor would contribute to increased ground and surface fuel loads, which may lead to increased fire severity and intensity during a fire event.

Cumulative Effects. If soil cover were reduced to bare soil following a wildfire, the soil would be more susceptible to erosion. In addition, fire can create a nonwettable layer below the surface, sometimes described as a "tin roof" effect (DeBano 2000). During a precipitation event, soil above the nonwettable layer can become saturated and erode downslope due to rill formation and raindrop splash. Immediately following a fire, the affected stand may not meet the Forest Plan standard of 50 percent cover of organic matter. However, within several months, a thin layer of needles dropped from scorched trees would likely increase surface cover of organic matter (Pannkuk and Robichaud 2003). Fires short circuit the decomposition pathway, rapidly oxidizing organic matter and releasing available nutrients to plants and soil organisms. When organic matter burns, essential nutrients can be transferred to the atmosphere through volatilization and ash convection (Raison et al. 1984). Nutrients may also be lost following fire due to leaching (Boerner 1982). Some nutrients are returned relatively quickly by terrestrial cycling pathways. Compared to the pre-burn condition, a large reduction in the organic matter covering the soil would reduce the insulating effect this layer has on soil temperature. Under a reduced organic layer, soils would experience greater temperature extremes. In addition, a blackened surface, due to partially combusted organic materials, would absorb more light and become warmer than a soil without a dark surface (Ahlgren and Ahlgren 1960). Soil temperatures may be elevated for months or years depending on the degree of organic matter consumption (Neary et al. 1999). Such changes in the soil temperature regime would affect the rates of biological activity in the soil, resulting in altered nutrient cycling regimes.

4.2.4.5 Alternative A: Soil porosity and Detrimental Compaction

Direct Effects. Tables 4-20 and 4-21 show the existing level of skid trail and landing cover within the Fuel Treatment Units. Under the no-action alternative, the extent and degree of compaction are expected to decline slowly over time. This process may take several decades in forested environments (Grigal 2000). Root penetration, extension, and decay, along with the burrowing action of soil dwelling animals, would contribute to the increase in soil porosity and decrease in compaction. In addition, incorporation of organic matter into the soil by biological processes, such as invertebrate and vertebrate soil mixing and decomposition, would help reduce soil bulk density and the degree of compaction in affected areas over time.

Indirect Effects. As the degree and extent of soil compaction is reduced slowly over time, soil productivity would increase. Soil infiltration would be enhanced as porosity is increased. Increased infiltration may reduce surface runoff and subsequent erosion and sedimentation.

Table 4-20. Cumulative effects on skid trail and landing cover in Fuel Treatment Units.

Fuel Treatment Unit No.	Percent of Existing Detrimental Compaction	Percent of Existing Landings and Skids	Estimated Cumulative Total of Percent Landings and Skid Trails	Compaction Potential[a]
23	10	22	28	0 to1
24	14	25	31	1
25	5	14	20	1
26	0	0	6	1
27	0	9	15	1
28	0	20	26	1
29	0	0	6	0
30	2	5	11	0 to1
31	10	10	16	1
32	12	27	33	0
33	14	42	48	1
34	0	8	14	1
1	30	0	6	2
2	8	12	18	1 to 2
3	29	29	35	0 to 3
4	15	23	29	0 to 3
5	5	19	25	0 to 1
6	20	2	8	0 to 1
7	25	18	24	0 to1
8	9	23	29	1 to 2
9	0	2	8	1
10	5	15	21	1
11	7	29	35	0 to 1
12	11	25	31	0 to1
13	8	28	34	1
14	17	15	21	1
15	18	31	37	1
16	4	8	14	0
17	8	15	21	0 to1
18	20	16	22	0 to 1
19	0	40	46	0
20	7	0	6	0
21	12	47	53	0
22	4	13	19	0
35	13	33	39	0 to1
36	30	50	56	0
37	0	10	16	0
39	50	0	6	0
40	5	10	16	0
41	5	7	13	0

Table 4-20. Cumulative effects on skid trail and landing cover in Fuel Treatment Units (continued).

Fuel Treatment Unit No.	Percent of Existing Detrimental Compaction	Percent of Existing Landings and Skids	Estimated Cumulative Total of Percent Lands and Skid Trails	Compaction Potential[a]
42	2	18	24	0
43	30	10	16	0
44	0	10	16	0
45	7	22	28	0
46	0	0	6	0
47	0	20	26	0
48	0	20	26	0
49	6	8	14	0
50	40	30	36	0
51	5	45	51	0
52	40	50	56	0
53	0	0	6	0
54	1	18	24	0

Table 4-21. Cumulative effects on skid trail and landing cover in Area Thinning Units.

Area Thinning Unit No.	Percent of Existing Detrimental Compaction	Percent of Existing Landings and Skids	Estimated Cumulative Total of Percent Lands and Skid Trails	Compaction Potential[a]
101	10	15	21	0 to 3
102	13	17	23	0 to 3
103	10	14	20	0 to 3
106	0	10	16	1 to 2
109	0	0	6	0 to 3
115	20	20	26	0 to 3
116	20	10	16	0 to 3
117	6	19	25	0 to 3
119	14	23	29	0 to 3
120	19	23	29	0 to 3
123	30	40	46	0 to 3
124	33	13	19	0 to 3

Note:

a. Compaction potential classes: 0 is slightly compactable, 1 is slightly to moderately compactable, 2 is moderately compactable, and 3 is highly compactable.

Cumulative Effects. In the absence of future timber harvests, road construction, or other compacting activities, soil compaction is expected to decline as described above. In the event of a future wildfire, severe soil heating may cause physical changes in soils, including a reduction in soil porosity (Clark 1994).

4.2.4.6 Alternative B (Proposed Action): Cumulative Watershed Effects, Riparian Management Objectives

The objectives of the RHCA treatments include reducing the potential for adverse effects from high-intensity wildfire and enhancing riparian vegetation, structure, and function. Historically, fire has been an integral disturbance agent in riparian systems (Dwire and Kauffman 2003; Everett et al. 2003; Skinner 2003). However, fire suppression has reduced the influence of fire, resulting in fuel accumulation and increased likelihood of large, severe wildfires (Taylor and Skinner 1998). During wildfires, drainages can behave like chimneys, rapidly directing fire upslope through the drainage area. These RHCA treatments would provide a safer and more effective fire suppression environment, improve forest health, and provide for a more sustainable vegetation condition consistent with protecting and maintaining riparian habitat values. An interdisciplinary team (comprised of a fisheries biologist, wildlife biologist, botanist, soil scientist, and fuels specialist) evaluated riparian areas in the proposed Diamond Project Treatment Units to determine treatment needs and streamside protection measures. Hill slope, stream channels, soil, vegetation, and habitat characteristics were considered when developing the RHCA treatments. Design elements were incorporated into RHCA treatments in all alternatives to prevent accelerated erosion and sedimentation into the drainage network, regardless of tree removal prescriptions. These include additional mulching of bare soil, modified skid trail spacing, and operational considerations to reduce ground disturbance. The RHCA treatments are designed to address the 10 Riparian Management Objectives for the Diamond Project, discussed below. In several cases, the effects on one objective also apply to other objectives (for example, effects on sediment).

RMO 1. *Maintain or restore water quality to a degree that provides for stable and productive riparian and aquatic ecosystems. Water quality parameters that apply to these ecosystems include timing and character of temperature, sediment, and nutrients.*

Effects on RMO 1. Headcut stabilization treatments would reduce sediment inputs from headcuts that are migrating upstream. These are largely located in streams that drain to the Boulder Creek stream system. Short-term sediment delivery to streams may occur after burning. However, scorched conifers often drop needles following low- or moderate-severity fires. This needle cast would provide ground cover that may help reduce rill and inter-rill erosion and sediment delivery (Pannkuk and Robichaud 2003). Despite the risk of erosion, the greater long-term benefit of treating the RHCAs would be the potential protection from catastrophic wildfire.

Sediment may be reduced due to proposed road activities. In all action alternatives, 9.6 miles of roads are proposed for decommissioning—some may be re-contoured, subsoiled, seeded, and reforested. These actions would promote vegetative recovery, which can decrease compaction, increase infiltration into the roadbed, and increase soil stability and limit concentrated flow as well as surface erosion. All temporary roads would be decommissioned after use.

In order to help maintain favorable microclimates in RHCAs, hardwoods would be retained in all units. This is especially important in the known trout fishery streams, including Moonlight Creek, Lights Creek, and Indian Creek.

The retention of larger fuels, forest floor cover, and deciduous hardwood trees would help maintain the nutrient reservoir stored in organic material.

RMO 2. *Maintain or restore the stream channel integrity, channel processes, and sediment regime under which the riparian and aquatic ecosystems developed. Elements of the sediment regime include the timing, volume, and character of sediment input and transport.*

Effects on RMO 2. Headcut stabilization treatments would help maintain the channel by slowing or stopping the headcut migration upstream. As a result, sediment inputs from the eroding channel bottom would be reduced. The effects of entering RHCAs with vegetative treatments would include increasing the size of residual trees in RHCAs, preventing potential catastrophic wildfire, reducing future losses of large diameter trees and large woody debris (LWD) to fire, and increasing future LWD recruitment of intermediate to large logs. In forested stream systems, debris would help maintain channel stability, decrease flow velocity, trap sediment, and protect banks from erosion (Berg et al. 2002). Ground disturbance by equipment would be limited because only slopes less than 25 percent would be entered with ground-based equipment. The retention and concentration of large-diameter snags within RHCAs would occur. There may be short-term erosion from management activities, as discussed above, with a longer-term reduction in the risk of catastrophic wildfire. In all action alternatives, 9.6 miles of roads are proposed for decommissioning, which would reduce erosion into the aquatic system. The green-line characteristics would not be compromised, and thus, stream channel integrity would be maintained.

RMO 3. *Maintain or restore in-stream flow to support desired riparian and aquatic habitats, the stability and effective function of stream channels, and the ability to route flood discharges.*

Effects on RMO 3. Within RHCAs, the green line would be preserved and remain unaffected by harvest activities. Within the immediate riparian areas, the physical effects derived from in-channel LWD would be sustained because no natural in-channel debris would be removed. Future recruitment of LWD would be encouraged through release of the existing conifers and by meeting the snag retention standards for channel morphology, channel function, and bank stability. Thinning within the RHCA may initially reduce the interception of precipitation, thus potentially increasing runoff in the short term. Thinning within the RHCAs may reduce evapotranspiration, thus retaining increased groundwater. The main objective is to reduce the potential for catastrophic wildfire, and thus, retain the RHCA's desired riparian and aquatic habitats, effective stream channel function, and the ability to route flood discharges. In-stream flows would be assessed during equipment operations with respect to drafting requirements.

RMO 4. *Maintain or restore the natural timing and variability of the water table in meadows and wetlands.*

Effects on RMO 4. Activities proposed in the Project Area are not expected to negatively affect the timing and variability of water tables within meadows and wetlands. Positive effects resulting from RHCA thinning include increased water percolation and groundwater, which may make more water available to meadows and wetlands. All sensitive riparian areas (springs, bogs, wetlands, and meadows) would be protected by the Scientific Analysis Team's guideline buffers and the implementation of BMPs. Wet meadows and green lines would not be entered. Ground-based equipment would only be allowed on stable soils, slopes less than 25 percent, and nonsensitive locations (in accordance with the BMPs). Headcut stabilization treatments would help prevent headcuts from migrating to upstream meadows or wetlands, where they could lower the water table.

RMO 5. *Maintain or restore the diversity and productive nature of native and desired nonnative plant communities in the riparian zone.*

Effects on RMO 5. The proposal to decommission 9.6 miles of roads would help protect native plant communities from noxious weed introductions from off-highway vehicle (OHV) traffic. Thinning conifers and retaining all hardwood species in RHCAs would reduce competition with deciduous hardwood species. Some RHCAs would be thinned to promote aspen health in the Treatment Areas. Canada thistle has the potential to replace many grasses and forbs in the riparian zone, thereby reducing species diversity, but treating Canada thistle would help control this invasive noxious weed and protect riparian species diversity.

RMO 6. *Maintain or restore riparian vegetation to provide an amount and distribution of large woody debris characteristics of natural aquatic riparian ecosystems.*

Effects on RMO 6. The treatments proposed in DFPZ Units are designed to reduce the concentrations of fine fuels. Where down logs exist, 10 to 15 tons per acre of the largest down logs having diameters greater than 12 inches would be retained. There would be minimal burning of LWD logs greater than 12 inches dbh. Thinning within RHCAs may release the residual conifers and deciduous trees to increase diameter growth. LWD retention standards would be implemented. Potential recruitment of LWD into the stream channel would be retained and enhanced. There would be a reduction in potential catastrophic wildfire and, therefore, a greater potential of LWD retention. Back burning would occur during times where there is increased moisture, resulting in less LWD consumption. Also, the prescription is to consume the fine fuels (residual fine fuel less than 3 inches in diameter would not exceed 5 tons per acre).

RMO 7. *Maintain or restore habitat to support populations of well-distributed native and desired nonnative plant, vertebrate, and invertebrate populations that contribute to the viability of riparian plant communities.*

Effects on RMO 7. The retention of overstory litter fall would provide substrate for macroinvertebrate shredders, which helps maintain the integrity of the stream ecosystem. Riparian zones (specifically the green line), springs, seeps, and bogs would be identified and protected from harvest activities. Effects would further be reduced by the application of BMPs and Standard Management Requirements. Treatment of noxious weeds, particularly Canada thistle occurrences in a number of RHCAs, would help reduce any competition between the thistle and desirable riparian vegetation.

RMO 8. *Maintain or restore riparian vegetation to provide adequate summer and winter thermal regulation within the riparian and aquatic zones.*

Effects on RMO 8. Activities proposed in the Project Area are not expected to negatively affect riparian vegetation. Summer and winter thermal regulations in the riparian and aquatic zones would be maintained. All group selection harvest would occur outside of RHCAs. Canopy cover over streams would not be removed. There would be no harvest of deciduous hardwoods, and thus, the green line would be maintained and enhanced.

RMO 9. *Maintain or restore vegetation to help achieve rates of surface erosion, bank erosion, and channel migration characteristics of those under which the desired communities developed.*

Effects on RMO 9. The maximum Erosion Hazard Rating for soil types in the Diamond Project Area, ranging from moderate to very high, suggests that channel development may have occurred under significant sediment loads. The riparian green line of stream channels would not be affected by the proposed management activities, and natural recovery processes within the streamside area would help moderate stream temperatures. Riparian vegetation may increase in vigor due to increased water yield and reduced competition by conifers through thinning in the RHCAs. Within the immediate riparian areas, the physical effects derived from in-channel LWD would be retained because no natural debris would be removed. Future recruitment of LWD, which is structurally important for channel morphology, channel function, and bank stability, would be encouraged through snag retention requirements and release of existing live conifers (the effects on RMOs 1 and 2 would also apply here.)

RMO 10. *Maintain and restore riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved within the specific geoclimatic ecoregion.*

Effects on RMO 10. Riparian and aquatic habitats necessary to foster the unique genetic fish stocks would be maintained and restored by the proposed management practices. Culvert replacements would allow fish passage and improved trout distribution in Lone Rock, West Branch Lights, Morton, and Boulder Creeks, and tributaries to Hungry and Indian Creeks.

4.2.4.7 Alternative B: Cumulative Watershed Effects—ERA Analysis

Direct Effects. The proposed fuel treatment and area thinning activities would increase ERA values in the subwatersheds where treatments would occur. Road reconstruction and construction would increase ERA values due to construction disturbance and, in the case of new roads, the addition of roaded acres on the landscape. Road decommissioning would decrease ERA values because road effects, such as runoff and sedimentation, would be reduced, and roaded acres would be removed from the landscape. Road closures would not affect ERA values because the road surface, road bed, and stream crossings would not be altered by the closure. Under alternative B, the increase in ERA values was predicted to range from 0 to 77 percent of the TOC, depending on the subwatershed. This would result in cumulative ERA values ranging from 9 to 186 percent of the TOC. The ERA contribution for proposed activities is shown above in table 4-19.

Indirect Effects. Harvest activities may locally alter soil moisture regimes and subsequent water yield due to altered interception and evapotranspiration. Harvested areas would be more susceptible to erosion and sediment transport to the channel network. The implementation of BMPs would help reduce these effects. Road decommissioning may entail culvert removal, subsoiling of the roadbed, recontouring the hillslope, and/or seeding the affected area. These measures would help initiate revegetation and recovery of the road area. Over time, decommissioned roads would produce less sediment and surface runoff to adjacent watercourses. As a result, their contribution towards the ERA of a watershed would be reduced. Kolka and Smidt (2004) reported that recontouring hill slopes significantly reduced soil compaction, surface runoff, and sediment production compared to subsoiling or cover cropping. Road construction would create new sources of sediment and disrupt the hydrologic continuity on affected hill slopes. Reconstruction would consist of brushing, blading the road surface, improving drainage, and replacing or upgrading culverts where needed. Short-term increases in sediment may be offset by long-term improvements to water quality as a result of improved road drainage and stream crossings.

Cumulative Effects. Table 4-19 above shows the modeled ERA in the analysis subwatershed placed at high risk for detrimental effects based on ERA increases. Higher ERA values are generally associated with higher peak flows that are more erosive and can lead to increased channel scour and higher sediment loads off-site. Stream channels in poor condition tend to be more sensitive to increases in peak flows because the channels frequently lack an effective root mass to bind streambanks and large organic debris to retain bedload materials. These channels are frequently downcut (have eroded down into the bottom of their channels), and all flow is confined to the channel rather than to a broader floodplain. Given these conditions, sediment is more readily eroded from these channels with subsequent deposition of sediment downstream. The relatively large increases in ERA, coupled with being over the TOC, would place the following subwatersheds at a higher risk of detrimental effects: East Branch Lights, Pierce, Mid Boulder-east, Mid Boulder-west, Indian above Antelope-middle, Upper Boulder east tributary, and Cold. The Upper Boulder west tributary and Boulder-top subwatersheds would also be at a higher risk of detrimental effects due to large increases in ERA that are approaching the TOC. All other areas were rated at low or moderate risk of detrimental effects.

Road decommissioning would reduce ERA contributions by roads and result in long-term beneficial effects on water quality. Increases in ERA may lead to detrimental effects, including erosion from treated hillsides and chronic sedimentation. The primary factors leading to this would include a reduction of canopy cover, ground disturbance (particularly due to road effects), and loss of ground cover. The prescriptions for the Diamond Project include harvests, underburning, and mastication. The harvest operations would cause associated disturbance from skid trails, site preparation, and transportation needs, such as temporary roads. Erosion into stream channels could decrease coldwater fish habitat quality by infilling pools and embedding spawning gravels. Following these prescriptions, there would be some canopy retention and surface vegetation recovery that would contribute to rebuilding forest floor materials. The required Best Management Practices (BMPs) would minimize the risk of detrimental effects associated with harvest operations.

4.2.4.8 Alternative B: Soil Assessment

Based on the standards contained in the Forest Plan and Region 5 soil standards, there would be a moderate risk that soil productivity would be impaired. Alternatives B would have a greater amount of mechanical treatments than alternatives D or F, and slightly less (about 6 acres) mechanical treatment than alternative C. Alternative B would have the same amount of ground disturbance from equipment, skid trails, and landings as alternative C, which proposes additional mechanical hand treatments for weeds. The direct, indirect, and cumulative effects on soil productivity indicator measures would be similar to alternative C and greater than alternatives A, D, and F.

4.2.4.9 Alternative B: Soil Cover and Organic Matter

Direct Effects. Soil cover and organic matter are inherently linked and so are discussed together as forest floor material. Increases in forest floor material generally correlate with increases in soil cover and surface fine organic matter. It is difficult to accurately predict treatment effects on forest floor materials. Harvest operations may increase activity fuels and forest floor material, while pile burning and underburning would reduce the cover of this material. Mastication would increase soil cover and organic matter because materials are broadcast away from the machine. Pile burning would remove forest floor materials locally, and underburning is expected to occur under prescribed conditions that would not result in complete combustion of the duff and litter layers. Westmoreland (2004) conducted post-harvest monitoring for ground cover in thinned units and areas harvested with group selection silvicultural techniques on the Plumas and Tahoe National Forests. Pre-treatment cover conditions were similar to those found in the Diamond Project Area. Westmoreland reported an average absolute decrease in soil cover of 9 percent. Assuming the Diamond Project Treatment Units undergo the same decrease, all sampled units, with the exception of the four Fuel Treatment Units that do not meet the standard in their existing condition, would still meet the USDA Forest Service Region 5 standard of 50 percent. As discussed in chapter 3, low soil cover in the four units not at standard likely resulted from very low productivity of these units, given the environmental conditions there. While differences in sampling method and intensities, as well as harvest and site preparation practices, complicate this type of comparison, it is reasonable to assume that effective ground cover would be decreased. There may be a low risk that treated units would not meet the Region 5 standard following treatment. The design criteria for this project regarding LWD material provides for the retention of 10 to 15 tons per acre of the largest down logs. This retention level would be more than adequate in meeting the Forest Service Region 5 standard of a minimum of five logs per acre for all Treatment Units that meet the standard in the existing condition (only four individual units do not currently meet the standard).

Indirect Effects. A reduction in forest floor cover would increase the risk of erosion in affected areas. The amount and type of erosion depends on the character of the area. For example, patches of forest floor material across a large area would be more effective at intercepting surface water than large areas devoid of cover. Local reductions in forest floor material may have local effects on soil temperature. Larger reductions may result in greater temperature extremes in the soil. The removal of canopy cover may result in increased temperatures at the forest floor as well as reduced moisture content of forest floor materials (Erickson et al. 1985).

Cumulative Effects. The treatments proposed in the action alternatives are expected to reduce forest floor materials from the existing condition. The cumulative effects of the proposed activities, when considered with the past, present, and future activities, are expected to result in forest floor conditions that remain in compliance with the Forest Plan and Region 5 standards. A reduction in ground cover would likely be short lived if nearby overstory trees remain intact. Over time, litter from trees and shrubs would contribute to the development of effective ground cover in bare areas. A wildfire entering a treated area may result in a greater reduction in ground cover than the proposed treatments alone. Following the proposed treatments, forest floor material would decrease in some areas due to mechanical displacement or consumption by fire and would increase in other areas due to additions of masticated material. Patches of organic matter would provide habitat for soil invertebrates and microorganisms. Patches of bare areas would be susceptible to local erosion. Increases in woody materials on the forest floor due to mastication may cause short-term changes in decomposition and carbon and nutrient dynamics in affected areas. Microorganisms that decompose wood would immobilize nitrogen and other nutrients while decaying the woody material. As the wood decomposes, those nutrients would be released and made available to plants and other organisms (Swift 1977). Microclimate changes at the forest floor due to reduced canopy cover could alter rates of decomposition and nutrient turnover in the surface fine organic matter of harvested stands (Erickson 1985).

4.2.4.10 Alternative B: Soil Porosity and Compaction

Direct Effects. The use of heavy forestry equipment and frequent stand entries would increase the potential for soil compaction (Powers 1999). The relationship between compacted and heavily disturbed ground to the decline in soil productivity over time is well documented (Horwath et al. 2000; Grigal 2000). Page-Dumroese et al. (2006) provide a summary of a number of studies that examined soil compaction increases following harvest operations. Timber harvest and biomass removal would require the use of skid trails and landings. For each Fuel Treatment Unit and Area Thinning Unit, the number of skid trail and landing acres needed for the proposed activities were evaluated with proxy data from the “2005 HFQLG Soils Monitoring Report.” Because the areas proposed for treatment have been harvested before, it is expected that as much as 20 percent of the existing skid trails would be used for the proposed harvest. This would reduce the area disturbed by the creation of new skid trails. Tables 4-20 and 4-21 above show the expected change in skid trail and landing cover for each Fuel Treatment Unit and Area Thinning Unit. Although treatment prescriptions vary among the action alternatives, it is assumed that all action alternatives would require the same amount of skid trails and landings to service the treated acres within Treatment Units. All landings and skid trail approaches to landings would be subsoiled after use to reduce compaction effects. When properly designed and implemented, subsoiling is effective at reducing compaction (Kolka and Smidt 2004). As a result, these subsoiled areas were not included in the estimated increase in compacted area.

In their existing condition, five units in Moonlight DFPZ, seven units in the Wild DFPZ, and five of the surveyed Area Thinning Units currently do not meet Forest Plan standards. As part of the Diamond Project design, portions of these units would be subsoiled following the proposed treatment activities. If these units were treated, they would be reevaluated under the direction of the District soil scientist. Subsoiling would be prescribed to ameliorate detrimental compaction and place the units in an improved condition that will be consistent with Forest Plan standards and guidelines.

For any mechanical harvest, the extent and degree of compaction depend on site-specific soil conditions such as texture and stoniness, moisture content at the time of operations, and harvest equipment features. Project Design Criteria include implementation of BMPs and other soil protection measures, such as wet weather standards, to minimize soil compaction. Erosion control and compaction remediation measures for landings and skid trails are addressed by BMP 1-16 ("log landing erosion control") and BMP 1-17 ("erosion control on skid trails").

Indirect Effects. Increases in compacted areas are expected due to the need for new skid trails. In these areas, compaction may reduce the infiltration capacity, reduce available water in the soil, impede root growth, and alter nutrient uptake and tree growth. The effects of soil compaction on tree growth can vary depending on soil texture. In some cases, compaction can enhance growth on sandy loam soils, while reducing growth on soils with high clay contents (Gomez et al. 2002).

Cumulative Effects. Tables 4-20 and 4-21 above show the predicted cumulative level of skid trail and landing cover for the Fuel Treatment Units and Area Thinning Units. Detrimental compaction is difficult to predict due to the environmental variables discussed in the direct effects section above. With the implementation of the Design Criteria for this project, and the fact that a large number of the units have a low compaction potential, it is reasonable to expect that only a portion of the new skid trails would contribute to the cumulative amount of detrimental compaction.

4.2.4.11 Alternative B: Herbicide Effects

Clopyralid herbicide treatments would be performed by manual ground application using backpack sprayers at an application rate of 0.25 acid equivalent pound per acre (ae lb/ac). The formulation would also include a surfactant (Syl-Tac®) and a marker dye (Hi-Light® Blue). Clopyralid would be used to treat dry and upland sites, and buffers that range from 50 feet to 150 feet would be implemented—50 feet from streams, meadows, seeps, and springs without sensitive amphibians and 150 feet from streams, meadows, seeps, and springs with sensitive species. The aquatic formulation of Glyphosate is proposed for lowland treatments and would be applied by hand using a wick applicator at an application rate of 2.25 ae lbs/ac. Based on stream type, buffers for glyphosate would range between 10 and 50 feet from streams without sensitive amphibians and between 50 and 150 feet from streams with sensitive amphibian species.

There is a considerable body of information describing the potential effects on soil and water resources associated with using each of the proposed herbicides. Much of this information is contained in the risk assessments completed by SERA (SERA 2003; SERA 2004), under contract to the Forest Service, and in the HFQLG Act final supplemental EIS (USDA Forest Service 2003). These documents are incorporated by reference into this effects analysis for the Diamond Project.

The HFQLG final supplemental EIS analyzed the likelihood of detection of clopyralid and glyphosate in surface waters following backpack spray application methods and with full implementation of all water quality Best Management Practices. The HFQLG final supplemental EIS concluded that it was unlikely that glyphosate and clopyralid would be detected in forest streams in the Pilot Project Area when streamside buffers and ground applications are used. This conclusion was partially based on the white paper, "A Review of and Assessment of the Results of Water Monitoring for Herbicide Residues for the Years 1991 to 1999" (Forest Service Region 5), which compiled and summarized the results from 15 separate water monitoring reports written by hydrologists and geologists on the Angeles, Eldorado, Lassen, Sierra, and Stanislaus National Forests. These reports documented the results of over 800 surface- and ground-water samples taken for reforestation and noxious weed eradication projects that used three herbicides (glyphosate, hexazinone, and triclopyr).

According to “A Review of and Assessment of the Results of Water Monitoring for Herbicide Residues for the Years 1991 to 1999” (Forest Service Region 5), detections of glyphosate have been associated with its use in riparian areas or applications that did not follow established Best Management Practices. The only cited occurrence of a detection occurred in only 1 of 12 samples. The detection was low (15 parts per billion), and the application was by spray in the actual stream channel at greater than 1.5 ae lbs/acre. In the proposed action, glyphosate would be applied by wick, which would effectively eliminate the chance of drift because herbicide is not emitted by spray, and the buffer would be between 10 and 150 feet from the stream channel. The incorporation of these design elements would greatly reduce the risk of indirect effects due to drift.

The proposed use of herbicides includes the additional use of a surfactant (Syl-Tac®) and a marker dye (Hi-Light® Blue). Surfactants are used to facilitate or enhance the absorbing, emulsifying, dispersing, spreading, sticking, wetting, or penetrating properties of herbicides. Syl-Tac® is considered an organosilicone surfactant, which is a blend of vegetable oils and silicon-based surfactants that are popular because of the superior spreading ability of silicone and the penetrating characteristics of the seed oil. This particular product is the combination blend of two other registered surfactants: Hasten®, an esterified canola seed oil and Sylgard®, which is basically described as a formulation of three separate siloxanes and silicones. The assessments of hazards related to surfactants is limited by the proprietary nature of the formulations, but the EPA has not classified the compounds in Syl-Tac® as hazardous, so the compounds do not carry a poison symbol and are considered as low acute toxicity compounds. There is little information in the scientific literature on the effects of seeds oils and silicone-based surfactants on aquatic organisms. Surfactants, by their very nature, are intended to increase the effect of a pesticide by increasing the amount of pesticide that is in contact with the target. This is not synergistic, but more accurately a reflection of increased dose of the herbicide active ingredient into the plant. The “Analysis of Issues Surrounding the Use of Spray Adjuvants with Herbicides” (Bakke 2003) cites technical references that indicate a lack of synergistic effects between surfactants and pesticides. This suggests that surfactants do not increase the toxic effects of herbicides. This paper also listed the results of standard acute aquatic species toxicity testing for Hasten®, Syl-Tac®, and Sylgard® (Bakke 2003), which indicated that any potential effects on aquatic species would be unlikely under normal application rates. Studies have shown that the mobility of materials throughout the soil profile is a function of the concentration of the surfactants in the soil solution. For this to occur, concentrations of surfactant must be high, in the range of 1,000 parts per million (ppm) or more (Bakke 2003). This level is unlikely to be reached under normal application rates as proposed by this action, which would likely have concentration considerably less than 40 ppm. “Although the potential exists for surfactants to affect the environmental fate of herbicides in the soil, any potential effects would be unlikely under normal conditions because of the relatively low concentration of surfactants in the soil/water matrix. Localized effects could be seen if a spill occurred on the soil, so that concentration of surfactant approached or exceeded about 1,000 ppm” (Bakke 2003).

The colorant Hi-Light® Blue would be added to the herbicide mixtures prior to the application so that the actual treated area can be readily determined. This helps to prevent skips and overlaps. Hi-Light® Blue is a water soluble dye that contains no listed hazardous substances. It is considered to be virtually nontoxic to humans. Its effect on nontarget terrestrial and aquatic species is unknown; however, its use has not resulted in any known problems. The dye used in Hi-Light® Blue is commonly used in toilet bowl cleaners and as a colorant for lake and ponds (SERA 1997b).

Direct Effects. No direct effects on soil productivity are predicted from the proposed herbicide treatment in alternatives B, D, and F. The potential for adverse effects of herbicide residues in soil and water would be minimized or eliminated by incorporating the proposed Design Criteria and applying BMPs for herbicide application (as described in appendix C), which include carefully planned herbicide use according to the label and other relevant requirements, spill contingency plans, proper disposal of containers and cleaning equipment, adequate buffer strips, spray drift control, and restricted use of herbicides near water bodies with sensitive amphibian species.

Drift calculations from the SERA risk assessments (SERA 2003, 2004) analyzed the potential for herbicide drift during applications of clopyralid and glyphosate using backpack sprayers under two wind speed conditions: (1) 0 to 5 miles per hour (mph) winds in which droplets could drift as far as 23 feet, and (2) 15 mph winds with the potential to drift up to 68 feet. Based on these calculations and a 0–5 mph maximum wind speed for application using a backpack sprayer, the proposed 50- to 150-foot buffer surrounding streams would greatly reduce the potential for the herbicide to reach water due to drift.

Mobility and Persistence of Glyphosate—Glyphosate has limited mobility because it tends to adsorb strongly to soil particles, especially to clay and to iron and aluminum ions. While it has high water solubility, it does not tend to leach through the soil profile in most soils. Although glyphosate has a relatively short half-life in soil (25–130 days) (USDA, 2003 HGQLG final supplemental EIS), adsorption to soil can create an herbicide sink, which may take longer to dissipate. In soils with high sand content (about 80 percent), leaching and longer persistence have been observed (Smith 1996; Eberbach 1983). Generally, glyphosate is degraded in soils within three months (USDA 1988). A study by Piccolo (1994) indicated that glyphosate desorbed (the compound detaches from the soil particle) at a higher rate than had been indicated by previous research. The results, however, were obtained by laboratory experiments and were not taken under natural conditions. The compound only detached after several hours of severe mechanical shaking. These conditions do not occur in the natural system.

Mobility and Persistence of Clopyralid—According to the HFQLG final supplemental EIS (appendix F), clopyralid is quite soluble, and its persistence in soil can vary depending on environmental conditions—its half-life can range from 10 days to 10 months. Although clopyralid does not bind readily in soil, it dissipates rapidly in some common soil conditions. No known metabolites of clopyralid have been identified, and the only known field monitoring of ground-applied clopyralid in California's forest streams resulted in undetectable levels (HFQLG final supplemental EIS, appendix F).

Further analysis from the SERA 2004 assessment indicates that clopyralid was monitored in stream water during application and subsequently for 72 hours after application at a site 0.5 kilometer downstream from the application site. The limit of detection in this study was 0.001 milligram per liter (mg/L). During and immediately after application, only trace levels of clopyralid were detected in the stream water, suggesting that direct spray or drift to the stream was negligible. The highest levels of clopyralid occurred during or shortly after storm events. The maximum level in the stream water was 0.017 mg/L. Over the 19-day monitoring period, the total rainfall was 133 millimeters or about 5.2 inches. The rainfall of 5.2 inches over a 19-day period corresponds to about 0.27 inch per day or about 100 inches per year. Rainfall in the project area is considerably less than 100 inches per year. Under alternatives B, D, and F, clopyralid would be applied in late summer and fall when precipitation is usually minimal.

According to the SERA risk assessment (2004), clopyralid or any other herbicide may be transported to off-site soil by runoff or percolation. Runoff and percolation are both considered in estimating contamination of ambient water. For assessing off-site soil contamination, however, only runoff is considered. This approach is reasonable because off-site runoff will contaminate the off-site soil surface. Percolation, on the other hand, represents the amount of the herbicide that is transported below the root zone and may thus impact water quality.

The HFQLG final supplemental EIS (in "Appendix F: Environmental Fate of Candidate Herbicides," page F-4) indicated that clopyralid can persist in surface waters for potentially 30 days or more, but insufficient information is available to generalize about surface water concentrations of clopyralid from forest applications. Appendix F also stated that runoff does not appear to be a major concern with clopyralid, and that rains would most likely cause clopyralid to leach into the soil column rather than runoff. Although the potential exists for Clopyralid to leach into groundwater, many cited lysimeter studies and models argue for restricted leaching potential because Clopyralid rapidly dissipates and degrades under actual environmental field conditions (HFQLG final supplemental EIS, appendix F).

The probability is very low that a detectable level of either of the two proposed herbicides would reach surface water (flowing streams, springs, seeps, and wetlands/riparian areas). The probability of the Diamond Project violating a water quality standard would be very small—this is based on the glyphosate and clopyralid risk assessments (SERA 2003, 2004) and on the results of over eight years of monitoring glyphosate in Forest Service Region 5. At the levels proposed for application, neither clopyralid nor glyphosate is expected to have direct detrimental effects on water quality.

Soil Microorganisms—According to the SERA (2003) risk assessment, glyphosate is readily metabolized by soil bacteria with aminomethyl phosphonic acid as a major metabolite. In addition, many species of soil microorganisms can use glyphosate as sole carbon. There is very little information suggesting that glyphosate is harmful to soil microorganisms under field conditions, and a substantial body of information indicates that glyphosate would likely enhance or have no effect on soil microorganisms.

In application rates of 1.2 ae lbs/acre (0.54 kilograms per hectare), a transient decrease in populations of soil fungi and bacteria was noted after 2 months but no effect was apparent after 6 months. Similarly, at an application rate of 7.12 ae lbs/acre (3.23 kilograms per hectare), no effect was seen on soil fungi and bacteria after 10 to 14 months. A transient decrease in soil microbial activity was also noted after the application, but no lasting effects on soil have been reported (SERA 2003).

Several field studies involving microbial activity in soil after glyphosate exposures note an increase rather than decrease in soil microorganisms or microbial activity. Application of glyphosate may cause transient increases in soil fungi that may be detrimental to some plants, and some studies have shown that inoculation of soil with various pathogenic soil fungi may result in an apparent enhancement of glyphosate toxicity (SERA 2003).

According to SERA (2004), clopyralid toxicity data on soil organisms are limited, but the projected maximum concentrations under normal application rates would be far below potentially toxic levels. The information on soil organisms is limited and consists only of an acute lethal concentration (LC) value for earthworms reported as greater than 1,000 mg/kg in soil, and a report on soil microorganisms indicates a "no observed effect level" (NOEC) of 10 ppm (10 mg/kg) in soil for effects on nitrification, nitrogen fixation, and degradation of carbonaceous material. Nonetheless, this information does not provide any basis for asserting that adverse effects on soil organisms are plausible.

Indirect Effects. Based on a review of the literature and monitoring reports from other Region 5 herbicide projects, the proposed spray treatments are not expected to significantly increase the potential for erosion. Reducing the amount of ground cover protecting the soil, and thus increasing erosion rates, is a potential indirect effect. However, it is expected that none of the action alternatives would significantly reduce existing ground cover in treated areas. Litter and duff inputs may be reduced slightly due to the reduction in shrub canopy, but existing litter and duff would continue to provide an adequate amount of ground cover. Vegetation killed by herbicides would continue to provide a canopy cover until the leaves fall, which would then add to the existing ground cover.

Cumulative Effects. Glyphosate and clopyralid are not expected to accumulate in the soils within the Project Area. According to the HFQLG final supplemental EIS, "Surface water concentrations of glyphosate and clopyralid are anticipated to be undetectable, assuming backpack application using BMPs, and no cumulative effects are anticipated from application of these herbicides, because their detectability is anticipated to be zero."

A cumulative watershed effects analysis explores the potential for possible cumulative indirect effects on hydrologic function as a result of removing vegetative cover, ground disturbance, and soil compaction. Since the proposed herbicide treatments would not result in additional bare or compacted soil, the proposed herbicide treatments would not result in new ERAs that would change the results of the cumulative watershed effect ERA analysis. In fact, the HFQLG final supplemental EIS determined through modeling that the watershed effects of herbicide maintenance treatment would be small, relative to other disturbances within watersheds of the Pilot Project Area, and would not significantly increase cumulative watershed effects (HFQLG final supplemental EIS, page 176).

Previous discussion reveals that there is little chance that either glyphosate or clopyralid is expected to reach streams because of their limited transport mobility; relatively short half-lives; buffers along streams; application criteria, which takes into account the time of year, wind velocity, and period to the next rainfall; and other BMPs for herbicide application. In conclusion, no significant adverse cumulative watershed effects associated with the herbicide application alternatives are expected.

4.2.4.12 Alternative C: Cumulative Watershed Effects, Riparian Management Objectives

The effects of alternative C on the RMOs would be identical to alternative B, with the exception of RMO 5, which addresses the diversity of desired plant communities. Alternative C is identical to alternative B except that noxious weeds would not be treated with herbicides. Instead, some weed locations would be treated with hand-pulling, cutting, or flaming. These treatments are likely to be less effective at controlling weeds. In RHCAs, Canada thistle and other noxious weeds are undesirable nonnative plants.

4.2.4.13 Alternative C: Cumulative Watershed Effects, ERA Analysis

Direct Effects. Under alternative C, the increases in ERA values were predicted to range from 0 to 77 percent of the TOC, depending on the subwatershed. This would result in cumulative ERA values ranging from 9 to 186 percent of the TOC.

Indirect Effects. Indirect effects would be the same as those discussed under alternative B above. The ineffectiveness of the noxious weed treatments in this alternative could allow for the spread of noxious weeds over time. The spread of such weeds in riparian areas could decrease the diversity and productivity of native and desired nonnative riparian plant communities.

Cumulative Effects. Table 4-19 above shows the modeled ERA in the analysis subwatershed placed at high risk for detrimental effects based on ERA increases. Higher ERA values are generally associated with higher peak flows that are more erosive and can lead to increased channel scour and higher sediment loads off-site. Stream channels in poor condition tend to be more sensitive to increases in peak flows because the channels frequently lack an effective root mass to bind streambanks and large organic debris to retain bedload materials. These channels are frequently downcut (have eroded down into the bottom of their channels), and all flow is confined to the channel rather than to a broader floodplain. Given these conditions, sediment is more readily eroded from these channels with subsequent deposition of sediment downstream. The relatively large increases in ERA, coupled with being over the TOC, would place the following subwatersheds at a higher risk of detrimental effects: East Branch Lights, Pierce, Mid Boulder-east, Mid Boulder-west, Indian above Antelope-middle, Upper Boulder east tributary, and Cold. The Upper Boulder-west tributary and Boulder-top subwatersheds would also be at a higher risk of detrimental effects due to large increases in ERA that are approaching the TOC. All other areas were rated at low or moderate risk of detrimental effects.

4.2.4.14 Alternative C: Soil Assessment

Direct, Indirect, and Cumulative Effects. Based on the standards contained in the Forest Plan and Region 5 soil standards, there would be a moderate risk that soil productivity would be impaired. Alternatives C would have a greater amount of mechanical treatments than alternatives D or F, and slightly more (about 6 acres) mechanical treatment (hand pulling weeds) than alternative B. Alternative C would have the same amount of ground disturbance from equipment, skid trails, and landings as alternative B, which proposes herbicide treatments for weeds. The direct, indirect, and cumulative effects on soil productivity indicator measures would be similar to B, described in detail above, and greater than alternatives A, D, and F.

4.2.4.15 Alternative D: Cumulative Watershed Effects, Mitigation Measures and Riparian Management Objectives

Alternative D incorporates a number of mitigation measures to specifically address watershed and riparian concerns, which relate directly to the RMOs. The mitigation measures are described in chapter 2 and incorporate both slope treatments and channel treatments. The slope treatments would be implemented in subwatersheds that exceed the TOC due to treatments proposed in alternative D. These treatments are described as follows:

- Drop treatments in the Cold Stream subwatershed.
- Reforest 100 percent of Group Selection Units.
- Implement erosion control measures to filter sediment from Group Selection Units on slopes greater than 20 percent. Use slash, chips, or weed-free straw to disperse concentrated flow coming from Group Selection Units into surrounding vegetated areas.
- Increase the number of water bars 25 percent above Forest Service Handbook ([FSH] 2409.15 Chapter 61.42d) direction on skid trails only within RHCAs.
- Retain patches of biomass for a total of about 5 to 10 acres in mountain yellow-legged frog habitat in perennial and intermittent RHCAs; would be limited to hand thinning treatments in Area Thinning Units.

The channel treatments would occur within the Boulder and Indian Creek drainage networks. Table 4-22 summarizes the channel treatments, which would occur in all subwatersheds that would exceed the TOC due to activities proposed in alternative D. These subwatersheds are concentrated largely in the Boulder Creek drainage network (consisting of Boulder Creek and its tributaries). In addition, two of these subwatersheds are in the Indian Creek drainage network (consisting of Indian Creek and its tributaries), specifically in areas above Antelope Lake. Several treatments would occur in subwatersheds that would not exceed the TOC, however they are hydrologically linked either upstream or downstream and would help mitigate effects to the stream system.

Table 4-22. Alternative D: Watershed mitigation measures – channel treatments.

Drainage Network	Subwatershed		Alternative D ERA (%TOC)	Mitigation measures – Channel treatments
	No.	Name		
Boulder Creek and tributaries	22	Upper Boulder – west tributary	98	Headcut stabilization
	23	Thompson Creek	82	Headcut stabilization
	24	Mid Boulder - east	113	Bank stabilization, grade control at Hallett Meadow
	25	Mid Boulder - west	107	Headcut stabilization
	26	Lower Boulder	66	Grade control structure and step pool construction above Boulder Creek inlet to Antelope Lake
	34	Upper Boulder east tributary	112	Bank stabilization
	35	Boulder - top	89	Bank stabilization, grade control at Lowe Flat
Indian Creek and tributaries	18	Indian above Antelope - top	64	Headcut stabilization
	21	Pierce	115	Headcut stabilization, bank stabilization
	28	Indian above Antelope - middle	118	Bank stabilization

The mitigation measures are designed to reduce the susceptibility of adverse cumulative watershed effects, particularly in subwatersheds where ERA values would exceed the TOC. As stated in the Forest Service Soil and Water Conservation Handbook (USDA Forest Service 1988a),

> The TOC does not represent the exact point at which cumulative watershed effects will occur. Rather, it serves as a "yellow flag" indicator of increasing susceptibility for significant adverse cumulative effects occurring within a watershed. Susceptibility of CWE [cumulative watershed effects] generally increases from low to high as the level of land disturbing activities increase toward or past the TOC.

As a result, if the "yellow flag" warning indicates exceedance of the TOC, the Diamond interdisciplinary team developed measures to protect watershed resources in the subwatersheds of concern. In each of these subwatersheds, unstable channel conditions have been observed that increase their sensitivity to adverse watershed effects. Headcuts and bank instability were documented during the 2005 field season by the watershed field crew. Channel condition at Lowe Flat, Hallett Meadow, and Boulder Meadow (near the mitigation treatment in subwatershed 26) was assessed for the Draft Upper Indian Creek Watershed Analysis (USDA Forest Service 2002). These three response channels were classified as functional-at risk to nonfunctional, based on adequacy of vegetation, landform, or large woody debris, following Proper Functioning Condition protocols (BLM 1998).

The mitigation measures would help further meet the 10 RMOs. Channel and slope treatments would help reduce sediment inputs from both upslope areas and from unstable, eroding channels. The proposed headcut and bank instability treatments would maintain and enhance channel integrity, and improve effective stream function. The proposed treatments at Lowe Flat and Hallett Meadow would help prevent erosion and channel downcutting in these meadow systems. As a result, water storage in these areas would be maintained or improved. Revegetation of the stabilized banks would promote the diversity and productivity of desired plant communities. Mountain yellow-legged frog habitat would be maintained, as described in the aquatics portion of section 4.3 ("Wildlife – Aquatic and Terrestrial").

4.2.4.16 Alternative D: Cumulative Watershed Effects, ERA Analysis

Direct Effects. The mitigation measures incorporated in alternative D were not used to modify ERA values. In this way, the ERA and TOC "accounting system" will still allow for direct comparisons of ground disturbance between alternatives. The cumulative effects of the mitigation measures are discussed in the preceding section. Under alternative D, the change in ERA values was predicted to range from 0 to 66 percent of the TOC, depending on the subwatershed. This would result in cumulative ERA values ranging from 7 to 186 percent of the TOC.

Indirect Effects. Indirect effects would be the similar to those discussed in alternative B above. The applications of herbicide would protect the diversity and productivity of native and desired nonnative riparian plant communities from the invasion of noxious weeds.

Cumulative Effects. Table 4-19 above shows the modeled ERA in the analysis subwatersheds placed at high risk for detrimental effects based on ERA increases. Higher ERA values are generally associated with higher peak flows that are more erosive and can lead to increased channel scour and higher sediment loads off-site. Stream channels in poor condition tend to be more sensitive to increases in peak flows because the channels frequently lack an effective root mass to bind streambanks and large organic debris to retain bedload materials. These channels are frequently downcut (have eroded down into the bottom of their channels), and all flow is confined to the channel rather than to a broader floodplain. Given these conditions, sediment is more readily eroded from these channels with subsequent deposition of sediment downstream. In themselves (without any mitigations), the relatively large increases in ERA, coupled with being over the TOC, would place the following subwatersheds at a higher risk of detrimental effects: Pierce, Mid Boulder-east, Mid Boulder-west, Indian above Antelope-middle, Upper Boulder-east tributary, and Cold. The Upper Boulder west tributary and Boulder-top subwatersheds would also be at a higher risk of detrimental effects due to large increases in ERA that are approaching the TOC. All other areas were rated at low or moderate risk of detrimental effects.

The cumulative ERA values, however, do not account for the mitigation measures incorporated in the design of alternative D. As such, they should not be interpreted independent of the discussion above addressing mitigations and the RMOs. The mitigations would effectively reduce the risk of detrimental effects in each of the subwatersheds by increasing channel stability, enhancing streamside vegetation, and reducing potential chronic sediment sources to the streams and to Antelope Lake.

4.2.4.17 Alternative D: Soil Assessment

Direct, Indirect, and Cumulative Effects. Based on the standards contained in the Forest Plan and Forest Service Region 5 soil standards, there would be a moderate risk that soil productivity would be impaired. Alternative D would have a moderate amount of mechanical treatments, so there would be a moderate amount of ground disturbance from equipment, skid trails, and landings. The direct, indirect, and cumulative effects on soil productivity would be similar to alternatives B and C and greater than alternatives A and F.

4.2.4.18 Alternative F: Cumulative Watershed Effects, Riparian Management Objectives

The potential effects of alternative F on RMOs would be similar to those described in detail under alternative B above. Fewer acres of treatments would occur compared to alternative B. As a result, fewer acres of RHCAs would be treated in Area Thinning Units. All treatment acres were reduced to maintain ERA levels at or below the TOC. Where RHCAs would be treated, the effects of those activities would be identical to those discussed for RMOs under alternative B.

4.2.4.19 Alternative F: Cumulative Watershed Effects, ERA Analysis

Direct Effects. The increase in ERA values under alternative F were predicted to range from 0 to 55 percent of the TOC, depending on the subwatershed. This would result in cumulative ERA values ranging from 7 to 100 percent of the TOC.

Indirect Effects. The indirect effects would be similar to those discussed under alternative B above. The applications of herbicide would protect the diversity and productivity of native and desired nonnative riparian plant communities from the invasion of noxious weeds.

Cumulative Effects. Table 4-19 above shows the modeled ERA in the analysis subwatershed placed at high risk for detrimental effects based on ERA increases. Higher ERA values are generally associated with higher peak flows that are more erosive and can lead to increased channel scour and higher sediment loads off-site. Stream channels in poor condition tend to be more sensitive to increases in peak flows because the channels frequently lack an effective root mass to bind streambanks and large organic debris to retain bedload materials. These channels are frequently downcut (have eroded down into the bottom of their channels), and all flow is confined to the channel rather than to a broader floodplain. Given these conditions, sediment is more readily eroded from these channels with subsequent deposition of sediment downstream. Alternative F was designed to reduce disturbances in several higher-risk subwatersheds that have been heavily affected, either by the Stream Fire or by relatively recent harvest activities. There would be no subwatersheds over the TOC due to actions in this alternative. However, the following subwatersheds would be at a higher risk for detrimental effects due to the large increases in ERA that are approaching or at the TOC: Pierce, Upper Boulder west tributary, Mid Boulder-east, Mid Boulder-west, and Indian above Antelope-middle. All other areas were rated at low or moderate risk of detrimental effects.

4.2.4.20 Alternative F: Soil Assessment

Direct, Indirect, and Cumulative Effects. Based on the standards contained in the Forest Plan and Region 5 soil standards, there would be a moderate risk that soil productivity would be impaired. Alternative F would have the least amount of mechanical treatments among the action alternatives, so there would be a lower amount of ground disturbance from equipment, skid trails, and landings. The direct, indirect, and cumulative effects on soil productivity would be less than alternatives B, C, and D and greater than alternative A.

4.3 Wildlife – Aquatic and Terrestrial

4.3.1 Summary of Effects

The "Diamond Vegetation Project: Biological Assessment / Biological Evaluation for Aquatic and Terrestrial Wildlife Species" (Collins and Hopkins 2006) provides a discussion of the direct, indirect, and cumulative effects for all sensitive animal species analyzed for the Diamond Project. The BA/BE is located in the Diamond Project Record and incorporated by reference. The BA/BE concluded that the Diamond Project would not affect the following species: California red-legged frog, Valley elderberry longhorn beetle, bald eagle, northern leopard frog, greater sandhill crane, Swainson's hawk, Foothill yellow-legged frogs, and American peregrine falcon.

Based on the direct, indirect, and cumulative effects discussed in the BA/BE, it was concluded that the Diamond Project would affect individuals but would likely not result in a trend toward listing or loss of viability for the following: hardhead minnow, mountain yellow-legged frog, northwestern pond turtle, great gray owl, Sierra Nevada red fox, California wolverine, pallid bat, Townsend's big eared bat, western red bat, willow flycatcher, California spotted owl, northern goshawk, American marten, and Pacific fisher.

The NEPA (*National Environmental Policy Act*) process requires agencies to identify "the significant environmental issues deserving study and de-emphasizing insignificant issues, narrowing the scope of the environmental impact statement" 40 CFR 15001.1(d). Due to the high visibility of old-forest species in California, and the potential impacts of fuels treatment, group selection, and area thinning on forested habitat, the effects on California spotted owl, northern goshawk, American marten, and Pacific fisher are emphasized in this EIS. The mountain yellow-legged frog is also emphasized in this EIS due to the proposed use of herbicides in the Riparian Habitat Conservation Areas (RHCAs) and the proposed DFPZ and area thinning within RHCAs.

4.3.1.1 Aquatic Wildlife Species

Alternative A (No Action). Alternative A would pose no risk and uncertainty associated with the proposed actions, but it would maintain a high risk of potential habitat loss from wildfire. The action alternatives would reduce this risk. There would no direct effects such as crushing of mountain yellow-legged frogs (MYLF), smothering of eggs, or exposure to herbicides from a potential spill. No watershed restoration projects would occur to improve aquatic species passage, headcut stabilization, road decommissioning, and road reconstruction. The project mitigation measures, which include slope and channel treatments, would not be implemented (as proposed in alternative D). Aquatic fragmentation would continue at the same degree. Sedimentation would continue at the same rate from headcuts, egregious roads, and poorly maintained roads. The RHCAs would not be treated, and high fuel conditions would remain, leaving RHCAs at risk of catastrophic wildfire and loss of habitat for MYLF and trout Management Indicator Species (MIS) species. In addition, the hydrologic direct, indirect, and cumulative effects of alternative A are described in sections 4.2.4.2 and 4.2.4.3 (chapter 4 "Soils and Hydrology" section).

All Action Alternatives (B, C, D, and F). All action alternatives propose fuel treatments (DFPZ construction and area thinning) that would be developed to maintain and enhance RHCAs. Implementation of project design standards (as described in chapter 2) would reduce potential adverse effects from these activities. A complete discussion the effects of the action alternatives on the Riparian Management Objectives (from the Scientific Analysis Team guidelines) can be found above in section 4.2.4.6 of the "Soils and Hydrology" section. The cumulative watershed effects analysis has determined the existing Equivalent Roaded Acres (ERAs) in the identified subwatersheds and the potential for the action alternatives to cause the subwatershed to exceed the Threshold of Concern (TOC), possibly resulting in adverse cumulative watershed effects. Higher ERA values are generally associated with higher peak flows that are more erosive and can lead to increased channel scour and higher sediment loads off-site. Stream channels in poor condition tend to be more sensitive to increased peak flows. The CWE analysis provides a detailed comparison of ERA values within RHCAs by each alternative (refer to section 4.2 – "Soils and Hydrology" in this chapter). As discussed in section 4.2, relatively large changes in ERA would translate to changes in the risk of detrimental effects, and marginal increases in ERA would result in similar marginal changes in risk of detrimental watershed effects. The ERA effects common to all action alternatives and the hydrologic direct, indirect, and cumulative effects of alternatives B and C are described in section 4.2 above.

Alternatives B and C would increase the level of risk and uncertainty associated with effects of habitat change on the MYLF occupancy and productivity. Alternatives D and F would increase the level of risk to a lesser degree than alternatives B and C. The direct and indirect effects of each alternative, together with the additive or cumulative effects of each alternative, have been considered in evaluating this risk and uncertainty. Indian above Antelope (subwatershed #28) would be at the TOC with the implementation of alternative F and above the TOC with the implementation of alternative B, C, or D. There are no know MYLF populations in this subwatershed, but a resident population of rainbow trout exists.

Mountain yellow-legged frogs—As explained in section 4.2, "The TOC does not represent the exact point at which cumulative watershed effects will occur. Rather, it serves as a "yellow flag" indicator of increasing susceptibility for significant adverse cumulative effects occurring within a watershed" (USDA Forest Service 1988a). A "yellow flag" is raised when watersheds are above TOC and streams in poor condition are more susceptible to increased scour and potential for adverse downstream effects. Intensive stream condition inventories were conducted on eight reaches in the Watershed Analysis Area, and stream surveys were conducted on 37 miles. Survey results show that the following streams, which contain populations of MYLF, are in poor to moderate condition: Boulder, Pierce, and Thompson Creeks (subwatersheds 21–26, 34, and 35). Field recognizance also found much of Lone Rock Creek is in poor condition. Refer to table 4-19 (in section 4.2) for the predicted subwatershed disturbance in ERA for each alternative. The Lower Lone Rock Creek subwatershed #32 (which has an MYLF population) is substantially above the TOC due to the 2001 Stream Fire. None of the action alternatives propose RHCA treatments in the Lower Lone Rock Creek subwatershed. Boulder and Pierce Creeks (subwatersheds 21, 24, 25, and 34) would exceed the TOC with implementation of alternative B, C, or D treatments with the potential for adverse watershed effects. This potential would be reduced with the implementation of the mitigation measures developed for alternative D, which were developed to reduce increased sedimentation into the stream channels and protect sensitive amphibians and downstream beneficial uses. With the implementation of alternative F, all subwatersheds that are currently below the TOC would remain below the TOC. There should be minimal adverse cumulative watershed effects on these subwatersheds with the implementation of alternative D or F.

4.3.1.2 Terrestrial Wildlife Species

Alternative A (No Action). Alternative A would pose no risk and uncertainty associated with the proposed actions, but it would maintain a high risk of potential habitat loss from wildfire, while the action alternatives would reduce this risk.

All Action Alternatives (B, C, D, and F). The fuel treatments proposed in alternatives B, C, D, and F would change suitable spotted owl foraging habitat to unsuitable habitat in wildlife habitat designated as California Wildlife Habitat Relationship (CWHR) size classes 4M and 4D (1,696–1,816 acres reduced). Fuel treatments would be designed to reduce the fuel ladders; this would be accomplished by reducing the lower tree layer and modifying the mid and upper tree layer by removing trees to create open spacing between residual crowns. Alternatives B, C, D, and F in CWHR size classes 4M and 4D would remove 70 percent of the lower vegetation canopy layer (trees less than 10 inches dbh) and modify both the mid and upper canopy layers to achieve 30 to 45 percent canopy cover. This action would create a more open understory remove thickets that provide hiding/roosting habitat for both fledgling and adult spotted owls; create a warmer site with increased light and heat penetration, which reduces the cool microclimates that owls seem to prefer; and modify structural diversity with removal of trees across all size classes up to 30 inches. The removal of structures less than 30 inches dbh usually results in a decrease in potential future snags / down woody material and deformities in structures, which could benefit owls and owl prey. Implementation of alternative B, C, D, or F would remove suitable habitat from all group openings that are within CWHR size classes 4M and 4D (472–669 acres).

Under alternatives B, C, and D, fuel treatments in CWHR size classes 5M and 5D would retain all trees greater than 30 inches dbh and maintain a 40 to 45 percent canopy cover. Under alternative F, fuel treatments within these CWHR size classes would retain all trees greater than 20 inches dbh and maintain a 50 percent canopy cover where it exists. All actions alternatives would reduce the lower vegetation canopy layer and the mid and upper canopy layers would be modified to achieve a minimum 40 percent canopy cover. Alternatives B, C, and D would remove up to 75 percent of the biomass (0–10 inch dbh trees) in order to retain the target canopy cover of 40 to 45 percent. Alternative F would retain trees greater than 20 inch dbh and maintain 50 percent canopy cover, and the biomass left in DFPZ stands would average around 65 percent. As a beneficial effect, alternative F would overall contribute to stand and environmental conditions that more closely resemble what is found in owl habitat. This may increase the possibility that owls would continue using such Fuel Treatment Units for nesting, roosting, and foraging or that the habitat quality owls seek could be attained faster over time than with the open simplicity provided by alternatives B, C, and D. Implementation of alternatives B, C, D, and F would remove suitable habitat from all group openings that are within CWHR size classes 5M and 5D (106-408 acres).

Threatened and Endangered Animal Species—One federally listed Threatened or Endangered species, the bald eagle, would be affected by the action alternatives. Approximately 400 acres in the Bald Eagle Management Area around Antelope Lake would be treated for area thinning. The Antelope Lake Bald Eagle Management Plan (USFS PNF 2006) encourages thinning treatments within these stands in order to accelerate growth and provide for future CWHR size class 4 and 5 trees. No impact on the nesting eagles at Antelope Lake is anticipated as a result of the proposed treatments.

Selected Sensitive Species Associated with Older Forest Stands—Table 4-23 shows the cumulative changes in CWHR size classes 4M, 4D, 5M, and 5D that could occur from implementing the DFPZs, group selections, and area thinnings proposed in the action alternatives.

Table 4-23. Approximate change in CWHR size classes 4M, 4D, 5M, and 5D habitat types in the Wildlife Analysis Area (based on 130,653 National Forest acres).

CWHR Size Class	Alternative A Current Acres	Alternatives B and C Post-Project (percent remaining)	Alternative D Post-Project (percent remaining)	Alternative F Post-Project (percent remaining)
4M	47,903	45,831	45,819	46,053
		(95.7%)	(95.6%)	(96.1%)
4D	6,575	6,167	6,226	6,256
		(93.8%)	(94.7%)	(95.2%)
5M	28,314	28,243	28,240	28,348
		(99.8%)	(99.7%)	(100.1%)
5D	5,769	5,432	5,543	5,630
		(94.2%)	(96.1%)	(97.6%)
Total Change	**88,561**	**85,673**	**85,828**	**86,287**
		96.7%	**96.9%**	**97.4%**

Note: All acres shown are National Forest acres.

California Spotted Owl—Fuel treatments, group selections, or area thinning would not occur in Protected Activity Centers (PACs) or Spotted Owl Habitat Areas (SOHAs). These reserved lands were created to protect the areas (including nest and roost sites) most important for owls from being modified by fuel treatments. The proposed fuel treatments would be designed to reduce high-intensity fires around these reserved areas.

The availability of nesting habitat (CWHR size classes 5M and 5D) following project completion would range from 33,675 acres (97 percent of existing nesting habitat) to 33,978 acres (99 percent of existing habitat) distributed across the 130,653 National Forest acres that comprise the 159,102-acre Wildlife Analysis Area. The availability of post-project foraging habitat (CWHR size classes 4M and 4D) would range from 51,998 acres (95 percent of existing nesting habitat) to 52,309 acres (96 percent of existing habitat) distributed within the Wildlife Analysis Area. Nesting and foraging habitat would be distributed across the Wildlife Analysis Area, including lands in PACs, SOHAs, Home Range Core Areas (HRCAs), and the forested habitat connecting these owl sites, providing for continued occupancy of PACs in the Wildlife Analysis Area. Implementing group selection at the densities proposed in the action alternatives would maintain habitat connectivity across the Wildlife Analysis Area and would not create barriers to movement or isolate large blocks of suitable habitat.

Northern Goshawk—Fuel treatments, group selections, or area thinning proposed in the action alternatives would not occur in the PACs.

The availability of post-project nesting habitat would range from 85,673 acres (96.7 percent of existing nesting habitat) to 86,286 acres (97.4 percent of existing habitat) distributed across the 130,653 National Forest acres that are part of the Wildlife Analysis Area.

Mesocarnivores (American Marten and Pacific Fisher)—The availability of post-project denning habitat would range from 11,599 acres (94 percent of existing denning habitat) to 11,886 acres (96.2 percent of existing habitat) distributed across 130,653 acres in the Plumas National Forest.

To reduce negative impacts on wildlife in terms of connectivity and forest interior habitat, all action alternatives propose that group selection densities in Treatment Units be below 11 percent. Alternatives B and C would create the most groups (1,130 acres), with an average group density of 3.6 percent across all units. Alternative D would create 950 group acres, with an average group density of 4 percent. Alternative F would create the fewest groups (610 acres), with an average group density of 2.6 percent. It appears that alternatives B, C, D, and F would maintain habitat connectivity across the Wildlife Analysis Area and would not create barriers to movement or isolate large blocks of suitable habitat.

4.3.2 Regulatory Framework

The current management direction for Threatened, Endangered, Proposed, Sensitive, and Management Indicator Species on the Plumas National Forest can be found in the following documents:

- Code of Federal Regulations (23, 36, 50 CFR)
- Forest Service Manual and Handbooks (FSM/H 1200, 1500, 1700, 2600)
- *Endangered Species Act* of 1976
- *National Environmental Policy Act* of 1969
- *National Forest Management Act* of 1976
- *Plumas National Forest Land and Resource Management Plan* (1988)
- USDA Forest Service Region 5 Best Management Practices
- Bald Eagle and Peregrine Falcon Recovery Plans, which establish population goals for recovery of these species
- Regional Forester (Region 5) policy and management direction
- Regional Forester (Region 5) Sensitive Plant and Animal Species List (June 10, 1998), with subsequent updates up through August 4, 2004
- U.S. Fish and Wildlife Service Quarterly Species List (updates through August 11, 2004)
- *Herger-Feinstein Quincy Library Group Forest Recovery Act* (HFQLG Act) – August 1999 Record of Decision on the final environmental impact statement (EIS)
- Sierra Nevada Forest Plan Amendment – January 2001 Record of Decision on the final EIS

- Sierra Nevada Forest Plan Amendment – January 2004 Record of Decision on the final supplemental EIS

4.3.3 Methodology for Assessing Impacts

4.3.3.1 Geographic Area Evaluated for Impacts on Wildlife

Aquatic Wildlife. The "aquatic wildlife species analysis area" geographic boundary was delineated based on the potential direct, indirect, and cumulative effects on aquatic resources. The detailed analyses of effects of the Diamond Project are contained in the "Diamond Fuel Treatment, Group Selection, and Area Thinning Project: Biological Assessment / Biological Evaluation Terrestrial and Aquatic Wildlife" (Collins and Hopkins 2006) and the "Management Indicator Species Report" (Rotta and Hopkins 2006). The Analysis Area for aquatic wildlife species is the same as the "Watershed Analysis Area" used for the cumulative watershed effects analysis as described in the "Soils and Hydrology" section (4.2) of this chapter. All potential direct, indirect, and cumulative effects on aquatic species would occur within the Watershed Analysis Area.

Terrestrial Wildlife. The "Wildlife Analysis Area" boundary for terrestrial wildlife was delineated based on the potential direct, indirect, and cumulative effects on California spotted owl Protected Activity Centers (PACs), Home Range Core Area (HRCAs), and breeding home range distribution. The Diamond Project Area does not fall along the lines of HRCAs in which project activity would occur but encompasses the next outlying HRCA beyond where project activity would occur. A larger area was included in the determination of the Wildlife Analysis Area boundary. This larger area is centered around each PAC to encompass breeding home range acres. The Wildlife Analysis Area extends to a point at which no direct or indirect effects would be discernable and would not act cumulatively with other actions. The Wildlife Analysis Area (159,102 acres) extends beyond the Diamond Project Area (which is approximately 100,000 acres). Of these 159,102 acres, 130,653 are National Forest lands (the Plumas National Forest manages 112,377 acres and the Lassen National Forest manages 18,276 acres), and 28,449 acres are private lands within the Wildlife Analysis Area. No project treatments would occur on Lassen National Forest lands. All direct, indirect, and cumulative effects discussed in this section would occur within the 159,102-acre Wildlife Analysis Area.

4.3.3.2 Indicator Measures

Aquatic Wildlife Species

Issue: Proposed mechanical treatments (DFPZ and Area Thinning) may threaten population viability of sensitive wildlife species though habitat degradation.

Indicator Measure—Acres of treatment within RHCAs and the resulting percent of TOC in relation to stream condition (see table 4-26). Acres were used as the indicator measure to show the effects of the proposed action and alternatives on changes of availability of suitable mountain yellow-legged frog habitat, including affected acres in the Watershed Analysis Area and RHCAs. In addition, a second issue that relates to aquatic resources is that "implementing" ground-disturbing activities in watersheds that are approaching or over the TOC could increase the risk of adverse effects and cumulative watershed effects. The ERA and TOC are used as indicator measures to show if a watershed is approaching, at, or over the TOC. The indicator measures also show if additional activities would result in adverse effects on the watershed, stream channel, and associated beneficial uses.

Issue: Declining watershed, riparian, and aquatic conditions such as aquatic species barriers and headcut erosion.

Indicator Measure—Miles of improved aquatic habitat connectivity. Miles of stream habitat and numbers of fish barriers were used as the indicator measures to show the effects of the proposed action and alternatives on changes of availability of suitable trout Management Indicator Species (MIS) habitat, including affected acres in the Watershed Analysis Area.

Terrestrial Wildlife Species

California Spotted Owl—Acres were used as the indicator measure to show the effects of the proposed action and alternatives on changes of availability of suitable California spotted owl habitat, including affected acres in the Wildlife Analysis Area and HRCAs.

Northern Goshawk—Acres were used as the indicator measure to show the effects of the proposed action and alternatives on changes of availability of suitable northern goshawk habitat.

Mesocarnivores—Acres of suitable habitat and habitat connectivity were the indicator measures used to show the effects of the proposed action and alternatives on Pacific fisher and American marten habitat and connectivity.

Forest Interior Habitat—Habitat connectivity and the risk of habitat loss in the treatment areas were the indicator measures used to show effects on forest interior habitat.

Management Indicator Species—Acres were used as the indicator measure to show the effects of the proposed action and alternatives on changes to the availability of suitable MIS habitat.

4.3.3.3 Design Criteria

Chapter 2 provides detailed information about the Design Criteria used for each alternative. Also, see appendix C, which includes the Standard Management Requirements and Best Management Practices. The project design standards for all action alternatives include the standards and guidelines identified in table 2 of the 2004 Record of Decision on the SNFPA final supplemental EIS and the use of the Limited Operating Periods identified in table 2.3 of the 1999 HFQLG final EIS.

4.3.3.4 Assumptions for Aquatic Wildlife Species

An assumption was made that the exposure scenarios (refer to the 2003 HFQLG final supplemental EIS) would be representative of the effects on aquatic wildlife species considered in the analysis.

It is unknown where MYLFs are breeding in the Watershed Analysis Area, although tadpoles have been found in low-gradient drainages in meadows. Ponds, reservoirs, and springs in the subwatersheds could potentially be breeding habitat and would be protected with a minimum 100- to 150-foot no-entry buffer that would exclude mechanical equipment or herbicides.

4.3.3.5 Duration of Impacts

Aquatic Wildlife Species. The recovery period is estimated at about 35 years due to eastside conditions of low rainfall and low soil productivity. Therefore, activities that occurred 35 years ago and or could occur 35 years into the future may potentially have cumulative effects within the Watershed Analysis Area. High-intensity fire events recover in 15 years (ground cover recovery) and low- or moderate-intensity fires were restricted to the last 10 years. These are the time periods that vegetation should recover within the subwatersheds and RHCAs. The past activities for over-story removal and clearcuts may be felt into the future for a minimum 75 to 150 years, which is the time a seedling would take to grow to a mature tree greater than 30 inches dbh and provide habitat-forming large woody debris within the stream channels.

Terrestrial Wildlife Species. The direct effects would likely be limited to the project implementation phase. Indirect effects would last beyond the implementation period and occur within the temporal bound of the cumulative effects analysis. Cumulative effects are based on past actions that have occurred in the Diamond Project Area since 1977 (for which there is some information available on the effects of wildlife), and carried forward for 50 to 100 years to reflect the potential long-term effects of the proposed Diamond Project vegetation treatments.

4.3.3.6 Herbicide Hazard Analysis

An herbicide is a pesticide that kills plants or inhibits their growth. To evaluate the effects of herbicides on wildlife, it is critical to consider several factors such as toxicity, exposure, dose, and the biology and behavior of species that could potentially be exposed to the herbicide. Toxicity is the potential a pesticide has for causing harm to a specific species or group of species.

All action alternatives (except for alternative C, which does not include herbicide use) propose to treat approximately 128 gross acres (22 net acres) with herbicides. The herbicide, clopyralid, would be applied to about 10 net acres infested with Canada thistle, a noxious weed. A backpack sprayer would be used to spray upland infestations along roads, skid trails, and landings. The herbicide glyphosate would be applied to Canada thistle in lowland areas but would not be used within 10 to 150 feet of streams. Glyphosate would be used on a total of 12 net acres, and a wick applicator would be used by hand to selectively apply the herbicide. Two spray solution additives (referred to as adjuvants) would be mixed with the herbicide solution to improve performance of the spray mixture. One adjuvant is a vegetable oil and silicone-based surfactant and the other is a water-soluble colorant (marker dye). Refer to chapter 2 in this EIS for a complete description of the Design Criteria for herbicide use.

Wildlife may be exposed to herbicides if they are in the vicinity of contaminated surface waters or treated vegetation. The routes of exposure include oral, dermal, and inhalation. Oral exposures might occur through ingestion of contaminated food (such as insects) or water (small puddles during application) or incidental ingestion of contaminated plants during foraging or other activities. Dermal exposures are likely to be most important for burrowing mammals (through contact with contaminated soils) and animals that spend considerable amounts of time within ground vegetation.

Fish and invertebrate exposure rates are based on water contamination rates. Syracuse Environmental Research Associates, Inc. (SERA) provides very few studies related to the effects of herbicides on amphibian species. There is extremely limited published data on the relationship of herbicides on MYLFs. The risk to a variety of aquatic, amphibian, and reptilian species varies with the chemical(s), rate(s), timing, and other factors, which can vary by site condition (USDA 2003).

As with any assessment, risk must be qualified by the general reservation for the risk assessment; that is, absolute safety cannot be proven, and the absence of risk can never be demonstrated. The proposed herbicides, marker die, and surfactant have been tested in only a limited number of species and under conditions that may or may not well-represent populations of free-ranging nontarget animals or some populations of nontarget plants. The far majority of information available was on experiments conducted on particular animals in laboratory environments. While laboratory experiments can be used to determine certain factors (such as acute toxicity, reproductive risk, neurotoxic risk, and immunotoxic risk) that must be considered, laboratory experiments do not account for wildlife in their natural environments. Adverse effects (such as lethargy, weight loss, nausea, and fluid loss due to diarrhea or vomiting) can influence wildlife health by altering their ability to compete for food, locate and/or capture food, avoid or fight off predators, or reproduce—all of which can potentially lead to mortality. Further, these laboratory experiments cannot calculate for wildlife behavior, including avoidance and selection.

The 2003 HFQLG Act final supplemental EIS illustrates a wide range of exposure scenarios for avian, mammal, and fish test species and looks at only the typical application rates at the highest exposure levels for each of the two herbicides and surfactants proposed for use in the Diamond Project. The effects of both clopyralid and glyphosate, as well as the two adjuvants, on wildlife were analyzed in the final supplemental EIS. The risk assessments for clopyralid and glyphosate on avian, mammal, and aquatic species can be found on pages 106–108, 120–121, 210–223 of the final supplemental EIS. The herbicide application rates considered for these risk assessments were at or below the application rates proposed for the Diamond Project. The conclusion in the final supplemental EIS was that applications at these proposed rates should have a low risk of adverse effects on all avian and mammal species. The appendices and the project file for the final supplemental EIS contain detailed information about herbicide exposure factors and the methodology for calculating potential exposures in animals. With regard to cumulative effects, the final supplemental EIS (pages 129–136) for avian insectivores, avian herbivores, raptors, mammals, fish, and invertebrates determined that "direct and indirect adverse effects are not expected, therefore, cumulative adverse effects are not expected to occur." Thompson (1998) notes that pertinent data for amphibians is largely unavailable and suggests using great caution in conducting amphibian risk assessment. Given the unpredictability of potential exposures, and the lack of toxicological data relevant to subcutaneous exposures for adult frogs, it is not possible to fully assess risks to these species. Amphibians have complex life cycles. They have more opportunities for exposure to chemicals and are subjected to more potential routes of exposure than other vertebrates (Hall and Henry 1992, as cited in HFQLG Act final EIS).

The Syracuse Environmental Research Associates, Inc. (SERA 2003, 2004) risk assessment worksheets for clopyralid and glyphosate evaluated toxicity, dose, and biology of a species and developed a “Hazard Quotient” for a number of scenarios. A Hazard Quotient is basically a mathematical calculation that is expressed numerically in terms of risk, where neutral risk is equal to 1, and the risk of toxicity increases as the value rises above 1 and decreases as the value drops below 1. For the application rates and application method (backpack sprayer) proposed for Canada Thistle, all Hazard Quotients for the two herbicides are below 1 for all terrestrial and aquatic vertebrate species and aquatic invertebrate species evaluated in the SERA worksheets. There is the potential for an herbicide spill into streams or other bodies of water directly affecting fish and aquatic invertebrates with the potential of a chronic exposure. A spill plan will be followed for herbicide application within the Project Area. The Hazard Quotient for wicking application is assumed to be even lower than the backpack sprayer application due to the more direct application and control.

The application methods would be aimed specifically to the individual Canada thistle plants, not applied at a broadcast scale. No change in nontargeted plants and vegetative succession would occur as a result of herbicide application on this noxious weed. Canada thistle plants are highly unpalatable and are not consumed by herbivores, but seed-eating birds, such as goldfinches and pine siskins, could possibly feed on the seeds. The removal of 25 acres of Canada thistle would not cause a reduction in any food base for any vertebrate species in the Wildlife Analysis Area. The removal of this noxious weed would provide less competition for native plant species, which could lead to small increases in native grass and forb growth.

Additional noxious weed treatments would include 2 acres of Scotch broom removal using a hand wrench, six locations of spotted knapweed using hand-held string trimmer or flaming with a propane torch, and two locations each of manual removal of yellow starthistle, medusahead, and Russian thistle. None of these noxious weed species provide staple or suitable forage or cover for wildlife.

Alternative C does not propose herbicide use. Approximately 20 acres over 228 locations would be treated by other methods. Approximately 18.5 acres would consist of Canada thistle treatment, using either hand pulling/digging, cutting with a hand-held string trimmer, and covering plants with plastic sheeting. Other noxious weed species would be treated as described above.

4.3.4 Environmental Consequences: General Effects on Mountain Yellow-Legged Frogs and Their Habitat

4.3.4.1 Alternative A (No Action)

The DFPZ, group selection, and area thinning treatments would not occur under the no-action alternative, so there would be no exacted effects on the channel network. The fuel loads left by alternative A could make potential wildfires in the area difficult to suppress and create a more intense burn, which could lead in a potential loss of RHCAs. Typically, burn severity and the effects of wildfire disturbance are often limited in near-stream areas compared to upland areas. The effects of fire adjacent to channels can be devastating to the integrity of stream proper function and condition. Channel degradation, erosion, and sedimentation and the resulting effects on stream and riparian habitats and water quality would likely increase following a stand-replacing fire.

The accumulation of downed and standing wood in a RHCA over the long term, in combination with new vegetation and similar upslope conditions, would result in a very high wildfire risk. Dead wood of all sizes, in addition to new vegetation, would add to fuel loading including fuel ladders. These long-term changes in forest structure would increase fuel hazards and increase the probability of a stand-destroying fire in the future. The loss of upland and riparian vegetation increases slope run-off and sedimentation and decreases water quality, thus adversely affecting downstream MYLF habitat. Roads in the Project Area would not be improved for drainage and aquatic species habitat connectivity. Sedimentation from road runoff into the drainages and fragmentation of aquatic habitats would continue.

The no-action alternative would not protect riparian corridors and adjacent stream channels. There would be no treatments to reduce the risk of high-intensity wildfire. There would be the potential for RHCAs to act like chimneys and carry fire up and down the watershed. There would be no fuel reduction projects to promote watershed restoration or to protect watersheds from catastrophic wildfire. Fire would not be restored to protect riparian forest health (Olson and Agee 2005). As exhibited with the 2001 Stream Fire, the aquatic ecosystem would have increased sedimentation caused by runoff from roads and adjacent hill slopes denuded of vegetation. These high sediment loads may continue for years, greatly increasing the time for recovery (Noss et al. 2006).

Direct Effects. There would be no direct effects on MYLF habitat because no activities would occur to cause disturbance to individual frogs or to impact existing habitat conditions.

Indirect Effects. The indirect effects of the no-action alternative would include the potential for future wildfire and its impact on habitat development and recovery. The fuel loads that would be left by this alternative would make potential wildfires in the area difficult to suppress and create a more intense burn, which could lead to increased rates of spread resulting in potential loss of RHCAs and suitable MYLF habitat. Any acres that burned at high intensity could contribute to increased sedimentation, which would adversely affect aquatic habitats and potential breeding habitat for the MYLF. There would be no application of herbicides to affect breeding or dispersing frogs and/or their prey base.

Cumulative Effects. The no-action alternative would not provide for the protection of MYLF habitat, and there would be no actions designed to reduce the risk of high-intensity wildfire. There is the potential for RHCAs to act like chimneys that can carry fire up and down the watershed. Watershed restoration through the fuel reduction projects would not occur to protect watersheds from catastrophic wildfire. Cumulative effects from private land use (gravel extraction, livestock grazing, and urbanization) would continue to create water quality problems, including sedimentation and bank cutting.

4.3.4.2 Effects Common to All Action Alternatives (B, C, D, and F): Mountain Yellow-legged Frog (All Proposed Treatments Except Herbicide Use)

The direct, indirect, and cumulative effects on Threatened, Endangered, and Sensitive aquatic species are presented in the BA/BE for the Diamond Project (Collins and Hopkins 2006); however, the MYLF is analyzed in detail below (see table 4-24 for the 12 subwatersheds in the Watershed Analysis Area with known MYLF populations).

Table 4-24. The 12 subwatersheds in the Watershed Analysis Area with known MYLF populations.

					Alternatives B and C		Alternative D		Alternative F		Alternatives B and C	Alternative D	Alternative F
Sub Watershed Number	**Sub Watershed Name**	**Sub Watershed Acres**	**TES Aquatic Species**	**RHCA Acres**	**RHCA Acres Treated**	**Percent of RHCAs Treated**	**RHCA Acres Treated**	**Percent of RHCAs Treated**	**RHCA Acres Treated**	**Percent of RHCAs Treated**	**Percent ERA**	**Percent ERA**	**Percent ERA**
1	Upper West Branch Lights	2,196.12	MYLF (2)	94	14	14.89	14	14.89	14	14.89			
10	East Branch Lights	3,476.42	FYLF/MYLF								13 (+3)[a,b]	12(+2)[a]	11(+1)[a]
21	Pierce	2,507.70	MYLF (1)	647	147	22.72	147	22.72	55	8.50	14(+7)[a,b]	14(+7)[a,b]	12(+5)[a]
22	Upper Boulder West Tributary	848.22	MYLF (7)	192[c]	76[c]	39.58[c]	77[c]	40.10[c]	77[c]	40.10[c]			
23	Thompson	2,372.25	MYLF (2)	298[c]	119[c]	39.93[c]	119[c]	39.93[c]	119[c]	39.93[c]			
24	Mid Boulder - East	968.9	MYLF suspected[a]	283[c]	140[c]	49.47[c]	79	27.92	48	16.96	15 (+9)[a,b]	14(+8)[a,b]	11(+5)[a]
25	Mid Boulder - West	894.17	MYLF suspected[a]	206[c]	84[c]	40.78[c]	84[c]	40.78[c]	54[c]	26.21[c]	13 (+8)[a,b]	13 (+8)[a,b]	11(+6)[a]
26	Lower Boulder	1,662.72	MYLF (1)	497	33	6.64	31	6.24	31	6.24			
32	Lower Lone Rock	1,451.18	MYLF (2)[a]	134	0	0.00	0	0.00	0	0.00	16(0)[a,d]	16(0)[a,d]	16(0)[a,d]
33	Lower Lone Rock Valley	2,149.85	MYLF (1)[a]	121	0	0.00	0	0.00	0	0.00			
34	Upper Boulder East Tributary	2,377.39	MYLF (3)[a]	220[c]	130[c]	59.09[c]	130[c]	59.09[c]	78[c]	35.45[c]	13(+6)[a,b]	13(+6)[a,b]	12(+5)[a]
35	Boulder - top	1,699.30	MYLF (15) NPT (1)	391[c]	196[c]	50.13[c]	196[c]	50.13[c]	44[c]	11.25[c]			

Notes:

WB = West Branch

EB = East Branch

MYLF = mountain yellow-legged frog

FYLF = foothill yellow-legged frog

NPT = northwestern pond turtle

a. This is the percent change in ERA value, by alternative, from the existing condition.

b. These are the subwatersheds that would be at the TOC after proposed treatments.

c. Greater than 40 percent of RHCA acres proposed for vegetative treatment.

d. These are the subwatersheds at the TOC under existing conditions (without treatment).

The Design Criteria developed to meet the Riparian Management Objectives (RMOs), which are described in chapter 2 of this EIS, include buffers prohibiting ground-based equipment from within 100 to 150 feet of perennial drainages, ponds, and lakes. The proposed vegetation and fuel treatment activities would occur during the dry season when any potential frogs would not be traveling overland but would be in riparian zones. Mechanical harvesting activities would not result in direct mortality because these activities would be scheduled during the nondispersal period (before October 15 or the first wetting rains) and because mechanical harvesting is prohibited in RHCAs. The findings from two years of the three-year MYLF telemetry study on the Plumas National Forest found that MYLF are closely associated with perennial streams, with movement of no more than 1–3 meters (~3–10 feet) from the edge of water, and that there was increased movement away from the stream channel during precipitation (Matthews et al. 2004–2005; MGW 2005, 2006). Implementation of the proposed treatments would be in accordance with riparian protection standards, which include Scientific Analysis Team guidelines and the associated RMOs (refer to section 4.2.4.6 in the "Soils and Hydrology" section of this chapter), in addition to all applicable Best Management Practices and Standard Resource Protection Measures for soils. Consequently, direct effects are not expected to occur.

Direct Effects of DFPZ, Area Thinning, and Mastication Treatments. Project activities requiring the use of heavy equipment (such as for timber harvest and mastication) or could cause ground disturbance (grubbing) would have the potential to disturb and/or kill individual frogs if they are present during those activities. The reduction of down woody material from fuel treatments may result in the actual crushing of frogs. The chance of this occurring would be minimal due to the close association this species has with water.

No direct adverse effects are expected to occur from project activities; however, potential direct effects could occur from proposed vegetation and fuels treatments in RCHAs. Loss of riparian vegetation, especially along shorelines, would increase access for predators and reduce estivation sites. Decreased shading of aquatic systems would increase water temperatures, which could cause reduced rates of embryonic survival and potentially contribute to the declining trend in frog populations. In addition, the initial thinning of conifers could decrease input of leaf fall and insects from floodplains into streams, which could contribute to a decrease in a primary food source. A reduction in availability of this organic material may result in poor survival of tadpoles to metamorphosis. Organic debris serves as concealment for larvae, and loss of such hiding cover makes the larvae more susceptible to predation. These factors could contribute to declining population trends. However, any potential adverse direct effects would be avoided by implementation of project design standards, Limited Operating Periods, and management standards and guidelines. In addition, specific mitigation measures have been developed for alternative D—these are described in chapter 2.

Direct Effects of Prescribed Fire. Direct impacts can result from prescribe fire treatment. It is assumed that the normal window for prescribed fire would be in the latter part of spring as the snowmelts and fuels begin to dry or in the fall months after sufficient rainfall has occurred to minimize the chances of escape fire. The spring and fall are both periods of active movement of frogs.

Frogs often disperse from their breeding habitat to forage and seek summer habitat if water is not available. The summer habitat could include spaces under boulders or rock and organic debris such as downed trees or logs. Any movement of large woody debris may result in the actual crushing of frogs and/or the reduction of non-riparian habitat.

Direct Effects of Road Treatments. All action alternatives propose to decommission 9.6 miles of road that have been identified as egregious to the aquatic system. The Diamond Project Interdisciplinary Team (ID Team) has determined that these roads degrade water quality and the associated aquatic species habitat for macroinvertebrates, MYLF, and trout MIS. The proposed closure and decommissioning of these roads would reduce the potential for erosion into the aquatic system and impairment of water quality.

The ecological processes that occur in the hyporheic zones (where the land and water meet in saturated sediments beneath and beside a river channel) can have strong effects on stream water quality. Rivers with extensive hyporheic zones retain and process nutrients efficiently, which has a positive effect on water quality and on the ecology of the riparian zone. Scientific research emphasizes the importance of maintaining connectivity between the channel, hyporheic zones, and riparian components of a river ecosystem (as cited in Rotta and Hopkins 2004). The proposed decommissioning of 9.6 miles of roads (and associated improvement and/or removal of culverts over drainages) would help restore this connectivity.

Direct Effects of Construction of Aquatic Species Passage, Headcut Repair, and Aspen Regeneration Treatments. Mechanical equipment would be used to replace and/or construct aquatic species passage structures, construction of headcut structures, and to skid felled conifer trees in the RHCAs as part of the proposed aspen treatments. The Design Criteria described in chapter 2 of this EIS include buffers prohibiting ground-based equipment from within 100 to 150 feet of perennial drainages, ponds, and lakes for aspen treatments. Mechanical equipment would be allowed within the stream channel in areas for improve aquatic species passage and to construct headcut structures. One structure is proposed within known MYLF habitat at the top of Boulder Creek.

Direct Effects of DFPZ, Area Thinning, Cypress Restoration, and Mastication Treatments. Project activities that would require the use of heavy equipment (such as for timber harvest and mastication) or could cause ground disturbance (grubbing) would have the potential to disturb and/or kill individual frogs if they are present during those activities. The reduction of down woody material from fuel treatments may require physical relocation of MYLF because movement of such material may result in the actual crushing of frogs and/or the reduction of non-riparian habitat.

Indirect Effects of DFPZ, Area Thinning, and Mastication. Riparian habitats would be entered during DFPZ and area thinning treatments for the purpose of restoring, maintaining, or improving riparian habitat conditions. Treatments would include the removal of encroaching vegetation or vegetation that is lowering the water table. The short-term direct beneficial effects on some habitats and habitat connectivity over the long-term would result from the reduction of fuel accumulation and, thus, a reduction of the risk of stand-replacing fires. There effects would benefit aquatic/riparian-dependent species. Large fires create large-scale, high-contrast fragmentation across the landscape, which removes suitable MYLF habitat, isolates habitat patches, and creates large openings that may prevent species occupancy, emigration, and immigration. Thus, the action alternatives would reduce the long-term threat of stand-replacing fires, which would offset their short-term minor effects (USDA 2003).

The MYLF dispersal habitat provides riparian connectivity between breeding habitat, summer and over-wintering habitat, and potential upland habitat. There are a total of 3,003 acres of RHCAs in the 12 subwatersheds (refer to table 4-24) with known MYLF occupancy. Prior to implementation of the action alternatives, three of the subwatersheds are currently over the TOC. The action alternatives propose RHCA treatments in approximately 520 to 939 acres, or 17 to 31 percent of the total RHCA acres in the 12 subwatersheds. Eight subwatersheds would be over the TOC with implementation of the action alternatives and would have the potential for adverse cumulative watershed effects.

With implementation of the project design standards, streamside zones would maintain effective filter and absorptive zones for sediment originating from upslope treatment areas. The removal of vegetation in these equipment-exclusion zones would be allowed and would be determined on a site-by-site basis to protect the sensitive attributes associated with riparian areas.

In addition, proposed treatments would normally occur when soil conditions are such that compaction in minimized, however, soil disturbance or displacement does take place. Exposed, unprotected soil has the potential to move into the aquatic system as a result of the season's first significant rain. High levels of sediment can fill deep pools, alter and fill interstitial spaces in streambed materials with fine particulates, change flow characteristic, reduce dissolved oxygen, and restrict waste removal (Chapman 1988).

Mechanical vegetative and fuel treatments may have down slope effects on habitat. Mechanical treatments may involve removing woody material, either standing woody material or down woody material. This open stand condition would tend to result in warmer, drier conditions that are inhospitable to MYLF. In order to help maintain favorable microclimates in RHCAs, hardwoods would be retained in all units. This is especially important in the known MYLF creeks that include Boulder, Lone Rock, Pierce, Thompson, and Moonlight.

The retention of larger fuels, forest floor cover, and deciduous hardwood trees would help maintain the nutrient reservoir stored in organic material. Within the immediate riparian areas, the physical effects derived from in-channel large woody debris (LWD) would be retained because no natural debris would be removed. Future recruitment of LWD, which is structurally important for channel morphology, channel function, and bank stability, would be encouraged through snag retention requirements and release of existing live conifers.

Within RHCAs, the green line would be preserved and remain unaffected by harvest activities. The stability and effective function of the stream channels to route flood discharges is maintained or restored. Within the immediate riparian areas, the physical effects derived from in-channel large woody debris would be sustained because no natural in-channel debris would be removed. Future recruitment of large woody debris would be encouraged through the release of the existing conifers and by meeting the snag retention standards for channel morphology, channel function, and bank stability. Area thinning in RHCAs may initially reduce the interception of precipitation, thus potentially increasing runoff in the short term; conversely, area thinning in the RHCAs may reduce evapotranspiration, thus promoting retention of groundwater.

The retention of overstory litter fall would provide substrate for macroinvertebrate shredders, which helps maintain the integrity of the stream ecosystem. Riparian zones (specifically, the green line), springs, seeps, and bogs would be identified and protected from harvest activities. The

Mt. Hough Ranger District silviculturist estimates that minimal skid trails would cross stream channels. In addition, it is expected that none of the skid trails associated with DFPZ construction and area thinning would cross RHCAs. Consequently, indirect effects due to skidding would likely not occur or, at the most, would be minimal.

Indirect Effects of Prescribed Fire. Approximately 736 acres of prescribed burning is proposed in DFPZ and Area Thinning Units that occur in RHCAs. The prescribed fire design standards allow only backing fire, which would reduce the loss of riparian vegetation and duff layer and thus prevent soil erosion. No ignition of prescribed fire would occur within 25 horizontal feet of perennial streams and 15 feet of seasonal streams; however, backing fire would be allowed into these areas (refer to table 4-18 in the "Soils and Hydrology" section of this chapter). The loss of streamside vegetation and duff layer in riparian areas after prescribed fire could result in increased short-term sediment delivery to streams. The fire intensity of these burns should be low enough to allow some retention of duff layer and riparian vegetation, which would prevent soil erosion and expedite recovery. However, scorched conifers often drop needles following low- or moderate-severity fires, and this needle cast provides ground cover that can help reduce erosion and sediment delivery (Pannkuk and Robichaud 2003). Despite the risk of erosion, the greater long-term benefit of treating RHCAs would be the potential protection from catastrophic wildfire. Additionally, the reduction in the risk of habitat loss due to wildfires resulting from prescribed fire activities would have long-term benefits for these watersheds.

The prescription for the RHCA would minimize the loss of ground cover, minimize erosion and sedimentation, and reduce impacts on fish, amphibian, and reptile habitat. The Standard Resource Protection Measures (see appendix C) would also contribute to minimizing indirect effects on amphibian and reptile species. Burns occurring before the first soaking rains of the fall are least likely to indirectly affect amphibians and reptiles, as they are most likely to be in RHCAs at that time. Burns occurring during the spring are more likely to cause indirect effects on any potential amphibians and reptiles because individuals are most likely to be outside RHCAs at that time. Water temperatures would not be affected because very little canopy cover would be removed along streams.

The prescribed burns would be designed to retain large pieces of dead and down material and maintain adequate ground cover to reduce erosion. The implementation of Standard Resource Protection Measures for the project would reduce the probability of habitat loss for all species following prescribed fire. The proposed project could have a beneficial indirect effect because it may reduce the potential for a stand-replacing wildfire, which is a threat to habitat for forest-dwelling species.

Pile burning could potentially harm any amphibians or reptiles that use the piles as shelter during overland dispersal (fall through spring), but Best Management Practices and Scientific Analysis Team and RHCA guidelines, Design Criteria, and Limited Operating Periods would be applied prior to implementation of treatments to reduce the potential for effects on aquatic species.

Indirect Effects of Road Treatments. The building of roads and their continued use have the potential to be the largest contributor of surface erosion and delivered sediment. Early erosion and delivered sediment modeling (Gray and Megahan 1981) in the Idaho batholith concluded that a standard 16-foot road on a 5–7 percent grade could produce 67,500 tons per square mile of eroded material after the first year of construction, declining to a steady state rate of 5,000 tons per square mile after three years.

The action alternatives propose 6–9 miles of road reconstruction to improve drainage and grade the road in order to reduce sedimentation into the streams. There would be an increased initial pulse of sediment into the aquatic habitats from road reconstruction, and sediment may be reduced due to proposed road activities. In all action alternatives, 9.6 miles of roads are proposed for decommissioning (some may be re-contoured, subsoiled, seeded, and reforested), which would allow vegetative recovery and lead to decreased compaction, increased infiltration into the roadbed, and increased soil stability and would also limit concentrated flow as well as surface erosion derived from temporary roads. All temporary roads would be decommissioned after use.

During dust abatement activities, in-stream flows would be assessed during equipment operations, with respect to drafting requirements.

Indirect Effects of Aquatic Species Passage. Riparian and aquatic habitats necessary to foster the unique genetic fish stocks would be maintained and restored by the proposed management practices. Culvert replacements would allow fish passage and improve trout distribution in Lone Rock, West Branch Lights, Morton, and Boulder Creeks, and tributaries to Hungry and Indian Creeks.

There would be long-term direct beneficial effects from improving aquatic connectivity and resizing the culverts to accommodate a 100-year flood in the Project Area. The proposed aquatic species passage projects would improve watershed connectivity and open up 10–20 miles of potential moderate to high quality stream habitat. Aquatic species passage is proposed primarily in drainages without known populations of MYLF but with a known fishery. All applicable Best Management Practices would be implemented during the replacement of the culverts. Mulching and revegetation would be implemented as determined on a site-by-site basis to prevent soil erosion following project implementation. This work would be conducted in fall when the water level is lower, and there would be fewer impacts on fish.

The installation (replacement) of culverts would create short-term direct effects for one to three months—effects would include increased sedimentation and reduced water quality from the ground-based equipment that would be used in the drainage during culvert replacement. There is the very slight potential for a MYLF to get crushed by equipment or suffocated by sediment churned up by the installation of a new culvert or upgrading of the existing culvert. The treatment sites would be electrofished prior to construction.

Indirect Effects of Headcut / Meadow Restoration. There would be 100- to 150-foot buffer around wetlands and ponds in which mechanical equipment would not be allowed to enter. An aquatic or terrestrial biologist would check stream crossings, springs, and water sources for the presence of sensitive frog or turtle species prior to project implementation.

The repair of headcuts would reduce downstream sedimentation onto potential MYLF habitat and improve water quality. There would be an improvement in properly functioning conditions and thus improved water retention in the meadows and increased instream flows later into the summer. There would be a short-term flush of sediment into the stream channels from equipment in these stream channels, resulting in the potential to affect MYLF egg masses and tadpoles.

Indirect Effects of Aspen Thinning Treatments. The diversity and productive nature of native and desired nonnative plant communities in the riparian zone would be maintained or restored by the proposed DFPZ, area thinning, and aspen treatments in the RHCAs. Thinning conifers and retaining all hardwood species in RHCAs would reduce competition with deciduous hardwood species. Some RHCAs would be thinned to promote aspen health in the treatment areas. The treatment of Canada thistle would help control this invasive noxious weed. Without these treatments, plant biodiversity would be compromised by riparian plants competing with conifers for sunlight, water, and nutrients. The retention of overstory litter fall would provide substrate for the macroinvertebrate shredders that help maintain the integrity of the stream ecosystem. Riparian zones (specifically the green line), springs, seeps, and bogs would be identified and protected from harvest activities.

Cumulative Effects. The existing condition is an aggregate of past actions as described in appendix B. All the past actions listed in appendix B have resulted in what is now the baseline for the cumulative effects analysis.

Cumulative effects on amphibian habitat have occurred from vegetation management, recreational uses, cattle grazing, introduction of nonnative species, road construction, timber salvage activities, water diversions, and wildfire. The 2001 Stream Fire was a high-severity fire that burned through Lone Rock and Cold Creeks.

Stream condition surveys were conducted in RHCAs located within DFPZ Treatment Units. Surveys were conducted in subwatersheds under, approaching, and exceeding the TOC. Some of the streams surveyed have had cumulative effects from past disturbances and have experienced new cumulative effects from timber harvesting on private land, roads, and urban development (refer to the "Hydrology Report" in the project file for more specific information).

The Record of Decision on the HFQLG Act final EIS, and its associated Scientific Analysis Team guidelines for DFPZ construction, and the Record of Decision on the SNFPA aquatic strategy for DFPZ maintenance would not only prevent or strictly control any additional impacts on frog habitat, but would result in actual habitat restoration and enhancement for some streams. It is unlikely that the proposed activities would be a significant addition to cumulative effects on aquatic species. Habitat characteristics would not change to a degree where these effects would limit populations, so there would likely be very few cumulative effects. Cumulative effects are expected to be low because direct and indirect effects would be minimal.

Cumulative effects on the MYLF could occur with the incremental loss of the quantity and/or quality of habitat for this species. Overall, increases in recreational use of the National Forest lands, and the use (through grazing, recreation, timber harvesting, road construction, OHVs, and mining) of natural resources on private and federal lands may contribute to habitat loss for this species. Appendix B lists the past, present, and reasonably foreseeable future actions that would contribute to cumulative effects in the Project Area.

4.3.4.3 Alternatives A (No Action): No Borax Treatments

Without treatment of stumps greater than 14 inches dbh, the fresh cut stumps would be susceptible to *annosum* spore colonization and an increase in the spread of *annosum* root disease. This would increase the potential of mortality in the dominant and codominant trees, lower tree canopies from the resulting mortality, and the associated increase in fuel density. These conditions would create an initial increase in large woody debris (LWD) recruitment into the stream channels over the 50 years that this disease can persist in the forest and then a reduced LWD recruitment due to reduced dominant and codominant trees in the stand due to this potential infection. This could affect the microclimate of the RHCAs and degrade suitable MYLF habitat in the future.

4.3.4.4 All Action Alternatives (B, C, D, and F): Borax Treatments

All action alternatives propose to apply Borax (trade name, Sporax®) to all harvested conifer stumps 14 inches in diameter and greater in Fuel Treatment Units, Area Thinning Units, and Group Selection Units (as specified in chapter 2, section 2.2.6 "Design Criteria Common to All Action Alternatives) to minimize residual tree susceptibility to *annosum* root rot.

Direct and Indirect Effects of Borax Treatments. The projected levels of Borax application (in pounds per acre) for each treatment and prescription are displayed in table 4-12 (refer to section 4.1 above). The suggested application rate of 1 pound per 50 square feet of stump surface would be applied to freshly cut stumps (Wilbur Ellis 2001). This application rate and projected levels of Borax application is consistent and well within those analyzed in the Human Health and Ecological Risk Assessment for Borax (Sporax®) Final Report (USDA 2006). Based on the Pesticide Fact Sheet prepared by Information Ventures, Inc. (1995), this rate is considered nontoxic to vertebrate species. Kliejunas (1991) presents data that suggest that the proper use of Borax to prevent *annosum* root disease poses a very low risk of adverse environmental effects, and that Borax diffuses quickly into the stump and is not available for leaching into the ground surrounding the stump. The actual doses resulting from stump treatments would be expected to be orders of magnitude lower (see section 4.1 and table 4-12 above).

The SERA risk assessment final report (USDA 2006) concludes, "the use of Sporax in Forest Service programs will not typically or substantially contribute to concentrations of boron in water or soil." In addition, the SERA report concludes "the use of Sporax® in the control of annosum root disease does not present a significant risk to humans or wildlife species under most conditions of normal use, even under the highest application rate" (USDA 2006).

Boron, the agent of toxicological concern in Borax, was further evaluated in the most recent risk assessment for Borax (USDA 2006). The evaluation focused on wildlife species' direct consumption from the stump and ingestion of contaminated water. Field trials reported in this assessment revealed that the use of Borax on stumps does not present a significant risk to wildlife species under most conditions of normal use, even under the highest application rates. With implementation of Best Management Practices, Standard Management Requirements, and project design standards, there should be no negative direct, indirect, or cumulative effects on MYLFs or their habitat from the application of Borax to stumps in the Project Area.

4.3.5 Environmental Consequences of Each Action Alternative

4.3.5.1 Alternative B (Proposed Action)

Direct Effects. Alternative B proposes that 6–7 road crossings be replaced or improved to facilitate all life stages of aquatic species passage. The installation (replacement) of culverts or raising the pool-tail crest would create short-term direct effects lasting 1–3 months. The effects would include increased sedimentation and reduced water quality from the ground-based equipment that would be used in the drainage during culvert replacement. There would be the very slight potential that an MYLF could get crushed by equipment or suffocated by sediment churned up by the installation of a new culvert or upgrading of the existing culvert. The treatment sites would be electrofished prior to construction.

There would be no direct effects on MYLF from the headcut restoration projects.

Indirect Effects. Alternative B would have the greatest amount of mechanical treatments (8,430 acres), so there would be the greatest amount of ground disturbance from equipment, skid trails, and landings.

Alternative B proposes the greatest amount of RHCA treatment (hand thinning, mechanical thinning, mastication, and underburning – 1,450 acres).

The cumulative Equivalent Roaded Acre (ERA) values would exceed the TOC in seven subwatersheds, placing them all at a high risk for cumulative effects. Large ERA increases, approaching the TOC, would place two additional subwatersheds at a high risk of cumulative watershed effects. Tables 4-24 above shows the subwatersheds that have known populations of MYLF and also those subwatersheds that are at or above the TOC. The Lower Lone Rock Creek subwatershed is above threshold (a TOC of 16 percent), and none of the action alternatives propose activity in this subwatershed. Alternative B proposes 1.3 more miles of reconstruction. Any potential effects on downstream beneficial uses would be mitigated by the decommissioning and/or closure of 9.6 miles of roads. Approximately 33.2 miles of road would be reconstructed under alternative B, which would help reduce erosion and sedimentation and mitigate increased sediment to downstream MYLF habitat that would be produced by the 2 miles of new road construction proposed under alternative B.

Cumulative Effects (Alternatives B, C, D, and F). The values shown in table 4-24 above for the ERA percent of TOC would be within 20 to 25 percent in nine subwatersheds. Three of those nine subwatersheds currently have high ERA values and are well over the TOC due to the 2001 Stream Fire. The cumulative effects analysis for the MYLF includes the Watershed Analysis Area, which encompasses private and federal lands, 48 subwatersheds, Antelope Lake and associated recreation areas, and eight grazing allotments. The cumulative effects Analysis Area was bounded in this manner because these subwatersheds and associated aquatic habitat encompass any area the proposed action alternatives may affect. The Diamond Project would impact a range of 11,342 to 14,512 acres of vegetation treatments. Twelve subwatersheds (as listed in table 4-24 above) have known MYLF populations with a total of 3,003 acres of RHCAs. Alternatives B, C, D, and F propose to treat 520–939 acres (17–31 percent of the acreage within RHCAs).

The past, present, and reasonably foreseeable future actions are described in appendix B and in detail in the “Terrestrial Wildlife” section below—the effects of those actions are described below. In addition, a complete cumulative watershed effects analysis has been completed.

The analysis of cumulative effects on aquatic species included actions implemented over the past 35 years and those actions that could be implemented 35 years into the future. This timeframe is the length of time that forest management activities can take to recover on the eastside of the Plumas National Forest. In addition, the terrestrial wildlife section below goes back approximately 30 years, with some narrative of the extensive logging that occurred in the late 1800s to mid-1900s. Those past logging activities removed a substantial component of the large-diameter conifers. Clearly, intensive timber management has reduced the size of large woody debris in the stream reaches within the Watershed Analysis Area. The 2001 Stream Fire created an abundance of snags over a 3,000-acre area, with very high snag densities still existing in the majority of the fire landscape. The recruitment of medium to large woody debris is prominent in the area affected by the Stream Fire along Cold Stream, where high concentrations of medium to large snags are still standing or have fallen into the stream due to at high-severity wildfire.

Based on the cumulative effects analysis, the habitat for MYLF is in low to moderate condition from all the past and present management activities and hydrologic and weather events. There is a trend of improvement of the reaches monitored over 5–10 years, possibly due to the increased protective standards and guidelines implemented by the state of California and included in the Records of Decision on the HFQLG final EIS and SNFPA final supplemental EIS. Under the action alternatives, five to six of the subwatersheds with known MYLF are above the TOC and susceptible to adverse watershed effects. In addition, two subwatersheds are at the TOC and are also susceptible to adverse watershed effects (refer to table 4-26 above). In the event of future hydrologic events, these subwatersheds would be susceptible to erosion and could generate large pulses of sediment into the stream channel. However, detailed Design Criteria (see chapter 2 of this document) should prevent adverse effects on the MYLF. The assessment of cumulative effects was made based on implementation of riparian and aquatic protection measures proposed for the action alternatives. It is expected that cumulative effects based on implementing alternative B, D or F would have minimal indirect effects, and direct adverse effects of herbicides are not expected to occur.

It has been determined that with implementation of Standard Management Requirements, Best Management Practices, standard and guidelines, and project design standards, there would be minimal to no cumulative effects on MYLF from the action alternatives. Therefore, in conclusion, direct and indirect effects may impact individual species, but cumulatively, this would not lead to a trend toward listing.

4.3.5.2 Alternative C (No Herbicides)

Direct Effects. Herbicides are not proposed under alternative C, so there would be no potential for direct effects on aquatic species from herbicide use.

Indirect Effects. All indirect effects would be similar to alternative B, except those that would result from herbicide treatments because none are proposed in alternative C. There is the potential for indirect effects on aquatic species habitat from the proliferation of Canadian thistle in riparian habitats and the competition this plant can create for native riparian plant species and on water, space, and soil nutrients.

The effects on rare plant species as a result of vegetation and fuels treatments would be the same as those discussed in the previous section for alternatives B, D, and F. Since no herbicides are proposed under alternative C, there would be no indirect effects from herbicide treatments. The primary difference between this alternative and the action alternatives is the potential for indirect effects resulting from increased spread of noxious weed species.

Under this alternative, the control of noxious weed introduction and spread is addressed through a combination of nonherbicide treatment methods that include hand pulling, cutting, mowing, and covering. Alternative C proposes to treat fewer locations and acres of noxious weeds due to both time and feasibility constraints (see the "Botanical Resources and Noxious Weeds" section (4.5) in this chapter for a complete discussion). Under alternative C, weed infestations would continue to expand in areas not treated, and sensitive plant species occurring near noxious weed locations that were not treated would have a higher likelihood of being impacted by future weed spread.

Cumulative Effects. The cumulative effects of vegetation and fuels treatments would be the same as those discussed in the previous section for alternatives B, D, and F. The primary difference between alternative C and the other action alternatives is an increased risk of noxious weed spread from lack of herbicide use under alternative C.

4.3.5.3 Alternative D

Direct Effects. Alternative D proposes 26.7 miles of road reconstruction, which would include improving or replacing road crossings to facilitate all life stages of aquatic species passage. The installation (replacement) of culverts or raising of the pool-tail crest would create short-term direct effects (1–3 months), such as increased sedimentation and reduced water quality, from the ground-based equipment that would be used in the drainage during culvert replacement. There is the very slight potential for an MYLF to get crushed by equipment or suffocated by sediment churned up by the installation of a new culvert or upgrading of the existing culvert. The treatment sites would be electrofished prior to construction.

There would be no direct effects on MYLF from the headcut restoration projects.

Indirect Effects. Alternative D would have a moderate amount of mechanical treatments (1,000 acres less than alternatives B and C but 1,150 acres more than alternative F), so there would be a moderate amount of ground disturbance from equipment, skid trails, and landings. The direct, indirect, and cumulative effects on soil productivity would be similar to alternatives B and C and greater than alternatives A and F. Table 4-24 above identifies the 12 subwatersheds where MYLF are present and the percent change in ERA value, by alternative, from the existing condition. The table also identifies the subwatersheds that are at or would be above the TOC following implementation of any of the action alternatives. Mitigation measures (see chapter 2) have been designed to reduce the potential for adverse down stream cumulative effects. The mitigation measures include the retention of pockets of healthy conifer regeneration to maintain cool, damp microclimate in the summer. These dense younger stands (high risk fire stands) can provide the environmental conditions (cooler, damper microclimate conditions) used by frogs during dispersal and uplands use. The proposed fuels reduction treatments would result in a more open stand condition but would maintain a minimum 50 percent canopy closure.

Fewer miles of road reconstruction are proposed in alternative D, so there would be less improvement of drainage and grade of the road to reduce sedimentation into the streams. There would be an increased initial pulse of sediment into the aquatic habitats from road reconstruction, but there are 1.3 less miles of road construction proposed in alternative D. Any potential effects on downstream beneficial uses would be mitigated by the decommissioning and/or closure of 9.6 miles of roads. Approximately 26.7 miles of road would be reconstructed, which is approximately 6.5 miles less than alternative B. These actions would reduce erosion and sedimentation and mitigate increased sediment to downstream MYLF habitat produced by the 0.7 mile of new road construction proposed under alternative D.

Cumulative Effects. The cumulative effects for alternative C would be the same as those described above for alternative B.

4.3.5.4 Alternative F

Direct Effects. Fewer acres are proposed for treatment in the RHCAs. There would be less potential for frogs to be crushed by mechanical equipment due to decreased activity. Design Criteria (refer to chapter 2) have been developed to prevent direct and indirect impacts on MYLF and other aquatic species.

Indirect Effects. Alternative F would have the least amount of mechanical treatments among the action alternatives, so there would be a lower amount of ground disturbance from equipment, skid trails, and landings. The direct, indirect, and cumulative effects on soil productivity would be less than alternatives B, C, and D and greater than alternative A.

Table 4-24 above identifies the 12 subwatersheds where MYLF are present and the percent change in ERA value, by alternative, from the existing condition. The table also identifies the subwatersheds that are at or would be above the TOC following implementation of any of the action alternatives. Any potential cumulative watershed effects would be mitigated by the retention of vigorous groups of regeneration and by applying Standard Management Requirements and Best Management Practices. As with all action alternatives, the building of roads and their continued use have the potential to be the largest contributor of surface erosion and delivered sediment. Fewer miles of road reconstruction would be implemented with alternative F, so there would be less improvement of drainage and grade the road to reduce sedimentation into the streams. There would be an increased initial pulse of sediment into the aquatic habitats by proposed road reconstruction (24.2 miles) and 0.7 mile of road construction, which is 1.3 miles less than in alternatives B and C and the same as alternative F. Any potential effects to downstream beneficial uses would be mitigated by the decommissioning and/or closure of 9.6 miles of roads. The proposed road treatments would reduce erosion and sedimentation and mitigate increased sediment to downstream MYLF habitat

Cumulative Effects. The cumulative effects for alternative F would be the same as those described above for alternative B.

4.3.6 Herbicide Hazard Analysis

Chapter 2 describes the proposed herbicides for treating noxious weeds in the Diamond Project Area. Pages 101–107 of the BA/BE for the HFQLG Act final supplemental EIS (USDA Forest Service 2003) describe the factors that influence how wildlife may be exposed to herbicides. Several of these factors are used to calculate exposures of herbicides on animals (expressed as potential doses to animals). Pages 107-141 of the BA/BE illustrate a wide range of exposure scenarios for avian, mammal, fish, and invertebrate test species and look at only the typical application rates of the highest exposures for the two herbicides. An assumption was made that the exposure scenarios would be representative of the effects on wildlife species considered in the analysis in this EIS.

Herbicide effects related to individual species are discussed below in the direct and indirect effects discussions. The effects of herbicide use have been fully evaluated; however, there is a vast amount of information regarding herbicides use that cannot be summarized completely in this document.

4.3.6.1 Proposed Surfactants With Herbicide Application

Hi-Light® Blue and Syl-tac™ are proposed surfactants to improve the performance of the proposed herbicides.

Hi-Light® Blue. This is a water-soluble dye that contains no listed hazardous substances. It is considered to be virtually nontoxic to humans. Its effect on nontarget terrestrial and aquatic species is unknown, although its use has not resulted in any known problems. The dye used in Hi-Light® Blue is commonly used in toilet bowl cleaners and as a colorant for lakes and ponds (SERA 1997b).

Syl-tac™. Syl-tac™ has a signal word of "Caution." It may cause slight skin and eye irritation. Syl-tac™ is a mixture of two other products (Hasten® and Sylgard® 309).

Hasten®. The main ingredient in Hasten® is identified in the Syl-tac® product information as esterified canola seed oil. The Material Safety Data Sheet lists isopropylamine as a hazardous ingredient at levels of 2 percent in the formulation. Isopropylamine is a severe eye and skin irritant and can be harmful if inhaled in large amounts. The Occupational Safety and Health Administration and National Institute for Occupational Safety and Health have established standards for inhalation limits during a workday for this material. It is more acutely toxic than the Hasten® formulation, with oral LD_{50} (lethal dose – see the "Glossary" for a definition) values in a rat of 820 milligrams per kilogram (mg/kg). Hasten® is not considered a mutagen (something that increases the rate of mutation of cells or organisms).

Sylgard® 309. No significant findings of biological relevance were seen in females, while males showed some effects (body weight gain and changes in food consumption) at the highest dose (see the "Human Health Risk Assessment" in appendix E of this document). This would indicate a subchronic NOEL (No Observed Effect Level) of 300 mg/kg/day. There has been concern expressed about the toxicity of silicone-based surfactants on terrestrial insects.

4.3.6.2 Alternatives B, D, and F (With Herbicide Use): Effects on Mountain Yellow-legged Frog

The SERA risk assessments (SERA 2003, 2004) reference very few studies related to the effects of herbicides on any amphibian species, and there are extremely limited published data on the effects of the proposed herbicides on MYLF.

The project Design Criteria (presented in chapter 2) for herbicide application retain a 50- to 150-foot buffer from streams with sensitive amphibians. Glyphosate (Roundup®) would be used within 50 to 150 feet of known MYLF-occupied drainages, and clopyralid would be used within 150 feet of known MYLF-occupied drainages.

Direct Effects. An accidental spill of glyphosate and clopyralid in RHCAs occupied by MYLF could cause potential direct effects on all life stages of MYLF.

Glyphosate (Roundup®) has been tested on few amphibian species. The tests were conducted mostly under laboratory conditions and on larval amphibians. Recent laboratory studies indicate that Roundup® may be highly lethal to North American tadpoles, but a determination needs to be made as to whether this effect also occurs under more natural conditions and in post-metamorphic amphibians.

Tadpoles were found to be many times more sensitive to the full Roundup formulation of glyphosate than juveniles or adults (Bidwell and Gorrie 1995; Mann and Bidwell 1999) and considerably more sensitive to the formulation of technical grade glyphosate. The difference in toxicity between glyphosate and Roundup® is likely due to the toxicity of the surfactant in the formulated herbicide. This surfactant toxicity has been recognized for several years in fish. Some surfactants affect aquatic organisms by damaging gills. This may explain why tadpoles, which respire with gills, are more sensitive to Roundup® than adult frogs. The lethal concentration (LC_{50}) values indicate little safety margin between concentrations in shallow waters and LCs for frogs (Roberts 2003; Bidwell and Gorrie 1995) (see the "Glossary" at the end of this document for an explanation of LC_{50}).

As classified by the U.S. Environmental Protection Agency, glyphosate formulations are considered practically nontoxic to birds and mammals, moderately to practically nontoxic to fish and invertebrates, and slightly to moderately toxic to amphibians (Giesy et al. 2000). Thus, the conventional wisdom has been that the application of glyphosate, a chemical designed to kill plants, has minor effects on any animals that might be present. Yet, in a study by Relyea in 2005, it was shown that Roundup®, a compound designed to kill plants, can cause extremely high rates of mortality in amphibians, which could lead to population declines.

For larval amphibians, glyphosate has been tested on relatively few species (Mann and Bidwell 1999; Perkins et al. 2000; Lajmanovich 2003), including only four species of tadpoles in North America (Smith 2001; Chen et al. 2004; Edginton et al. 2004; Howe et al. 2004; Thompson et al. 2004; Wojtaszek et al. 2004). Collectively, this represents 0.2 percent of amphibian species (Relyea 2005).

There is the potential for a loss of individual MYLF with a potential of a spill or a frog being accidentally sprayed during application. The potential for this is very low due to implementation of herbicide design standards, herbicide spill plan, and Best Management Practices.

Indirect Effects. Even though aquatic and riparian habitats would be avoided, the potential for run-off, percolation, and herbicide drift into watercourses or spray contaminating food sources, such as invertebrates and aquatic or riparian plants, is of some concern.

Surface and subsurface runoff and wind erosion are particularly important in the aquatic environment. Under normal and expected conditions of herbicide and surfactant use, background concentrations would be found in the aquatic environment. This concentration is highly site-specific and depends on many factors, including the mobility of a given herbicide in the soil, soil type, soil pH, soil moisture holding capability, rainfall, and application rate, chemical degradation, and ambient and soil temperatures. For specific information regarding these factors, refer to the "Environmental Fate" section (appendix F of the 2003 HFQLG Act final supplemental EIS). Estimates of background herbicide concentrations in the aquatic environment following normal herbicide application are given in the SERA assessments (SERA 1996–2001 and 2003).

The acute exposure for a stream contaminated by runoff and/or percolation was available for glyphosate. All were below lethal and NOEC (No Observed Effect Concentration) levels. The acute exposure for a stream contaminated by runoff and/or percolation for fish species is discussed above under risk assessment and an effects discussion below. Acute exposures were below the lethal dose / lethal concentration (LD/LC_{50}) for glyphosate.

In compliance with the Design Criteria presented in chapter 2, the application of herbicides would not occur within a 50-foot buffer from streams with sensitive amphibians and would not occur within a 10-foot buffer of streams without known sensitive amphibian populations. Glyphosate is proposed for use in the RHCAs and would be applied with a hand applicator, so there would be minimal "drift" or exposure of nontarget species. Clopyralid has the potential to leach into the groundwater, persist in soils, and is not proposed within RHCAs. Clopyralid would not applied within 100 feet of ephemeral and intermittent streams or within 150 to 300 feet of perennial nonfish-bearing and fish-bearing streams. The persistence of clopyralid in soils is described as ranging from "persistent" to "nonpersistent." In a differing opinion, Cox (1998:17) cited several sources (Pik et al. 1977; Bovey and Richardson 1991; and Tanphiphat and Burrill 1987) in describing clopyralid as persisting in soil from 2 to 14 months after application, depending upon soil type, climate, and other factors. Again, site-specific environmental conditions probably drive these determinations. The potential for clopyralid leaching is best considered site-specifically; for instance, sandy soil, sinkholes, or severely fractured surfaces with high rainfall, a shallow water table, and sparse microbial population are most likely to experience leaching (SERA 1999) and groundwater contamination (Information Ventures, Inc. 1995). "There is a high potential for clopyralid to leach into groundwater when applied over shallow aquifers or to soils having high permeability" (U.S. Department of Energy 1999). The soils in most of the Diamond Project Area is decomposed granite and highly porous.

The probability is very low that a detectable level of either of the two proposed herbicides would reach surface waters (flowing streams, springs, seeps, and wetlands/riparian areas). The probability of the Diamond Project violating a water quality standard would be very small—this is based on the glyphosate and clopyralid risk assessments (SERA 2003, 2004) and on the results of over eight years of monitoring glyphosate in Forest Service Region 5. At the levels proposed for application, neither clopyralid nor glyphosate is expected to have direct detrimental effects on water quality (refer to the "Soils and Hydrology," section 4.2 in this chapter).

Herbicide drift is also of concern. The factors considered are wind, slope, and air moisture. Invertebrate prey species and vegetation could be affected by herbicide drift, but actual effects are unknown. It is expected that any effects from potential drift of herbicides would be far less than from the exposure rates from direct spray. The potential for herbicide drift would be greatly reduced by the wick method of application. Any indirect effect on MYLF would be very low due to implementation of herbicide design standards, an herbicide spill plan, and Best Management Practices.

Cumulative Effects of Herbicide Activities. Chapter 2 provides a summary of the proposed herbicide use in the Watershed Analysis Area between 2000 and 2003. The closest documented herbicide use to the existing Pulsifer's milk-vetch locations is approximately 1 mile away on private land in Genesee Valley (CDPR 2006). The only known future herbicide activities on public lands in the Watershed Analysis Area are under the Roadside Noxious Weed Project. The closest location proposed for treatment under this project is located more than 2 miles away from the existing Pulsifer's milk-vetch locations. Taking these factors into account, as well as the negligible to minor direct and indirect effects that could result from the proposed herbicide treatments, the cumulative effect on this species as a result of these actions would also be negligible to minor.

4.3.7 Environmental Consequences: Aquatic Management Indicator Species

4.3.7.1 Alternative A (No Action): Effects on Rainbow Trout

Direct, Indirect, and Cumulative Effects. Alternative A does not propose any treatments (such as aquatic species passage, stream bank stabilization, meadow restoration, and road decommissioning) that would result in direct beneficial effects on fisheries habitat.

Under alternative A, the main transportation roads in the Project Area would remain in a less-than-satisfactory condition, allowing poor road access for the public and fire management to persist in some areas. Roads in good condition provide access for emergency response, woodcutting, mining, sightseeing, and other recreational activities. Roads not closed or decommissioned would continue to contribute to accelerating erosion processes, affecting rainbow trout habitat by altering water quality and aquatic habitat, and potentially increasing cumulative watershed effects.

There would be no application of herbicides in the Diamond Project Area, so no direct environmental effects associated with the application of herbicides would occur.

4.3.7.2 All Action Alternatives (All Treatments Except Herbicides): Effects on Rainbow Trout

A complete discussion of how the action alternatives meet the Riparian Management Objectives from the Scientific Analysis Team guidelines can be found in section 4.2.4.6 of the "Soils and Hydrology" section above. The cumulative watershed effects (CWE) analysis has determined the existing Equivalent Roaded Acres (ERAs) in the identified subwatersheds and the potential for the action alternatives to cause the subwatershed to exceed the TOC, possibly resulting in adverse cumulative watershed effects. Higher ERA values are generally associated with higher peak flows that are more erosive and can lead to increased channel scour and higher sediment loads off site. Stream channels in poor condition tend to be more sensitive to increased peak flows. The CWE analysis provides a detailed comparison, by alternative, of the ERA values in the RHCAs (refer to section 4.2 "Soils and Hydrology" in this chapter). As discussed in section 4.2, relatively large changes in ERA would translate to changes in the risk of detrimental effects, and marginal increases in ERA would result in similarly marginal changes in risk of detrimental watershed effects.

The ERA effects common to all action alternatives are described in section 4.2, as are the hydrologic direct, indirect and cumulative effects of alternatives B, C, and D. Alternatives B and C would increase the level of risk and uncertainty associated with effects of habitat change on rainbow trout within nine subwatersheds at high risk of cumulative effects. Alternative D could produce a risk of detrimental downstream effects within eight subwatersheds at high risk of cumulative effects. In addition, the potential adverse cumulative adverse watershed effects from implementation of alternative D would be reduced by the proposed mitigation measures (see chapter 2). Alternative F would increase the level of risk to a lesser degree than alternatives B, C, and D with five subwatersheds as risk of detrimental downstream effects. The direct and indirect effects of each alternative, together with the additive or cumulative effects of each alternative, have been considered in evaluating this risk and uncertainty. Indian above Antelope subwatershed #28 would be at the TOC with the implementation of alternative F and above the TOC with the implementation of alternative B, C, or D. A resident population of rainbow trout exists within this subwatershed. Again, those watershed at or above the TOC with streams in low to moderate condition are prone to increased turbidity and scour of the stream channel and degradation of rainbow trout habitat.

Stream channel integrity, channel processes, and sediment regimes would be maintained by meeting the management objective of only entering RHCAs if vegetative treatments would increase the size of residual trees in the RHCAs, prevent potential catastrophic wildfire, reduce future losses of large diameter trees and large woody debris (LWD) to fire, and increase future large woody debris recruitment of intermediate to large logs. In forested stream systems, debris can help maintain channel stability, decrease flow velocity, trap sediment, and protect banks from erosion (Berg et al. 2002). Ground-based equipment would only access slopes less than 25 percent, which would limit the amount of ground disturbance. The retention and concentration of large-diameter snags in RHCAs would occur. There may be short-term erosion from management activities, as discussed above, with a longer-term reduction in the risk of catastrophic wildfire.

The stability and effective function of the stream channels to route flood discharges would be maintained or restored. The green line in RHCAs would be preserved and would remain unaffected by harvest activities. Within the immediate riparian areas, the physical effects derived from in-channel large woody debris would be sustained because no natural in-channel debris would be removed. Future recruitment of large woody debris would be encouraged through release of the existing conifers and by complying with the snag retention standards for channel morphology, channel function, and bank stability. Thinning in the RHCA may initially reduce the interception of precipitation, thus potentially increasing runoff in the short term. Thinning in the RHCAs may reduce evapotranspiration, thereby retaining increased groundwater. The main objective is to reduce the potential for catastrophic wildfire, and thus, retain the RHCA's desired riparian and aquatic habitats, effective stream channel function, and the ability to route flood discharges. In-stream flows would be assessed during equipment operations, with respect to drafting requirements.

The proposed treatment activities are not expected to negatively impact the timing and variability of water tables in meadows and wetlands. The positive effects that would result from RHCA thinning include increased water percolation and groundwater, which may make more water available to meadows and wetlands. All sensitive riparian areas (springs, bogs, wetlands, and meadows) would be protected by the Scientific Analysis Team's guideline buffers and the implementation of Best Management Practices (BMPs). Wet meadows and green lines would not be entered. Ground-based equipment would only be allowed on stable soils, slopes less than 25 percent, and nonsensitive locations (in accordance with the BMPs – see appendix C).

All aquatic habitats supporting trout fisheries have been identified (MIS Report 2006). Activities proposed in the Project Area are not expected to negatively impact riparian vegetation. Summer and winter thermal regulations in the riparian and aquatic zones would be maintained. All group selection harvest would occur outside of RHCAs. Canopy cover over streams would not be removed. There would be no harvest of deciduous hardwoods, and thus, the green line would be maintained and enhanced.

Riparian vegetation and conifers in the RHCAs would be maintained or restored to help achieve rates of surface erosion, bank erosion, and channel migration characteristics of those under which the desired communities developed. The maximum erosion hazard, which ranges from moderate to very high, for soil types in the Diamond Project Area, suggests that channel development may have occurred under significant sediment loads (refer to the "Soils and Hydrology" section 3.2) in chapter 3. The riparian green line of stream channels would not be impacted by the proposed management activities, and natural recovery processes within the streamside area would help moderate stream temperatures. Riparian vegetation may increase in vigor due to increased water yield and reduced competition by conifers through thinning in the RHCAs. Within the immediate riparian areas, the physical effects derived from in-channel large woody debris would be retained because no natural debris would be removed. Future recruitment of large woody debris, which is structurally important for channel morphology, channel function, and bank stability, would be encouraged through snag retention requirements and release of existing live conifers.

A long-term direct beneficial effect would result from the improvement of aquatic connectivity and resizing the culvert to accommodate a 100-year flood in the Project Area. The proposed aquatic species passage projects would improve watershed connectivity and open up 10–20 miles of potential high-quality spawning, holding, and rearing habitat for rainbow trout All applicable Best Management Practices would be implemented during the replacement of the culverts. Mulching and revegetation would be implemented as determined on a site-by-site basis to prevent soil erosion following project implementation. This work would be conducted in fall when the water level is lower, and there would be fewer impacts on rainbow trout.

Riparian and aquatic habitats necessary to foster the unique genetic fish stocks would be maintained and restored by the proposed management practices. Culvert replacements would allow fish passage and improved trout distribution in Lone Rock, West Branch Lights, Morton, and Boulder Creeks and tributaries to Hungry and Indian Creeks.

Direct Effects. No direct adverse effects are expected to occur from the proposed treatments.

Indirect Effects. Decreased shading of aquatic systems would increase water temperatures, which could cause reduced rates of embryonic survival and potentially contribute to the declining trend in trout populations. In addition, the initial thinning of conifers could decrease input of leaf fall and insects from floodplains into streams, which could contribute to a decrease in a primary food source such as macroinvertebrates. However, any potential adverse direct effects would be avoided by implementation of project design standards, Limited Operating Periods, and management standards and guidelines.

Antelope Lake supports rainbow trout in addition to brown trout, largemouth and smallmouth bass, channel catfish, pumpkinseed, and bullhead. There would be no direct, indirect, or cumulative effect on the fishery in Antelope Lake as a result of implementation of project design standards, Best Management Practices, and Standard Management Requirements.

Cumulative Effects. Refer to the mountain yellow-legged frog discussion above in section 4.3.5 and also the Cumulative Watershed Effects analysis in section 4.2.4 (Gains and Moghaddas 2006).

The analysis of cumulative effects evaluated the potential for impacts on aquatic MIS from project activities compared to existing conditions; that is, the existing condition reflected by changes that have occurred over the past 35 years within the Watershed Analysis Area. Past actions in the area include timber harvest, large wildfires, recreation use, mining, and cattle grazing. Past timber harvesting on National Forest and private lands, together with the large wildfires, have created a diverse mix of vegetation types and age classes across the Watershed Analysis Area. A detailed description of past timber and range activities is described in section 4.1 and appendix B. Clearly, intensive timber management has reduced the size of large woody debris in the stream reaches within the Watershed Analysis Area. The 2001 Stream Fire created an abundance of snags over 3,000 acres, with very high snag densities still existing in the majority of the fire landscape. The recruitment of medium to large woody debris is prominent in the Stream Fire area along Cold Stream where high concentrations of medium to large snags still stand or have fallen into the stream due to the high-severity wildfire.

The California Department of Fish and Game poisoned Antelope Lake with rotenone in 1971 and again in 1976 to remove nongame fish, primarily golden shiners. These treatments dramatically increased the number and size of trout the lake could support in the short term, but golden shiner populations recuperated after only a few years. A third rotenone treatment was proposed in 1984 but never occurred. Since then, golden shiner populations have been controlled by introducing warm water competitors such as channel catfish and black bass. The lake has recovered and now supports rainbow trout in addition to brown trout, largemouth and smallmouth bass, channel catfish, pumpkinseed, and bullhead.

4.3.7.3 Alternatives B, D, and F (With Herbicide Treatments): Rainbow Trout Management Indicator Species

Information about aquatic invertebrates, aquatic macrophytes, and algae are not included in the following section. If these organisms were affected by herbicides or NPE-based surfactants, this could affect fish (see table 4-25) indirectly by changing the food supply or habitat. Refer to plant and invertebrate sections for complete discussions. The following compound-specific discussions are excerpts from the indicated SERA or Forest Service documents. Exposure numbers are from the project file worksheets.

Table 4-25. Expected herbicide exposure rates to surrogate fish species from typical application rates and central /typical water contamination rates.

Herbicide	Application Rate	Test Species	Lethal Concentration[a] (mg/L = ppm)	Exposure Rate	NOEC[b, c] Effect Level or Concentrations
Clopyralid	0.25 ae lbs/acre	Fathead minnow Rainbow trout Bluegill	>1,015 mg/L 103.5 mg/L 1000 mg/L	0.0022 mg/L (acute) 0.00052 mg/L (chronic) 0.9084 mg/L (spill)	23.1 mg/L (acute and chronic)
Glyphosate	3 ae lbs/acre	Fathead minnow Rainbow trout Bluegill Coho salmon (fry) Sockeye salmon (fry)	84.9 mg/L 38 ppm >24 mg/L 12.8 ppm 8.7 ppm	0.0077 mg/L (acute) 0.00255 mg/L (chronic) 9.24 mg//L (spill)	1.0 mg/L = glyphosate 0.1 mg/L = Roundup (acute and chronic)

Sources: SERA 1996-2001 and 2003; USFS 2003; and Re-registration Eligibility Decisions 1993, 1995, and 1998.

Notes:

mg/L = milligrams per liter

ppm = parts per million

a. Lethal Concentration = LC_{50}.

b. NOEC – No Observed Effect Concentration.

c. Tests were not conducted above NOECs.

Clopyralid (SERA 1999)—Clopyralid appears to have a very low potential to cause adverse effects in any aquatic species. Table 4-26 shows that the application rate of 0.25 acid equivalent pound per acre (ae lb/acre) results in a potential acute exposure for the aquatic animal of 0.0022 milligrams per liter (mg/L) for runoff and percolation; 0.00052 mg/L for potential chronic exposures; and 0.9084 mg/L for a spill scenario. These concentrations are far below the LC_{50} values for fathead minnow (greater than 1,015 mg/L), rainbow trout (103.5 mg/L), and bluegill (1,000 mg/L). The water flea (*Daphnia*) is the only species of aquatic invertebrate for which there are available data. *Daphnia*, a benchmark species for fish, had acute and chronic NOEC values at 23.1 mg/L and an LC_{50} of 232-350 mg/L, well above the exposure rate levels. For all of the scenarios considered in this analysis, the potential exposure rates are below the NOEC and LC_{50} for the water flea, and all potential exposure rates for fish and aquatic invertebrates are below the LC_{50} and NOEC values.

Glyphosate (SERA 1996)—At the typical application rate of 2.55 ae lb/acre, the anticipated short-term (acute) levels in water as a result of runoff or percolation could be 0.0077 mg/L, chronic values could be 0.00255 mg/L. In the event of a spill, glyphosate could be in the water at levels of 9.24 mg/L. Exposures by way of percolation and runoff would be below the LD_{50} for fish (as low as 8.7 mg/L) and the fish NOEC for glyphosate (1 mg/L), so it is unlikely that effects would occur from the application of glyphosate. However, a spill would represent a risk of toxic effects on fish. A major difference between the effect of glyphosate and glyphosate formulations on aquatic and terrestrial organisms concerns the polyethoxylated tallow amine surfactant (POEA) used in Roundup formulations. For fish, the surfactant is more toxic than glyphosate. This is reflected in the lower NOEC for Roundup of 0.1 mg/L. For exposures via percolation and runoff, the acute and chronic exposures would still be below the Roundup® NOEC, hence no adverse effects on fish would be anticipated. A spill involving Roundup®, like glyphosate itself, would represent a risk of toxic effects.

Table 4-26. Expected herbicide exposure rates to surrogate aquatic invertebrate species from typical application rates and central /typical water contamination rates.

Herbicide	Application Rate	Test Species	Exposure Rate (mg/L = ppm)	NOEC	LC_{50}[a] for animal (48 to 96 hour exposures)
Clopyralid	0.25 ae lbs/acre	*Daphnia magna* (water flea)	0.0022 mg/L (acute) 0.00052 mg/L (chronic) 0.9084 mg/L (spill)	23.1 mg/L[b, c]	232–350 mg/L
Glyphosate	3.0 ae lbs/acre	*Daphnia* sp. Midge larvae Grass shrimp Fiddler crab Larval oyster	0.0077 mg/L (acute) 0.00255 mg/L (chronic) 9.24 mg/L (spill)	— — 210 ppm[d, e] 650 ppm[d, e] 10 ppm[d, e]	218–780 ppm 1,216 ppm

Source: SERA 1996-2001 and 2003; USFS 2003; and Re-registration Eligibility Decisions 1993, 1995, and 1998.

Notes:

ae lbs/acre = acid equivalent pounds per acres
mg/L = milligrams per liter
ppm = parts per million

a. Tests for LC_{50} were not available.

b. This is the *No Observed Effect Concentration* (NOEC).

c. Chronic exposure

d. This is the *No Observed Effect Level* (NOEL).

e. Acute exposure

The LC_{50} for the water flea ranges between 218 and 780 mg/L. The acute NOEC for aquatic invertebrates is less than or equal to 11.0 mg/L, and the chronic NOEC is 0.7 mg/L. The exposure rates for aquatic invertebrates are below NOECs and LC_{50} for all species tested.

In most cases central exposures were compared to the lowest exposure levels at which lethal or adverse effects were experienced. Conversely, the far majority of information available was on experiments conducted on specific animals in laboratory settings. While laboratory experiments can be used to determine acute toxicity, reproductive risk, neurotoxic risk, and immunotoxic risk, laboratory experiments do not account for wildlife in their natural environments. Effects could create health problems in wildlife (such as lethargy, weight loss, nausea, fluid loss due to diarrhea or vomiting), which can affect their ability to compete for food, locate and/or capture food, avoid or fight off predators, reproduce, and potentially lead to mortality.

The ERAs for herbicide use are very small because of the nature of the possible delivery systems and the coefficients of disturbance assigned. Most of herbicides proposed for the Diamond Project would be applied with a backpack sprayer. The possible acreage to be treated is likewise very small, and the combination does not register many ERAs over the course of the planning period.

Glyphosate could produce some level of risk to aquatic and riparian associated species. However, based on species protection measures and mitigations included in chapter 2, there would not be direct or indirect adverse effects from the proposed herbicide. Therefore, it is expected that, cumulatively, the proposed pounds and acres of herbicides and surfactants would not contribute to past, present, or future cumulative effects.

The application of glyphosate and clopyralid on 22 net acres of noxious weeds was discussed earlier in this section. Within the RHCAs, glyphosate has been identified as the herbicide that would be used in lowland areas anywhere from 10 to 150 feet from streams and sites occupied by mountain yellow-legged frog. Glyphosate would be applied selectively by hand using a wick applicator on a total of 12 net acres. The application methods would be aimed specifically to the individual target plants, not applied at a broadcast scale. To avoid affecting nontarget species, application would not occur when wind speeds exceed 5 miles per hour or when drift is visually observed. No other species other than Canada thistle is targeted, thus herbicide application would be very specific and would not target any other plants.

Direct Effects. An accidental spill of glyphosate and clopyralid in RHCAs occupied by rainbow trout could cause potential direct effects on all life stages of this species.

Indirect Effects. The potential for run-off, percolation, and drift of herbicides into watercourses or spray, which would contaminate food sources such as invertebrates and aquatic or riparian plants, is of some concern—even though aquatic and riparian habitats would be avoided.

Surface and subsurface runoff and wind erosion are particularly important in the aquatic environment. Under normal and expected conditions of herbicide and surfactant use, background concentrations would be found in the aquatic environment. This concentration is highly site specific and depends on many factors, including the mobility of a given herbicide in the soil, soil type, soil pH, soil moisture holding capability, rainfall, and application rate, chemical degradation, and ambient and soil temperatures. For specific information regarding these factors, refer to “Environmental Fate” (HFQLG Act final supplement EIS, appendix F). The SERA reports (1996–2001 and 2003) provide estimates of background herbicide concentrations in the aquatic environment following normal herbicide application.

The acute exposure for a stream contaminated by runoff and/or percolation was available for glyphosate and surfactant. All were below lethal and NOEC levels. The acute exposure for a stream contaminated by runoff and/or percolation for fish species is discussed above under risk assessment and an effects discussion below. Acute exposures were below the LD/LC_{50} for glyphosate.

The probability is very low that a detectable level of either of the two proposed herbicides would reach surface water (flowing streams, springs, seeps, and wetlands/riparian areas). The probability of the Diamond Project violating a water quality standard would be very small—this is based on the glyphosate and clopyralid risk assessments (SERA 2003 and 2004) and on the results of over eight years of monitoring glyphosate in Region 5. At the levels proposed for application, neither clopyralid nor glyphosate is expected to have direct detrimental effects on water quality (refer to the “Soils and Hydrology” section above).

Herbicide drift is also of concern. Several factors to consider are wind, slope, and air moisture. Invertebrate prey species and vegetation could be affected by herbicide drift, but the actual effects are unknown. It is expected that any effects from potential drift of herbicides or surfactants would be far less than from the exposure rates from direct spray. The potential for herbicide drift is greatly reduced by the wick method of application.

Cumulative Effects: Herbicide Activities. Table 4-36 (in the "Botanical Resources and Noxious Weeds" section of this chapter) provides a summary of herbicide use in the Diamond Botany Analysis Area between 2001 and 2004. The closest documented herbicide use to the existing Pulsifer's milk-vetch locations is approximately one mile away on private land in Genesee Valley (California Department of Pesticide Regulation 2006). The only known future herbicide activities on public lands in the Analysis Area are under the Roadside Noxious Weed Project. The closest location proposed for treatment under the Diamond Project is located more than two miles away from the existing Pulsifer's milk-vetch. Taking these factors into account, as well as the negligible to minor direct and indirect effects as a result of the proposed herbicide treatments, the cumulative effect on this species as a result of these actions would also be negligible to minor.

4.3.8 Environmental Consequences: Terrestrial Threatened and Endangered Wildlife Species

4.3.8.1 Valley Elderberry Longhorn Beetle

The Diamond Project is outside the range of the beetle; therefore, this species would experience no project-related effects and is not discussed further in this document.

4.3.8.2 Alternative A (No Action): Effects on Bald Eagle

Direct Effects. There would be no direct effects on the bald eagle or existing bald eagle habitat. No activities would occur that would cause disturbance to nesting, wintering, or migrating birds.

Indirect Effects. The indirect effects of no action would include the potential for future wildfire and related impacts on habitat development and recovery. The fuel loads that would be left by this alternative would make potential wildfires in the area difficult to suppress and could create a more intense burn. Increased rates of spread would result in potential loss of suitable bald eagle nesting habitat and other important habitat attributes such as large trees and snags.

The area thinning recommendations for habitat management presented in the Antelope Lake Bald Eagle Management Plan to promote present and future bald eagle nesting and foraging activities within the Antelope Lake Bald Eagle Management Area (BEMA) would not occur.

Cumulative Effects. No acres of suitable habitat would be treated and would not reduce the average suitability of any habitat types within the analysis area for bald eagles.

The Antelope-Border Defensible Fuel Profile Zone (DFPZ) was implemented between 2001–2004 in accordance with the *Herger-Feinstein Quincy Library Group Forest Recovery Act* (HFQLG Act) around the north and east ends of Antelope Lake. This project thinned conifers from below (variable density thinning) and underburned approximately 430 acres within the BEMA. This DFPZ project was developed in coordination with the development of the original Antelope Lake Bald Eagle Management Plan and efforts were made by the Forest Service and U.S. Fish and Wildlife Service to ensure their compatibility. The project objectives were to protect and enhance bald eagle habitat by reducing the risk of high-intensity wildfire and by enhancing the growth of dominant and codominant trees, which may provide future nesting opportunities for eagles.

The Stream Fire salvage/restoration project was implemented in 2003–2004 in the area of the Stream Fire. Fire salvage removed all dead trees and left all trees showing greater than 5 percent green limbs. No change in CWHR type created by the fire occurred with fire salvage.

There are no known future actions planned on private or state lands in the Wildlife Analysis Area that would impact any bald eagles or bald eagle habitat.

The only future foreseeable HFQLG Pilot Project that would possibly impact the BEMA is the 2009 Antelope Creek Project, which would fall entirely within the Diamond Project Area. Based on the November 2005 Program of Work, the Antelope Creek Project would implement approximately 1,014 acres of fuel treatments, area thinning, and group selection for an approximate total of 20 million board feet. There is currently no proposed DFPZ. Because the entire project landscape falls within the Diamond Project Area, approximately 1,014 acres of treatment would occur in the Diamond Project Area. The effects of these actions on wildlife habitat would be similar in nature to the effects from the same actions described for the Diamond Project. All groups would become CWHR size classes 1 and 2, and fuel treatments could result in an increase in CWHR size class 4P (P = poor). This and any other future foreseeable Forest Service projects within the BEMA would comply with habitat management recommendations outlined in the 2006 *Antelope Lake Bald Eagle Management Plan*.

Determination. The Forest Service has determined that the no-action alternative for the Diamond Project would not affect the bald eagle.

4.3.8.3 All Action Alternatives (B, C, D, E, and F): Effects on Bald Eagle

Direct Effects. The potential risk factors for the bald eagle from resource management activities were addressed in the 2001 SNFPA final EIS (USDA Forest Service 2001). These risk factors included "modification or loss of habitat or habitat components (primarily large trees) and behavioral disturbance to nesting eagles from vegetation treatment, facilities maintenance (to include roads), recreation, or other associated activities within occupied habitat, which could prevent or inhibit nesting or lead to nest failure" (SNFPA 2001, chapter 3, part 4.3, page 10). As evidenced by the 2001 Stream Fire, the risk of losing terrestrial habitat, including existing and potential nest trees, due to wildfire is a reality.

Area thinning is proposed on approximately 20 acres of the secondary zone of the Boat Ramp bald eagle territory next to Antelope Lake. This Treatment Area is located northwest of the nest site, approximately 0.75 mile from the nest, and near the area that was burnt by the 2001 Stream Fire. In addition, approximately 380 acres of the Antelope Lake Bald Eagle Management Area (BEMA) would be treated with area thinning. All proposed treatments would be located at the northwest end of the BEMA near the campgrounds, in an area not used by eagles and of a low priority for eagle nest tree management. There should be no change in habitat type because the treatments to reduce fuel/fire ladders with area thinning would be compatible with eagle management and the bald eagle management plan, as it ties in with the Antelope Border DFPZ.

Indirect Effects. Changes in the fishery production are not expected in Antelope Lake (the only aquatic system capable of supporting a forage source for bald eagles) as a result of implementing proposed fuel treatments, group selection, and area thinning. Implementing Best Management Practices and meeting all Riparian Management Objectives (the RMO analysis is located in the "Soils and Hydrology" section of this chapter and in the "Cumulative Watershed Effects Report") would ensure that there would be no indirect effects on the fishery or fishery habitat.

Area thinning prescriptions are designed to accelerate stand growth and provide for future CWHR size class 4 and 5 trees. Area thinning prescriptions are also designed to encourage long-term regeneration of large pines by maintaining the largest and most fire-resilient dominant and co-dominant trees. The result of such thinning prescriptions could therefore provide additional suitable nesting habitat for bald eagles in the future.

Cumulative Effects. Area thinning of 400 acres in the BEMA under the proposed alternatives, in association with the impacts from vegetative changes due to the 2001 Stream Fire, would contribute to cumulative effects on bald eagle habitat and known bald eagle territories. As stated previously, there should be no change in habitat type; the actions of reducing the fuel/fire ladders with area thinning would be compatible with eagle management and the *Bald Eagle Management Plan* because it ties in with the Antelope Border DFPZ. No group selection harvests would be located in the BEMA. There should be no impact on the nesting eagles at Antelope Lake. No changes in bald eagle territory occupancy or the bald eagle population on the Plumas National Forest is expected to occur. There are no known future actions planned on private or state lands in the Wildlife Analysis Area that would impact any bald eagles or bald eagle habitat.

Prior to known bald eagle occupancy, the California Department of Fish and Game poisoned Antelope Lake with rotenone in 1971 and again in 1976 to remove nongame fish, primarily golden shiners. These treatments dramatically increased the number and size of trout the lake could support in the short term, but golden shiner populations recuperated after only a few years. A third rotenone treatment was proposed in 1984 but never occurred. Since then, golden shiner populations have been controlled by introducing warm water competitors such as channel catfish and black bass. The lake now supports rainbow and brown trout, largemouth and smallmouth bass, channel catfish, pumpkinseed, and bullhead, all of which can serve as prey species for bald eagles.

In June 1979, a 6-acre clearcut was created within 55 meters (180 feet) of the original eagle nest (Antelope I). Sale administrators reported seeing bald eagles flying and calling during logging operations but were unaware of the nest location. This clearcut removed visual screening and wind protection. In addition, Forest Service Road 27N42 passed within 50 meters (160 feet) of this nest. This road receives a moderate amount of vehicular and snowmobile traffic, and stopped cars have been known to cause a flight response during the nesting season (Rotta, Forest Service, personal observation). Nevertheless, eagles have successfully nested at this site for 20 years, until the nest tree was consumed by the Stream Fire.

The August 2001 Stream Fire burnt approximately 3,482 acres. Within the BEMA, approximately 1,379 acres of terrestrial habitat mapped as suitable nesting burned: 1,135 acres at high tree mortality (greater than 75 percent mortality) and 244 acres at low tree mortality, or less than 75 percent mortality (Rotta 2003). Varying degrees of tree mortality were expected in the areas considered low mortality, but not enough mortality was expected that would change nesting habitat suitability.

A revised *Bald Eagle Management Plan* was developed to account for changes in habitat as a result of the Stream Fire and to update habitat information based on VESTRA, and these changes in habitat are documented in the revised plan (USFS PNF 2006). Approximately 75 percent (5,513 acres) of the land base in the post-fire Antelope Lake BEMA is comprised of suitable nesting habitat CWHR size classes 4P, 4M, 4D, 5P, 5M, and 5D). The Stream Fire adversely impacted the two bald eagle territories at Antelope Lake, resulting in (1) loss of Antelope Lake Dam Bald Eagle Nesting Territory (Antelope Lake I), including the nest tree; and (2) loss of a bald eagle nest tree at the Lost Cove Boat Ramp. There are currently still two nesting pairs using three nesting territories at Antelope Lake. Thus, the changes as a result of the Stream Fire caused no loss in nesting pairs, although in the five years since the Stream Fire, productivity has declined, actually falling below parameters set by the recovery goals (USFS PNF 2006).

The result of the Stream Fire Restoration / Salvage within the BEMA was that 1,521 acres of the total 2,184 acres that burned in the BEMA were entered for restoration. All acres that were entered retained, on average, four to six snags per acre in the largest size classes, and no green trees were removed in any unit. Green trees (and/or snags) were left along the shoreline at a density of four per acre within 200 feet of the shoreline. All treatments included removal of fuel ladders consisting of fire killed material less than 6 inches dbh. The removal of this material reduced fuel loadings that would reduce fire intensity in these stands.

Subsequent salvage removal and restoration efforts occurred in the area in 2003 to 2005. Approximately 30 acres were removed from planned restoration activities around the new Antelope I nest site. No treatment occurred within these 30 acres, which left the nest stand and surrounding area in its existing condition, which has been favorable for eagle nesting and production after the fire event. Hazard trees along the paved roads and along Forest Service Road 26N54 were removed in September/October 2002 within and adjacent to this stand.

Within the Antelope Nest II stand at the Boat Ramp, understory conifers killed by fire were removed to reduce existing dead tree fire ladders and to remove future hazardous fuels buildup. No trees over 6 inches dbh were removed. Approximately 44 acres around the Antelope III nest (south side) was salvaged logged but retained six of the largest snags per acre, while the trees less than the smallest diameter snag retained were removed. The intent was to provide the existing overstory structure present in the stand, while treating the understory component to reduce fuel loading between the pavement and the lakeshore. To eliminate disturbance to nesting bald eagles, a Limited Operating Period (LOP) prohibiting contractual operations, as well as eliminating helicopter disturbance, was implemented from November 1 to August 31. This LOP applied to log hauling north on roads 27N42 and 26N54, as well as use of road 28N03 from the dam to the Vista Point during the nesting season.

Approximately 570 acres of fire-consumed habitat in the BEMA was replanted in the fall of 2004 and spring of 2005.

The Antelope-Border DFPZ has been implemented in accordance with the HFQLG Act around the north and east ends of Antelope Lake. This DFPZ meets the desired condition specified in appendix J of the HFQLG Act final EIS. This project thinned conifers from below (variable density thinning) and underburned approximately 430 acres in the BEMA (see the *Antelope-Border Defensible Fuel Profile Zone Environmental Assessment*). This activity occurred between 2001 and 2004. This DFPZ project was developed in coordination with the development of the original

Antelope Lake Bald Eagle Management Plan, and efforts were made by the Forest Service and U.S. Fish and Wildlife Service to ensure their compatibility. The Diamond Project should protect and enhance bald eagle habitat by reducing the risk of high-intensity wildfire and by enhancing the growth of dominant and codominant trees, which may provide future nesting opportunities for eagles.

All nest sites in the Antelope Lake BEMA are within the Antelope Lake cattle grazing allotment, which supports 150 pairs for one month. Cattle graze the meadows, shoreline, and uplands from September 1 to approximately October 1. The Forest Service and permittee share fence maintenance responsibilities around Antelope Lake. A portion of the fence was destroyed in the Stream Fire. When it was rebuilt by Forest Service crews, it was relocated to reduce potential use within the Stream Fire area. There are no direct impacts on nesting eagles because of the time of year that livestock use the allotment, but grazing along shorelines may indirectly impact eagles by reducing the amount of cover available for waterfowl. It is unknown to what extent, if any, that grazing impacts waterfowl populations; however, the current range program at Antelope Lake does not appear to conflict with eagles or eagle management.

Roadwork activities (consisting of oiling, chip sealing, and shoulder maintenance) have been continually conducted along the paved roads surrounding the lake. What impact this roadwork has on nesting birds is not well documented, but to date, it has not been associated with any adverse behaviors leading to nest abandonment or failure. Now that the Antelope III nest is located immediately adjacent to paved road 28N03, close coordination for normal road maintenance on this road will be required to prevent disturbance during the nesting season. The Antelope I nest is located in easy view from road 26N54 and also requires close road maintenance and use coordination.

All facilities, including roads, are subject to periodic felling and removal of hazard trees.

Recreational use includes cross-country skiing and snowmobiling in the winter, but the majority of recreational use occurs in the summer. Summer recreational use (such as swimming, boating, water skiing and fishing) have steadily increased since the construction of the reservoir. In addition, there has been a relatively recent increase in the popularity of jet skis at the lake. Most recreational lake/water use occurs from April to October, with peak use of water-related activities occurring in July and August.

The Personal Use Firewood Program allows the public to purchase a woodcutting permit and remove fuel and firewood from National Forest lands. This activity is not allowed at Antelope Lake between the shoreline and the paved roads, including campgrounds, day use areas, and the boat ramp. Personal use woodcutting is allowed outside this area, with no restriction in terms of season. Woodcutting activity has not been shown to be a disruptive activity around the nest sites at Antelope Lake, but it could be more problematic in the future due to the availability of dead wood and lack of visual/noise vegetative screening as a result of the Stream Fire.

The lake has supported from two to five osprey territories since 1979. Osprey feed primarily on fish directly competing with the eagle for food. Ospreys seem to be victims of food robbing by eagles, so competitive interactions may impact ospreys more than eagles.

The *Bald Eagle Protection Act* defines “disturb” as follows: “To agitate or bother a bald or golden eagle to the degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, causing injury, death, or nest abandonment." In addition to immediate impacts, this definition encompasses impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, and if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits and causes injury, death, or nest abandonment (*Federal Register*: February 16, 2006, vol. 71, no. 32).

Determination. The Forest Service has determined that the action alternatives for the Diamond Project would not affect the bald eagle. All proposed treatments within the Antelope Lake BEMA fully comply with habitat management recommendations stated in the 2006 revised *Antelope Lake Bald Eagle Management Plan*, which was consulted on with the U.S. Fish and Wildlife Service. No change in suitable habitat type is expected to occur as a result of treatments. Area thinning prescriptions would help protect and promote present and future bald eagle nesting and foraging activities.

4.3.9 Environmental Consequences: Sensitive Species

The "Diamond Vegetation Project: Biological Assessment / Biological Evaluation for Terrestrial and Aquatic Wildlife Species" (Collins and Hopkins 2006) provides a discussion of the direct, indirect, and cumulative effects for all sensitive wildlife species analyzed for the Diamond Project. The BA/BE is located in the Diamond Project Record and incorporated by reference. The *National Environmental Policy Act* (NEPA) process requires agencies to identify "the significant environmental issues deserving study and de-emphasizing insignificant issues, narrowing the scope of the environmental impact statement" (40 CFR 15001.1(d)). Due to the high visibility of old-forest species in California, and the potential impacts of fuels treatment, group selection, and area thinning on forested habitat, the effects on California spotted owl, northern goshawk, American marten, and Pacific fisher are emphasized in this EIS.

4.3.9.1 Alternative A (No Action): Effects on California Spotted Owl

Direct Effects. There would be no direct effects on the spotted owl or existing spotted owl habitat. No activities would occur that would cause disturbance to nesting or foraging birds.

Indirect Effects. The indirect effects of no action would include an increased risk for future wildfire and related impacts on habitat development and recovery. The fuel loads that would be left by this alternative would make potential wildfires in the area difficult to suppress and could create a more intense burn. Increased rates of spread would result in potential loss of suitable owl nesting habitat and other important habitat attributes such as large trees and snags and down woody material. Thus, under alternative A, suitable habitat for productive owl sites could become patchy or unevenly distributed, and the abundance of owls in the Wildlife Analysis Area could decline.

Cumulative Effects. The no-action alternative for the Diamond Project would not provide for the long-term protection of spotted owl habitat from catastrophic fire. There would be no actions designed to reduce the risk of high-intensity wildfire. Total wildfire acres and high-intensity wildfire acres are anticipated to increase from current levels under this alternative (based on analysis conducted in the SNFPA final EIS (2001), which could lead to lower owl abundance in the Wildlife

Analysis Area compared to existing conditions. There would be no thinning to enhance the growth of dominant and codominant trees that may provide future habitat availability.

With the current Plumas National Forest woodcutting program, the entire Diamond Project Treatment Units and Analysis Area would be open to public woodcutting 12 months a year, except around Antelope Lake, limited only by available access. Uncontrolled public use in the areas used by spotted owls, especially during the nesting season, could cause disturbance that might disrupt and preclude successful nesting. No roads would be closed or decommissioned under this alternative.

1. There would be no short-term reduction in owl habitat, no treatments in HRCAs, and no change in forest interior habitat.
2. There would be no fuel treatments, which would make habitat vulnerable to high-intensity wildfire and increase the risk of large-scale habitat fragmentation, loss of Protected Activity Centers (PACs), and loss of owl habitat in the long term.
3. Implementation of alternative A would involve little to no risk to owl habitat in the short term, and thus, immediate owl activity would be less uncertain.

Determination. The Forest Service has determined that alternative A would not affect the California spotted owl.

4.3.9.2 All Action Alternatives (B, C, D, and F): Effects on California Spotted Owl

Direct Effects. The analysis of direct effects on California spotted owl is focused on PACs and Spotted Owl Habitat Areas (SOHAs) existing or created as a result of surveys. The effects on other potentially suitable nesting and foraging habitat outside of PACs are discussed in the "Indirect Effects" section below. Direct effects are expected to be minimal for all action alternatives, as described below.

- Direct effects on spotted owls are not anticipated within PACs or SOHAs because no Treatment Units fall within these protected areas.

- If spotted owls are detected during future surveys or project-related activities, PACs and Home Range Core Areas (HRCAs) would be delineated, and all treatments would be modified to comply with the standards and guidelines in the HFQLG Act final EIS and Record of Decision.

- Limited Operating Periods (LOPs) would be implemented within 0.25 mile of Treatment Units for active nests identified during present and future surveys or incidental detections.

- Proposed treatment activities could occur as early as spring of 2007 and may continue five years beyond the initiation of implementation. The California spotted owl survey protocol requires additional surveys if project activities continue more than two years after the last survey year. New territories (nests) that were not located using survey protocol could be established during project implementation.

- No new road construction would occur in spotted owl PACs or SOHAs. A LOP could be applied for any road reconstruction in PACs.

- A LOP would be applied to haul routes within 0.25 mile of an active nest. LOPs are expected to reduce impacts from increased human activity and vehicle and equipment noise. Disturbance would be limited to individual Treatment Units and would last a few days to two weeks in any location. Impacts from disturbance are not expected to substantially affect habitat use or reproductive capacity of this species.

The analysis of direct effects is based on data gathered during the 2005 survey. Surveys continue in 2006 to complete the two-year survey effort. The proposed treatments could occur in spring 2007 and continue an additional five to seven years. There is the potential that spotted owls could establish new territories (activity centers) during project implementation and would not be protected as PACs.

Indirect Effects. Based on the VESTRA mapping and CWHR model, about 34,083 acres of the National Forest land in the Wildlife Analysis Area may be considered suitable spotted owl nesting habitat (CWHR size classes 5M and 5D), and about 54,478 of the National Forest acres may be considered suitable foraging habitat (CWHR size classes 4M and 4D) (refer to table 4-23 above).

As part of a strategic system of DFPZs, the Diamond Project would reduce understory fuel buildup and reduce the potential for high-intensity wildfires, which have a great potential to degrade vast tracts of habitat for this species. Fire history, as well as the large parcels of burned-over areas in the Diamond Project, indicate the area is prone to large stand-replacing fires, where low to moderate fires used to occur.

Changes to suitable foraging habitat (CWHR size classes 4M and 4D) outside of HRCAs as a result of implementing fuel treatments (DFPZs) under all action alternatives would occur where large structural components would be removed, and canopy cover would be opened up to 35 to 40 percent, resulting in open canopy forested stands considered unsuitable habitat. Reductions in canopy cover are expected to occur with the removal of some trees less than or equal to 29 inches dbh. The combined impacts of mechanical thinning of the understory and achieving the desired conditions for fuel treatments by opening up the overstory would result in creating more open canopy forest from dense or closed canopy forest (moderate [M] and dense [D] stands decreasing to poor [P], thus opening up to around 40 percent canopy cover). There may also be some additional risks (removing trees, opening up the canopy, and reducing nesting opportunities) associated with isolated torching events during prescribed fire.

Under all action alternatives, fuel treatments in suitable nesting habitat (CWHR size classes 5M and 5D) are projected to remain suitable for spotted owls (that is, reduced to or remaining at 5M). Fuel treatments in these CWHR size classes would remove some trees lees than or equal to 29 inches dbh but retain a minimum of 40 percent canopy cover. The removal of large structural components and mechanical thinning of the understory, with a minimum canopy cover retention of between 40 and 45 percent, would result in dense stands decreasing to moderate, and moderate stands remaining moderate. However, the condition of these stands immediately following treatment would exist at the low end of suitable nesting habitat. There may also be some additional risks (removing trees, opening up the canopy, and reducing nesting opportunities) associated with isolated torching events during prescribed fire.

With alternative F, fuel treatments in suitable nesting habitat (CWHR size classes 5M and 5D) are designed to maintain stands at 50 percent canopy cover. Mechanical thinning, as designed, would retain all trees greater than 20 inches dbh. As a result of these design elements, moderate stands in this size class would remain moderate, and dense stands would decrease to moderate.

Forest health objectives, stated in chapter 2, include improving vigor of residual trees by reducing stand density and competition. An important design element common to all action alternatives that would help meet such objectives is biomass (less than or equal to 10-inch trees) removal. This size class in a stand provides complexity and structure, as well as the diverse microclimates that owls seek to control exposure and changes in ambient temperature for roosting. Biomass removal can degrade or remove hiding cover in the lower and mid canopy often used by young of the year owlets. Each action alternative was designed to adequately meet forest health objectives, as well as retain a percentage of existing biomass within each stand. On average, the following percentage of stand biomass would be retained:

DFPZs: Alternatives B, C, and D – 20 to 25 percent; alternative F – 70 percent in CWHR size classes 4M and 4D that are within HRCAs and 65 percent in CWHR size classes 5M and 5D.

Area Thinning: Alternatives B and C – 67 to 73 percent; alternatives D and F – 33 to 38 percent in CWHR size classes 4M and 4D and 67 to 3 percent in CWHR size classes 5M and 5D.

Changes to suitable foraging (CWHR size classes 4M and 4D) and nesting (CWHR size classes 5M and 5D) habitat as a result of implementing area thinning treatments under all action alternatives would result in moderate stands staying moderate and dense stands decreasing to moderate. This is because all stands in these CWHR size classes would be maintained at 40 percent canopy cover or greater. Under alternatives B and C, all CWHR stands greater than or equal to 50 percent canopy cover would be maintained at 50 percent canopy cover. CWHR size classes 5M and 5D stands under alternatives D and F would also be maintained at 50 percent canopy cover. Alternatives D and F are designed to bring CWHR size classes 4M and 4D stands down to 40 percent canopy cover. In summary, stand heterogeneity would decline, as would canopy, as a result of area thinning treatments, but the declines are not expected to cause the stand to move to an unsuitable state.

Irwin and Rock (2004) found that the probability of stand use by spotted owl increased strongly as basal area rose from 80 to 320 square feet per acre (optimum range is between 160 and 320 square feet per acre) and was positively influenced by the number of trees per acre that were greater than 26 inches dbh. With implementation of fuel treatment (DFPZ) areas under alternatives B, C, or D, the residual basal area in CWHR size class 4 would be 126 square feet per acre and 146 square feet per acre in CWHR size class 5. Alternative F would implement the same DFPZ prescriptions as alternatives B, C, and D within CWHR size class 4 that are outside of HRCAs, resulting in a basal area of 126 square feet per acre. Under Alternative F, CWHR size class 4 within HRCAs would be 173 square feet per acre. CWHR size class 5 under alternative F would have 175 square feet per acre. Trees greater than 30 inches dbh would be 3 per acre in CWHR size class 4 and 5 per acre in CWHR size class 5 (see the “Vegetation Report” in the Diamond Project record). These figures represent what is projected to remain on site immediately after fuels treatment.

With implementation of alternative B or C, the residual basal area in Area Thinning Units (immediately post-project implementation) in CWHR size class 4 would be 173 square feet per acre, and for alternative D or F, the residual basal area would be 145 square feet per acre. For all action alternatives, the basal area in CWHR size class 5 would be 175 square feet per acre. Trees greater than 30 inches dbh would not change from existing conditions and would be 3 per acre in CWHR size class 4 and 5 per acre in CWHR size class 5.

The group selection treatments would result in the creation of forest openings and gaps that have the following conditions:

1. Most conifers below 30 inches dbh have been removed and desirable conifer species (such as sugar pine) and regeneration and oaks/hardwoods have been retained as explained in the proposed action;

2. Two of the largest snags per acre that do not pose a health and safety risk to operations have been retained; and

3. Project-generated fuels have been treated with prescribed fire, but 10 to 15 tons per acre of the largest down logs greater than 12 inches in diameter have been retained where it exists.

Under all action alternatives, allowance would be made to retain up to two of the largest snags per acre in Group Selection Units, unless removal would be necessary for safety and operability. Based on past projects (such as Stony Ridge) and discussions with Occupational Safety and Health Administration safety representatives, it is anticipated that the majority of snags would be felled, and very few snags would be left in the 1,130 acres of group selection under alternatives B and C; 950 acres of group selection under alternative D; and 610 acres of group selection under alternative F.

Group selection treatments would create early seral stages and would contribute to heterogeneous stand structures that may be more resilient to disturbance events (such as fire, drought, and insect and disease infestations) on the landscape scale. The treatment would not result in areas that prevent access to adjoining suitable habitat. By design, group selections make up less than 11 percent of any given stand. The small size of the groups (0.5 acre to 2 acres) would not preclude owls from flying over or around the treated areas. While the implementation of the group selections may not result in fragmentation in the classic sense, they would reduce the value of the habitat within the stand and would likely cause changes in the behavioral use of the territory, particularly with respect to foraging.

The total acres of suitable owl habitat (CWHR size classes 4M, 4D, 5M, and 5D) that are currently available and the acres of suitable owl habitat in the Wildlife Analysis Area that would remain after implementation of any of the action alternatives are presented in table 4-23 above.

Home ranges of neighboring spotted owls commonly overlap (Verner et al. 1992: 149). The action alternatives could possibly result in indirect effects on owls by causing a shift in owl home range use and increasing the potential for intraspecific (single species) competition between neighbors. The increased competition associated with using the same restricted habitat parcels could impact owl behavior, possibly affecting nesting and reproduction. Because of this, the direct affects on HRCAs could have indirect affects on the adjacent PACs/HRCAs that were not directly affected by the action alternatives. This is especially true if the directly affected HRCA overlaps with another HRCA. There are a total of 44 PACs/HRCAs in the Wildlife Analysis Area: 28 would be directly affected, and 16 would be indirectly affected. The Wildlife Analysis Area also contains 12 SOHAs, which are included in the 44 PACs/HRCAs (see Diamond BA/BE, attachments 4–6).

than 30 inches dbh would not change from existing conditions and would be 3 per acre in CWHR size class 4 and 5 per acre in CWHR size class 5.

The group selection treatments would result in the creation of forest openings and gaps that have the following conditions:

1. Most conifers below 30 inches dbh have been removed and desirable conifer species (such as sugar pine) and regeneration and oaks/hardwoods have been retained as explained in the proposed action;

2. Two of the largest snags per acre that do not pose a health and safety risk to operations have been retained; and

3. Project-generated fuels have been treated with prescribed fire, but 10 to 15 tons per acre of the largest down logs greater than 12 inches in diameter have been retained where it exists.

Under all action alternatives, allowance would be made to retain up to two of the largest snags per acre in Group Selection Units, unless removal would be necessary for safety and operability. Based on past projects (such as Stony Ridge) and discussions with Occupational Safety and Health Administration safety representatives, it is anticipated that the majority of snags would be felled, and very few snags would be left in the 1,130 acres of group selection under alternatives B and C; 950 acres of group selection under alternative D; and 610 acres of group selection under alternative F.

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The total acres of suitable owl habitat (CWHR size classes 4M, 4D, 5M, and 5D) that are currently available and the acres of suitable owl habitat in the Wildlife Analysis Area that would remain after implementation of any of the action alternatives are presented in table 4-23 above.

Home ranges of neighboring spotted owls commonly overlap (Verner et al. 1992: 149). The action alternatives could possibly result in indirect effects on owls by causing a shift in owl home range use and increasing the potential for intraspecific (single species) competition between neighbors. The increased competition associated with using the same restricted habitat parcels could impact owl behavior, possibly affecting nesting and reproduction. Because of this, the direct affects on HRCAs could have indirect affects on the adjacent PACs/HRCAs that were not directly affected by the action alternatives. This is especially true if the directly affected HRCA overlaps with another HRCA. There are a total of 44 PACs/HRCAs in the Wildlife Analysis Area: 28 would be directly affected, and 16 would be indirectly affected. The Wildlife Analysis Area also contains 12 SOHAs, which are included in the 44 PACs/HRCAs (BA/BE attachments 5, 7a-e, and 8a-c).

Approximately 899 acres of suitable habitat (CWHR size classes 4M, 4D, 5M, and 5D) within HRCAs could potentially be rendered unsuitable under alternatives B and C, 779 acres under alternative D, and 551 acres under alternative F; this is based on DFPZ and group selection prescriptions within the 28 HRCAs that would be directly affected. The acres of habitat change range from a high of 75 acres in the HRCA associated with PL071 (alternatives D and F) to a low of 1 acre in the HRCA associated with PL199 (alternative B), and no change in several HRCAs associated with alternatives D and F.

The average reduction in suitable acres for the 28 directly affected HRCAs would be 32 acres with alternatives B and C, 28 acres with alternative D, and 20 acres with alternative F. It is anticipated that owl behavioral and competitive interactions may increase, which could impact owl activity and occupancy of PACs/HRCAs that are already low in suitable habitat. Although the HRCAs are well-distributed across the Wildlife Analysis Area, they are also confined by large blocks of unsuitable habitat resulting from past wildfires and by private lands, which may or may not provide suitable habitat.

Several studies provide insight into spatial availability of habitat for California spotted owls. (Hunter et al. 1995; Bingham and Noon 1997; Meyer et al. 1998; Franklin et al. 2000; Zabel et al. 2003; Blakesley 2003). Each of these studies found that core areas within about 200 hectares (500 acres) of nests were influential in determining occupancy and/or fitness. Blakesley (2003) states that occupancy, apparent survival, and nesting success all increased with increasing amounts of old-forest characteristics, and reproductive output decreased with increasing amount of nonhabitat within the nest area (nest area = 203 hectare scale, or 500 acres). Blakesley's data indicates that 50 percent suitable habitat within the core area is an important threshold. These studies suggest that effects outside of the PAC (on another 200 acres) may influence a site's "quality" for spotted owls. Based on these studies, it could be assumed that management actions that reduce high-quality spotted owl habitat within a 500-acre area around known nests could present more risk to owls than activities occurring outside of this area. There would be no activities within the 300-acre PAC with the Diamond Project. Table 4-27 shows the existing conditions within the twenty-three 500-acre nest cores affected by the proposed action.

Table 4-27 indicates that 21 of the 23 directly affected nest cores have more than 50 percent suitable habitat. Aerial photos show that the two nest cores under 50 percent suitable habitat (PL043, PL122) have additional suitable acres located on private land. Therefore the total amount of suitable habitat available within these two nest cores is not fully represented by Forest Service acres alone.

Table 4-28 summarizes the impacts on owl nest cores from all treatments proposed in the action alternatives. The number of nest cores with greater than 50 percent suitable habitat (21 out of 23) and greater than 70 percent suitable habitat (14 out of 23) would remain unchanged from pre-treatment levels, with 10 nest cores seeing a reduction in suitable acres of less than 1 percent. Of the 23 nest cores that could be affected, only two (PL167 and PL220) would see a reduction in suitable acres greater than 4 percent. PL167 and PL220 would maintain 73 percent and 53 percent suitable nest core acres, respectively. PL220 has not been territorially active or reproductive since 1992, therefore the risk of affecting territorial behavior due to the actions in the core area is considered to be low.

Table 4-27. Summary of existing conditions in spotted owl 500-acre nest cores that could be affected by the action alternatives.

Territory	Suitable Acres (all owners)	Suitable Acres (Forest Service lands)	Percent of Suitable Acres Within 500-acre Area (all owners)	Percent of Suitable Acres Within 500-acre Area (Forest Service Lands)
PL005	425	337	85	67
PL006	372	372	74	74
PL007	457	397	91	79
PL041	411	347	82	69
PL043	459	246	92	49
PL044	494	471	99	94
PL073	406	406	81	81
PL106	454	454	91	91
PL122	347	236	69	47
PL123	362	315	72	63
PL126	429	392	86	78
PL167	402	402	80	80
PL199	480	465	96	93
PL201	401	401	80	80
PL220	300	300	60	60
PL229	481	320	96	64
PL230	469	469	94	94
PL253	450	376	90	75
PL263	405	302	81	60
PL286	470	413	94	83
PL301	423	423	85	85
PL303	347	347	69	69
Tent3	431	431	86	86

Table 4-28. Summary of treatment effects, by alternative, on spotted owl 500-acre nest cores.

Territory	Acres Changed to Unsuitable			Suitable Acres After Treatment within Territory			Percent of Nest Core Suitable Post Treatment	Percent Decline in Suitable Habitat		
	Alternative			Alternative				Alternative		
	B and C	D	F	B and C	D	F		B and C	D	F
PL005	2	2	2	335	335	335	67	0	0	0
PL006	8	0	0	364	372	372	73–74	1	0	0
PL007	3	3	3	394	394	394	79	0	0	0
PL041	6	0	0	341	347	347	68–69	1	0	0
PL043	2	0	0	244	246	246	49	0	0	0
PL044	3	0	0	468	471	471	94	0	0	0
PL073	16	9	9	390	397	397	78–79	3	2	2
PL106	7	1	0	447	453	454	89–91	2	0	0
PL122	4	4	4	232	232	232	46–47	1	1	1
PL123	1	1	0	314	314	315	63	0	0	0
PL126	3	3	3	389	389	389	78	0	0	0
PL167	38	38	38	364	364	364	73	7	7	7
PL199	8	0	0	457	465	465	91–93	2	0	0
PL201	4	0	0	397	401	401	79–80	1	0	0
PL220	36	36	34	264	264	266	53	7	7	7
PL229	2	2	0	318	318	320	64	0	0	0
PL230	17	13	13	452	456	456	90–91	4	3	3
PL253	1	1	1	375	375	375	75	0	0	0
PL263	2	3	1	300	299	301	60	0	0	0
PL286	20	20	15	393	393	398	79–80	4	4	3
PL301	0	0	0	423	423	423	85	0	0	0
PL303	12	9	9	335	338	338	67–68	2	1	1
Temp3	14	10	10	417	421	421	83–84	3	2	2

It is uncertain as to whether the same number of owl sites (17) occupied in 2003 and 2005 would be occupied in the Wildlife Analysis Area following project completion. Risks to owl occupancy would possibly increase in the PACs/HRCAs that would experience a reduction in suitable nest core acres as a result of treatments. The PACs and SOHAs would be avoided during treatments, and the majority of the habitat in the 700-acre plus HRCAs would not be affected by treatments. Thus, the potential risk of reduced PAC/HRCA occupancy resulting from project implementation would be low. There would be no change to habitat in the 14 PACs that would be indirectly affected, and the associated HRCAs would still be present to support owl occupancy. The fuels treatments proposed under the action alternatives could decrease the risk of losing owl habitat, including PACs, SOHAs, and HRCAs, to high-intensity wildfire.

By quantifying the habitat changes within the home range as a result of project actions, a risk assessment based on habitat needs as outlined by Verner et al. (1992), Blakesley et al. (2001), and Blakesley (2003), among others, can be completed. This method or derivatives of this method have been used for over a decade to predict potential effects and the subsequent risk of implementing vegetation management projects. While there is a large amount of data on habitat suitability with regard to spotted owls, there have been no comprehensive studies on the impacts of vegetation management activities on reproductive success, impacts to prey, and long-term viability at the landscape level within a managed landscape. Specifically, although a risk assessment can be made when projects reduce habitat within a territory below a given threshold, no data exists that permit a reasoned prediction of impacts that vegetation management activities may have when the amount of suitable habitat remains above a given threshold. The Plumas-Lassen Administrative Study (2005) was initiated to address these management concerns. The results of that long-term study would have a direct application of findings for this project.

The size of the home range selected for this analysis is reflective of breeding home range sizes elsewhere in the Sierra bioregion for mixed conifer forests. While a specific home range size is not discussed per se in the 2004 Record of Decision on the SNFPA final supplemental EIS, the Record of Decision does reference an analysis-size circle of 1.5 miles in diameter around the activity center, which equates to approximately 4,500 acres. The home range sizes for the California spotted owl are reported to vary between 3,000 acres (Verner et al. 1992; Call 1990) for breeding pairs to as much as 12,500 acres (Verner et al. 1992) for nonbreeding pairs on the east slopes of the Cascade Range. This analysis uses findings from Verner et. al. (1992) and SNFPA guidelines (USDA 2004a) in delineating spotted owl home ranges as a circle of approximately 4,500 acres (1.5-mile radius) surrounding the territorial site. A detailed discussion of home ranges and core areas is provided in the Diamond BA/BE.

Table 4-29 shows the amount of suitable habitat and effects of treatment in each territorial home range potentially affected by the Diamond Project. All home ranges under each alternative would retain at least 1,000 acres of suitable habitat, which would meet the post-treatment requirements of the HFQLG final EIS, and all but one (LS015) would be above 30 percent suitable habitat within the 4,500-acre home range, the minimum threshold recommended by Bart (1995). The home range for LS015 is located in white fir and red fir habitat around Red Rock Lookout and Diamond Peak, at elevations mostly above 7,000 feet. Of the 2,994 Forest Service acres in this home range, only 28 percent is deemed suitable, due in large part to the Wyethia (Mule Ear) meadows and rock outcrops present. In addition, 33 percent of the 4,500-acre home range for LS015 is private lands, which may provide additional suitable acres. PL005 and PL253 have suitable Forest Service acres approaching the 30 percent threshold. Each of these two territories have over 50 percent total home range acres on private lands.

With all action alternatives, Borax would be applied to all cut stumps greater than 14 inches dbh within the DFPZ and Group Selection Units to minimize the susceptibility to *annosum* root rot. In the most recent risk assessment for Borax (USDA 2006), Boron, the agent of toxicological concern in Borax, was further evaluated. The focus of the evaluation was on wildlife's direct consumption from the stump and ingestion of contaminated water. The assessment concluded that the use of Borax on stumps does not present a significant risk to wildlife species under most conditions of normal use, even under the highest application rates.

The proposed herbicide applications of glyphosate and clopyralid on 22 net acres of noxious weeds (action alternatives B, D, and F) are discussed in chapter 2. With alternative C, no herbicides would be applied (please refer to the herbicide effects discussion in section 4.3.6 above).

Table 4-29. Summary of treatment effects on the California spotted owl home range in the Wildlife Analysis Area.

PAC ID	Existing Suitable Forest Acres within Home Range (4M, 4D, 5M, 5D)	Acres within Home Range Reduced to Unsuitable			Post-treatment Suitable Acres Remaining within the Home Range (percent reduction)			Percent of Suitable Acres After Treatments
		Alternative			Alternative			
		B	D	F	B	D	F	
LS007	2,886	59	59	46	2,827 (2%)	2,827 (2%)	2,840 (2%)	63%
LS009	2,343	13	0	0	2,329 (1%)	2,342 (0)	2,342 (0)	52%
LS015	1,278	21	21	18	1,257 (2%)	1,256 (2%)	1,260 (1%)	28%
LS027	3,371	45	45	38	3,326 (1%)	3,325 (1%)	3,333 (1%)	74%
PL005	1,531	55	44	30	1,476 (4%)	1,487 (3%)	1,500 (2%)	33%
PL006	2,661	18	0	0	2,643 (1%)	2,661 (0)	2,661 (0)	59%
PL041	2,239	147	111	96	2,092 (7%)	2,128 (5%)	2,142 (4%)	46–47%
PL042	2,371	21	0	0	2,350 (1%)	2,371 (0)	2,371 (0)	52–53%
PL043	2,139	96	83	75	2,044 (4%)	2,056 (4%)	2,064 (4%)	45–46%
PL044	2,839	35	29	27	2,804 (1%)	2,809 (1%)	2,811 (1%)	62%
PL071	2,544	103	103	102	2,441 (4%)	2,440 (4%)	2,441 (4%)	54%
PL072	3,154	7	7	7	3,146 (0)	3,146 (0)	3,146 (0)	70%
PL073	3,037	312	301	244	2,725 (10%)	2,736 (10%)	2,793 (8%)	61–62%
PL085	3,538	0	0	0	3,538 (0)	3,537 (0)	3,537 (0)	79%
PL106	2,804	86	72	64	2,718 (3%)	2,732 (3%)	2,740 (2%)	60–61%
PL107	2,412	22	0	0	2,390 (1%)	2,411 (0)	2,411 (0)	53–54%
PL122	2,039	72	69	62	1,967 (4%)	1,970 (3%)	1,977 (3%)	44%
PL123	2,597	83	61	32	2,514 (3%)	2,536 (2%)	2,565 (1%)	56–57%
PL125	2,339	58	58	38	2281 (2%)	2,281 (2%)	2,301 (2%)	51%
PL126	2,432	211	211	121	2,221 (9%)	2,221 (9%)	2,311 (5%)	49–51%
PL163	2,823	55	55	51	2,768 (2%)	2,768 (2%)	2,771 (2%)	62%
PL167	3,312	206	196	195	3,106 (6%)	3,116 (6%)	3,117 (6%)	69%
PL198	4,070	7	0	0	4,064 (0)	4,070 (0)	4,070 (0)	90%
PL199	2,946	173	134	127	2,774 (6%)	2,811 (5%)	2,819 (4%)	62–63%
PL201	3,730	217	188	181	3,513 (6%)	3,542 (5%)	3,549 (5%)	78–79%
PL220	2,772	157	149	117	2,616 (6%)	2,623 (5%)	2,655 (4%)	58–59%
PL229	2,517	61	54	13	2,456 (2%)	2,462 (2%)	2,503 (1%)	55–56%
PL230	3,577	266	250	211	3,311 (7%)	3,327 (7%)	3,366 (6%)	74–75%
PL253	1,449	55	55	48	1,394 (4%)	1,394 (4%)	1,400 (3%)	31%
PL262	2,905	89	82	68	2,816 (3%)	2,823 (3%)	2,837 (2%)	63%
PL263	2,874	105	89	74	2,769 (4%)	2,785 (3%)	2,799 (3%)	62%
PL284	2,870	33	26	0	2,837 (1%)	2,844 (1%)	2,870 (0)	63–64%
PL286	2,728	76	77	64	2,652 (3%)	2,650 (3%)	2,664 (2%)	59%
PL287	3,290	82	82	79	3,208 (3%)	3,207 (3%)	3,211 (2%)	71%
PL301	3,311	213	211	172	3,098 (6%)	3,099 (6%)	3,139 (5%)	69–70%
PL303	2,995	178	105	101	2,818 (6%)	2,890 (4%)	2,894 (3%)	63–64%
TEMP1	3,464	18	12	12	3,445 (1%)	3,451 (0)	3,451 (0)	77%
TEMP2	2,279	38	0	0	2,241 (2%)	2,278 (0)	2,278 (0)	50–51%
TEMP3	2,804	234	224	166	2,570 (8%)	2,579 (8%)	2,637 (6%)	57–59%

Cumulative Effects Common to Old-forest Species, including the California Spotted Owl. The analysis of cumulative effects of the proposed project evaluates its anticipated impact on Threatened, Endangered, and Sensitive species and Management Indicator Species (MIS) and compares those effects to the existing condition (the existing condition reflected by changes that have occurred in the past) within the 159,102-acre Wildlife Analysis Area. Past actions in the area include timber harvest, large wildfires, recreation use, wildlife habitat improvement, grazing, and mining. Past timber harvesting on National Forest and private land, together with the large wildfires, have created a mix of vegetation types and age classes across the Wildlife Analysis Area that has shaped the distribution of old-forest and early seral wildlife species, as reflected by the existing vegetative condition.

The past management history of the Diamond Project Area has strongly influenced stand structure, species composition, fuels, and potential fire behavior at both stand and landscape levels. Fire exclusion and extensive drought-related mortality has created relatively homogeneous areas typified by small even-aged trees existing at high densities. High-density stands are more susceptible to density-dependent mortality driven by drought and insect and disease infestations. Despite many past salvage treatments to remove drought-related mortality, much of this material has fallen over in the last 17 years and become dead and down fuel with high fuel loadings. The high densities of small trees and high fuel loads contribute to continued accumulation of surface, ladder, and canopy fuels, and this accumulation increases the potential for stand-replacing high-severity fire events.

Timber harvest and related activities on public lands from 1977 to 2005 affected approximately 27,120 acres in the 159,102-acre Wildlife Analysis Area (approximately 17 percent of the Wildlife Analysis Area). Various silvicultural prescriptions were employed, including approximately 2,853 acres of regeneration (clearcut); 4,000 acres of overstory removal; 1,060 acres of shelterwood; 1,000 acres of sanitation; 3,900 acres of selection; 7,300 acres of commercial thinning; and 1,600 acres of salvage. Site preparation for planting, pre-commercial thinning, and salvage were also part of the timber harvest activities (see appendix B). Many of these harvest activities (clearcut, shelterwood, overstory removal, thinning) have resulted in either loss of suitable habitat (stands taken below 40 percent canopy cover) or reduction in habitat value through reductions in canopy cover and removal of stand decadence. These past actions resulted in reduced canopies and simplified overstory and understory structure within treated stands, which could have increased overall habitat diversity at the landscape level at the time of implementation. Attachment 2 in the BA/BE displays the existing vegetative condition on National Forest, expressed in CWHR types (VESTRA 2002), which reflects past occurrences and management activities that have resulted in vegetative change, which in turn dictate wildlife species occurrence and distribution.

In the past, numerous timber harvest operations in the Wildlife Analysis Area implemented even-age forestry, resulting in approximately 2,853 acres of plantations that now range in age from 16 to 30 years. The last effort to create openings with even-aged management on National Forest land in the Wildlife Analysis Area was in 1990. Past clearcuts created openings within continuous forest cover that now contributes to both habitat diversity and edge effect in the form of early seral stage stands, as well as an element of forest habitat discontinuity and fragmentation. This action has increased habitat for species that use early seral habitat and decreased habitat for species that require forested stands and continuous cover. Early seral habitat, including plantations created as a result of even-aged forestry, make up approximately 6.5 percent of the 159,102-acre Wildlife Analysis Area.

The bulk of the plantations in the Analysis Area exist as a result of reforestation efforts after large wildfires.

Numerous timber sales have occurred in the Wildlife Analysis Area since the 1970s (see appendix B). Approximately 12,000 acres within the Analysis Area were analyzed for impacts to wildlife and wildlife habitat between 1980 and 1991. The level of analysis for past projects was less intensive compared to current analysis. What can be determined from these many analyses is that those species that were tied to older forest habitat always experienced some decline in habitat suitability as a result of altering old-forest habitat. Even-aged forestry was the typical management practice during that time, with approximately 2,889 acres of clearcuts created between 1977 and 1990. It can be assumed that these clearcuts predominately occurred in CWHR size classes 4M, 4D, 5M, and 5D. Overstory removal silvicultural systems implemented actions removing the larger trees from multi-aged stands, leaving a more open, younger forested stand. Sanitation and salvage prescriptions removed the dead, dying, and projected-to-die trees, thereby removing decadence and structural diversity from stands. All of these actions, through analysis, often translated into a projected decrease in habitat capability (on a timber compartment basis) for owls that ranged from 1 percent up to 9 percent.

During this period of time, owl management varied from protecting nest sites or known roost sites with some sort of buffer (0.25 mile distance or some site-specific acre figure), but there was no set guideline. The 1988 *Plumas National Forest Land and Resource Management Plan* (the “Forest Plan”) provided for a network of Spotted Owl Habitat Areas (SOHAs) across the forest. The SOHAs were designed to maintain species viability, and in 1988, as part of the timber sale process, habitat management plans for SOHAs were developed to determine the amounts of suitable habitat present to determine whether each SOHA would be managed for even-aged, uneven-aged, or dedicated (no harvest) management. Timber harvest during the 1980s, using various silvicultural prescriptions, no doubt occurred in areas that today are protected as PACs and SOHAs and managed for Home Range Core Areas (HRCAs).

After July 1991, all timber projects within the Sierra Nevada were using the cumulative effects analysis process to evaluate the potential effects of a proposed project on spotted owls. Necessary adjustments were made to projects to ensure that the proposed actions would not reduce or degrade the total suitable owl habitat below levels needed to support the current estimated number of owls in the Wildlife Analysis Area. This cumulative effects analysis process generally resulted in no timber harvest occurring within suitable spotted owl habitat. Three sales in the Wildlife Analysis Area were evaluated using the cumulative effects analysis process, which resulted in the removal from the proposed timber sales of all suitable spotted owl habitat. Approximately 2,236 acres of unsuitable habitat were treated with these three timber sales using sanitation, single tree selection, and overstory removal; no even-aged clearcutting was implemented.

In 1993, all timber projects within the Sierra Nevada were using the California Spotted Owl Interim Guidelines (CASPO) to evaluate the potential effects of a proposed project on spotted owls (CASPO 1993). The three sales mentioned above that were evaluated using the cumulative effects analysis process, as well as eight additional sales, were analyzed using CASPO interim guidelines. Approximately 6,143 acres were treated with these timber sales using commercial thinning, selection, and salvage removal; no even-aged clearcutting was implemented. No PACs or SOHAs were entered with activities.

Vegetation projects after 1999 were analyzed under the guidelines of the 1999 Record of Decision on the HFQLG final EIS and the 2001 Record of Decision on the SNFPA final EIS. Projects in the Wildlife Analysis Area included the Antelope-Border Project, which implemented thinning and fuel treatments within primarily eastside pine habitat and mixed conifer habitat on the north and east sides of Antelope Lake. The fuel treatment prescriptions were designed to thin from below, resulting in no change in habitat for spotted owl, goshawk, or forest carnivores. The Stream Fire salvage/restoration project was implemented in 2003–2004 in the area of the Stream Fire. Fire salvage removed all dead trees and left all trees showing greater than 5 percent green limbs. No change in CWHR type created by the fire occurred with fire salvage.

The timber/fuels/vegetation projects in the Wildlife Analysis Area focused on even-aged (clearcut, overstory removal) forestry in the 1970s and 1980s, then switched to sanitation and single-tree selection, and then to commercial thinning and fuels reduction in the 1990s. This change in focus, brought on by changes in management guidelines, has created habitat conditions that support the wildlife populations currently present in the Wildlife Analysis Area.

Private land logging activities in the Wildlife Analysis Area that have occurred since 1982 include 145 acres of shelter wood removal; 56 acres of commercial thinning; 9,048 acres of selection; 60 acres of salvage; and 35 acres of clearcutting. Approximately 21 of the 35 acres of clearcut harvest activity has occurred since 2001, while the selection harvesting has been occurring consistently every other year since 1994. Clearcuts created early seral habitat and will remain as early seral (grass/forb/brush/ seedling-sapling) for at least the next 10–20 years. After year 20, conifers may start to dominate the vegetative cover, and by year 50, should be classified as size class 3 trees (6–11 inches dbh). With brush control and release activities, trees could attain this size class earlier than 50 years. Selection harvest usually results in opening up the stand while maintaining forested cover, providing for an uneven-age stand with scattered brush understory throughout. Thus, past management actions on private lands have provided for an uneven-aged continuous forest cover across the private land landscape.

There have been approximately 15,000 acres of wildfires in the Wildlife Analysis Area since 1918, with 5,100 acres burnt since 1977. These fires have ranged in size from 16 acres up to 3,502 acres (which was the Stream Fire in 2001). These wildland fires burned at high intensity and created large, monotypic openings of early seral brush habitat within the forest that contribute to large-scale fragmentation of continuous forest cover. Much of this habitat is currently occupied by conifer plantation, montane chaparral, and hardwood forest. Brushfields within and between the plantations (such as in Morton Creek, Wildcat Ridge, and Genesee Valley) support very decadent, impenetrable brush. Large brushfields created by wildfire are used extensively by early seral and mid-seral wildlife species but not used by species requiring old forest and continuous forest conifer cover. Approximately 5,560 acres of underburning for fuel reduction have been conducted within the Wildlife Analysis Area since 1996, resulting in reduced levels of down slash, increased grass/forb growth and regenerated younger age class of brush species.

Since the 1980s, numerous salvage sales have occurred in the Wildlife Analysis Area that removed dead and dying trees. Most of these projects consisted of low-intensity, large-scale treatments (removing a few trees per acre over large numbers of acres) to reduce the standing dead fuels caused by drought and insects. Many of these salvage sales occurred along roadsides, thereby removing roadside hazard trees. All salvage projects reduced the structural habitat components needed for snag and down wood dependent species, but also reduced the fuels within landscapes to reduce potential wildfire intensity. For the most part, salvage sales did not change the pre-existing CWHR vegetation type, although during large-scale insect outbreaks, tree mortality would occur in dense pockets, and the subsequent salvage could result in removing all dead trees within these pockets, creating small openings within the forested stands. The existing condition in the Wildlife Analysis Area, as displayed by VESTRA vegetation mapping, reflects the changes resulting from high-intensity salvage removal. The number of salvage projects declined dramatically after the implementation of the CASPO Interim Guidelines (1993), and no salvage projects occurred in the Wildlife Analysis Area until 1997 when multi-product sales (which implemented commercial thinning, biomass and salvage removal) began to be implemented.

Within the Wildlife Analysis Area, approximately 71 aspen stands totaling 194 acres have been treated to enhance the health and productivity of the aspen plant community. In 2000, conifers between 10 and 24 inches dbh were removed from 25 stands totaling 77 acres. Between 2001 and 2005, these same acres, as well as an additional 117 acres, had the non-merchantable-sized conifers (up to 8 inches dbh) cut, piled, and burned to remove conifer competition. No old-forest habitat was impacted with this action.

Since 2001, it is estimated that approximately 3 percent of the commercial woodcutting permits issued for the Mt. Hough Ranger District occurred in the Diamond Project Area, amounting to approximately 25 cords of wood. Commercial woodcutting in the past usually consisted of cutting on and removing existing cull decks, which are manmade habitat features on the landscape used by various mammalian species for cover and den sites. The removal of these features reduces down woody component availability for owl prey species. It is estimated that, since 2001, approximately 5 percent of the Christmas tree permits issued for the Mt. Hough Ranger District occurred in the Diamond Project Area, amounting to approximately 550 permits.

Recreational activities in the Wildlife Analysis Area contribute to cumulative effects on wildlife in terms of increased levels of human disturbance and noise that can result in displacement of wildlife species from selected habitats. The displacement is usually temporary and seasonal, but if disturbance occurs during critical periods (nesting season, winter), effects can be longer term. Most of the recreation use in the Wildlife Analysis Area consists of dispersed activities (by both individuals and small groups) such as hiking, horseback riding, mountain biking, dirt biking, pleasure driving, ATVs, hunting, fishing, camping, rock hounding, mining, and firewood gathering. The Antelope Lake Recreation Area encompasses 2,300 acres containing three developed campgrounds, one picnic area, one boat ramp, and one information center. This area receives approximately 30,000 visitor days per year. Developed recreation site maintenance requires hazard tree removal, pile burning, and replacing signs, fire rings, tables, and older buildings. The Wildlife Analysis Area is within deer hunting zone X6A, which allocated 380 deer tags in 2005.

There are approximately 17 miles of nonmotorized trails in the Project Area. Annual trail maintenance work consists of clearing hazard trees, maintaining erosion control devices, and replacing signs. Snowmobile use during the winter months is dispersed across the Wildlife Analysis Area.

There are approximately 75 active placer mining claims and 140 lode claims in the Wildlife Analysis Area. The timeframe for the dredging season is from the third week of May through October 1 each year. Mining activity in the Wildlife Analysis Area does not have much cumulative effect on terrestrial vegetation. Mining within aquatic habitats can increase sediment transport, increase bank instability, and alter streambed and riparian habitat at localized areas, contributing to both short- and long-term degradation of aquatic habitat quality. There are approximately 11 abandoned mineshafts in the Wildlife Analysis Area and 6 Special Use Permits, which include power lines, recreation events, and a weather station.

There are eight livestock grazing allotments in the Wildlife Analysis Area —two of the allotments in the Taylor Lake and Hungry Creek areas have been vacant since the early 1990s. The combined number of livestock grazed on four allotments (Antelope, Lone Rock, Antelope Lake and Lights Creek) amounts to approximately 504 cow/calf pairs grazing anywhere from June 1 to September 15, with livestock use around Antelope Lake running from September 3 to October 4. The Jenkins allotment is in the Wildlife Analysis Area but located on the Beckwourth Ranger District at the extreme southeast section of the Analysis Area. Most of the 600 cow/calf pairs on this allotment graze outside of the Analysis Area. Some livestock drift does occur from the Lassen National Forest in the Diamond Mountain area. Grazing strategies, season of use, and utilization standards for all allotments have changed over the last 20 years; continuous grazing systems in the area have switched to deferred and rest-rotation systems, which are designed to improved cattle distribution and decrease use within riparian areas. The proposed action alternatives would open up forested stands, improving grass/forb growth in the understory of thinned areas and within group selection areas. Livestock could use this transitory range, which would reduce grazing pressure on the primary range (meadow, riparian areas). This short-term increase in transitory range grazing capacity would not change current or future stocking rates.

Canada Thistle is abundant in many areas of key wildlife habitat, including riparian stringers and aspen stands. Reducing the spread of noxious weeds can improve early seral wildlife habitat by allowing for increased growth and availability of native grass/forb species.

Wildlife habitat improvement projects have included the placement of several guzzlers and construction of 37 waterholes using either backhoe or explosives to collect late-season spring flows. Nine fenced exclosures were constructed between 1985 and 1990 to protect streambank erosion control efforts, fisheries habitat improvements, aspen stands, and spring sites from livestock damage. Approximately 81 acres of roads were closed for vegetative recovery and to reduce access into wildlife habitats. Several waterfowl improvement projects occurred at Antelope Lake, including moat/nest mound construction and nesting island development. Lodgepole pine was removed from approximately 14 acres with Hallet Meadow to maintain the open meadow component. Several burn projects designed to improve deer forage have been implemented, including Genesee winter range and Hallet summer range burns. There are currently no known planned projects proposed for the Wildlife Analysis Area, but wildlife habitat planning is an ongoing effort, subject to priorities, partnerships, and funding.

The Personal Use Firewood Program on the Plumas National Forest is an ongoing program that has been in existence for years and will continue. This program allows the public to purchase a woodcutting permit and remove fuel and firewood from National Forest lands. A 10-year average (1991–2000) indicates that 3,273 permits were issued annually, resulting in the annual sale of 10,417 cords of wood on the Plumas National Forest. Since 1993 there has been a fluctuating trend in both number of permits and cords sold. For example, in the year 2000, the 2,227 permits issued sold 6,392 cords; while in 2004, 758 permits were sold for a total of 2,400 cords; in 2005 942 permits were issued for 2,478 cords. Much of this wood material either consists of down logs found in the forest, along forest roads, and within cull decks created by past logging operations, or as standing snags. The Diamond Project Area (excluding an area between the shoreline and paved road at Antelope Lake) is open to woodcutting. Snags and logs would continue to be removed, resulting in the cumulative loss of these habitat components across the landscape, negatively affecting those species dependent on such structures. Snags are recruited annually from live trees through natural processes at a rate that may sustain this loss in the Analysis Area; snag and log removal is most common along or within a short distance from open roads. More area would be accessible to woodcutting with the no-action alternative because no existing roads would be closed.

Table 4-30 provides a cumulative total of the amount of suitable owl nesting habitat that would be impacted by the fuel treatments, group selection harvests, and individual tree selection harvests projects implemented under the HFQLG Pilot Project on the Mt. Hough Ranger District.

Table 4-30. Cumulative reductions in spotted owl nesting habitat (CWHR size classes 5M, 5D, and 6) on the Mt. Hough Ranger District under HFQLG Pilot Project implementation.

Meadow Valley Project (Alternative C)	Empire Project (Alternative D)	Diamond Project (Alternatives B, C, D, F)	Potential Cumulative Change
Spotted Owl Nesting Habitat			
-945 acres	-1,472 acres	-105 to -408 acres	2,522 to 2,825 acres

As table 4-30 indicates, all of the action alternatives (B, C, D, and F) could contribute to a cumulative reduction in spotted owl nesting habitat. It is uncertain as to what influence these various reductions in habitat would do to owl activity and occupancy in the Wildlife Analysis Area. As noted above in the direct and indirect effects sections, spotted owl PACs and SOHAs have been excluded from the Diamond Project Treatment Units. Additional PACs and HRCAs would be created in the future, if warranted, by new site-specific owl information.

Follow-up fuels actions on existing fuel reduction projects would occur in the near future. These projects would begin in 2006 and be completed over three to five years. Approximately 1,785 acres of underburning in three projects (Hungry, Greenflat, and Lucky “S”) would be initial treatments, whereas 1,000 acres in North Antelope would be a reburn. In addition to underburning, the Hungry Project would have 2,125 acres of grapple piling and/or mastication.

The earliest the District fuels specialists can project a need for fuel treatment maintenance is approximately 10 years after completion in the Sierra mixed conifer-ponderosa pine type. The predicted future maintenance for fuels treatments includes prescribed fire, mechanical treatment, and hand treatment. This applies to all action alternatives. In red fir stands, mastication of the regenerating brush would be a more likely treatment than using prescribed fire. The effects of fuel treatment maintenance actions within 10 years on habitat are not anticipated to cause any changes to forest canopy cover or residual tree size; only brush, small seedlings/saplings, and any natural slash accumulations would be removed by these actions. Maintenance fuels reduction treatments are not expected for aspen, chaparral, montane hardwood and riparian or meadow areas.

The Eagle Lake Ranger District on the Lassen National Forest is proposing three future projects that could theoretically fall within the Lassen National Forest portion of the Diamond Project Area. These projects include the Southside DFPZ (approximately 245 acres planned in June 2006), Keddie DFPZ (approximately 1,300 acres), and Susan River DFPZ (approximately 1,200 planned acres). These projects would implement actions for fuel treatments similar to the Diamond Project. A site-specific analysis of direct, indirect, and cumulative effects of these projects would be documented in a separate analysis.

Future foreseeable projects that could occur within the boundary of the Diamond Wildlife Analysis Area include the Keddie Project (2008) and the Genesee and Antelope Creek Projects (2009).

Approximately 8,760 acres of the Keddie Project landscape falls within the Wildlife Analysis Area, which is approximately 10 percent of the Keddie Project landscape. Based on the November 2005 Program of Work, the Keddie Project would implement approximately 8,412 acres of fuel treatments (including DFPZs), area thinning, and group selection for an approximate total of 32 million board feet. Within the Wildlife Analysis Area, this would include the Cooks DFPZ (approximately 1,056 acres). It is not known how many acres of area thinning and group selection would occur. Based on the percentage of the Keddie landscape within the Wildlife Analysis Area, it is estimated that approximately 840 acres of treatments would occur. Thus, it appears as if the DFPZ would be the dominant treatment; groups could occur within the DFPZ. It is reasonable to assume that the effects of these actions on wildlife habitat would be similar in nature to the effects from the same actions described for the Diamond Project. All groups would become CWHR size classes 1 and 2, and fuel treatments could result in an increase in CWHR size class 4P.

Approximately 8,460 acres of the Genesee Project landscape fall within the Wildlife Analysis Area, which is approximately 21 percent of the Genesee Project landscape. Based on the November 2005 Program of Work, the Genesee project would implement approximately 1,839 acres of fuel treatments, area thinning, and group selection, for an approximate total of 11 million board feet. There is currently no proposed Genesee DFPZ identified. It is not known how many acres of area thinning and group selection could occur, but based on the percentage of the Genesee landscape within the Wildlife Analysis Area, it is estimated that approximately 386 acres of group selection and area thinning could occur within the Wildlife Analysis Area. The effects of these actions on wildlife habitat would be similar in nature to the effects from the same actions described for the Diamond Project. All groups would become CWHR size classes 1 and 2, and fuel treatments could result in an increase in CWHR size class 4P.

The entire 13,219 acres of the Antelope Creek Project landscape falls within the Wildlife Analysis Area. Based on the November 2005 Program of Work, the Antelope Creek project would implement approximately 1,014 acres of fuel treatments, area thinning, and group selection for an approximate total of 20 million board feet. There is currently no proposed DFPZ. Because the entire project landscape falls within the Wildlife Analysis Area, approximately 1,014 acres of treatment would occur in the Wildlife Analysis Area. The effects of these actions on wildlife habitat would be similar in nature to the effects from the same actions described for the Diamond Project. All groups would become CWHR size classes 1 and 2, and fuel treatments could result in an increase in CWHR size class 4P.

Future land and recreation projects that could occur in the Wildlife Analysis Area include designation of off-highway vehicle (OHV) trails, closure of two mineshafts using a constructed foam plug, the conveyance of parcels of National Forest land that are isolated or inefficient to manage due to location or other characteristics, and continuation of long-term special use permits for power lines and weather stations. An application has been received by the Forest Service for a new project that would install up to 12 wind energy towers along Diamond Mountain. All of these future projects would be assessed on a site–specific basis for direct and indirect effects through the NEPA (*National Environmental Policy Act*) process. No changes in CWHR size classes 4M, 4D, 5M, and 5D are expected with any of these projects, although no analysis has been conducted on the type of habitat present on the parcels identified for potential sale.

The cumulative effects of HFQLG Pilot Project actions (such as the Diamond Project and other vegetation management actions in the Sierra Nevada) were assessed in the *Sierra Nevada Forest Plan Amendment Final Supplement Environmental Impact Statement* (SNFPA final supplemental EIS), to which this Diamond Project EIS is tiered. The habitat modeling used for the final supplemental EIS was intended to indicate the direction, magnitude, and timeframes (general trends) of change and was not intended to provide precise information. That assessment (pages 260–280 in the SNFPA final supplemental EIS) acknowledged that suitable foraging habitat provided by CWHR size class 4 stands would diminish in early decades under the Sierra Nevada Forest Plan Amendment but would be offset by increases in acreage of CWHR size class 5 and 6 stands. According to projections (SNFPA final supplemental EIS, table 4.3.2.3g), 20 years after implementation of the Sierra Nevada Forest Plan Amendment, there would be an 11 percent increase of total spotted owl habitat (CWHR size classes 4M, 4D, 5M, and 5D) in the HFQLG Pilot Project Planning Area. By project year 50, there would be a drop in net gain of 6 percent; and by year 130, there would be a net reduction of 7 percent. However, in the Sierra Nevada bioregion as a whole, there would be a 13 percent increase in total habitat by project year 20, 18 percent by year 50, and 20 percent by year 130.

Within the HFQLG Pilot Project Planning Area, full implementation of HFQLG Pilot Project under the SNFPA 2004 Record of Decision is projected to result in roughly 65,000 fewer acres of suitable habitat (CWHR size classes 4M, 4D, 5M, 5D, and 6) in project year 20 than under the SNFPA 2001 Record of Decision (alternative S1). This would primarily be due to (1) implementation of group selection harvests, and (2) the fact that standards and guidelines for CWHR size classes 4M and 4D do not have any minimum canopy cover requirements and have a 30 percent basal area retention standard. Also, under the 2004 Record of Decision on the SNFPA final supplemental EIS, the canopy cover in CWHR size class 5M and 5D stands is more likely to drop to 40 percent in the DFPZs (SNFPA final supplemental EIS chapter 4, page 269). The spotted owl population is currently within the 95 percent confidence limits of a stable population (Franklin et al. [2003] in the 2004 SNFPA final supplemental EIS); therefore, the final supplemental EIS and supporting BA/BE concluded that these cumulative habitat changes (within the range of the California spotted owl in both the Sierra Nevada and HFQLG Pilot Project Planning Area) would not result in a trend toward listing or loss of viability of the California spotted owl.

As a requirement of the HFQLG final EIS, over the course of the Pilot Project, suitable habitat for old-forest-dependent species and aquatic/riparian-dependent species (including amphibians) shall not be reduced by more than 10 percent below 1999 levels. The CWHR types selected by the monitoring team to represent suitable habitat for late successional species includes CWHR size classes 5M, 5D, and 6. Data from the HFQLG final EIS indicate that the baseline total for CWHR size classes 5M, 5D, and 6 is 186,401 acres within the HFQLG Planning Area. Thus, a 10 percent reduction would be approximately 18,640 acres. The analysis for the Diamond Project concludes that there would be a reduction in these strata types of approximately 408 acres under alternatives B and C, 300 acres under alternative D, and 106 acres under alternative F. Therefore, there would be a small cumulative contribution to the loss of suitable habitat for old-forest-dependent species within the HFQLG Planning Area as a result of implementing any of the four action alternatives. The project analysis considered the cumulative effects of any reductions of habitat and complies with the direction contained in the Record of Decision (on the HFQLG final EIS) to limit the loss of this habitat type to no more than 10 percent below 1999 levels for the HFQLG Pilot Project. The HFQLG 2005 Monitoring Summary Report (February 10, 2006) states that as of this date, 3,282 acres have or will have a reduction based on projects with a signed Record of Decision, and this would be approximately 1.7 percent of the acres with these strata in the Pilot Project. The Diamond Project BA/BE indicates that approximately 3,388 to 3,690 acres of old forest would be reduced in the HFQLG Pilot Project Area as a result of projected changes from the Diamond Project. On-the-ground monitoring would refine this figure to reflect actual changes in strata. Nevertheless, the trend appears to be that the reduction of this old-forest habitat would be well below the 10 percent figure.

The Forest Inventory and Analysis data collected from the Diamond Project Area was run through the Forest Vegetation Simulator growth and yield model. The modeling results show that tree growth and subsequent habitat recovery would follow the trends projected in the HFQLG final supplemental EIS. The modeling indicates that all action alternatives (which would implement fuels treatments and individual tree selection) for the Diamond Project could result in additional suitable owl habitat over time (project years 20 through 50). Individual groups are projected to be CWHR size class 3M by year 50, with structurally suitable habitat occurring beyond year 50 (refer to the "Vegetation Report" in the Diamond Project record).

Large-scale changes in owl habitat as a result of recent wildfires and anticipated future fires in spotted owl habitat have been identified as a potential threat affecting spotted owl distribution (*Federal Register*, vol. 71, no. 100 / May 24, 2006 / Proposed Rules). An annual average of 4.5 PACs have been lost or severely modified by wildfire since 1998 in the range of the California spotted owl (SNFPA final supplemental EIS chapter 3, page 145). Table 3.2.2.3b in the SNFPA final supplemental EIS indicates that approximately 7 PACs on the Plumas National Forest are considered to be lost due to fire effects. None of these PACs have been removed from the PAC network in Plumas National Forest, and at least three have been redesignated around the periphery of the Stream Fire—owls have been found in all three sites (Sloat 2002; GANDA 2003; surveys in 2005 by Holmes Forestry). Approximately 2,300 acres of suitable owl habitat (CWHR size classes 4M, 4D, 5M, 5D, and 6) were lost with the Stream Fire. Spotted owls may have relocated to habitat outside of the fire perimeter, which could have resulted in increased crowding and competition with established owls, resulting in lower owl numbers and occupancy in the general area. The large-scale fires that have occurred in the Wildlife Analysis Area (Wildcat Ridge area and Morton Creek) in the past probably consumed spotted owl habitat and were large enough to probably displace spotted owls.

The petition to list the California spotted owl identified West Nile Virus as a serious potential threat to owls and that its effects on owls be monitored (70 *Federal Register*, June 21, 2005). West Nile Virus has not yet been detected in a wild spotted owls (ibid.). In 2004 researchers tested for West Nile Virus (California spotted owls in the Eldorado Study Area and northern spotted owls in the Willow Creek Study Area), and in 2005, blood samples were taken from spotted owls in the Plumas and Lassen National Forests. None of these owls tested positive for West Nile Virus exposure (ibid.; J. Keane, personal communications, 2005). The U.S. Fish and Wildlife Service found that there was no substantial information that West Nile Virus may threaten the continued existence of spotted owls (70 *Federal Register*, 35612, June 21, 2005).

The documented range expansion of the barred owl has been hypothesized as a contributing factor in the decline in northern spotted owls, through both hybridization as well as replacing the spotted owl in some areas. It is thought that this range expansion and subsequent northern spotted owl displacement can be a result of forest fragmentation and the barred owl's ability to adapt better to a mosaic of habitats. It is suspected that barred owl expansion into the range of the California spotted owl is occurring due to these same reasons.

Barred owls have expanded their range in California as far south as Sequoia National Park, and in the last two years (2004/2005), the known range of barred owls has expanded 200 miles southward in the Sierras (*Federal Register*, vol. 71, no. 100 / May 24, 2006 / Proposed Rules). The U.S. Fish and Wildlife Service has concluded that barred owls constitute a threat to site occupancy, reproduction, and survival of the California spotted owl, but that there is currently not enough information to conclude that hybridization with barred owls poses a threat (ibid.).

According to the most recent annual report of the Plumas-Lassen Administrative Study (USFS PSW 2006) there have been 33 barred owl detections in the entire Northern Sierra Nevada (El Dorado National Forest north) since 1989; 20 of the detection have been in the last three years. Of these 20, 9 have been barred owls, and 11 have been sparred owls (barred X spotted hybrid). There have been 10 detections in the last three years (6 barred and 4 sparred) in the Plumas-Lassen Administrative Study analysis Area within the HFQLG Pilot Project Area. None of these detections have occurred within the Wildlife Analysis Area.

Determination. The Forest Service has determined that, for all action alternatives, the Diamond Project may affect individuals but is not likely to result in a trend toward federal listing or loss of viability of the spotted owl.

4.3.9.3 Summary of Effects of the Action Alternatives (B, C, D, and F)

The four action alternatives avoid habitat modification within PACs/SOHAs. No changes in spotted owl PAC/HRCA/SOHA occupancy or the spotted owl population on the Plumas National Forest are expected to occur.

The viability of California spotted owls in the Sierra Nevada is uncertain (SNFPA final EIS 2001, volume 4, appendix E-51). The key uncertainties related to viability in the Sierra Nevada include (1) factors driving population trends; (2) habitat relationships and habitat quality; (3) current distribution, amount, and quality of habitat; and (4) treatment effects, including fuels and silvicultural treatments, on habitat and populations at multiple scales. The most current and comprehensive study of owl populations conducted by the U.S. Fish and Wildlife Service indicate that most populations in the Sierra Nevada are stable or increasing (*Federal Register*, vol. 71, no. 100, May 24, 2006 / Proposed Rules). Among the U.S. Fish and Wildlife Service's conclusions were that forest fuels reduction activities may have a short-term impact on owl populations, but fuels reduction would have a long-term benefit to California spotted owls by reducing the risk of catastrophic wildfires that pose a major threat to owl habitat (ibid.).

Lee and Irwin (2005), using a combination of population data from the southern Sierra Nevada and canopy cover measurements and forest simulation models, demonstrated that modest fuels treatments (mechanical thinning plus fuel break construction) in the Sierra Nevada would not be expected to reduce canopy cover sufficiently to have measurable effects on owl reproduction. Lee and Irwin (2005) predicted that with mechanical thinning, plus fuel break construction treatments (including DFPZ construction scenario), in combination with either no fire or mixed lethal fire scenarios, would not degrade canopy conditions in productive owl territories or impede improvement of nonproductive territories. In contrast, lethal fire simulations produced a pronounced and lasting negative effect. The general trend with all fuel treatments was toward higher proportions of intermediate canopy covers (40 to 69 percent) and lower proportions of sparse canopy cover (0 to 39 percent) over time; whereas, lethal fire scenarios produced sparse canopy cover discernible four decades later. "The immediacy of the fire threat creates an urgency to act even as key uncertainties remain" (Lee and Irwin 2005).

4.3.9.4 Alternatives B (Proposed Action) and C: Effects on California Spotted Owl

1. There would be a potential decrease in spotted owl foraging habitat of about 2,480 acres, and a decrease in nesting habitat of about 408 acres, leaving 95.4 percent of the existing suitable foraging habitat and 98.8 percent of the existing suitable nesting habitat on National Forest acres in the Wildlife Analysis Area.

2. A total of approximately 899 acres of suitable habitat in 28 HRCAs would become unsuitable, with an average reduction of 32 acres per HRCA.

3. Based on the direct/indirect effects, implementation of alternative B or C would contribute to cumulative effects on spotted owl and spotted owl habitat. There would be a cumulative reduction in habitat for the next 50 years in Fuel Treatment Units to 50+ years in Group Selection Units. For items 1–2 above, implementation of alternative B or C would produce the highest risk of all alternatives to owl habitat in the short term and greatest uncertainty about future owl activity.

4. Implementation of fuels treatments could decrease the likelihood of crown fires and increase the ability of fire management to suppress, control, and contain fires. This could reduce the potential risk of increased large-scale habitat fragmentation and loss of owl

habitat as a result of high-intensity wildfire. This alternative would reduce the risk of loss from wildfires for a minimum of six PACs immediately adjacent to and upslope of the proposed Fuel Treatment Units.

4.3.9.5 Alternative D: Effects on California Spotted Owl

1. There would be a potential decrease in spotted owl foraging habitat by about 2,433 acres and a decrease in nesting habitat by about 300 acres, leaving 95.5 percent of the existing suitable foraging habitat and 99.1 percent of the existing suitable nesting habitat on National Forest acres in the Wildlife Analysis Area.

2. Approximately 779 acres of suitable habitat in 28 HRCAs would become unsuitable, with an average reduction of 28 acres per HRCA.

3. Based on the direct/indirect effects, implementation of this alternative would contribute to cumulative effects on spotted owl and spotted owl habitat. There would be a cumulative reduction in habitat for the next 50 years in fuel treatments to 50+ years in group selection areas. As a result of items 1–2 above, the implementation of alternative D would produce a level of risk to owl habitat in the short term and uncertainty about future owl activity. The risk would be slightly less than with alternatives B and C.

4. The implementation of fuel treatments could decrease the likelihood of crown fires and increase the ability of fire management to suppress, control, and contain fires. This could reduce the potential risk of increased large-scale habitat fragmentation and loss of owl habitat from high-intensity wildfire. This alternative would reduce the risk of loss from wildfires for a minimum of six PACs immediately adjacent to and upslope of the proposed Fuel Treatment Units.

4.3.9.6 Alternative F: Effects on California Spotted Owl

1. There would be a potential decrease in spotted owl foraging habitat by about 2,169 acres and a decrease in nesting habitat by about 105 acres, leaving 96 percent of the existing suitable foraging habitat and 99.6 percent of the existing suitable nesting habitat on National Forest acres in the Wildlife Analysis Area. It is acknowledged that the quality of the foraging habitat may be reduced due to understory thinning and removal of structural attributes comprising the understory canopy layer.

2. Approximately 551 acres of suitable habitat in 28 HRCAs would become unsuitable, with an average reduction of 18 acres per HRCA.

3. Based on the direct/indirect effects, implementation of this alternative would contribute to cumulative effects on spotted owl and spotted owl habitat. There would be a cumulative reduction in habitat for the next 50 years in fuel treatments to 50+ years in group selection areas. As a result of items 1–2 above, implementation of alternative F would involve a level of risk to owl habitat in the short term and uncertainty about future owl activity. This level of risk would be less than the other action alternatives.

4. The implementation of fuel treatments could decrease the likelihood of crown fires and increase the ability of fire management to suppress, control, and contain fires. This could reduce the potential risk of increased large-scale habitat fragmentation and loss of owl habitat from high-intensity wildfire. This alternative would reduce the risk of loss from wildfires for a minimum of six PACs immediately adjacent to and upslope of the proposed Fuel Treatment Units.

4.3.9.7 Alternative A (No Action): Effects on Northern Goshawk

Direct Effects. There would be no direct effects on the goshawk or existing goshawk habitat because no treatment activities would occur to cause disturbance to nesting or foraging birds.

Indirect Effects. The indirect effects of no action would include the potential for future wildfire and its impact on habitat development and recovery. The fuel loads that would be left by this alternative would make potential wildfires in the area difficult to suppress and create a more intense burn, which could lead to increased rates of spread. This would result in potential loss of suitable goshawk nesting habitat and other important prey habitat attributes such as large trees and snags and down woody material.

Cumulative Effects. The no-action alternative would not provide for the long-term protection of goshawk habitat from catastrophic fire, and there would be no actions designed to reduce the risk of high-intensity wildfire. Total wildfire acres and high-intensity wildfire acres are anticipated to increase from current levels under this alternative (based on the analysis conducted for the 2001 Sierra Nevada Forest Plan Amendment).

With the current Plumas National Forest woodcutting program, the Diamond Project Area would be open to public woodcutting 12 months a year, except around Antelope Lake, limited only by available access. Uncontrolled public use in the areas used by goshawks, especially during the nesting season, could cause disturbance that would disrupt and preclude successful nesting.

1. There would be no short-term reduction in goshawk habitat.

2. The lack of fuel treatment would leave habitat vulnerable to high-intensity wildfire, increasing the risk of large-scale habitat fragmentation, loss of PACs, and loss of goshawk habitat.

3. Implementation of no action would result in little to no risk to goshawk habitat in the short term, and thus, future goshawk activity would be less uncertain.

Determination. The Forest Service has determined that alternative A would not affect the northern goshawk.

4.3.9.8 All Action Alternatives (B, C, D, and F): Effects on Northern Goshawk

Direct Effects. The analysis of direct effects on northern goshawk is focused on known PACs up to and including the 2005 surveys. The effects on other potentially suitable nesting and foraging habitat outside of PACs are discussed in the “Indirect Effects” section below.

No direct effects on northern goshawk are expected because of the following factors:

1. Goshawk PACs would not be entered for the Diamond Project. Currently, there are 11 goshawk PACs (2,149 acres) in the Wildlife Analysis Area. Five goshawk PACs overlap with spotted owl PAC habitat (goshawk nesting habitat requirements are similar to California spotted owl nesting requirements [HFQLG Act, page 3-106]).

2. Limited Operating Periods would be implemented for Treatment Units and haul roads within 0.25 mile of active nest sites from February 15 to September 15. The Limited Operating Periods are expected to eliminate effects from increased human activity and vehicle and equipment noise. If new northern goshawk activity centers, such as nests or young, are detected in future surveys or project activities, PACs would be delineated and applicable resource protection measures (such as Limited Operating Periods) would be applied.

3. No new road construction would occur in northern goshawk PACs. For any road reconstruction in PACs, a Limited Operating Period would be applied to all goshawk activity centers.

The analysis of direct effects is based on data gathered during the 2005 survey. Surveys are being repeated in 2006 to complete the two-year survey effort. The proposed treatments could occur in summer 2007 and continue an additional 5–7 years. There is the potential that goshawks could establish new territories (activity centers) during project implementation that would not be protected as PACs.

Indirect Effects. Please refer to the indirect effects discussion for the spotted owl for changes to suitable habitat (CWHR size classes 4M, 4D, 5M, and 5D) that could result from implementing fuel treatments, group selection harvests, and area thinning under each action alternative.

All new roads that were constructed in support of the Diamond Project would be closed upon project completion. Thus, no long-term increases in human activities are expected as a result of the action alternatives. No roads would be constructed in PACs. As part of a strategic system of DFPZs, the Diamond Project would help eliminate understory fuel buildup and may reduce the potential for high-severity wildfires, which have the potential to eliminate vast tracts of habitat.

It is an unknown as to how some of the important prey species (small mammals, birds) preferred by goshawks would respond to opening up forested stands with fuel treatments and Group Selection Units. Based on CWHR modeling, it is known that several bird species respond favorably to either opening up forested stands and/or openings, while some do not (HFQLG final EIS, appendix I). The increased diversity and edges created by groups within forested stands may provide foraging habitat that would increase use of the landscape by goshawks. The response of prey species, including small mammals and passerine bird use of group openings, is one of the main objectives of the post-implementation monitoring that would be conducted by the Pacific Southwest Research Station through the Plumas-Lassen Administrative Study. This study could provide information regarding the response by these prey species to the DFPZs and group selections.

With all action alternatives, Borax (Sporax) would be applied to all cut stumps greater than 14 inches dbh within the DFPZ and Group Selection Units to minimize the susceptibility to *annosum* root rot. In the most recent risk assessment for Borax (USDA 2006), Boron, the agent of toxicological concern in Borax, was further evaluated. The focus of the evaluation was wildlife's direct consumption from the stump and ingestion of contaminated water. The assessment concluded that the use of Borax on stumps does not present a significant risk to wildlife species under most conditions of normal use, even under the highest application rates.

The proposed herbicide applications of glyphosate and clopyralid on 22 net acres of noxious weeds (action alternatives B, D, and F) are discussed in chapter 2. With alternative C, no herbicides would be applied (please refer to "Herbicide Effects Analysis" above in section 4.3.6).

Cumulative Effects. Cumulative effects on the goshawk could occur with the incremental loss of the quantity and/or quality of habitat for this species. Overall, increases in recreational use of National Forest lands, and the use of natural resources on state, private, and federal lands, may contribute to habitat loss for this species. High-intensity stand-replacing fires, and the means by which land managers control them, have contributed and may continue to contribute to loss of habitat for this species.

Please refer to the cumulative effects discussion above for the California spotted owl, as well as cumulative effects discussed in the Diamond Project BA/BE. This discussion focused on past timber sales as they related to impacts on suitable owl habitat, more specifically CWHR size classes 4M, 4D, 5M, and 5D. These same CWHR types are considered suitable goshawk nesting habitat. Those projects treated between 1980 and 1990 impacted goshawk habitat similar to the impacts described for spotted owls. Through analysis, all of these actions often translated into a projected decrease in habitat capability (on a timber compartment basis) for goshawks that ranged from 1 percent up to 9 percent. Conversely, deer habitat, which is not reflective of the CWHR types identified as goshawk nesting habitat, usually experienced an increase in projected habitat capability from 2 to 11 percent. Thus, dense forested stands of medium and large trees were being removed and opened up, which resulted in a decrease in goshawk habitat and an increase in deer habitat.

Table 4-31 provides a cumulative total of the amount of suitable goshawk nesting habitat that would be impacted by the fuel treatments, group selection, and area thinning implemented under the HFQLG Pilot Project on the Mt. Hough Ranger District.

Table 4-31. Cumulative reductions in northern goshawk nesting habitat on the Mt. Hough Ranger District.

Meadow Valley Project (Alternative C)	Empire Project (Alternative D)	Diamond Project (Alternatives B, C, D, F)	Potential Cumulative Change
Northern Goshawk Nesting Habitat			
-4,282 acres	-4,980 acres	-2,275 to -2,888 acres	6,390 to 12,524 acres

Data sets from studies in the western United States (Woodbridge and Detrich 1994; Destefano et al. 1994; Reynolds et al. 1994; Reynolds and Joy 1998) establish a range of crude densities from one territory per 2,123 acres to one territory per 4,003 acres; territory centers are roughly 1.9 to 2.3 miles apart. These crude densities include both suitable and unsuitable habitat in the study areas. The crude densities for goshawk territories (PACs) in the Diamond Wildlife Analysis Area are much lower than these figures: one territory for 7,875 acres in the entire Analysis Area; one territory per 6,343 acres on National Forest acres in the Wildlife Analysis Area; or one territory per 3,827 acres based on total suitable National Forest nesting habitat in Wildlife Analysis Area. Territory centers range from dense (0.5 to 1 mile apart) to scattered (4 to 5 miles apart). Based on the density and spacing of known goshawk territories, it appears that the crude density of goshawk territories in the Wildlife Analysis Area may be less than what has been reported in the literature. Densities may be a product of the past activities (timber sales, wildfires) that have occurred in the Analysis Area. The large blocks of unsuitable nesting habitat created by three large wildfires may contribute to lower densities and increased spacing.

Based on table 4-31 above, the Diamond Project would potentially contribute to a cumulative reduction in goshawk nesting habitat in the HFQLG Pilot Project Area. It is uncertain as to what influence this reduction in habitat would do to goshawk activity and occupancy in the Wildlife Analysis Area. It is not anticipated that the cumulative habitat reduction would result in loss of occupancy and productivity of known goshawk PACs. This is based on the location of project activities in relation to known PACs, no habitat alteration in PACs, distribution of known PACs, and a minimum of 95 percent retention of available suitable nesting habitat distributed across the Wildlife Analysis Area following project implementation.

Determination. The Forest Service has determined that for all action alternatives, the Diamond Project may affect individuals but is not likely to result in a trend toward federal listing or loss of viability for the northern goshawk.

4.3.9.9 Summary of Effects of the Action Alternatives

Alternatives B (Proposed Action) and C: Effects on Northern Goshawk.

1. There would be a potential decrease in goshawk nesting habitat by about 2,888 acres, leaving 96.7 percent of the existing suitable nesting habitat on National Forest acres within the Wildlife Analysis Area.

2. None of the actions proposed in the alternatives would occur in goshawk PACs.

3. Based on the direct and indirect effects, implementation of alternative B or C would contribute to cumulative effects on goshawk and goshawk habitat. There would be a cumulative reduction in habitat for the next 50 years in fuel treatments to 50+ years in group selection areas. Implementation of alternative B or C would involve the greatest level of risk to goshawk habitat in the short term and uncertainty about future goshawk activity than alternatives D and F.

4. Implementation of fuels treatments could decrease the likelihood of crown fires and increase the ability of fire management to suppress, control, and contain fires. This

could reduce the potential risk of increased large-scale habitat fragmentation and loss of goshawk habitat as a result of high-intensity wildfire. Alternatives B and C would reduce the risk of loss from wildfires for a minimum of three PACs immediately adjacent to and upslope of the proposed Fuel Treatment Units.

Alternative D.

1. There would be a potential decrease in goshawk nesting habitat by about 2,734 acres, leaving 97 percent of the existing suitable nesting habitat on National Forest acres within the Wildlife Analysis Area.

2. None of the actions proposed in the alternatives would occur in goshawk PACs.

3. Based on the direct and indirect effects, implementation of this alternative would contribute to cumulative effects on goshawk and goshawk habitat. There would be a cumulative reduction in habitat for the next 50 years in fuel treatments to 50+ years in group selection areas.

4. Implementation of fuels treatments could decrease the likelihood of crown fires and increase the ability of fire management to suppress, control, and contain fires. This could reduce the potential risk of increased large-scale habitat fragmentation and loss of goshawk habitat as a result of high-intensity wildfire. This alternative would reduce the risk of loss from wildfires for a minimum of three PACs immediately adjacent to and upslope of the proposed Fuel Treatment Units.

Alternative F.

1. There would be a potential decrease in goshawk nesting habitat by about 2,275 acres, leaving 97.4 percent of the existing suitable nesting habitat on National Forest acres within the Wildlife Analysis Area.

2. None of the actions proposed in the alternatives would occur in goshawk PACs.

3. Based on the direct and indirect effects, implementation of this alternative would contribute to cumulative effects on goshawk and goshawk habitat. There would be a cumulative reduction in habitat for the next 50+ years in group selection areas. Implementation of alternative F would result in a level of risk to goshawk habitat in the short term and uncertainty about future goshawk activity; this level of risk would be less than all other alternatives.

4. Implementation of fuels treatments could decrease the likelihood of crown fires and increase ability of fire management to suppress, control, and contain fires. This could reduce the potential risk of increased large-scale habitat fragmentation and loss of goshawk habitat as a result of high-intensity wildfire. This alternative would reduce the risk of loss from wildfires for a minimum of three PACs immediately adjacent to and upslope of the proposed Fuel Treatment Units.

4.3.9.10 Alternative A (No Action): Effects on Mesocarnivores

The total suitable habitat in the Wildlife Analysis Area is 88,561 acres. The acres of carnivore network that lies within the Analysis Area is 27,311 acres, with 17,875 acres that are suitable (65 percent).

Direct Effects. There would be no direct effects on forest mesocarnivores (American marten, Pacific fisher) or their habitat because no activities would occur that would cause disturbance to denning, resting, dispersing, or foraging animals.

Indirect Effects. Indirect effects of no action include the potential for future wildfire and its impact on habitat development and recovery. The fuel loads that would be left by this alternative would make potential wildfires in the area difficult to suppress and create a more intense burn. This could then lead to increased rates of spread, resulting in potential loss of suitable forest habitat for mesocarnivores and other important prey habitat attributes such as large trees and snags and down woody material.

With the current Plumas National Forest woodcutting program, the entire Diamond Project Area would be open to public woodcutting 12 months a year, limited only by available access. Uncontrolled public use in the areas used by marten, especially during the denning season, could cause disturbance that would disrupt and preclude successful denning.

Cumulative Effects. The no-action alternative would not provide for the long-term protection of forest mesocarnivore habitat from catastrophic fire. There would be no actions designed to reduce the risk of high-intensity wildfire. Total wildfire acres and high-intensity wildfire acres are anticipated to increase from current levels under this alternative (based on the analysis conducted for the 2001 Sierra Nevada Forest Plan Amendment). The cumulative effect of recent private land clearcuts, older National Forest plantations, the large brushfields created by past wildfires, together with the potential for large-scale high-intensity wildfire, could result in additional large-scale habitat fragmentation and reduced connectivity. The large-scale habitat fragmentation created as a result of wildfire could further reduce the potential for the Wildlife Analysis Area to contribute to fisher reintroduction. Maintaining existing conditions over the long term would present a high degree of risk and uncertainty for fisher in the Sierra Nevada due to the probability of stand-replacing fires (2004 SNFPA final supplemental EIS, page 245).

Determination. The Forest Service has determined that alternative A would not affect the American marten or Pacific fisher.

4.3.9.11 All Action Alternatives (B, C, D, and F): Effects on Mesocarnivores

Direct Effects. Please refer to the effects discussion for the spotted owl for changes to suitable mesocarnivore habitat (CWHR size classes 4M, 4D, 5M, and 5D) as a result of implementing fuel treatments, group selection harvests, and area thinning under each action alternative. The number of denning and foraging habitat acres that could be reduced by each alternative is discussed below.

For fisher and marten habitat, based on table 4-25, alternatives B and C would reduce CWHR size class 4D and 5D denning habitat within the Wildlife Analysis Area on 745 acres and reduce 4M and

5M foraging habitat quality on 2,143 acres. Alternative D would reduce CWHR size class 4D and 5D habitat quality on 575 acres and reduce 4M and 5M habitat quality on 2,158 acres. Alternative F would reduce CWHR size class 4D and 5D habitat quality on 458 acres and reduce 4M and 5M quality habitat on 1,816 acres.

There are 27,311 acres of carnivore network that lie within the Wildlife Analysis Area, and 17,875 of those acres (65 percent) are deemed suitable to forest carnivores. Alternatives B and C would create 276 acres of group selection within CWHR size class 4M, 4D, 5M, and 5D forested stands in the carnivore network. Alternative D would create 205 acres of groups in these same types within the network. Alternative F would create 144 acres of groups within the network. The percent reduction of suitable acres within the carnivore network from fuel treatments and group selection would be 1.9 percent for alternatives B and C, 1.5 percent for alternative D, and 1.1 percent for alternative F. Thus, a total of 197-340 acres of the 17,875 suitable forest carnivore network acres in the Wildlife Analysis Area would be reduced to unsuitable.

Indirect Effects. All new roads that would be constructed in support of the Diamond Project would be closed upon project completion, thus no long-term increases in human activities are expected. The decommissioning of 9.6 miles of existing roads would reduce human activities (such as snag removal and log removal through woodcutting) that often lead to decreased habitat capability (habitat loss, disturbance) for mesocarnivores. The open road density in the Diamond Project Area would decline under all action alternatives from the existing 2.4 miles per square mile to about 2.2 miles per square mile, which would still provide for low habitat capability for forest mesocarnivores. With implementation of the proposed strategic system of DFPZs, the Diamond Project would help reduce understory fuel buildup and may reduce the potential for high-severity wildfires, which have a great potential to degrade vast tracts of habitat for the marten and fisher.

It is not known how some of the important prey species (small mammals, birds) that are preferred by martens would respond to group selection. The increased diversity and edges created by groups in forested stands may provide increased foraging opportunities for martens. Responses of prey species' (small mammals, birds) use of group openings is one of the main objectives of the post-implementation monitoring that would be conducted by the Pacific Southwest Research Station through the Plumas-Lassen Administrative Study. This study could provide information regarding the response by these prey species to the DFPZs and group selection harvesting.

With all action alternatives, Borax would be applied to all cut stumps greater than 14 inches dbh within the DFPZ and Group Selection Units to minimize the susceptibility to *annosum* root rot. In the most recent risk assessment for Borax (SERA 2006), Boron, the agent of toxicological concern in Borax was further evaluated. The focus of the evaluation was on wildlife species' direct consumption from the stump and ingestion of contaminated water. The assessment concluded that the use of Borax on stumps does not present a significant risk to wildlife species under most conditions of normal use, even under the highest application rates.

The proposed herbicide applications of glyphosate and clopyralid on 22 net acres of noxious weeds (action alternatives B, D, and F) were discussed above in chapter 2 in section 2.2.2.5. With alternative C, no herbicides would be applied. Please refer to the herbicide hazard effects analysis discussion in section 4.3.3.6 of this chapter.

Cumulative Effects. Please refer to the cumulative effects discussion above for the California spotted owl, as well as the cumulative effects discussed in the Diamond Project BA/BE. The cumulative effects on forest mesocarnivores could occur with the incremental reduction of the quantity and/or quality of habitat for this species. Overall, increases in recreational use of National Forest System lands, and the use of natural resources on state, private, and federal lands, may contribute to habitat loss for this species. High-intensity stand-replacing fires, and the means by which land managers control them, have contributed, and may continue to contribute to loss of habitat for these species.

The action alternatives would not increase any large-scale, high-contrast fragmentation above existing levels. The cumulative effect of recent private land clearcuts, older National Forest plantations, the large brushfields created by past wildfires, together with implementation of groups would result in increased "patchwork" of open habitat and young age class vegetation between mature forested stands within the Analysis Area. This would increase edge effects and possibly increase potential risks to forest interior species movement and use in the Wildlife Analysis Area. Thus the Diamond Project would act cumulatively with past actions to slightly reduce the connectivity of habitat within the Wildlife Analysis Area, although connectivity would remain and improve over time as conifer cover is restored through natural processes and increased protection from high-intensity fire. Connectivity of dense forest habitat (moderate and dense stands in size classes 3, 4 and 5) is shown in attachment 10 of the Diamond Project BA/BE. Habitat connectivity is maintained across the Forest north to south from Mt. Jura across Kettle Rock to Moonlight Peak, and from Indian Creek to Diamond Mountain.

The greatest concern regarding the Pacific fisher in the Sierra Nevada range is the risk of further fragmentation due to large stand-replacing fire (SNFPA final supplemental EIS 2004, page 244). The design features of the proposed fuel treatments would retain habitat elements within the range of those used by fishers for foraging and dispersal. In addition, the design features would likely not create large barriers to further expansion and connectivity for fishers (ibid., page 243). The DFPZs would be created to reduce the potential for large stand-replacing fires.

Table 4-32 incorporates CWHR vegetation and GIS modeling, which indicate that all action alternatives post-treatment would provide similar numbers and size blocks of contiguous habitat. The changes in block size per alternative are based on (1) opening up and simplifying stand structure and forest canopy cover with DFPZs, and (2) implementation of group selection, which would reduce forest interior quality between groups.

Table 4-32. Pacific fisher habitat blocks (contiguous fisher habitat and CWHR size classes 4M, 4D, 5M, and 5D), by alternative.

Alternative	25- to 125-acre Habitat Block			125- to 250-acre Habitat Block			More Than 250-acre Habitat Block		
	No. Habitat Blocks	Average Size of Block (acres)	Size Range of Blocks (acres)	No. Habitat Blocks	Average Size of Block (acres)	Size Range of Blocks (acres)	No. Habitat Blocks	Average Size of Block (acres)	Size Range of Blocks (acres)
A	26	54	25–104	3	218	178–244	5	17,138	373–84,156
B, C	27	54	25–104	3	218	178–244	5	16,739	309–82,227
D	28	53	25–104	3	218	178–244	5	16,609	309–81,576
F	27	54	25–104	3	218	178–244	5	16,748	309–82,272

It does not appear that fishers inhabit the HFQLG Pilot Project Area, and even if fishers were reintroduced into northern California, it would probably be several years after reintroduction before available habitat would become fully occupied (ibid., page 243). Based on the home range and stand size reported for fishers in the April 8, 2004, *Federal Register*, it appears as if the Diamond Wildlife Analysis Area would support large blocks of contiguous suitable habitat that could support fisher in the future, in terms of both contiguous habitat and stands over 125 acres in size (refer to table 4-32 above). Based on studies of home range sizes referenced above (*Federal Register,* April 8, 2004), estimates of potentially suitable and contiguous habitat that must be present before an area can sustain a population of fishers, range from 31,600 acres in California; 39,780 acres in the northeastern United States; and 64,000 acres in British Columbia. Based on these figures and the number of suitable habitat blocks that would remain after treatment (refer to table 4-32 above), it appears that the Diamond Wildlife Analysis Area does support habitat attributes needed to contribute to the potential for recovery of the species in this area of the Plumas National Forest.-

Based on the direct and indirect effects, implementation of all action alternatives would contribute to cumulative effects on mesocarnivores and mesocarnivore habitat. There would be a cumulative reduction in habitat for the next 50 years in fuel treatments to 50+ years in group selection areas under alternatives B, C, D and F. Implementation of alternatives B and C would result in the highest risk of all alternatives to mesocarnivore habitat in the short term and greatest uncertainty about future mesocarnivore activity. Implementation of alternative F would result in a level of risk to mesocarnivore habitat in the short term and uncertainty about future mesocarnivore activity; this level of risk would be less than the other action alternatives. Based on known detections of marten on the Plumas National Forest, no changes in marten occupancy or populations on the Forest would occur.

Determination. The Forest Service has determined that, for all action alternatives, the Diamond Project may affect individuals but is not likely to result in a trend toward federal listing or loss of viability for the American marten or Pacific fisher.

4.3.9.12 All Action Alternatives (B, C, D, and F): Effects on Interior Forest Habitat

The group selection treatments would result in the creation of forest openings and gaps 0.5 acre to 2 acres in size that would have (1) all conifers below 30 inches in diameter removed and all oaks/hardwoods retained, (2) two of the largest snags per acre retained if they would not pose a health and safety risk to operations, and (3) project-generated fuels treated with prescribed fire, but 10 to 15 tons per acre of the largest down logs greater than 12 inches in diameter would be retained where it exists. With any of the four action alternatives, an allowance would be made to retain up to two of the largest snags per acre within Group Selection Units, unless removal would be necessary to ensure safety and operability.

Where 0.5- to 2-acre group selection harvests would be implemented, the CWHR size classes 4M, 4D, 5M, and 5D would be replaced in each group with a small opening to support brush/seedling growth, while the surrounding conifer stands between the groups would have linear openings created for skid trails for removing sawlogs from the groups to designated landings. Existing landings would be used, as well as new landings created. Area thinning could also occur within the forested stands between groups.

The greater the number (density) of Group Selection Units (groups) in a planning area, the smaller the amount of forest interior habitat provided by that planning area. All alternatives that would implement group selection would create openings in the forest, resulting in conditions that could reduce habitat quality and use by both spotted owls and martens. This could then increase the risk and uncertainty to populations associated with habitat alteration.

Past clearcutting has contributed to habitat fragmentation and reduced forest interior habitat in the Wildlife Analysis Area. The location and distribution of these existing clearcuts do not appear to be creating barriers to movement for forest interior species, as continuous forested habitat is present throughout and between existing clearcuts. Past clearcuts on the Plumas National Forest are older than 10 years and are dominated by brush and sapling and pole size (4-10 inches dbh) conifer trees. The cumulative effects of recent private land clearcuts, older National Forest plantations, the large brushfields created by past wildfires, together with implementation of groups at high density would result in increased "patchwork" of open habitat and young age class vegetation between mature forested stands in the Wildlife Analysis Area. This would increase edge effects and possibly increase potential risks of forest interior species movement and use in the Wildlife Analysis Area. Thus, the Diamond Project would act cumulatively with past actions to further reduce the connectivity of habitat within the Analysis Area, although connectivity would remain and improve over time as conifer cover is restored through natural processes and better protected from high-intensity fire.

It appears that all action alternatives would maintain habitat connectivity across the Wildlife Analysis Area for forest interior species (refer to table 4-32 above); treatments would not create barriers to movement or isolate large blocks of suitable habitat.

4.3.10 Environmental Consequences: Terrestrial Management Indicator Species

All Threatened, Endangered, and Sensitive (TES) species are discussed in the Diamond Project BA/BE. All of the Plumas non-TES Management Indicator Species (MIS) listed in table 3-21 of the BA/BE were used for project-level analysis for the Diamond Project (see MIS report in project record titled "Diamond Project: Affected Environment and Environmental Consequences –Management Indicator Species). These species are either present and/or have habitat that would be affected (directly or indirectly) by the project. The mule deer is highlighted in this EIS because of the potential impacts of the proposed action and alternatives on their habitat (early seral/shrub and oaks).

4.3.10.1 Alternative A (No Action): Effects on Mule Deer

There would be no fuel treatments or any other treatment implemented under the no-action alternative. This would make potential wildfires in the area difficult to suppress and create a more intense burn, which could lead to increased rates of spread resulting in additional acres burned. Given the 8 to 14 year fire return interval for the mixed conifer forest in the area (refer to the "Forest Vegetation, and Fire, Fuels, and Air Quality" section 4.1), it is likely that National Forest lands would burn. The existing fuel loads in the area could produce a high severity fire, which could kill resprouting species of shrubs, potentially create monocultures, provide a medium for noxious weeds, and burn minerals from the soil, leading to soil erosion and lower productivity. This would be true for the aspen stands within the area as well. Based on the past fire patterns on this predominately south to southwest aspect of the Diamond Project Area, wildfires in this area would burn intensively, creating larger, monotypic foraging areas with little mosaic forested cover within this foraging habitat.

There would be no reduction in the open road density in the Wildlife Analysis Area with the no-action alternative.

The no-action alternative would do nothing to reduce the identified possible limiting habitat factors for California deer herds (loss of brushfields, lack of prescribed fire, overstocked conifer stands, loss of aspen communities, increased road densities (CDFG 1998). The cumulative effects of no action could fall in line with the analysis conducted for the SNFPA (described above) and contribute to the decline of mule deer in the Project Area, the Plumas National Forest, and the Sierra Nevada range. In the short term, forested stands would not be opened up through thinning and underburning, thus very little regeneration of foraging habitat would occur. On the other hand, no action could result in potential larger and more intense wildfires, which, depending on weather conditions and fuel loadings, could either increase or decrease the productivity of foraging habitat.

Under the no-action alternative, continuing conifer competition with oaks would eventually reduce the number of acorn-producing oaks in the mixed conifer sites. The result would be a greater likelihood of intense wildfires that would destroy oaks and eliminate cover. Black oak recruitment into the larger size classes would not be improved if no vegetative manipulation were conducted to release oaks from conifer competition.

Based on the direct, indirect and cumulative effects of the no-action alternative, it is suspected that the carrying capacity on National Forest land would not be improved, thus there would be a stable to downward trend in deer numbers on National Forest. The no-action alternative would not contribute to meeting the Forest Plan goal of 24,000 deer on Plumas National Forest land. With the increased potential for a stand-replacing wildfire, (1) a high-intensity wildfire could reduce productivity of deer range for a long period of time, resulting in a long-term reduction in carrying capacity, or (2) depending on fire intensity, decadent brush and closed forest could be converted to potentially improved deer habitat, and carrying capacity could be improved above current levels.

4.3.10.2 All Action Alternatives (B, C, D and F): Effects on Mule Deer

Direct and Indirect Effects. Under all action alternatives, deer foraging habitat would increase slightly, and populations would likewise tend to increase for the reasons described below.

More open forest habitat would be created, allowing more sunlight and moisture to reach the forest floor, thus creating more forage and brush cover and increasing the forage-to-cover ratio of 30:70 to around 32:68 with the action alternatives. Habitat changes would occur on summer range for both the Sloat and Doyle Deer Herds. No treatments would occur on winter range. The post-project forage:cover ratio would persist for several years and slowly change as brush quality for forage declines due to increased shade from developing conifers in fuel treatment areas and increased conifer growth in Group Selection Units. It is predicted that in 12 to 15 years, the amount of forage would again decline. With reforestation, conifers would dominate the brush in group openings anywhere from 15 to 50 years, depending on site and aspect.

All action alternatives could potentially open up the canopy cover on 2,108 to 2,888 acres in Fuel Treatment Units of conifer habitat to around 40 percent canopy cover, potentially creating stands that may release black oaks within the Treatment Units. Oaks would be retained within DFPZs at 2,535 square feet basal area per acre.

The action alternatives could create from 609 to 1,129 acres of gaps and openings through the group selection harvest method. The retention of black oaks in Group Selection Units that occur within the mixed conifer type could contribute to small patches of oak-dominated openings for 15-50+ years. After the conifers start to dominate these groups, black oaks should be of the larger size class, contributing to higher production of acorns and providing a forage source for deer.

The decommissioning of 9.6 miles of existing roads with all action alternatives would slightly increase habitat effectiveness, potentially reducing roadkill, hunting mortality, illegal kill, and harassment of deer on summer range. New system road construction and temporary road construction varies by alternative, but all new construction would be closed with a barrier, and the temporary road construction would be decommissioned.

There could potentially be increased mortality as a result of increased traffic along all roads during project implementation. Treatment activities could disrupt fawning activity that would be occurring between June and August. This disruption could include direct mortality to hiding fawns, as well as displacement of fawns and does, which could increase fawn mortality through predation. There may be disturbances to individuals that may be foraging in habitat within or adjacent to units proposed for treatment; this would result in animals moving out of the area during treatment activities.

With all action alternatives, Borax would be applied to all cut stumps greater than 14 inches dbh within the DFPZ and Group Selection Units to minimize the susceptibility to *annosum* root rot. Use rates would be 1 pound to 50 square feet of stump surface. Based on the Pesticide Fact Sheet prepared by Information Ventures, Inc. (1995), this rate is considered nontoxic to vertebrate species. Kliejunas (1991) presents data that suggest that the proper use of Borax to prevent *annosum* root disease poses a very low risk of adverse environmental effects, and that Borax diffuses quickly into the stump and is not available for leaching into the ground surrounding the stump. Maximum doses of Borax are estimated to be 17.9 mg/kg for deer and 42 mg/kg for rabbits. These estimates are based on a broadcast application of 10 pounds per acre. The actual doses resulting from stump treatments would be expected to be orders of magnitude lower (see the “Forest Vegetation and Fire, Fuels, and Air Quality” section 4.2 and table 4-12 in that section).

In the most recent risk assessment for Borax (USDA 2006), Boron, the agent of toxicological concern in Borax was further evaluated. The evaluation focused on wildlife species’ direct consumption from the stump and ingestion of contaminated water. Field trials reported in this assessment revealed that deer were equally attracted to treated and untreated stumps, exhibited by sniffing and licking of stumps, and that there was no apparent attractant of the Borax treated stumps nor was there any apparent toxicity to deer that licked the treated stumps. The assessment concluded that the use of Borax on stumps does not present a significant risk to wildlife species under most conditions of normal use, even under the highest application rates.

The proposed herbicide applications of glyphosate and clopyralid on 22 net acres of noxious weeds (action alternatives B, D, and F) were discussed above in section 2.2.2.5 in chapter 2. With alternative C, no herbicides would be applied; instead, approximately 20 acres over 228 locations would be treated either by hand pulling/digging, using a weed whacker, and/or covering plants with plastic sheeting. No preferred forage plants would be affected by noxious weed removal.

Cumulative Effects. Attachment 2 in the Diamond Project BA/BE displays the existing vegetative condition (expressed in CWHR types [VESTRA 2002]), which reflects past occurrences and management activities that have resulted in vegetative change, which in turn dictate the occurrence and distribution of wildlife species.

Brushfields in the Wildlife Analysis Area are a result of wildfires that occurred from 6 to 90 years ago. There have been approximately 15,000 acres of wildfires in the Wildlife Analysis Area since 1918, with 5,100 acres burnt since 1977. These fires have ranged in size from 16 acres up to 3,500 acres (which was the Stream Fire in 2001). These wildland fires burned at high intensity and created large monotypic openings of early seral brush habitat within the forest that contribute to large-scale fragmentation of continuous forest cover. Much of this habitat is currently occupied by conifer plantations, montane chaparral, and hardwood forest. Brushfields between the plantations (such as in Morton Creek, Wildcat Ridge, and Genesee Valley) support very decadent, impenetrable, brush. Large brushfields created by wildfire are used extensively by early seral and mid-seral wildlife species. Underburning for fuel reduction has been conducted on approximately 5,560 acres in the Wildlife Analysis Area since 1996, resulting in reduced levels of down slash, increased grass/forb growth, and regenerated younger age class of brush species. Much of this habitat is currently occupied by montane chaparral, hardwood forest, an pine plantations. The area burned by the 2001 Stream Fire is providing high-quality forage consisting predominately of forbs and snowbrush (*C. velutinous*).

Timber harvest and related activities on public lands from 1977 to 2005 affected approximately 27,120 acres in the 159,102-acre Wildlife Analysis Area. Various silvicultural prescriptions were employed including approximately 2,853 acres of regeneration (clearcut); 4,000 acres of overstory removal; 1,060 acres of shelterwood; 1,000 acres of sanitation; 3,900 acres of group selection; 7,300 acres of commercial thinning; and 1,600 acres of salvage. Site preparation for planting, pre-commercial thinning and salvage were also part of the timber harvest activities (appendix G). Many of these harvest activities (clearcut, shelterwood, overstory removal, thinning) have resulted in creation of suitable habitat by creating openings and edges or have increased habitat values through reductions in canopy cover (stands taken below 40 percent canopy cover). All of these past actions have often translated into a projected increase in habitat capability (on a timber compartment basis) for deer that ranged from 2 percent up to 11 percent.

Numerous past timber harvest operations in the Wildlife Analysis Area implemented even-age forestry, resulting in approximately 2,853 acres of plantations that now range in age from 16 to 30 years. Past clearcuts created openings within continuous forest cover that now contribute to both habitat diversity and edge effect in the form of early seral stage stands. These changes have increased habitat for species that use early seral habitat and decreased habitat for species that require forested stands and continuous cover. Early seral habitat, including plantations created as a result of even-aged forestry, make up approximately 6.5 percent of the 159,102-acre Wildlife Analysis Area. The bulk of the plantations in the Analysis Area exist as a result of reforestation efforts after large wildfires.

Private logging activities in the Watershed Analysis Area that occurred since 1982 include 145 acres of shelter wood removal; 56 acres commercial thinning; 9,048 acres individual tree selection; 60 acres of salvage; and 35 acres of clearcut. Approximately 21 of the 35 acres of clearcut have occurred since 2001, while the selection harvesting has been occurring consistently every other year since 1994. Clearcuts created early seral habitat and will remain as early seral (grass/forb/brush/seedling-sapling) for at least the next 10–20 years. After year 20, conifers may start to dominate the vegetative cover, and by year 50, should be classified as size class 3 trees (6–11 inches dbh). With brush control and release activities, trees could attain this size class earlier than 50 years. Selection harvest usually results in opening up the stand while maintaining forested cover, providing for an uneven-age stand with scattered brush understory throughout.

The Meadow Valley DFPZ / Group Selection Project (2005) and the Empire Project (2006) would improve foraging habitat by opening up forested canopy cover and allowing for increased forage plants with creation of the DFPZs and up to 1,971 acres of group openings in the Sloat Deer Herd. The Diamond Project would create an additional 194 to 420 acres of group openings within the range of the Sloat Deer Herd and 415 to 709 acres of group openings within the range of the Doyle Deer Herd. The road density in the Sloat Deer Herd range would be improved to 2.35 miles per square mile and 2.2 miles per square mile in the Doyle Deer Herd range. The Diamond Project is expected to reduce open road density from 3 to 2.9 miles per square mile. Thus, the cumulative effects on the Sloat Deer Herd from the Meadow Valley, Empire, and Diamond Projects would be beneficial because more foraging habitat would be created and habitat effectiveness would be improved. The result would be improved deer habitat in three distinct portions of this herd's range.

Since 2000, the Antelope Border and Stony Ridge projects implemented actions in the Doyle Deer Herd range that opened up stands through thinning with fuel treatments, including underburns, which should have resulted in improved forage conditions for deer across 3,750 acres. Most of the understory forage consisted of bitterbrush and snowbrush (*Ceanothus velutinous*). The understory species that would be affected by the Diamond Project within this range consist of these same species but also with many browse species associated with sierra mixed conifer (bittercherry, whitethorn ceanothus, and greenleaf manzanita). It is anticipated that the response to management actions by browse species may be much more productive than the other two projects because of this species' composition. The Stony Ridge Project also created 250 acres of group selection openings within mixed conifer and pine stands that are responding with increased grass/forb growth and brush sprouting. The Stony Ridge Project is mentioned here with regard to cumulative effects on the Doyle Deer Herd even though the project is not within the Diamond Wildlife Analysis Area.

The SNFPA (Sierra Nevada Forest Plan Amendment) final EIS displayed that mule deer habitat utility declines under all alternatives, including implementation of the standards and guidelines outlined in the Record of Decision on that document (SNFPA final EIS volume 3, part 4.2, page 26). This decline was based on the assumption that practices that open up canopies through mechanical treatments (like thinning, biomass, and salvage logging within green stands) do not generate dense understories of shrubs, forbs, and grasses that provide deer foraging habitat. The current direction under the SNFPA emphasizes mechanical treatments in order to insure potential changes to canopy cover are minimized. Because of anticipated lower generation of dense understories as a result of mechanical treatments, deer habitat declines by negative 5.6 to negative 6.6 percent are expected over a five-decade period across the Sierra Nevada range. The analysis of alternative S2 in the SNFPA final supplemental EIS in 2004 projected no difference in deer habitat from what the 2001 SNFPA analysis disclosed.

Mule deer foraging habitat in the Wildlife Analysis Area could be improved as a result of implementing any of the action alternatives. The Diamond Project could also promote higher quality habitat (from existing conditions) until brush is shaded out or becomes decadent in 12 to 50 years. With reforestation, brush would be set back through release and plantation thinning treatments, allowed to recover and provide a small amount of new browse, and eventually be shaded out by the growing conifers at about 50 to 60 years.

The action alternatives would implement positive habitat manipulations that may tend to reduce factors that could potentially limit habitat for California deer herds. These habitat manipulations include the creation of brushfields, using prescribed fire; opening up overstocked conifer stands; improving aspen plant communities; and reducing road densities (CDFG 1998). Within these treated areas there could be a short-term increase in brush/forb regeneration that would flourish with group openings and any treated area that would be underburned, prescribed burned, or masticated. This increase in deer use may be more reflective of changes in use patterns by deer than any major increase in animals. On the other hand, other identified limiting factors (predation) could also be increased by the action alternatives.

Future foreseeable actions may include additional underburning projects on 2,785 acres starting in 2006, as well as DFPZ maintenance (underburning, hand thinning) around 10-years post project implementation. These actions could benefit deer for a time by regenerating sprouting brush until the forest canopy closes in and shades out brush.

Based on the direct and indirect effects, implementation of any of the action alternatives would contribute to an increase in open forest habitat and improve the grass/forb/brush mix, which would result in increased forage and decreased forested cover, as well as decreased road density. These cumulative effects would improve two limiting factors (open forest habitat and road density) identified by the California Department of Fish and Game (CDFG) that affect deer herd health. In addition, conifer removal as proposed in the action alternatives would improve 233 to 547 acres of aspen communities, which is consistent with the habitat-based effort to reverse the decline in deer populations in Deer Assessment Unit #3 (CDFG 1999) by encouraging aspen regeneration.

The action alternatives are designed to reduce the risk of future stand-replacing fires and promote the reestablishment and development of a mature closed-canopy mixed conifer forest. The short-term cumulative effects would improve the forage base and edge effects that would benefit deer. The long-term cumulative effects of these actions would fall in line with the analysis conducted for the SNFPA (described above) and potentially contribute to the decline of mule deer in the Project Area, the Plumas National Forest, and the Sierra Nevada range.

Based on the direct, indirect, and cumulative effects of the action alternatives, it is suspected that the carrying capacity in the Analysis Area would be improved and deer numbers would respond to the habitat changes such that there would be some upward trend in the Sloat and Doyle Deer Herd population for the next 10-20 years. Improving carrying capacity on National Forest land would contribute to moving the population toward its herd population goal, as well as contributing to the Forest Plan goal of 24,000 deer on Plumas National Forest land.

4.3.11 Environmental Consequences: Neotropical Migratory Birds

4.3.11.1 Alternative A (No Action)

Direct Effects. There would be no direct effects on Neotropical migratory birds under this alternative because no treatments are proposed.

Indirect Effects. Logically, it could be inferred that with the no-action alternative, shrub communities and plantations would continue to trend towards conifer communities, and the conifer communities would trend towards denser canopy cover with a declining shrub understory. These trends would favor closed-canopy bird species and not favor open-canopy and shrub species. In reality, the effects of the no-action alternative would include the potential for future wildfire and its impact on habitat maintenance and development. The high fuel loads that would be left by this alternative would make potential wildfires in the area difficult to suppress and create a more intense burn. This could then lead to increased rates of spread, resulting in additional acres burned. Given the realized 8- to 14-year fire-return interval for the mixed conifer in this area, it is likely that National Forest lands would burn again, resulting in the loss of the largest trees and snags, an increase in large-scale fragmentation of forested landscapes, loss of large riparian structures, and simplification of habitat diversity.

Cumulative Effects. Some Neotropical migratory birds use early successional habitats that develop after a wildfire (SNFPA final supplemental EIS 2004). These early successional habitats would be at a much larger, homogenous (same species) pattern across landscapes as a result of wildfire. The cumulative effect of recent regeneration harvest on private land together with no fuel treatments (no action) would overall increase the amount of, as well as improve habitat conditions for birds that prefer early successional and open-canopied habitat across the landscape. This would primarily be due to increased habitat as a result of wildfire. Birds preferring closed-canopy conifer habitats would most likely incur more acres of habitat loss, including reduced size of habitat patches.

4.3.11.2 All Action Alternatives (B, C, D, and F): Neotropical Migratory Birds

Direct and Indirect Effects. As indicated in the Management Indicator Species Report (located in the project record), actions that open up forest stands through thinning, such as with the proposed fuels treatment thinning prescriptions, would result in projected increases in habitat trends for several selected Neotropical migratory bird species (warbling vireo, chipping sparrow, lazuli bunting, white-crowned sparrow, western bluebird, common nighthawk, and common poorwill). These species respond favorably to the opening up of forest canopy, which allows for increased understory plant diversity. Swainson’s thrush appears to be adversely affected by thinning actions that convert closed forested stands to open forested stands. The olive-sided flycatcher and evening grosbeak also appear to have a projected decrease in habitat suitability. Alternative F would create a fewer number of open stands across the Wildlife Analysis Area and would subsequently maintain more habitat for Swainson’s thrush, olive-sided flycatcher, and evening grosbeak.

Actions that create openings in the forested landscape with group selection harvests could result in declines in species habitat trends for osprey, Swainson's thrush, warbling vireo, yellow warbler, western wood-peewee, evening grosbeak, red crossbill, and band-tailed pigeon. There are three species (white-crowned sparrow, lazuli bunting, and common nighthawk) that have a projected increase in habitat suitability because they respond favorably to habitat that contains small gaps in the forest landscape.

With all action alternatives, Borax would be applied to all cut stumps greater than 14 inches dbh within the DFPZs to minimize the susceptibility to *annosum* root rot. Use rates would be 1 pound to 50 square feet of stump surface. Based on the Pesticide Fact Sheet prepared by Information Ventures, Inc. (1995), this rate is considered nontoxic to vertebrate species, including birds. Borax does not build up (bioaccumulate) in fish, inferring no build up occurs in other vertebrate species. Thus, Borax applied to stumps should not affect Neotropical migratory birds.

In the most recent risk assessment for Borax (USDA 2006), Boron, the agent of toxicological concern in Borax was further evaluated. The focus of the evaluation was on wildlife species' direct consumption of Borax from the treated stump and ingestion of contaminated water. Clinical trials for birds showed that exposure to Borax is practically nontoxic, with no significant clinical signs of toxicity at dietary concentrations up to 5,000 ppm (parts per million). The amount of Borax applied on a 1-foot in diameter stump would be approximately 7 grams (0.25 ounce). Consuming 7 grams of Borax (the amount applied to the stump) would be equivalent to 35–70 percent of the body weight of small mammals and birds. It is not feasible that ingestion of this much Borax would occur by any wildlife species. The assessment concluded that the use of Borax on stumps does not present a significant risk to wildlife species under most conditions of normal use, even under the highest application rates.

The proposed herbicide applications of glyphosate and clopyralid on 22 net acres of noxious weeds (action alternatives B, D, and F) are discussed in chapter 2. With alternative C, no herbicides would be applied.

Cumulative Effects. The cumulative actions of the past may have benefited species that prefer early successional, as well as more open habitats. Species that prefer shrub habitat benefited as shrub habitats increased with even-aged regeneration management actions, while species preferring closed canopies likely declined in numbers. With fire suppression and minimal vegetation management in the Project Area, together with natural succession, species preferring closed canopies may have rebounded as canopy covers filled in; conversely, as shrub habitat declined through conifer development, these species may have declined some. The cumulative effect of recent regeneration harvest on private land, together with Diamond Project group selection harvests and fuel treatments, would overall improve habitat conditions for birds that prefer openings and open-canopied habitat across the landscape. Based on the CWHR model, Swainson's thrush, evening grosbeak, and red crossbill would have decreased habitat suitability.

Various bird species that nest in riparian habitat could be at an increased risk of brood parasitism by brown-headed cowbirds. This could be attributed to an increased amount of open forest, as well as small openings and increased edge. Very little brown-headed cowbird presence in the Wildlife Analysis Area has been documented, even though the majority of the Analysis Area supports active livestock grazing. Facilities that are often associated with brown-headed cowbirds are not present in the Analysis Area; those facilities include pack stations, supplemental feeding stations, holding facilities, or corrals. There is some risk that brood parasitism could increase above existing levels in the Project Area as cowbirds respond to increased open habitat and edges.

In addition to habitat modification and its affect on Neotropical migratory birds, direct effects on nesting birds (including young birds that cannot yet fly) would occur as a result of tree removal, mastication, and prescribed burning. It is recognized that the proposed Diamond Project, if implemented during the breeding season (April–September), could directly impact nesting birds. The overall effect on Neotropical migratory bird populations is not known.

4.3.11.3 Alternative A (No Action): Effects on Snags/Logs

Under the no-action alternative, the only snags that would be removed would be those removed by the public under the Personal Use Firewood Program and those removed as hazard trees around existing facilities, including roads. Hazard tree removal on National Forest lands along roads has been an ongoing action. All snags that present hazards to road traffic, regardless of size, are being, and will continue to be, removed. The removal of these snags would have a negative effect on individual animals that use snags.

The entire Project Area, with the exception of the Antelope Lake Recreation Area, would be open to public woodcutting 12 months a year, limited only by available access. The uncontrolled public use in areas used by woodpeckers and cavity-dependent species, especially during the nesting season, could cause disturbance that may disrupt and preclude successful recruitment of young. No roads would be closed or decommissioned under alternative A. This would allow for continued access for woodcutting and hazard tree removal, resulting in loss of snags. Woodcutting and hazard tree removal would eliminate decadence from the landscape, but overall snag numbers would likely increase over time due to natural recruitment. Stand-replacing fire would be ever more likely to occur and cause the premature loss of the largest snags, create an abundance of snags for short-term use, and reduce the long-term availability of forest and snag habitat in those large blocks that incurred the wildfire.

It is suspected that the direct, indirect, and cumulative effects of the no-action alternative would maintain stable populations of snags and logs in the short term. With increased risk of wildfire, there could be a short-term flush of snags as a result of stand-replacing fires that would benefit both nesting and foraging for some species. These snags would fall and not be available in the long term, and no replacement snags would be available for 50+ years. The longer-term impacts would result in potentially lower numbers of cavity nesting species than what currently exists because of the potential for large stand-replacing fires removing large blocks of habitat and reducing the availability of snags and snag recruitment, which would potentially reduce the carrying capacity of the area to support primary cavity nesting populations.

4.3.11.4 All Action Alternatives (B, C, D and F): Effects on Snags/Logs

Direct and Indirect Effects. Under the action alternatives, species mortality could occur if animals are in the cavity of a snag when it falls. This would be especially true if young of the year were in the cavity. The falling of snags could lead to a reduction in foraging habitat for woodpeckers that feed on insects and larvae in the snags.

The proposed snag retention standards for the Diamond Project are adequate to provide for habitat needs of woodpeckers (based on analysis of effects for the snag guidelines required in the 2001 Record of Decision on the SNFPA final EIS and 2004 final supplemental EIS). Under all action alternatives, at least four of the largest snags per acre would be retained where they exist in mixed conifer stands, and six of the largest snags per acre would be retained in red fir stands. Dead trees less than 15 inches dbh would, for the most part, be removed from all Treatment Units. Up to two of the largest snags per acre could be retained in group selection openings, but snags would be removed that pose a hazard to operability.

The potential direct loss of snags from the area due to project operations can be reflective of total acres treated by alternative. Alternative D would treat about 1,200 acres less than alternative B. Alternative F would treat about 3,468 less acres than alternative B. Assuming equal distribution and density of snags across the Diamond Project Area, alternative F would maintain more snags than the other action alternatives, and alternative B would potentially retain less snags than all alternatives.

Cumulative Effects. The past silvicultural and timber sale actions on both National Forest and private lands (described above in the cumulative effects section for the spotted owl) have contributed to a decline in snag and down log abundance across the Wildlife Analysis Area. All timber sale projects implemented before 1993 called for the retention of 1.5 snags per acre. Projects designed under the CASPO Interim Guidelines (1993 to 2001) called for up to 8 snags per acre. Down log retention standards have also changed over time—the current standard is to retain 10–15 tons per acre in large down wood. Very few of the past clearcut harvests retained many snags and few, if any, are still standing. It is suspected that snag recruitment in untreated stands through normal mortality has increased the abundance of snags and down logs on National Forest land since the mid-1990s due to the lack of harvest activity that has occurred in the Wildlife Analysis Area. The 2001 Stream Fire created an abundance of snags over a 3,000–acre area, and a very high density of snags still exists in the majority of the fire landscape.

The proposed vegetation treatments are designed to reduce the risk of future stand-replacing fires and promote the reestablishment and development of a mature open-canopy mixed conifer forest. Fuels reduction should create conditions that would lessen the risk for future stand-replacing fires, thus providing the opportunity to retain structural elements (likes snags) for a longer period of time.

All action alternatives propose varying miles of road construction, closure, and reconstruction (see mule deer above), but all action alternatives propose the decommissioning of 9.6 miles of existing open roads. Closing roads would potentially reduce access to snags that could be considered hazard trees or be available for firewood cutting.

Hazard tree removal on National Forest lands along roads has been an ongoing action. Hazard trees have been identified along the Indian Creek Road up to Antelope Lake, but no trees have been removed. Recently, additional hazard trees were removed from the 2001 Stream Fire area. For future projects, all snags that present hazards to road traffic, campgrounds, and other facilities, regardless of size, would be removed. Removing these snags could have a negative effect on individual animals that use snags, although these hazard trees make up a very small amount of the total snag component in the Wildlife Analysis Area.

The entire Project Area, with the exception of the Antelope Lake Recreation Area, would be open to public woodcutting 12 months a year under the Plumas National Forest Personal Use Woodcutting Program, and woodcutting would only be limited by available access. Uncontrolled public use within areas used by woodpeckers and cavity-dependent species, especially during the nesting season, could cause disturbance that may disrupt and preclude successful recruitment of young.

Based on the past and ongoing activities presented above, and in combination with the direct and indirect effects of the Diamond Project, implementation of the action alternatives would contribute to an increase in open forest habitat and a decrease in the existing snag densities and future down log densities in treated areas. Thus, the cumulative effects in the Wildlife Analysis Area would be a decrease in snag and down log numbers, with snags in the Project Area being retained somewhere between two and six per acre within treated areas, and at least this same density in the remainder of the unburned, untreated National Forest acres in the Wildlife Analysis Area.

The current population trends for certain woodpeckers were identified in section 3.2.3 of the *Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement.* Those trends were “stable” for the hairy woodpecker and northern flicker; possibly “decreasing” for the pileated woodpecker and red-breasted sapsucker; and possibly “increasing” for the white-headed woodpecker. Under all action alternatives, there could be slight changes to woodpecker habitat suitability. Suitability would decline for pileated and white-headed woodpeckers, while the rest of the woodpecker species would have slight increases or no changes in habitat suitability. Thus, a decline in population trends in both pileated and white-headed woodpeckers is possible with all action alternatives.

It is suspected that the direct, indirect, and cumulative effects of the proposed action and action alternatives would result in some short-term decreases in woodpecker numbers because the disturbances associated with activities, as well as the modification of habitat reducing stand level habitat suitability, as well as snag removal, would increase the risk to individual woodpeckers. Reductions in habitat suitability for pileated and white-headed woodpeckers are expected to have short-term impacts on these species. It is anticipated that the longer-term impacts would result in woodpecker numbers rebounding to pre-project levels as the risk to wildfire is reduced, the forest canopy cover closes in, roads are closed, mature oaks that are retained and released with management actions attain some decadence, and snag recruitment continues across the landscape.

4.4 Economics

4.4.1 Introduction

The economic environment of the Plumas National Forest is described in the 1988 *Plumas National Forest Land and Resource Management Plan* (the “Forest Plan”), which was amended by the August 1999 Record of Decision for the final environmental impact statement (EIS) on the *Herger-Feinstein Quincy Library Group Forest Recovery Act* (HFQLG Act) and the 2004 Record of Decision for the Sierra Nevada Forest Plan Amendment final supplemental EIS. The demographic and economic information for the counties in which the Plumas National Forest is situated has been compiled to provide a baseline for studying socioeconomic impacts of the Diamond Project. This information is on file at the Mount Hough Ranger District and is available upon request.

4.4.2 Regulatory Framework

The HFQLG Act directs the Secretary of Agriculture to implement a Pilot Project on federal lands in the Plumas National Forest, Lassen National Forest, and the Sierraville Ranger District of the Tahoe National Forest in California. The Pilot Project is designed to maintain ecological integrity, community stability, and forest health. In addition, the Secretary shall use the most cost-effective means in conducting the Pilot Project.

4.4.3 Methodology for Assessing Impacts on Economics

4.4.3.1 Scope of the Analysis

This economic analysis focuses on those revenues and treatment costs associated with implementing group selection and fuel reduction treatments in the Diamond Project Area. The purpose of this economic analysis is to present the potential revenues and costs associated with each of the alternatives for comparison purposes.

This analysis does not include monetary values assigned to resource outputs such as wildlife, watersheds, soils, recreation, visual quality, and fisheries. It is intended only as a relative measure of differences between alternatives based on direct costs and values used. Other values are discussed in the appropriate sections of this document.

4.4.3.2 Analysis Methods

Timber harvest values used in this economic analysis were based on the California State Board of Equalization Timber Harvest Values (January 1, 2005–June 30, 2005). Harvest costs and road improvement costs were developed from the latest timber sale appraisal values. Mechanical (mastication, grapple pulling), manual (hand cutting, hand piling), and prescribed fire (underburning, pile burning) treatments are based on the latest service contract prices, Knutson-Vandenberg, and brush disposal sale area improvement plans.

4.4.4 Economic Consequences

Economic consequences are a measure of the overall value of the five alternatives (which includes the no-action alternative) considered in this analysis. The level and mix of goods and services available to the public varies by alternative, resulting in a range of impacts on the social and economic environment. The impacts discussed in this section include estimated government expenditures and revenues, as well as monetary impacts on local communities.

Direct monetary impacts are discussed in terms of net cash value to the U.S. Treasury, including the costs associated with implementing the treatments and direct, indirect, and induced job opportunities.

In general, the monetary value of each alternative depends on the amount and method of timber harvest and the acreage planned for fuels reduction treatments. Areas with positive timber harvest values would pay for associated fuels reduction activities on those acres. Fuels reduction treatment costs that exceed harvest revenues would become service contracts to be financed through appropriated funds when available.

The HFQLG Act final EIS and Record of Decision described the economic impacts of implementing the Pilot Project. This economic analysis does not revisit the information presented in the HFQLG final EIS and Record of Decision, but for comparison purposes, it focuses only on those revenues and treatment costs associated with each of the alternatives.

Employment. Employment opportunities can have direct, indirect, or induced effects on the local economy. Direct effects are associated with the primary producer. For example, the manufacturing of lumber from the Diamond Project would have a direct effect on employment opportunities. Indirect effects account for employment in service industries that serve the lumber manufacturer. These industries may include logging, trucking, and fuel supplies. Induced effects are driven by wages, and the wages paid to workers by the primary and service industries are circulated through the local economy for food, housing, transportation, and other living expenses. The sum of direct, indirect, and induced effects is the total economic impact in terms of jobs, which typically range from 10 to 15 jobs per million board feet of timber harvested.

Revenue to the Government. Net revenue is the difference between the revenues generated by an alternative and the costs required to implement the alternative. In this analysis, revenues come from harvest of timber.

Payments to Counties. Local counties receiving payments through the *Receipt Act* rather than the *Secure Rural Schools and Community Self-Determination Act* would share part of the revenues generated from the timber harvest (refer to table 3-24 in chapter 3). The actual payment amount depends on estimated stumpage value and the price bid by the purchaser awarded the timber sale contract.

Treatment Costs. Treatment or management costs include those costs associated with timber harvesting, biomass removal, road improvements, fuels treatments, and mitigation measure requirements, as well as costs of resource enhancement measures not associated with the sale of timber. Costs vary widely depending on the amount of mechanical, manual, or thermal treatments prescribed; the board feet of sawlogs or tons of biomass removed per acre; and the accessibility of the treatment units.

Nonpriced Costs and Benefits. It should be noted that not all costs and values are represented in the economic analysis. Calculations do not include costs and values for those items that cannot be estimated in dollar terms. The economic analysis does not take into account nonpriced benefits such as improved long-term wildlife habitat, improved watershed conditions, improved fish passage, control of noxious weeds, and reduced fire hazard. The various habitat improvement opportunities, which are not funded from the project's timber receipts, may be funded through other sources such as watershed improvement needs, Resource Advisory Committees, wildlife habitat improvements, Knutson-Vandenberg, or other appropriated funds. Examples of costs not estimated in dollar terms are the reduction in scenic value in the early years of fuels treatments, air pollution from wildfires, or reestablishing a forest following a stand-replacing wildfire.

For a detailed discussion of these nonpriced benefits and costs, refer to the appropriate resource section in this document. These nonpriced benefits and costs will be considered along with the net economic value of each alternative in order to make a judgment as to which alternative offers the best overall mix of costs and benefits to society.

Table 4-33 summarizes the economic impacts of alternatives A, B, C, D, and F on the local economy.

Table 4-33. Comparison of economic impacts by alternative.

Deliverables/Revenue/Cost/Employment	Alternative			
	A	B and C	D	F
Total Sawlog Volume (million board feet)	0	28.6	29.1	20.7
Total Biomass Volume (million tons)	0	61	52	39
Net harvest revenues	$0	($2,000,000)	$479,000	($6,000)
Percent above value	0%	(31%)	8%	0%
DFPZ/Watershed Service Contracts	$0	($356,000)	($444,000)	($344,000)
All Other Service Contracts	$0	($652,000)	($645,000)	($603,000)
Total project value	$0	($3,008,000)	($610,000)	($953,000)
Total direct and indirect jobs	**0**	**520**	**501**	**366**
Total employee-related income	**$0**	**$22,356,000**	**$21,548,000**	**$15,732,000**

4.4.4.1 Alternative A (No Action)

Direct and Indirect Effects. This alternative would not reduce critical fuel loadings or harvest any timber. No funds would be generated for the U.S. Treasury or returned to local counties. No additional employment opportunities or wages paid to primary and service industry employees would be circulated through the local economy.

Cumulative Effects. The no-action alternative would result in a negative effect on the local industries that depend on service contracts or a steady supply of timber, as well as counties that use timber yield taxes to fund county programs. These local industries currently lack opportunities related to fuels reduction, site preparation, and timber harvest activities—the action alternatives would provide those opportunities. The local economy would also not receive benefits from associated employment, such as in food, lodging, and transportation businesses. Throughout northern California, cumulative years of reduced timber harvesting activities (including those on federal lands) have resulted in the loss of infrastructure to complete such activities. The loss of such infrastructure, including local mill closures, could significantly reduce or eliminate future economic and environmental opportunities from National Forest lands. The continuation of current conditions under alternative A would preclude opportunities for long-term employment and rural community stability because the fuel reduction activities related to the creation and maintenance of DFPZs would not occur.

Under the no-action alternative, wildlife habitat, meadow, and streambank restoration and enhancement could not take place without appropriated money from Congress. In addition, dense standing trees and down woody material in the Diamond Project Area would continue to pose a very high fire hazard to the surrounding areas. If the no-action alternative were implemented, additional money would be needed to conduct any fuel reduction treatment, as well as possible elevated fire suppression costs should fire reoccur in the Diamond Project vicinity. Table 4-33 above summarizes the economic impacts of all alternatives on the local economy.

4.4.4.2 All Action Alternatives (B, C, D, and F)

Direct and Indirect Effects. The net harvest revenues for group selection, thinning, and biomass removal would generate a negative $2,000,000 for alternatives B and C; $479,000 for alternative D; and a negative $6,000 for alternative F. The total project value would be a negative $3,008,000 for alternatives B and C; negative $610,000 for alternative D; and negative $953,000 for alternative F. Fire Reduction Benefits would be $4,636,000 for alternative B and C, $7,172,000 for alternative D and $5,233,000 for alternative F.

Thinning, biomass removal, and fuel treatments would directly generate 442 full-time employment opportunities for alternatives B and C, 439 full-time employment opportunities for alternative D, and 315 full-time employment opportunities for alternative F. All action alternatives would create additional employment opportunities in service industries (such as logging supply companies, trucking companies, and fuel suppliers) that serve the timber industry. There would also be an induced effect that is driven by wages. Wages paid to workers by the primary and service industries would be circulated through the local economy for food, housing, transportation, and other living expenses.

The sum of direct, indirect, and induced effects is the total economic impact in terms of jobs. In addition to the direct employment that would result from the harvesting and fuel reduction treatments in alternatives B, C, D, and F, and the indirect benefits of jobs in sawmills and energy generation plants, there would be some additional benefits to the local economy as wages earned by those employees are spent on living expenses. Alternatives B and C would generate an estimated 520 direct, indirect, and induced jobs; alternative D would generate an estimated 501 direct, indirect, and induced jobs; and alternative F would generate an estimated 366 direct, indirect, and induced jobs.

The helicopter logging that was proposed in alternatives D and F was dropped due to high cost. Considering logging costs and slash treatment and regeneration costs, treating groups by helicopter would have a net value of negative $4,360 per acre or a present value of minus 127 percent. In alternatives D and F, skyline logging was also dropped due to high cost, with a projected net value of negative $1,000 per acre or a present value of minus 29 percent. With temporary road construction, skyline logging would have a net value of negative $1,830 per acre and with system road construction, a net value of negative $4,330 per acre. Isolated treatment areas with high road reconstruction and road construction costs were dropped in alternatives D and F. Changing thinning prescriptions from 50 percent to 40 percent crown closure would improve the sale value by increasing sawtimber removal from 300 board feet to 2,500 board feet per acre.

Cumulative Effects. Each of the action alternatives would result in the same cumulative effect—an increase in the overall economic activity in the HFQLG Pilot Project Area. Though not a requirement, it was assumed for this analysis that most products from HFQLG Pilot Projects would be processed locally due to high hauling costs of products and equipment. Likewise, it is also assumed that most employment would largely be derived from Plumas and Lassen Counties. The Diamond Project timber sale revenues and service contract employment would complement all other HFQLG-funded projects across the Plumas National Forest. The economic goals for the project, as a whole across the Pilot Project Area, are discussed in the HFQLG Act final EIS.

See appendix D of this EIS for the complete economic analysis, by alternative.

4.4.5 Summary of Cumulative Effects

This economic analysis for the Diamond Project focuses on those revenues and treatment costs associated with implementing fuel reduction treatments, group selection, and area thinning. Implementation of the no-action alternative would have a negative impact on the local industries that depend on service contracts or a steady supply of timber, as well as counties that use timber yield taxes to fund county programs. If the no-action alternative were implemented, additional funds would be needed to conduct fuel reduction treatments or wildlife habitat, meadow, and streambank restoration.

All action alternatives would provide employment opportunities and generate harvest revenues and timber yield taxes.

4.5 Botanical Resources and Noxious Weeds

4.5.1 Introduction

The purpose of this section is to present a summary of the effects of the proposed project on all rare plant species and noxious weeds of record for the Botany Analysis Area. Throughout this section, the term "rare" is used to refer to federally Endangered, Threatened, and Candidate plant species; and Forest Service Region 5 Sensitive plants and Management Indicator Species (MIS). A complete discussion of effects is provided in the "Diamond Vegetation Management Project: Biological Evaluation of Potential Effects to Threatened, Endangered, and Sensitive Plant Species" (Coppoletta 2006), which is located in the project record and incorporated by reference.

4.5.2 Summary of Effects

4.5.2.1 Alternative A (No Action)

Rare Plant Species

- The no-action alternative would not affect any federally listed Threatened, Endangered, or Candidate plant species.
- The direct, indirect, and cumulative effects of the no-action alternative would be negligible for Pulsifer's milk-vetch (*Astragalus pulsiferae* var. *pulsiferae, Lomatium roseanum*), starry clarkia (*Clarkia stellata*), and Susanville penstemon (*Penstemon sudans*).
- Under the no-action alternative, Baker cypress (*Cupressus bakeri*) would continue to decline over time, with increased potential for future local extinction.
- This alternative would not impact any additional plant species listed as Sensitive or as a Management Indicator Species (MIS) species by Forest Service Region 5 (California) or the Plumas National Forest.

Noxious Weeds

- Under alternative A, noxious weeds would continue to spread at their current rate, resulting in a moderate risk of noxious weed introduction and spread over time.

4.5.2.2 Alternatives B, D, and F (With Herbicide Use)

Rare Plant Species

- The proposed project activities would not affect any federally listed Threatened, Endangered, or Candidate plant species because none of these species are known or expected to occur in the Botany Analysis Area.
- The direct, indirect, and cumulative effects of the proposed project would be negligible to minor, and in many cases beneficial, for Pulsifer's milk-vetch (*Astragalus pulsiferae* var. *pulsiferae*), adobe parsley (*Lomatium roseanum*), and Susanville penstemon (*Penstemon sudans*).

- Alternatives B, D, and F may affect some individuals of starry clarkia (*Clarkia stellata*); however, these effects would likely be beneficial and would likely not lead toward federal listing or loss of viability.

- Alternatives B, D, and F may affect some individuals of Baker cypress (*Cupressus bakeri*), a Special Interest Species; however, these effects would likely be beneficial.

- The proposed project would not impact any additional species listed as Sensitive or as an MIS species by Forest Service Region 5 (California) or the Plumas National Forest because none of these species are known or expected to occur in the Botany Analysis Area.

Noxious Weeds

- Implementation of these alternatives would result in a low risk of noxious weed introduction and spread.

4.5.2.3 Alternative C (Without Herbicide Use)

Rare Plant Species

- The proposed project activities would not affect any federally listed Threatened, Endangered, or Candidate plant species because none of these species are known or expected to occur in the Botany Analysis Area.

- The direct, indirect, and cumulative effects of the proposed project would be negligible to minor, and in many cases beneficial, for Pulsifer's milk-vetch (*Astragalus pulsiferae* var. *pulsiferae*), adobe parsley (*Lomatium roseanum*), and Susanville penstemon (*Penstemon sudans*).

- Alternative C may affect some individuals of starry clarkia (*Clarkia stellata*); however, these effects would likely be beneficial and would likely not lead toward federal listing or loss of viability.

- Alternative C may affect some individuals of Baker cypress (*Cupressus bakeri*), a Special Interest Species; however, these effects would likely be beneficial.

- The proposed project would not impact any additional species listed as Sensitive or as an MIS species by Forest Service Region 5 (California) or the Plumas National Forest because none of these species are known or are expected to occur in the Botany Analysis Area.

Noxious Weeds

- Implementation of this alternative would result in moderate risk of noxious weed introduction and spread.

4.5.3 Regulatory Framework

4.5.3.1 Sensitive (Rare) Species

The 1988 *Plumas National Forest Land and Resource Management Plan* ("Forest Plan") provides management direction for all Sensitive plants in the Forest; that direction is to "maintain viable populations of sensitive plant species" (USDA Forest Service 1988, page 4-34).

The Forest Plan also provides forestwide standards and guidelines to

- protect Sensitive and Special Interest plant species as needed to maintain viability;
- inventory and monitor Sensitive plant populations on an individual project basis; and
- develop species management guidelines to identify population goals and compatible management activities / prescriptions that will maintain viability.

Individual species conservation strategies, or species management guidelines, for the Plumas National Forest have not been completed for most of the Forest's Sensitive species. The Plumas National Forest has developed Interim Management Prescriptions that will be followed until the conservation strategies are completed (Madrid 1996).

4.5.3.2 Noxious weeds

The *Herger-Feinstein Quincy Library Group Forest Recovery Act Final Environmental Impact Statement* (HFQLG final EIS) and the 2004 Record of Decision on the Sierra Nevada Forest Plan Amendment (SNFPA) final supplemental EIS amended the management direction in the Forest Plan to address management of noxious weeds and invasive exotic (nonnative) weeds.

Table 2.4 of the HFQLG final EIS provides direction for noxious weed and invasive exotic weed management; this direction is to "Manage National Forest System lands so that management activities do not introduce or spread noxious or invasive exotic weeds." Table 2.4 of the HFQLG final EIS also provides guidelines to follow during project planning and implementation. These guidelines are included as Standard Management Requirements in appendix C of this document.

Appendix A of the SNFPA 2004 Record of Decision (page 36) establishes goals for noxious weed management using an integrated weed management approach according to the priority set forth in Forest Service Manual 2081.2:

> *Priority 1*—Prevent the introduction of new invaders.
>
> *Priority 2*—Conduct early treatment of new infestations.
>
> *Priority 3*—Contain and control established infestations.

Provisions for implementing these goals are embodied in the noxious weed management standards and guidelines of the SNFPA 2004 Record of Decision.

4.5.4 Methodology for Assessing Impacts

4.5.4.1 Geographic Area Evaluated for Impacts on Botanical Resources and Noxious Weeds

The geographic area or "Botany Analysis Area" used to analyze direct, indirect, and cumulative effects of the proposed project on botanical resources and noxious weeds consists of all proposed Treatment Units, including access roads to the Treatment Units, and the area within 1 mile of Treatment Unit boundaries (refer to figure 3-6 in chapter 3). The Botany Analysis Area, which encompasses approximately 127,000 acres, was chosen to capture all rare plants and noxious weed species that (a) occur within the proposed Treatment Units or (b) have suitable habitat within the Diamond Project Area as well as a "source" (potential for seed dispersal) population located in close proximity to the proposed activities. Those species located in the Botany Analysis Area were considered to have the highest potential to be impacted or influenced by the proposed project activities. Conversely, species outside the Botany Analysis Area were not considered to have a high likelihood of being impacted by project activities either directly, indirectly, or cumulatively.

4.5.4.2 Indicator Measures and Terminology

No indicator measures were used in the effects analysis for rare plant species because the number of occurrences, amount of suitable habitat, and potential effects were similar across all of the action alternatives.

There were apparent differences between alternatives with respect to the effect on noxious weed species. The indicator measures used to compare the effects across all of the alternatives were

- number and acres of noxious weed infestations proposed for treatment;
- effectiveness of the proposed control method;
- estimated cost of treatment; and
- projected increase in infested acres over time as a result of the proposed activities.

4.5.4.3 Analysis Methods

The analysis of effects on rare and noxious weed species was a three-step process (FSM 2672.43). In the first step, all listed or proposed rare and noxious weed species that are known or are believed to have potential to occur in the Project Area were identified. This list was developed by reviewing the

- U.S. Fish and Wildlife List for the Plumas National Forest
- USDA Forest Service Region 5 Sensitive Species List and Plumas National Forest Special Interest Species List
- Plumas National Forest rare plant and noxious weed records
- Plumas National Forest vegetation maps
- California Natural Diversity Database records

The second step was field reconnaissance surveys. Field surveys were conducted on approximately 57,300 acres within the Diamond Project Area between 2000 and 2005 (Dillingham 2006; Taylor 2000; Buck and Clifton 2001; Garcia and Associates 2001; Lubin and Gross 2002; Buck 2005; Dittes and Guardino 2005; Vollmar Consulting 2005; Wildwood Consulting 2005). These surveys were designed around the flowering period and ecology of those rare plant species and noxious weeds identified in step one. The surveyors compiled a comprehensive list of all species observed and reviewed it for rare species and noxious weeds. For each rare plant and noxious weed site found, information was collected that described the size of the occurrence and habitat characteristics and identified any existing or potential threats. Location information was collected using a Global Positioning System (GPS).

This information was used in step three of the analysis—conflict determination. For rare species, data were imported into a Global Information System (GIS) and used to analyze proximity to Treatment Units, identify detrimental treatment activities, and designate control areas.

Due to the abundance and distribution of Canada thistle (a noxious weed) in the Botany Analysis Area, as well as the high potential to be affected by project activities, the Vegetation Dynamics Development Tool (ESSA Technologies Ltd. 2005) was used to analyze the effects of the different alternatives (including the no-action alternative) on Canada thistle spread over time. This model was developed as a tool for managers to examine the impact that different management actions have on changes in vegetation. Different levels of disturbance associated with the proposed project activities and the effectiveness of different control methods are entered into the Vegetation Dynamics Development Tool model in order to project potential changes in Canada thistle abundance in the Diamond Project Area over time.

4.5.4.4 Design Criteria

Rare Plant Species. Rare plant species in the Diamond Project Area would be protected under all action alternatives using the following species-specific prescriptions (Hanson 2005):

Astragalus pulsiferae var. *pulsiferae* (Pulsifer's milk-vetch)—The three occurrences (0.06 acre) located in Area Thinning Unit 111 would be protected from soil displacement activities. Occurrences would be surrounded by a 50-foot buffer in which herbicides would be excluded. Prescribed fire activities involving only thermal disturbance would not need to specifically avoid each occurrence in the Treatment Unit; however, if fuel treatments were needed prior to burning, then hand thinning, scattering, and piling would occur outside of the occurrence. Fire control lines would not be constructed through occurrences. There would be at least five years between disturbance prescriptions within the same occurrence.

Clarkia stellata (Starry clarkia)—This species has been recommended for removal from the Forest Service Region 5 Sensitive species list due to its abundance, capacity to tolerate a range of disturbance regimes, and its ability to tolerate a wide range of habitat types. For these reasons, no protection measures are recommended under the Diamond Project.

Cupressus bakeri (Baker cypress)—The Baker cypress individual located in Area Thinning Unit 111 would be protected from ground-disturbing activities. Within the larger Baker cypress occurrence, a total of 73 acres of Baker cypress would be treated using a prescription that thins competing conifers and treats the stand with prescribed fire. No activities would occur in the remaining 104 acres of Baker cypress, all of which occur within the Mud Lake Research Natural Area. The objectives of this prescription are to promote Baker cypress growth, regeneration, and establishment and allow for the safe reintroduction of fire into the stand. Table 2-22 in chapter 2 provides a more detailed description of the Baker cypress prescription.

Lomatium roseanum (Adobe parsley)—The one occurrence (0.4 acre) in Area Thinning Unit 102 would be protected from all ground-disturbing activities and would be surrounded by a 50-foot buffer in which herbicides would be excluded.

Penstemon sudans (Susanville penstemon)—All occurrences (4.5 acres) located in Diamond Project Treatment Units would be protected from ground-disturbing activities, and occurrences would be surrounded by a 50-foot buffer in which herbicides would be excluded.

Noxious Weed Species. The potential to introduce noxious weeds would be reduced through implementation of Standard Management Requirements (see appendix C), which call for cleaning all vehicles and equipment prior to leaving known weed sites, the use of weed-free mulches and seed sources, and wherever possible, the designation of control areas where equipment and project activities would be excluded. Under all action alternatives, the control of noxious weed spread is addressed through the implementation of an integrated management strategy that proposes using a combination of mechanical, cultural, and in some cases, chemical treatment methods.

4.5.4.5 Assumptions

Only those rare plant species and noxious weeds with potential to be affected by the proposed project (that is, those within the Botany Analysis Area) were analyzed in detail in this document.

The spread of noxious weed species in the Botany Analysis Area was evaluated using the Vegetation Dynamics Development Tool. This model analyzed the effects of the proposed project activities on noxious weed spread using several assumptions including the timeframe of treatment activities, the probability of invasion, the effectiveness of proposed noxious weed control methods, and the definition of suitable noxious weed habitat.

4.5.4.6 Types and Duration of Impacts

Types of Impacts

Direct Effects—Direct effects would occur when plants are physically impacted. Examples of management activities that have the potential to directly affect rare plants include timber falling, application of Borax or herbicides, skid trail ripping, temporary road construction, and prescribed fire treatments. These actions can result in death, altered growth, or reduced seed set through physically breaking, crushing, burning, scorching, or uprooting plants.

Indirect Effects—Indirect effects on rare species are effects that are separated from an action in either time or space. These effects, which can be beneficial or detrimental to rare species, may include changes in vegetation composition, developmental pathways of vegetation, fire regimes, or the distribution and abundance of noxious weeds. Other indirect effects that are associated with herbicide treatments may include impacts to pollinators or mycorrhizae that are associated with rare species (see the "Glossary" for a definition of "mycorrhizae"). Adverse indirect effects are more likely to occur to those species that are intolerant of disturbance and tend to occupy interior forest habitats with high canopy cover. In contrast, for those species that tolerate or are dependent upon some level of disturbance and inhabit gaps and forest openings, treatments may have beneficial indirect effects.

Cumulative Effects—One crucial step in assessing cumulative effects on a particular resource is to compare the current condition of the resource (rare plants) and the projected changes as a result of management activities (such as fuels, vegetation, and noxious weed treatments) to the natural variability in the resources and processes of concern (MacDonald 2000). This assessment is particularly difficult for rare plant species because reference data are often lacking. In addition, the habitats in which many rare plant species are presently found have a long history of disturbance, making an undisturbed reference difficult to find.

Undeniably, past, present, and future activities have and will continue to alter rare plant populations and their habitats to various degrees. Therefore, the approach taken in this analysis is that if direct and indirect adverse effects on rare plant species in the Diamond Project Area are minimal or would not occur, then they would not contribute substantially to cumulative effects on the species. In addition, the effects of future projects would likely be minimal or similar to those described in this analysis if existing management guidelines (such as field surveys, protection of known rare species locations, and noxious weed mitigations) remain in place.

Duration of Impacts. It is difficult to state with certainty when the effects of the proposed treatments would no longer be altering the life history dynamics (such as germination, growth time necessary to reach sexual maturity, quantity of viable seed produced in a lifetime) of the rare plant species considered in this analysis. One method to estimate duration of effects is to assume that the effects of the action alternatives last as long as they are, singly or in combination with other anticipated effects, distinguishable from the effects of the no-action alternative. Using this as an assumption, the duration used to estimate effects in this analysis, is the recovery time of the vegetation to near baseline (current) conditions, which is approximately 100 years for group selection treatments and 50 years for fuel treatments.

The additive effects of past actions (such as wildfires, wildfire suppression, timber harvest, mining, nonnative plant introductions, and ranching) have shaped the present landscape and corresponding populations of rare plants. However, data describing the past distribution and abundance of rare plant species is extremely limited, making it impossible to quantify the effects of historic activities on the resources and conditions that are present today. Within the Botany Analysis Area, documentation of rare plant surveys began in the early 1980s; therefore, the baseline used for the effects analysis of past activities is 25 years. Documentation of noxious weed species in this area did not begin until much later; the first targeted noxious weed survey on file is 2002.

4.5.5 Environmental Consequences: General Effects on Rare Plant Species

The following provides a discussion of the direct, indirect, and cumulative effects that are applicable to all rare plant species considered in this analysis. A general discussion of cumulative effects (for all action alternatives) on all rare plant species is provided in section 4.5.5.4. Section 4.5.6 discusses the effects specific to each of the five rare plant species occurring in the Botany Analysis Area.

4.5.5.1 Alternative A (No Action)

Direct Effects. No direct effects are anticipated because no project-related activities would be implemented.

Indirect Effects. Stands would continue to grow and become more dense, resulting in increased shading, duff, and fuels accumulation and canopy closure. These conditions could negatively impact all of the rare plant species that have been documented in the Botany Analysis Area because all of the plants either naturally occupy open habitats or are tolerant, or in some cases dependent upon, some level of disturbance. These stand conditions and the continued exclusion of fire would also increase the risk of catastrophic wildfire, which could have detrimental effects on rare species.

The existing noxious weed infestations would continue to expand along roadsides, in forest openings, along riparian corridors, into meadows, and within other areas of suitable habitat. Noxious weed species pose a serious threat to biological diversity due to their ability to displace native species, alter nutrient and fire cycles, decrease the availability of forage for wildlife, and degrade soil structure (Bossard, Randall, and Hoshovsky 2000). Noxious weed establishment and spread in the Botany Analysis Area have the potential to negatively affect suitable habitat, not only for rare species, but also for all native plant species.

4.5.5.2 Action Alternatives B, D, and F

Direct Effects of Vegetation and Fuel Treatments. The direct effects on rare plant species would be avoided or reduced to a level compatible with each species' ecology by incorporating the protection measures for individual species found in section 4.5.4.4 of this document.

Direct Effects of Herbicide Treatments. The direct effect on rare species is considered negligible due to a combination of factors. First, all of the rare plants discussed in this analysis are found in upland habitat types. The herbicide proposed for treatment in these areas is clopyralid, which is a selective herbicide that affects species in the buckwheat, sunflower, and pea families; therefore, none of the rare species, with the exception of Pulsifer's milk vetch, would be at risk of direct effects.

Second, all of the rare plant locations, with the exception of three, are greater than 0.25 mile from any of the proposed herbicide treatment locations (see table 4-34). In addition, each species would be buffered by at least 50 feet from herbicide applications. These two factors would drastically reduce the risk of direct effects from herbicides.

Table 4-34. Estimated distances between rare plant species and proposed herbicide treatments.

Species	Total Number of Occurrences	Number of Occurrences		
		Greater Than 0.5 Mile from Herbicide Treatment	Between 0.25–0.5 Mile from Herbicide Treatment	Less than 0.25 Mile from Herbicide Treatment (actual distance)
Astragalus pulsiferae var. *pulsiferae* (Pulsifer's milk-vetch)	3	3	—	—
Clarkia stellata (starry clarkia)	3	2	1	—
Cupressus bakeri (Baker cypress)	2	1	—	1 (125 feet)
Lomatium roseanum (adobe parsley)	1	—	—	1 (980 feet)
Penstemon sudans (Susanville penstemon)	2	—	1	1 (320 feet)

Third, the methods proposed for application (wick and backpack) would greatly reduce the possibility of any direct effects on rare and nontarget native species.

The effects of clopyralid and glyphosate were discussed in the 2003 HFQLG final supplemental EIS (USDA Forest Service 2003), and this analysis tiers to that document. In general, information regarding the direct effects of the two herbicides, surfactant, and marker dye on rare plant species is almost nonexistent (USDA Forest Service 2003).

Both of the proposed herbicides are highly effective at killing target species. Clopyralid is a selective herbicide that affects target species by altering a plant's metabolism and growth and by interfering with the transport of nutrients (SERA 2004). In contrast, glyphosate is a nonselective herbicide that has the potential to affect both target and nontarget plant species by inhibiting or halting growth and disrupting cellular processes (SERA 2003).

The proposed surfactant (Syl-tac® or an equivalent formulation) is a blend of vegetable oil and a silicone-based surfactant. These are very unlikely to produce secondary breakdown products that would act as toxins to rare plant species. In addition, the proposed marker dye (Hi-light® Blue or equivalent formulation) is a water-soluble dye that contains no listed hazardous substances (SERA 1997) and is unlikely to cause adverse effects on rare plant species.

There is very little information available that describes the effects on rare species of the inert ingredients contained in clopyralid or glyphosate (USDA Forest Service 2003). Many of the inert ingredients in herbicides are proprietary in nature, and it is therefore difficult to determine what effects they may have on various species. However, Cox (1996, 1998, and 2000 *in* USDA Forest Service 2003) identified a number of inert ingredients associated with clopyralid and glyphosate and did not indicate that any were toxic to rare plant species.

For the remainder of this analysis, the discussion of effects resulting from herbicide application takes into consideration the effects of the herbicide's active and inert ingredients, metabolites, and additives (surfactant and marker dye).

Indirect Effects of Vegetation and Fuel Treatments. The proposed treatments would favor those species that occupy open habitats by reducing forest canopy and stand density, increasing the amount of light that reaches the forest floor, increasing the number of forest gaps or openings, and reducing the risk of high-intensity wildfire. All of the rare species documented within the Botany Analysis Area occupy naturally open habitats, are well adapted to high light intensities, or are tolerant of or even dependent upon some level of disturbance. Therefore, the proposed treatments have the potential to have a beneficial indirect effect by creating more suitable habitat over the landscape.

Noxious weed species are oftentimes classified as "pioneer" species or invaders. Disturbance, whether it is natural (a lightning-caused fire) or associated with project activities, often creates ideal conditions for weed introduction and establishment. Although rare plant species would be buffered from direct effects of project activities, there is still the risk of an indirect effect from weed invasion from adjacent areas that have been disturbed. Under alternatives B, D, and F, this risk would be greatly reduced through implementation of the proposed noxious weed treatments.

Indirect Effects of Herbicide Treatments. The indirect effects of herbicides on rare plant species can include accidental spills, spray drift, surface runoff, or a combination of these factors. In general, the primary hazard to nontarget terrestrial plant species is herbicide drift, which can be minimized by implementing the following design features: (1) avoidance through buffers, (2) spraying when the wind is absent or blowing away from the plants, and/or (3) using an application method other than spraying (USDA Forest Service 2003).

Applications of clopyralid or glyphosate in 0 to 5 mile per hour (mph) winds using a backpack sprayer have demonstrated that droplets can drift as far as 23 feet (SERA 2003, 2004). Applications made in a 15 mph wind have the potential to drift up to 68 feet. Based on these calculations, and a 0–5 mph maximum wind speed for application using a backpack sprayer, a 50-foot buffer surrounding Sensitive plant species would greatly reduce the potential for impacts due to drift. In the case of glyphosate, the proposed method of application is a wick, which reduces the chance of drift because herbicide is not emitted by spray. The incorporation of these design elements, as well as the geographic distance between rare species and the proposed herbicide treatments, would greatly reduce the risk of indirect effects due to drift.

Another potential indirect effect on rare plant species would be if an herbicide treatment were to negatively impact pollinator species. To quantify the potential impact on pollinator species, a scenario was analyzed to examine the effect of directly spraying a honey bee (assuming 100 percent absorption and over 50 percent of the body surface) with both of the proposed herbicides—clopyralid and glyphosate. The level of risk was determined using the "Hazard Quotient." A Hazard Quotient less than "1" is considered to be a low risk. The results of this analysis, which are presented in table 4-35, indicate that there would be a low risk to honey bees using the chemicals, rates, and volumes proposed under alternatives B, D, and F.

Table 4-35. Analysis of a scenario involving 100 percent absorption of glyphosate and clopyralid by a honey bee.

Herbicide Scenario (100% absorption)	Hazard Quotient		
	Typical Application Rate	Lower Application Rate	Upper Application Rate
Clopyralid	0.04	0.04	0.04
Glyphosate	0.70	0.70	0.70

There has also been some concern regarding the toxicity of silicone-based surfactants on terrestrial insects. This is primarily due to the effective spreading ability of these surfactants, which may amount to the physical effect of drowning (rather than any toxicological effects). Studies have indicated that the effect on terrestrial insects is highly dependent upon the dose (USDA Forest Service 2002). Silicone surfactants are usually applied at very low rates and, because they are very effective, are usually not applied at high spray volumes (USDA Forest Service 2002). Therefore, it is unlikely that insects would be exposed to the rates and doses of concern presented in the literature.

Under alternatives B, D, and F, there would be a low risk that the proposed herbicides or silicone-based surfactant would cause widespread effects on terrestrial insects due to (1) the need for a relatively high dose for a lethal effect, and (2) the fact that individual insects, rather than entire colonies or nests, would most likely be impacted (USDA Forest Service 2002).

Indirect Effects of Borax Treatments. The most recent risk assessment for Borax (USDA Forest Service 2006) indicates that there is a negligible risk of Borax exposure to nontarget plant species, even when applied at the maximum application rate used by the Forest Service. In all of the exposure scenarios for terrestrial plants, including pesticide-sensitive species, the level of risk was found to be low (that is, a Hazard Quotient of less than 1, USDA Forest Service 2006). Based on this analysis, as well as the open habitat types where most of the rare species in the Botany Analysis Area are found, the indirect effects of Borax application would likely be negligible.

4.5.5.3 Alternative C (No Herbicide Use)

Direct Effects. Direct effects would be avoided or reduced for rare plant species to a level compatible with each species' ecology by incorporating the protection measures for individual species found in section 4.5.4.4 of this document.

Indirect Effects. The proposed treatments would likely have a beneficial indirect effect on those species that occupy naturally open habitats by increasing the amount of suitable habitat over the landscape. The indirect effects on rare species would be the same as those discussed above for alternatives B, D, and F. Since no herbicides are proposed under this alternative, there would be no indirect effects from herbicide treatments.

The primary difference between this alternative and alternatives B, D, and F is the potential for indirect impacts resulting from increased spread of noxious weed species. Under this alternative, noxious weeds would continue to expand in areas that were not treated, and rare plant species in proximity to noxious weed locations that would not be treated under this alternative would have a higher likelihood of being impacted by future weed spread.

4.5.5.4 All Action Alternatives: Cumulative Effects on Rare Plant Species

The effects of past activities on rare plant species in the Botany Analysis Area are largely unknown. On the Plumas National Forest, rare plant surveys did not begin until the early 1980s. In many cases, even when project-level surveys were conducted, there is very little documentation that describes whether past projects avoided or protected rare plant species during project implementation. In addition to these unknowns, changes have been made to the Plumas National Forest Sensitive species list, including the addition of two species considered in this analysis: adobe lomatium and Susanville penstemon. Therefore, in order to incorporate the contribution of past activities into the cumulative effects of the proposed Diamond Project, this analysis uses the current abundance and distribution of rare plant species as a proxy for the impacts of past actions.

Over the past 25 years, the landscape in the Botany Analysis Area has experienced high levels of activity and, consequently, high levels of disturbance (see appendix B). The rare plant species presently known to occur in the Botany Analysis Area occupy open habitats and are tolerant of some level of disturbance. Therefore, it is possible that past activities in the Botany Analysis Area have had a beneficial effect on these species by creating openings and areas of suitable habitat across the landscape. However, these activities have also created a highly disturbed landscape, which has increased the susceptibility to noxious weed introduction and spread and increased the overall risk to native plant communities and rare species.

If existing management guidelines (such as field surveys, protection of known rare plant locations, and implementation of noxious weed mitigations) remain in place, the effects of future projects are likely to be minimal or similar to those described in this analysis. Ongoing activities, such as woodcutting, hunting, and dispersed recreation activities, are not likely to make a significant impact on rare plant species; however, these activities may act as vectors for weed spread.

4.5.6 Environmental Consequences: Effects on Specific Rare Plant Species

The following sections provide a discussion of the direct, indirect, and cumulative effects that are specific to each rare species that occurs in the Botany Analysis Area. The effects on each species as a result of the vegetation and fuels treatments were the same across all alternatives; therefore, this discussion is organized to *highlight differences* between the no-action alternatives; alternatives B, D, and F (noxious weed control with herbicides); and alternative C (noxious weed control without herbicides).

4.5.6.1 Alternative A (No Action): Effects on Pulsifer's Milk-Vetch

Direct Effects. No direct effects on Pulsifer’s milk-vetch (*Astragalus pulsiferae* var. *pulsiferae*) are anticipated because no project-related activities would be implemented.

Indirect Effects. The indirect effects of not implementing the proposed project would be negligible. Pulsifer’s milk-vetch is considered to be an “unusual edaphic” species, which means that it is often more influenced by soil conditions than by light regimes (USDA Forest Service 2003). In many cases, the areas where Pulsifer’s milk-vetch is found tend to naturally be more open than surrounding habitats. A potentially adverse effect on this species may be the increased risk of high-intensity wildfire as a result of not implementing vegetation and fuel treatments. Noxious weeds would also continue to spread at their current rate (see section 4.5.7.3), with the potential to invade areas of suitable habitat.

Cumulative Effects. The direct and indirect effects would be minor; therefore, there would be a low risk of cumulative effects. The direct and indirect effects on this species as a result of past activities are unknown, particularly because this species was not known to occur in this area prior to the 2005 field surveys. If existing management guidelines, such as rare plant surveys and protection of known rare species locations remain in place, the effects of future projects would likely be minimal or similar to those described in the analysis of the action alternatives.

4.5.6.2 Alternatives B, D, and F: Effects on Pulsifer's Milk-Vetch

Direct Effects. No direct effects on Pulsifer's milk-vetch are anticipated because all known locations would be flagged for avoidance. In addition, the occurrences that are located in Treatment Units are not in areas that are proposed for vegetation, fuel, or noxious weed management activities.

Indirect Effects. The indirect effects of implementing vegetation and fuel treatments would likely be negligible to minor and oftentimes beneficial. As discussed under the no-action alternative, Pulsifer's milk-vetch is usually more influenced by soil conditions than by light regimes. As a result, this species is typically not affected by moderate changes in vegetation structure. The use of prescribed fire generally has a negligible to minor, and in some cases beneficial, effect on both the species and its potential habitat (USDA Forest Service 2003). Pulsifer's milk-vetch also appears to tolerate some level of disturbance and has been shown to recruit after disturbance events.

The indirect effects of implementing the proposed herbicide treatment activities would be negligible. All Pulsifer's milk-vetch occurrences in the Botany Analysis Area are greater than 0.5 mile away from any proposed herbicide treatment (refer to table 4-34 above). Some native pollinators of *Astragalus* have been shown to be negatively impacted by pesticide applications (Karron 1987); however, the distance from the proposed treatments, combined with the low overall risk to pollinators (discussed in section 4.5.5.2), would make the effects on native pollinators of Pulsifer's milk vetch negligible. The use of herbicides to control Canada thistle was determined to be the most effective method of control (see section 4.5.7.4), and overall, this treatment would reduce the establishment and spread of noxious weeds and consequently reduce the threat to this rare species.

Cumulative Effects. The cumulative effects of implementing the proposed vegetation and fuel treatment activities would be negligible. The direct and indirect effects on this species from past activities are largely unknown. Under alternatives B, D, and F, all known locations of Pulsifer's milk-vetch would be protected from direct effects related to ground-disturbing activities. In addition, the indirect effect of implementing the vegetation and fuel treatments would be negligible.

The cumulative effect on Pulsifer's milk-vetch from the proposed herbicide treatments would be negligible to minor. Table 4-36 provides a summary of herbicide use in the Botany Analysis Area between 2000 and 2003. The closest herbicide location to the known Pulsifer's milk-vetch locations is approximately 1 mile away on private land in Genesee Valley (CDPR 2006). The only known future herbicide activities on public lands in the Botany Analysis Area are proposed under the Roadside Noxious Weed Project. The closest location proposed for treatment under this future project is located more than 2 miles away from the existing Pulsifer's milk-vetch locations. Taking these factors into account, as well as the negligible to minor direct and indirect effects from the proposed herbicide treatments, the cumulative effect on this species from these actions would also be negligible to minor.

Table 4-36. Total pesticide use reported in the Botany Analysis Area between 2001 and 2004.

Chemicals Applied	Total Pounds of Chemical Applied	Acres Treated
Clopyralid	21.6	89
Borax	1,260.0	780
Total	**1,281.6**	**869**

Source: California Department of Pesticide Regulation, 2006

4.5.6.3 Alternative C: Effects on Pulsifer's Milk-Vetch

Direct Effects. No direct effects on Pulsifer's milk-vetch are anticipated because all known locations would be flagged for avoidance. In addition, the occurrences that are located in Treatment Units are not within areas proposed for vegetation, fuel, or noxious weed management activities.

Indirect Effects. The indirect effects of implementing alternative C would be negligible to minor and oftentimes beneficial. Implementation of the proposed vegetation and fuel treatments would result in similar indirect effects as those described under alternatives B, D, and F. Since no herbicides are proposed under alternative C, there would be no indirect effects from herbicide treatments. The primary difference between this alternative and alternatives B, D, and F is the potential for indirect impacts resulting from increased spread of noxious weed species. The effect of alternative C on noxious weed spread is discussed in detail in section 4.5.7.5.

Cumulative Effects. The cumulative effect of implementing the proposed activities would be negligible. The cumulative effects of vegetation and fuels treatments would be the same as those discussed above for alternatives B, D, and F. Under alternative C, all known locations of Pulsifer's milk-vetch would be protected from direct effects relating to ground-disturbing activities. In addition, the indirect effect of implementing the vegetation and fuel treatments would be negligible. The primary difference between alternative C and alternatives B, D, and F is an increased risk of noxious weed spread (see section 4.5.7.5).

4.5.6.4 Determination for Pulsifer's Milk-Vetch

Alternative A (No Action). It is the Forest Service determination that alternative A (no action) would not affect Pulsifer's milk-vetch (*Astragalus pulsiferae* var. *pulsiferae*).

Action Alternatives. Based on the analysis described above, it is the Forest Service determination that the Diamond Project action alternatives (B, C, D, and F) may affect individuals but would likely not result in a trend toward federal listing or loss of viability for *Astragalus pulsiferae* var. *pulsiferae*.

4.5.6.5 Alternative A (No Action): Effects on Starry Clarkia

Direct Effects. No direct effects on Starry clarkia (*Clarkia stellata*) are anticipated because no project-related activities would occur.

Indirect Effects. Starry clarkia has the potential to be negatively affected by the no-action alternative because this species is often found in open habitats and has been shown to respond favorably to disturbance. Under alternative A, stands would continue to grow and become more dense, resulting in increased shading, duff and fuels accumulation, and canopy closure. This may lead to extirpation of this species from some of the known sites in the Botany Analysis Area. The effects on the seed bank of starry clarkia from a stand-replacing fire are unknown, but it is predicted that high-intensity wildfires would create suitable habitat for this species.

Cumulative Effects. The no-action alternative may affect starry clarkia because of potential changes to existing and suitable habitat. The direct and indirect effects on this species from past activities are unknown. However, the ecological characteristics of the species suggest that it is possible that past activities in the Botany Analysis Area have had a beneficial effect on this species by creating openings and areas of suitable habitat across the landscape. Future projects are likely to have effects similar to those described below under the action alternatives.

4.5.6.6 Alternatives B, D, and F: Effects on Starry Clarkia

Direct Effects. Starry clarkia may be directly affected by this project. Some individuals of this species may have their vigor and productivity reduced in the short term, or they may be killed by various project activities.

It is possible that some individuals may be negatively impacted by herbicide use because this species is scattered throughout the Botany Analysis Area. However, direct effects on starry clarkia would likely be negligible due to the herbicide specificity, design elements, and application method.

Indirect Effects. Starry clarkia may benefit from the proposed treatments even though some individuals may be directly affected as stated above. The species is known to readily colonize disturbed sites such as roadsides and skid trails. It is not known to occur in densely forested sites. Project-related activities would create ground disturbance and reduce canopy cover, thus creating more suitable habitat for this species to colonize.

Starry clarkia is scattered throughout the Botany Analysis Area, so there is some potential for indirect effects from herbicide drift. There is also minor potential for effects on native pollinators; however, the low overall risk to pollinators (discussed in section 4.5.5.2 above), would make the indirect effects associated with herbicide treatments negligible for starry clarkia.

Cumulative Effects. Starry clarkia has most likely benefited from the effects of past projects as is evidenced by its ability to colonize previously disturbed sites. The cumulative effects of this project could be beneficial due to the creation of openings and areas of suitable habitat across the landscape. Future projects would likely have similar beneficial effects.

4.5.6.7 Alternatives C: Effects on Starry Clarkia

Direct Effects. Starry clarkia may be directly affected by this project. Some individuals of this species may have their vigor and productivity reduced in the short term, or they may be killed by various project activities.

Indirect Effects. Starry clarkia may benefit from the proposed treatments even though some individuals may be directly impacted as stated above. The indirect effects would be the same as those discussed for alternatives B, D, and F. There would be no indirect effects from herbicide treatments because no herbicides are proposed under this alternative. The primary difference between this alternative and alternatives B, D, and F would be the potential for indirect impacts resulting from increased spread of noxious weed species. The effect of alternative C on noxious weed spread is discussed in detail in section 4.5.7.5.

Cumulative Effects. The cumulative effects to starry clarkia would be the same as those discussed above for alternatives B, D, and F. Starry clarkia has most likely benefited from the effects of past projects as is evidenced by its ability to colonize previously disturbed sites. The cumulative effects of this project could be beneficial due to the creation of openings and areas of suitable habitat across the landscape. Future projects would likely have similar beneficial effects. The primary difference between this alternative and other action alternatives would be an increased risk of noxious weed spread (see section 4.5.7.5).

4.5.6.8 Determination for Starry Clarkia

No Action Alternative. It is the Forest Service determination that alternative A would not affect *Clarkia stellata*.

Action Alternatives. Based on the analysis described above, it is the Forest Service determination that the Diamond Project action alternatives (B, C, D, and F) may affect individuals but would likely not result in a trend toward federal listing or loss of viability for *Clarkia stellata*.

4.5.6.9 Alternative A (No Action): Effects on Baker Cypress

Direct Effects. No direct effects on Baker Cypress (*Cupressus bakeri*) are anticipated because no project-related activities would be implemented.

Indirect Effects. Under the no-action alternative, there may be a high risk that this species would continue to decline over time, and that this occurrence may possibly be extirpated (no longer present).

Like many other cypress species in California, the long-term survival of Baker cypress is closely linked to fire (Vogl et al. 1977). Fire plays a crucial role in cypress regeneration by opening the cones and creating post-fire conditions such as exposed mineral soil and direct sunlight to the ground, which are necessary for germination (Vogl et al. 1977). Fire has been excluded from the Mud Lake Baker cypress stand in the Diamond Project Area for over a century. This lack of fire has created dense thickets of shade-tolerant conifers, such as white fir, which has resulted in a high level of cypress mortality (Wagener and Quick 1963; Keeler-Wolf 1985). The decline of Baker cypress in this stand due to competition and lack of regeneration was first noted by Wagener and Quick (1963) and has been recognized repeatedly since that time (Keeler-Wolf 1985; Plumas National Forest unpublished internal notes and files). The only evidence of Baker cypress reproduction in the Mud Lake stand is in the form of seedlings or saplings found near sites logged approximately 25 years ago.

Under the no-action alternative, the stands surrounding the Baker cypress would continue to become dense, particularly in smaller size classes of white fir. These conditions would lead to a continuing level of adult mortality because this species is considered a poor competitor. Although many cypress individuals can live several hundred years, there is also evidence that as cypress stands age, recruitment declines; therefore, some older trees may contribute less to the next generation than younger trees (Zedler 1977, 1995; Ne'eman et al. 1999). The levels of regeneration observed over the past 25 years in the Baker cypress stands are not considered adequate to sustain the species over the long term (Keeler-Wolf 1985; M. Coppoletta, USFS, personal observation, 2005).

Cumulative Effects. Under the no-action alternative, the negative indirect effects on Baker cypress, combined with the continued exclusion of fire in this stand, would increase the potential for a negative cumulative effect on this species.

Past fires, and a current lack of fire, have influenced the present structure of the forest at Mud Lake, as well as on the presence and distribution of Baker cypress in the occurrence in the Diamond Project Area (Keeler-Wolf 1985). Aerial photographs taken in 1941 and 1953 show the Mud Lake area dominated by an early successional, post-fire forest, with larger areas of montane chaparral than what is currently present (Keeler-Wolf 1985). Tree core data collected by Todd Keeler-Wolf in 1985 show a narrow range of tree ages, which suggests that a fire or a series of fires may have occurred near the turn of the century and affected the majority of the area within the Mud Lake Research Natural Area. The presence of fire scars on large trees in the Mud Lake Unit and an absence of fire scars on smaller trees provide additional evidence of low-severity fires in the past and the exclusion of fire over the last century (J. Moghaddas, USFS, personal communication, November 2005). Over the past 25 years, no fires or ignitions have been documented in the Baker cypress stand in the Diamond Project Area.

Some form of timber harvest activities has occurred in the landscape surrounding the Baker cypress stands since the turn of the century. Over the past 25 years, these activities have included green sales, salvage sales, and personal firewood harvest. Activities have been excluded from the majority of the Baker cypress stands since at least the time of the establishment of the Research Natural Area in 1989. These past actions, or lack of actions, in the Baker cypress stands have greatly contributed to the deteriorating condition of the Baker cypress stands.

4.5.6.10 Alternatives B, D, and F: Effects on Baker Cypress

Direct Effects. Under these action alternatives, some individuals may be killed or damaged by fire as a result of vegetation and fuel treatment activities. Adult Baker cypress have thin bark and are often damaged or killed by high-intensity fires (Stone 1965; Silen and Olson 1992). The survival of Baker cypress is entirely dependent upon successful post-fire regeneration from seed; this is because the species does not re-sprout from stumps or other vegetative parts (Vogl et al. 1977; Ne’eman et al. 1999). In naturally occurring stands, cypress species have been found to grow in even-aged stands, which suggest that most populations are formed by the germination of seed in a single cohort after a fire event (Ne’eman et al. 1999). Therefore, while adult cypress may be damaged or killed by fire, fire is also an essential factor required to establish the next generation.

Indirect Effects. Implementation of the activities proposed under alternatives B, D, or F would have a beneficial indirect effect on the Baker cypress stand. Under these alternatives, the stand surrounding the Baker cypress would be thinned to reduce the density of competing conifer species and treated with prescribed fire to stimulate regeneration.

Under alternatives B, D, and F, the post-treatment stand would show a large reduction in the density (trees per acre) of non-Baker cypress trees, particularly in smaller size classes. The proposed thinning treatments would result in a significantly more open stand and a reduction in fuel loads, which would allow for the safe reintroduction of fire. The overall effect of the vegetation and fuel treatments on Baker cypress would be a reduction in competition from shade-tolerant white fir and stimulation of regeneration. This has been observed in other Baker cypress stands where seedlings were observed mostly on skid trails from logging activities and, in many cases, in the immediate vicinity of a cypress tree downed during a logging operation (Stone 1965; M. Coppoletta, USFS, personal observation, 2005).

The potential for an indirect effect as a result of implementing the proposed herbicide treatment activities would be negligible when taking into account the distance from the treatment and the selectivity of the herbicide. The closest distance between a Baker cypress location and a proposed herbicide site is 125 feet. This treatment proposes to use clopyralid, a selective herbicide that impacts species in the buckwheat, sunflower, and pea families. There is also no potential for a negative effect on pollinator species because cypress species are wind pollinated.

Cumulative Effects. The Botany Analysis Area contains approximately 18 percent of all known Baker cypress occurrences (refer to figure 3-6 in chapter 3). The occurrences that are in the Botany Analysis Area represent a significant range limit for the species that is unique based on its high elevation, cool montane climate, and distance inland from the coast (Keeler-Wolf 1989). Within the occurrences proposed for treatment, the vegetation and fuel treatments are proposed in approximately 46 percent of the stand. Very few activities have occurred within this stand over the past 25 years. This lack of disturbance and exclusion of fire have significantly contributed to the declining condition of the Baker cypress stand. The ecological significance of the occurrences in the Botany Analysis Area, combined with the beneficial indirect effects expected as a result of the proposed project, would make the cumulative effects on Baker cypress beneficial.

4.5.6.11 Alternative C: Effects on Baker Cypress

Direct Effects. Under this alternative, some Baker cypress individuals may be killed or damaged by fire as a result of vegetation and fuel treatment activities. However, while adult cypress may be damaged or killed by vegetation or fuel management activities, fire is also an essential factor required to sustain the population. The direct effects on this species would be the same as those discussed for alternatives B, D, and F.

Indirect Effects. Implementation of the activities proposed under alternative C would have a beneficial indirect effect on the Baker cypress stand. The indirect effects on this species would be the same as those discussed for alternatives B, D, and F. There would be no indirect effects from herbicide treatments because no herbicides are proposed under this alternative. The primary difference between this alternative and alternatives B, D, and F would be the potential for indirect impacts resulting from increased spread of noxious weed species. The effect of alternative C on noxious weed spread is discussed in detail in section 4.5.7.5.

Cumulative Effects. The cumulative effects of vegetation and fuels treatments would be the same as those discussed above for alternatives B, D, and F. The ecological significance of the occurrence in the Botany Analysis Area, combined with the beneficial indirect effects expected as a result of the proposed project, would make the cumulative effects on Baker cypress beneficial. The primary difference between this alternative and the other action alternatives would be an increased risk of noxious weed spread (see section 4.5.7.5).

4.5.6.12 Alternative A (No Action): Effects on Adobe Parsley

Direct Effects. No direct effects on adobe parsley (*Lomatium roseanum*) are anticipated because no project-related activities would be implemented.

Indirect Effects. The indirect impact of not implementing vegetation management activities would likely be minor to negligible. Within the Botany Analysis Area and at other locations on the Plumas National Forest, this plant is found in rocky shallow soil and in habitats that are naturally open with little or no canopy or vegetative cover. Within similar communities in the Great Basin, fire suppression has been shown to lead to an increase in woody species such as sagebrush and a decrease in understory herbaceous vegetation (Wrobleski and Kauffman 2003). Therefore, over time, the no-action alternative may decrease the amount of open, suitable habitat for this species across the landscape. In addition, as discussed in section 4.5.7.3, noxious weed infestations would also continue to spread at their current rate, with the potential to invade areas of suitable habitat.

Cumulative Effects. Overall, the direct and indirect effects on this species from this alternative would be negligible to minor; therefore, there would be a low risk of cumulative effects. As discussed above in section 4.5.5.4, the direct and indirect effects on this species from past activities are unknown particularly because this species is a new addition to the Plumas National Forest Sensitive Species List. However, if existing management guidelines, such as rare plant surveys and protection of known rare species locations remain in place, the cumulative effects of proposed and future projects would likely be negligible.

4.5.6.13 Alternatives B, D, and F: Effects on Adobe Parsley

Direct Effects. No direct effects on adobe parsley are anticipated because the known occurrence would be flagged for avoidance. In addition, the occurrence is located in an area that is not proposed for vegetation, fuel, or noxious weed management activities.

Indirect Effects. The indirect effects of implementing vegetation and fuel treatments would likely be negligible to minor and may be beneficial. As discussed for the no-action alternative, adobe parsley grows in rocky shallow soil that is naturally open with little to no canopy cover. This habitat type suggests that adobe parsley can tolerate some level of disturbance. A study conducted by Wrobleski and Kauffman (2003) found that prescribed fire increased reproduction and vegetative growth for three species of *Lomatium* that grow in sagebrush communities. Therefore, the use of prescribed fire may have a beneficial effect on this species and its potential habitat (USDA Forest Service 2003).

Indirect effects associated with herbicide treatments would be negligible for adobe parsley due to the distance from the treatment and the selectivity of the herbicide. The one adobe parsley occurrence in the Botany Analysis Area is approximately 1,000 feet from the nearest herbicide treatment. This treatment proposes to use clopyralid, a selective herbicide that impacts species in the buckwheat, sunflower, and pea families. Therefore, the potential for an indirect effect from herbicide drift would be negligible when taking into account the distance from the treatment and the selectivity of the herbicide (adobe parsley is in the carrot family). The distance from the treatments also makes the potential impacts on native pollinators negligible.

The use of herbicides to control Canada thistle was determined to be the most effective method of control (see noxious weed section). Therefore, this treatment would greatly reduce the establishment and spread of noxious weeds and consequently reduce the threat to this sensitive species.

Cumulative Effects. The cumulative effect of implementing the proposed vegetation and fuels activities would likely be negligible to minor. Under alternatives B, D, and F, the known location of adobe parsley would be protected from direct effects relating to ground-disturbing activities. In addition, the indirect effect of implementing the vegetation and fuel treatments would likely be negligible to minor.

The direct and indirect effects on this species from past activities are unknown, particularly because this species is a new addition to the Plumas National Forest Sensitive Species List. However, based on what is known about the ecology of this species, it is possible that past activities have had a beneficial effect on this species by creating openings and areas of suitable habitat across the landscape. Present threats to this occurrence include cattle grazing impacts in the form of trailing and some recreational activities. This occurrence is also at a site proposed for a potential future wind energy testing site and meteorological tower (proposed for 2006–2009), and the impacts on this species will need to be evaluated at that time.

The cumulative effects on this species as a result of implementing the proposed herbicide treatments would be negligible to minor. Table 4-36 above provides a summary of herbicide use in the Botany Analysis Area between 2000 and 2003. The closest documented herbicide use to the existing adobe parsley location is approximately 2.8 miles away (CDPR 2006). The only known future herbicide use is proposed under the Roadside Noxious Weed Project. The closest location proposed for treatment under this project is located more than 8 miles away. Taking these factors into account, as well as the negligible to minor direct and indirect effects from the proposed herbicide treatments, the cumulative effect on this species from these actions would also likely be negligible to minor.

4.5.6.14 Alternative C: Effects on Adobe Parsley

Direct Effects. No direct effects are anticipated because the known occurrence would be flagged for avoidance. In addition, the occurrence is located in an area that is not proposed for vegetation, fuel, or noxious weed management activities.

Indirect Effects. The indirect effects of implementing alternative C would likely be negligible to minor and may be beneficial. Implementation of the proposed vegetation and fuel treatments would result in similar indirect effects as those described under alternatives B, D, and F. Since no herbicides are proposed under alternative C, there would be no indirect effects from herbicide treatments. The primary difference between this alternative and alternatives B, D, and F is the potential for indirect impacts resulting from increased spread of noxious weed species. The effect of alternative C on noxious weed spread is discussed in detail in section 4.5.7.5.

Cumulative Effects. The cumulative effect of implementing the proposed activities would be negligible. The cumulative effect of vegetation and fuels treatments would be the same as those discussed above for alternatives B, D, and F. Under alternative C, all known locations of adobe parsley would be protected from direct effects relating to ground-disturbing activities. In addition, the indirect effect of implementing the vegetation and fuel treatments would be negligible. The primary difference between alternative C and alternatives B, D, and F is an increased risk of noxious weed spread (see section 4.5.7.5).

4.5.6.15 Determination for Adobe Parsley

No Action Alternative. It is the Forest Service determination that alternative A would not affect *Lomatium roseanum*.

Action Alternatives. Based on the analysis described above, it is the Forest Service determination that the Diamond Project action alternatives (B, C, D, and F) may affect individuals but would likely not result in a trend toward federal listing or loss of viability for *Lomatium roseanum*.

4.5.6.16 Alternative A (No Action): Effects on Susanville Penstemon

Direct Effects. No direct effects on Susanville penstemon (*Penstemon sudans*) are anticipated because no project-related activities would be implemented.

Indirect Effects. The indirect impact of not implementing vegetation management activities would likely be minor to negligible. Susanville penstemon is found in dry, naturally open areas with little or no canopy or vegetative cover. Because this species is dependent upon open habitats, the no-action alternative may decrease the amount of suitable habitat for this species across the landscape. In addition, noxious weed infestations would continue to spread at their current rate, with the potential to invade areas of suitable habitat.

Cumulative Effects. The direct and indirect effects on this species from alternative A would be minor to negligible, so there would likely be a low risk of cumulative effects. The direct and indirect effects on this species from past activities are unknown, particularly because this species is a new addition to the Plumas National Forest Sensitive Species List. However, if existing management guidelines, such as rare plant surveys and protection of known rare species locations remain in place, the effects of the proposed and future projects would likely be minimal or similar to those described in the analysis of the action alternatives.

4.5.6.17 Alternatives B, D, and F: Effects on Susanville Penstemon

Direct Effects. No direct effects are anticipated because the known occurrence would be flagged for avoidance. In addition, the occurrence is located in an area that is not proposed for vegetation, fuel, or noxious weed management activities.

Indirect Effects. The indirect effect of implementing vegetation and fuel treatments would likely be negligible to minor and oftentimes beneficial. Susanville penstemon occupies dry, naturally open areas with little or no canopy or vegetative cover. Throughout its range, this species has been observed growing on unstable road shoulders, trail edges, and in old logging units, which suggests that it is able to tolerate considerable amounts of disturbance. Therefore, the indirect effects of the proposed vegetation and fuel treatments could potentially be beneficial to the species by opening up the canopy, creating gaps in the vegetation, and reducing understory fuel accumulation.

Indirect effects associated with herbicide treatments would be negligible for Susanville penstemon. All locations of Susanville penstemon, with one exception, are further than 0.25 mile from any proposed herbicide treatments. The one location that is less than 0.25 mile is located just over 300 feet from a site that would be treated with clopyralid, a selective herbicide that impacts species in the buckwheat, sunflower, and pea families. Taking into account the distance from the treatment and the selectivity (Susanville penstemon is in the figwort family), the potential for an indirect effect from herbicide drift would be negligible. The distance from the proposed treatments also make the potential effects on native pollinators negligible.

The use of herbicides on Canada thistle was determined to be the most effective method of control (see section 4.5.7 below). Overall, herbicide treatments would reduce the establishment and spread of noxious weeds and consequently reduce the threat to Susanville penstemon.

Cumulative Effects. Because the direct and indirect effects of this project are expected to be negligible to minor, they would not substantially contribute to the effects from past, present, and future activities.

Taking into consideration the habitat where this species occurs, it is unlikely that past vegetation management activities have negatively impacted this species. This occurrence is at a site proposed for a potential future wind energy testing site and meteorological tower (proposed for 2006–2009), and the impacts on this species would need to be evaluated at that time.

The cumulative effects on Susanville penstemon from implementation of the proposed herbicide treatments would be negligible to minor. Table 4-36 above provides a summary of herbicide use in the Botany Analysis Area between 2000 and 2003. The closest documented herbicide use to the existing Susanville penstemon location is approximately 2 miles away (CDPR 2006). The only known future herbicide use is limited to the proposed Roadside Noxious Weed Project—the closest location proposed for treatment under this project is located more than 9 miles away. Taking these factors into account, as well as the negligible to minor direct and indirect effects from the proposed herbicide treatments, the risk of cumulative effects on this species is low.

4.5.6.18 Alternative C: Effects on Susanville Penstemon

Direct Effects. No direct effects are anticipated because the known occurrence would be flagged for avoidance and because the occurrence is located in an area that is not proposed for vegetation, fuel, or noxious weed treatments.

Indirect Effects. The indirect effects of implementing vegetation and fuel treatments would likely be negligible to minor and oftentimes beneficial. Implementation of the proposed vegetation and fuel treatments would result in similar indirect effects as those described under alternatives B, D, and F. There would be no indirect effects from herbicide treatments because no herbicides are proposed under this alternative. The primary difference between this alternative and alternatives B, D, and F is the potential for indirect effects resulting from increased spread of noxious weed species, which is discussed in detail in section 4.5.7.5.

Cumulative Effects. The cumulative effects of implementing the proposed activities would be negligible to minor. The cumulative effects of vegetation and fuels treatments would be the same as those discussed in the previous section (alternatives B, D, and F). Under alternative C, all known locations of Susanville penstemon would be protected from direct effects relating to ground-disturbing activities. In addition, the indirect effect of implementing the vegetation and fuel treatments would be negligible. The primary difference between alternative C and alternatives B, D, and F is an increased risk of noxious weed spread (see section 4.5.7.5).

4.5.6.19 Determination for Susanville Penstemon

No Action Alternative. It is the Forest Service determination that alternative A would not affect *Penstemon sudans*.

Action Alternatives. Based on the analysis described above, it is the Forest Service determination that the Diamond Project action alternatives (B, C, D, and F) may affect individuals but would likely not result in a trend toward federal listing or loss of viability for *Penstemon sudans*.

4.5.7 Environmental Consequences: Effects on Noxious Weeds

4.5.7.1 Summary of Effects

The proposed vegetation, fuels, riparian, and road treatment activities would greatly increase the risk of noxious weed spread by creating disturbed conditions that favor noxious weed establishment and spread. The implementation of standard management practices (see appendix C) and noxious weed control measures would reduce the risk of noxious weed spread; however, this would be highly dependent upon the effectiveness of each proposed control method. Table 4-37 provides a summary of the effects of the proposed alternatives. The alternatives that resulted in similar effects were grouped together for the purpose of this analysis.

Table 4-37. Summary of potential effects on noxious weeds.

Indicator Measure	Alternative A	Alternatives B, D, and F (proposed herbicide use)	Alternative C (no herbicide use)
Risk of invasion and spread	Moderate	Low	Moderate
Number of noxious weed occurrences treated	None	491	228
Approximate number of acres treated	None	130	20
Effectiveness of treatment	Not applicable	High Weighted average: [a] 91%	Low Weighted average: [a] 58%
Estimated cost of treatment	Not applicable	$240 per acre	$780 per acre
Projected increase in acres over 50 years	Five times greater than present number	Four times greater than present number	Six times greater than present number

Note:

a. The weighed average incorporates the effectiveness of each treatment and the amount of that treatment being proposed.

Figure 4-10 presents the results from the Vegetation Dynamics Development Tool (ESSA Technologies Ltd. 2005), a model used to analyze the effects of the different alternatives on Canada thistle spread over time. By incorporating levels of disturbance associated with the proposed project activities and the effectiveness of different control methods, the model allows for the projected change in Canada thistle abundance in the Botany Analysis Area over time.

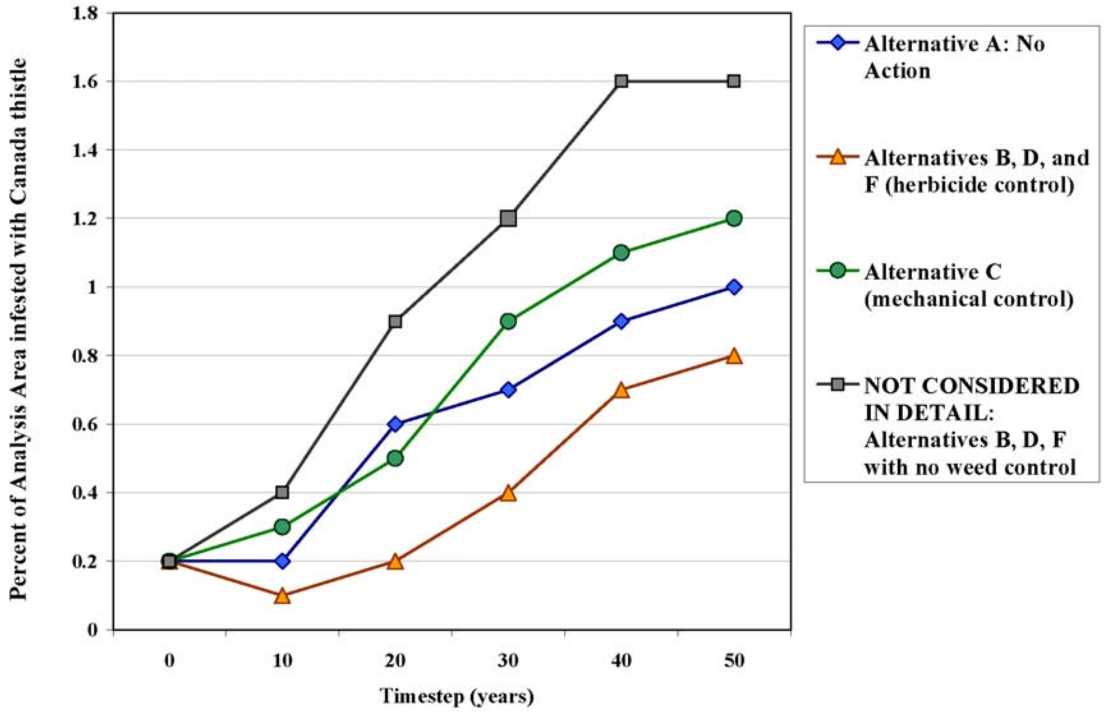

Figure 4-10. Predicted change in the number of acres occupied by Canada thistle in the Botany Analysis Area over time as a result of the proposed alternatives.

As shown in figure 4-10, the risk of spreading Canada thistle over time would be lowest with implementation of alternative B, D, or F, which include Standard Management Requirements to reduce risk of weed introduction (see appendix C) and propose herbicides for control of Canada thistle. There is a moderate risk of Canada thistle spread as a result of the no-action alternative and implementation of alternative C, which proposes mechanical control on high-priority Canada thistle occurrences. The highest risk of weed spread would occur if the proposed vegetation, fuels, and road treatments were implemented, but no noxious weed control measures were employed.

4.5.7.2 Effects Common to All Action Alternatives

Direct and Indirect Effects. Noxious weed species pose a serious threat to biological diversity because of their ability to displace native species, alter nutrient and fire cycles, decrease the availability of forage for wildlife, and degrade soil structure (Bossard, Randall, and Hoshovsky 2000). For example, in relatively undisturbed grasslands in Colorado, species diversity was found to be inversely proportional to the frequency of Canada thistle (Stachion and Zimdahl 1980 in Nuzzo 1997). Studies in areas dominated by spotted knapweed also found higher levels of surface runoff and soil erosion (Lacey et al. 1989 *in* Beck 1994).

Noxious weed species have the potential to affect native plant species indirectly through allelopathy (the production and release of plant compounds that inhibit the growth of other plants) (Bais et al. 2003), as well as through direct competition for nutrients, light, and water (Bossard, Randall, and Hoshovsky 2000). Canada thistle, in particular, has been shown to produce allelopathic chemicals that inhibit native species and to accumulate nitrates that cause poisoning in animals (Fuller and McClintock 1986 *in* Bossard, Randall, and Hoshovsky 2000).

Noxious weed species are oftentimes classified as “pioneer” species or invaders. Therefore, disturbance, whether it is natural (such as a lightning-caused fire) or associated with project activities, often creates ideal conditions for weed introduction and establishment. The proposed vegetation, fuels, riparian, and road treatment activities would greatly increase the amount of disturbance in the Diamond Project Area. At the site-specific level, the risk of weed establishment and spread is largely dependent upon the type and level of disturbance associated with each of the proposed treatment activities. For example, the risk of spread would be higher in areas with group selection activities compared to those areas that would be hand thinned. Table 2-30 in chapter 2 provides a comparison of the treatments, as well as the number of acres proposed under each treatment for each alternative. In general, alternatives B and C would have the greatest amount of disturbance, which would primarily be a result of the number of acres treated with group selection and mechanical thinning treatments.

Noxious weeds are spread by roads, recreational activities (such as camping, hiking, horseback riding, and hunting), and ongoing land management activities. The habitats in the Botany Analysis Area that are located next to roads are at a high risk of noxious weed invasion and spread. Roads contribute to dispersal of noxious weed species because they (1) create suitable habitat by altering environmental conditions, (2) make invasion more likely by stressing or removing native species, and (3) allow for easier movement by wild or human vectors (Trombulak and Frissell 2000). There are 125 noxious weed locations in the Botany Analysis Area that are within 50 feet of existing or proposed temporary roads.

Cumulative Effects. The effect of past activities on noxious weed species in the Botany Analysis Area is largely unknown. Targeted noxious weed surveys at the project-level first began in the Botany Analysis Area in 2002. Although information describing the past distribution and abundance of weed species in the Botany Analysis Area is largely lacking, Canada thistle was noted in the area on a few species lists as early as 1982 (Taylor 1982). In general, however, the lack of information makes it very difficult to draw definitive conclusions regarding the effects of past project activities on noxious weed introduction and spread.

Records for past projects that occurred in the Botany Analysis Area between 1982 and the present were examined to determine if (1) noxious weed species were surveyed for and/or documented prior to project implementation and (2) if noxious weed species are currently present within the boundary of past projects. Over 70 projects, ranging from large timber sales to small mining operations, were reviewed. Of these projects, only 18 percent of surveys mentioned the presence of noxious weeds or indicated that noxious weed surveys had been performed. In contrast, data collected during recent field surveys of the Diamond Project Area indicate that 65 percent of these past projects currently have noxious weed infestations within the old project boundary. The majority of these infestations are Canada thistle locations. While it is often difficult to make conclusions regarding the effects of past activities on noxious weed introduction and spread, the high level of past activity, combined with the current level of weed infestation, suggest that past activities have had a significant effect on noxious weed introduction and spread across the Botany Analysis Area.

Of the 520 noxious weed locations (covering approximately 195 acres) that have been documented to date in the Botany Analysis Area, 12 locations are treated annually using mechanical methods. In addition, one future project, designed to treat noxious weeds found within 50 feet of existing roads, is proposed to treat a small number of Canada thistle occurrences in the Botany Analysis Area. While these ongoing and future actions would decrease the potential for these occurrences to spread along roads, the actions would not greatly reduce the extent of Canada thistle infestations over the landscape.

4.5.7.3 Alternative A (No Action)

Direct Effects. This alternative would not result in new ground-disturbing activities so the amount of suitable noxious weed habitat would remain at its current level. Noxious weed infestations that are not treated on an on-going basis would continue to spread at their present rates.

Of the known noxious weed locations in the Botany Analysis Area, 12 have been, and would continue to be, treated annually using mechanical methods. The species currently treated include all spotted knapweed locations (0.01 acre), one yellow starthistle site (0.01 acre), and four Scotch broom locations (1.8 acres). To date, the methods used to treat spotted knapweed, Scotch broom, and yellow starthistle have shown some level of success at controlling the spread of existing infestations. For example, after three years of treatment, three of the Scotch broom infestations in the Botany Analysis Area decreased by 95 percent, while another site decreased to zero individuals. Under this alternative, none of the Russian thistle, Canada thistle, or medusahead sites would be treated.

Indirect Effects. Under the no-action alternative, no project activities would occur, and Canada thistle and other weed species that are not being actively treated would continue to expand along roadsides and into riparian and other native plant communities.

Canada thistle poses the largest threat to native plant communities in the Botany Analysis Area because of its abundance and distribution. The rates of Canada thistle spread that are documented in scientific literature range from less than 2 feet per year to over 40 feet per year (Donald 1990; USGS 2005; Nuzzo 1997; Bond and Turner 2004). In competitive environments, the rates of Canada thistle spread can range from 3 to 12 feet per year (Donald 1990).

Canada thistle is a shade-intolerant species, and its growth is shown to be discouraged in areas where there are low levels of disturbance and sufficient competition from native species. For example, in Rocky Mountain National Park, it was found that dry upslope conditions, thick canopies from woody species, and well-established grass meadows inhibited Canada thistle invasion and population size over time (Beck 1994). However, it was also noted that only a minor amount of disturbance (such as from elk grazing) was necessary to promote Canada thistle invasion and establishment.

The Vegetation Dynamics Development Tool model projections for the Botany Analysis Area predict that if the habitat surrounding existing infestations remains undisturbed and the Canada thistle occurrences remain untreated, the number of acres currently occupied by Canada thistle would slowly increase over time. According to the model, Canada thistle has the potential to increase its present level of infestation (in terms of acres) by almost 5-fold (refer to figure 4-10 above).

Cumulative Effects. No ground-disturbing activities would occur under alternative A, and there would be no project activities to contribute to the cumulative effects of noxious weeds. In addition, no

Russian thistle, Canada thistle, or medusahead sites would be treated. The large number of past activities, the large proportion of private land, and the abundance of Canada thistle and other weed species in the Botany Analysis Area make the habitat in the Diamond Project Area vulnerable to noxious weed spread, even in the absence of project activities. Existing vectors for noxious weed spread that are unrelated to the proposed project include recreational activities (such as horseback riding, hunting, and off-highway vehicle use) and ongoing management activities. These would continue to aide in the dispersal and spread of noxious weed species in the Botany Analysis Area.

Fire suppression activities that have occurred over the past century would continue under alternative A. The exclusion of fire would create forest conditions with a higher risk of high-severity wildfires, which can create conditions favorable to noxious weed spread. For example, in their comparison of low-severity and high-severity burns, Turner et al. (1997) found that the density of Canada thistle after severe surface and crown fires was two to four times greater than the density of Canada thistle after a light surface fire.

4.5.7.4 Alternatives B, D, and F

Direct Effects. The direct effects of applying fall herbicide treatments to Canada thistle over a two- to five-year period, and using a combination of mechanical and cultural methods for the remaining five noxious weed species in the Project Area, would greatly reduce the existing noxious weed infestations in the Diamond Project Area.

Alternatives B, D, and F address the control of noxious weed introduction and spread through the implementation of standard management practices (refer to appendix C), as well as a combination of mechanical, cultural, and chemical treatment methods. In total, treatment is proposed on 491 noxious weed infestations that cover approximately 130 acres. The specific control treatments proposed for each species based on their biology, ecology, and abundance in the Diamond Project Area are presented in chapter 2.

In order to evaluate the direct effectiveness of any noxious weed control method, it is necessary to consider the extent of the infestation, characteristics of the site, growth characteristics of the plant, treatment timing, and necessary number of treatments (Bayer 2000). All of the noxious weed infestations in the Diamond Project Area, with the exception of Canada thistle, are small in size, and most have been shown to be effectively controlled using mechanical and cultural (flaming) methods.

Section 4.5.5.2 above provides a greater description of the two herbicides (clopyralid and glyphosate) that are proposed for use under alternatives B, D, and F. Glyphosate has been shown to reduce root and shoot growth in Canada thistle (Carlson and Donald 1988 *in* Nuzzo 1997). In their study of Canada thistle control using an aquatic formulation of glyphosate (Rodeo®), Krueger-Mangold, Sheley, and Roos (2002) determined that a fall wick application of glyphosate was the most effective at decreasing Canada thistle (average of 82 percent), while at the same time maintaining native species richness.

Clopyralid has been shown to provide the most consistent control of Canada thistle in agricultural areas, where this species is a major pest (Lym and Zollinger 1995 *in* Nuzzo 1997). Repeat applications for two to four years have generally provided complete elimination of Canada thistle's root systems (Bayer 2000). It has been shown that a fall application of clopyralid can delay shoot growth and reduce shoot density the following summer (Donald 1992).

Indirect Effects. The proposed project treatments would greatly reduce the risk of noxious weed introduction and spread under alternatives B, D, and F. This reduction would be the result of implementation of Standard Management Requirements (see appendix C) and noxious weed control measures.

As discussed previously, implementation of the proposed vegetation, fuels, riparian, and road treatment activities would greatly increase the amount of disturbance in the Diamond Project Area. A reduction in the forest canopy and soil disturbance as a result of the proposed treatment activities would create conditions that favor both the establishment and spread of noxious weed species. Many weed species, including Canada thistle, can rapidly invade disturbed habitats, particularly in areas where little to no competing vegetation is present. For example, it is estimated that patches of Canada thistle can spread at a rate of 8 to 12 feet per year in areas with low competition from native plant species (Donald 1990).

In contrast to the other action alternatives, alternative D proposes additional mitigation measures that include channel and slope treatments within riparian areas. Although limited in scope and scale, these treatments would have the potential to increase the risk of Canada thistle invasion at a site-specific level due to the proximity of Canada thistle to the proposed locations and this species' ability to colonize riparian habitats. At present, no weed infestations are known within the areas identified for mitigation, and all weed sites documented within close proximity to the channel and slope treatments are proposed for control with either herbicide or mechanical treatments.

To gain a better understanding of the impact that the proposed activities would have on noxious weed spread, the Vegetation Dynamics Development Tool model was run under the assumption that the vegetation, fuels, and road treatments would occur but that no noxious weed treatments would occur (a worst-case scenario). The results of the modeling show that the projected increase in the number of acres of noxious weed infestations in the Botany Analysis Area would increase from less than 0.2 percent to approximately 1.6 percent. This represents an 8-fold increase (refer to figure 4-10 above), which is far greater than the increase projected for any of the proposed alternatives.

This risk of noxious weed introduction and spread would be greatly reduced under the proposed alternatives as a result of implementation of the Standard Management Requirements and noxious weed control measures. The design measures would never remove the risk of noxious weed invasion and spread entirely; however, these measures, particularly the proposed noxious weed treatments, would greatly reduce the indirect effect of noxious weed spread on native plant communities. Post-implementation monitoring of past projects with similar vegetation and fuels treatments has shown that aggressive treatment of noxious weeds prior to and through project implementation and incorporation of the Standard Management Requirements have been successful in eradicating small populations of noxious weeds as well as preventing new occurrences (Dillingham 2005).

Under alternatives B, D, and F, the projected increase in Canada thistle over 50 years would be (1) less than the estimated amount of spread under the no-action alternative, and (2) far less than the amount of spread predicted if vegetation, fuels, and road treatments were implemented with no weed control measures in place. Over a 50-year timeframe, projections from the model estimate a 4-fold increase in infested acres over the entire Botany Analysis Area.

This projected increase would result from a combination of factors. First, control activities were limited to two to five years; therefore, the model assumes that no control of any kind would occur after this time period. Second, the projection is for the entire Botany Analysis Area, a large proportion of which is under private ownership. Out of all known Canada thistle sites in the Botany Analysis Area (502 locations, 193 acres), approximately 95 percent of the acres are proposed for herbicide treatment (476 locations, 129 acres). The 5 percent of infestations that are not being treated are located on private lands, Lassen National Forest lands, or are located outside of the Diamond Project Area. Thus, much of the projected growth in Canada thistle would likely be concentrated in those areas not treated (that is, those locations outside the Diamond Project Area).

Cumulative Effects. As discussed above, the proposed vegetation, fuels, riparian, and road treatment activities would greatly increase the risk of noxious weed establishment and spread in the Botany Analysis Area by increasing the amount of suitable habitat for weeds. Implementation of the proposed noxious weed control measures and the Standard Management Requirements, as well as monitoring after project implementation, would greatly reduce this risk. By directly reducing the level and infestation of Canada thistle in the Diamond Project Area and reducing the growth of Canada thistle in the Botany Analysis Area over time, the cumulative effect of noxious weed spread would be greatly reduced.

4.5.7.5 Alternative C (No Herbicide Use)

Direct Effects. The direct effect of treating Canada thistle with mechanical methods, over a period of two to five years, would moderately reduce the existing number and acres of Canada thistle infestations in the Botany Analysis Area.

The control of noxious weed introduction and spread under alternative C would be addressed through the implementation of standard management practices and a combination of nonherbicide treatment methods. In total, 228 noxious weed infestations, covering approximately 20 acres, are proposed for treatment. The specific control methods are provided in chapter 2.

All of the noxious weed infestations in the Botany Analysis Area, with the exception of Canada thistle, are small in size, and most have been shown to be effectively controlled using mechanical methods. In contrast, Canada thistle is considered particularly difficult to eradicate with mechanical methods due to its ability to spread vegetatively and produce an extensive root system. Alternative C incorporates a combination of mechanical treatment methods for Canada thistle that includes hand pulling, cutting, mowing, and covering. These methods have been shown to provide some level of Canada thistle control. However, as several authors (Thunhorst and Swearingen 2001; Bond and Turner 2004) have emphasized, the success of these methods is highly dependent upon the level of infestation and the type of area being managed.

Repeated hand pulling, which is believed to drain the plant's reserves because it forces underground roots to produce new shoots (Bond and Turner 2004), has shown variable levels of success for long-term Canada thistle control. Cutting or pulling is recommended at least three times each season (Zouhar 2001). On the Plumas National Forest, one Canada thistle site, selected because of its location within a botanically significant area, has been repeatedly hand pulled since 2003. Over a three-year time period, this site was treated an average of six times during the field season at an average interval of 21 days. To date, treatment of this 2,000-square-foot area has produced little discernable impact on the Canada thistle population. A number of Canada thistle occurrences on the Lassen National Forest have also been treated by hand pulling or digging annually for five years. The number of plants in these populations has not shown any visible increase or decline over time (C. Odegard, USFS, personal communication, 2006).

Mowing or trimming at regular intervals has been shown to weaken Canada thistle, prevent flowering, and reduce or eliminate seed production (Weber 2003 *in* Bayer 2000); however, the level of control appears to be largely dependent upon the frequency of treatment. For example, in one study, mowing monthly over a period of four years practically eliminated Canada thistle (Welton et al. 1929 *in* Nuzzo 1997), while in another study, mowing fields twice annually only reduced Canada thistle to 1 percent of its initial value over four years (Hodgson 1968 *in* Nuzzo 1997). If the occurrence is small enough, covering with boards, sheet metal, or tar paper has also been shown to be an effective way to kill Canada thistle individuals (Spence and Hulbert 1935 *in* Nuzzo 1997).

Alternative C proposes to treat fewer Canada thistle occurrences than what is proposed under alternatives B, D, and F. The reduction in treatment locations and acreage under alternative C was the result of both time and feasibility constraints. First, the number of repeat applications required for the proposed methods to be effective ranged from two to four treatments per site per season (Bond and Turner 2004; Nuzzo 1997; Zouhar 2001). This increased the cost of mechanical treatment to over $700 per acre. Second, the proposed treatments are usually only recommended for small, newly established occurrences (Zouhar 2001). Therefore, only those occurrences that were smaller than 0.5 acre were considered for treatment. These constraints required treatments to be applied to high-priority sites, mainly those that were found along roads, skid trails, and landings and in riparian areas, aspen stands, and other areas with a high potential to be impacted by project activities.

Indirect Effects. The risk of noxious weed introduction and spread as a result of the proposed project activities would be only moderately reduced under alternatives C due to the implementation of the Standard Management Requirements and noxious weed control measures.

As discussed above under the indirect effects of alternatives B, D, and F, implementation of the proposed vegetation, fuels, riparian, and road treatment activities would greatly increase the amount of disturbance in the Diamond Project Area, and this would greatly increase the risk of noxious weed establishment and spread in the Project Area. Under alternative C, this risk may be moderately reduced with the implementation of Standard Management Requirements and mechanical treatment measures.

Under alternative C, the projected increase in Canada thistle over 50 years would be greater than both the estimated amount of spread under alternative A (no action) and estimated amount of spread under alternatives B, D, and F, which propose herbicide treatments. Over a 50-year time period, the Vegetation Dynamics Development Tool model projects a 6-fold increase in the number of infested acres in the Botany Analysis Area (refer to figure 4-10 above). In addition to the assumptions discussed above in the indirect effects of alternatives B, D, and F section, this relative increase would result from a combination of the (1) variable effectiveness of the proposed control methods and (2) reduced number of infestations treated. Of all known Canada thistle sites in the Botany Analysis

Area (502 locations, 193 acres), alternative C proposes to treat approximately 42 percent (213 locations, 18.5 acres) with mechanical treatment. Therefore, as was the case under alternatives B, D, and F, much of the projected growth in Canada thistle would likely be concentrated in those areas not treated.

Cumulative Effects. In relation to alternatives B, D, and F, the cumulative effects of noxious weed spread under alternative C would only be moderately reduced. As discussed above, the proposed vegetation, fuel, riparian, and road treatment activities would greatly increase the risk of noxious weed establishment and spread in the Botany Analysis Area by increasing the amount of suitable habitat for weeds. This risk would be reduced through the implementation of the noxious weed control measures proposed under alternative C and Standard Management Requirements, as well as monitoring after project implementation. However, the effectiveness of the proposed treatments would not significantly reduce the level and infestation of Canada thistle in the Diamond Project Area or the growth of Canada thistle area over time.

4.6 Transportation System

4.6.1 Regulatory Framework

The roads in the Diamond Project Area that are proposed for decommissioning or closure are causing significant resource impacts. These roads are not needed because other roads are available to provide the necessary access to implement group selection harvests and construct Defensible Fuel Profile Zones (DFPZ) as directed in the *Herger-Feinstein Quincy Library Group Forest Recovery Act* (HFQLG Act) (sections 401(b)(1), (d)(1), and (d)(2)) and the Sierra Nevada Forest Plan Amendment. The Forest Service is directed to reduce impacts on resources caused by the transportation system by implementing road relocation or improvements as part of the Riparian Management Plan (see appendix R of the HFQLG final environmental impact statement) as required by the HFQLG Act (sections 401(b)(1), (c)(2) (B), and (d)(4)).

4.6.2 Methodology for Assessing Impacts

4.6.2.1 Geographic Area Evaluated for Impacts on the Transportation System

The Diamond Project Area is located east of Indian Valley and southwest of Susanville in Plumas County, California, within the Mt. Hough Ranger District of the Plumas National Forest. It lies within all or parts of T28N, R10E; T28N, R11E; T28N, R12E; T28N, R13E; T27N, R10E; T27N, R11E; T27N, R12E; T27N, R13E; T26N, R11E and T26N, R12E. The Project Area is within portions of Plumas National Forest's Lights Creek Management Area #28 and Antelope Management Area #29.

4.6.2.2 Analysis Methods

The transportation system for the Diamond Project Area was evaluated through a roads analysis. The following needs were identified based on that analysis and known access needs for proposed DFPZ and group selection treatments:

- Road reconstruction and maintenance are needed to bring existing classified roads into compliance with current maintenance standards and to provide access to the DFPZ and group selection treatment areas. Reconstruction and road maintenance are also necessary to reduce erosion and sedimentation and to provide for public safety.
- Road decommissioning is needed to reduce erosion, sedimentation, and soil compaction and to reduce road density and wildlife impacts.
- Closure of spur roads is needed to reduce erosion, sedimentation, soil compaction, and impacts to wildlife.
- Culvert replacement, removal, or upgrade is needed to improve watershed connectivity.
- Temporary road construction is needed to access group selection and DFPZ Units where existing road access is absent.
- New road construction is needed to provide access to treatment areas where existing road access is impacting watershed resources.

- Harvest landing construction and reconstruction are needed to facilitate removal of wood products.

4.6.2.3 Design Criteria

The purpose of the National Forest road system is to provide suitable conditions for passage of all Forest Service and cooperator emergency vehicles and to meet resource management and public access needs. The road system and improvements should minimize adverse effects on watershed and wildlife values. Roads near streams or in riparian zones have the greatest probability of intercepting, concentrating, and diverting flows from natural flow paths and should be minimized where feasible. Road-stream crossings have the potential for failing and diverting water and should be minimized where feasible. Roads can reduce and fragment wildlife habitat, but they can also provide access for habitat protection from wildfire and treatments designed to improve habitat quality. Roads should be minimized where adverse effects outweigh benefits to wildlife.

To protect watershed resources, the desired conditions for roads that would be retained and improved (through road construction, reconstruction, or relocation) include the following:

- Accommodation of the 100-year flood at stream crossings, including streamflow, bedload, and debris;
- No diversion of streamflow along roads in the event of crossing failure;
- No diversion of natural hydrologic flow paths at stream crossings, including paths of streamflow, surface runoff, and groundwater; and
- No roads located in wetlands and meadows and minimization of road effects on natural flow patterns in wetlands and meadows.

4.6.3 Environmental Consequences

4.6.3.1 Alternative A (No Action)

Direct Effects. Reconstruction of classified roads would not occur, and impacts on watershed and user safety would continue on roads needing reconstruction. There would be no new direct impact on road surfaces from log haul activity, and there would be no increase in hazards to driver safety from logging traffic. Classified roads, unclassified roads, and abandoned skid trails would not be decommissioned and would continue to cause resource damage. Normal routine maintenance would occur based on current maintenance levels.

Roads would continue to negatively impact watersheds and public safety because no roads would be reconstructed, decommissioned, or closed. Fire access would be restricted because some roads would remain, or become, impassable.

Indirect Effects. No rights-of-way would be needed for the normal road maintenance completed in this area.

Cumulative Effects. No reduction in classified or unclassified roads would occur during normal road maintenance completed in this area.

4.6.3.2 Action Alternatives B, D, C, and F

Direct Effects. The Diamond Project proposes road decommissioning of approximately 9.6 miles of existing system roads (see table 4-38). None of the roads proposed for decommissioning are needed for the long-term transportation system. Decommissioning could include recontouring, removing drainage structures, subsoiling, restoring vegetative cover, and/or blocking access. Decommissioning of roads would reduce Equivalent Roaded Acre (ERA) values, thereby lowering cumulative watershed effects and soil compaction. Portions of roads in Riparian Habitat Conservation Areas (RHCAs) are in poor locations and causing direct stream impacts. The roads slated for decommissioning are not needed for fire access or resource management and are causing watershed and wildlife impacts. The proposed road decommissioning, closure, or reconstruction would contribute to watershed restoration, including meadow enhancement, fish passage, and stream stabilization. There are many unsurfaced roads in the Diamond Project Area that are contributing to degradation of water quality and aquatic habitat.

Table 4-38. Diamond Project classified and unclassified road decommissioning opportunities.

Road Number	Location Township/Range Section	Classified Miles	Roads with No Outlet	Roads with an Outlet
26N45A	26/12 S15	0.72	Dead-end Spur	
26N45A1	26/12 S15	0.22	Dead-end Spur	
27N07C	24/13 S33 27/12 S21	0.66	Dead-end Spur	
27N09A	27/11 S2,3	0.32	Relocate	
27N09E	27/11 S3	0.41	Relocate	
27N77	27/10 S1	0.31	Relocate	
28N15B	28/11 S12	0.45	Dead-end Spur	
28N26X2	28/12 S21	0.36	Dead-end Spur	
28N30D	27/10 S1	0.35	Dead-end Spur	
28N36	27/11 S8,18	1.03		Loop Road
28N39	28/11 S31	1.84	Dead-end Spur	
28N39B	28/11 S32	0.34	Dead-end Spur	
28N40	28/11 S32	0.90		Loop Road
28N52A	28/12 S17	0.49	Dead-end Spur	
28N99	27/12 S2	0.77		Loop Road
29N99A	28/12 S2328/11 S32	0.36	Dead-end Spur	
Total Classified		**9.53**		

Through project planning, the public was given the opportunity to participate and comment on proposed road closures and decommissioning. The Plumas National Forest is currently undergoing an off-highway vehicle (OHV) route inventory and designation process. Roads proposed for decommissioning or closure under the Diamond Project are creating unacceptable resource damage, to the extent that a delay in their closure would result in unacceptable and irretrievable impacts on the resource.

New construction of 2 miles of roads under alternatives B and C and 0.7 mile under alternatives D and F would be needed prior to project implementation (see tables 4-39 and 4-40). Log earth barriers would be used to close these roads after use.

Prior to project use, there would need to be 33.2 miles of road reconstruction for alternatives B and C, 26.7 miles for alternative D, and 24.2 miles for alternative F (see tables 4-41, 4-42, and 4-43). Reconstruction could consist of brushing, blading the road surface, improving drainage and replacing/upgrading culverts where needed. Hazard trees would be removed. Identification of hazard trees would follow guidelines in the Plumas National Forest Roadside / Facility Hazard Tree Abatement Action Plan (2003).

Table 4-39. Diamond Project proposed new road construction under alternatives B and C.

Road Number	Miles	Maintenance Level	Road Number	Miles	Maintenance Level
27N09A	0.55	1	28N02C	1.18	1
27N77	0.18	1	28N03	0.11	2
Total miles: 2.0					

Table 4-40. Diamond Project proposed new road construction under alternatives D and F.

Road Number	Miles	Maintenance Level	Road Number	Miles	Maintenance Level
27N09A	0.55	1	27N77	0.18	1
Total miles: 0.7					

Table 4-41. Diamond Project proposed road reconstruction under alternatives B and C.

Road Number	Miles	Maintenance Level	Road Number	Miles	Maintenance Level
26N10	1.13	2	26N45	4.91	2
26N46	2.18	2	26N99	2.02	2
27N09A	0.43	1	27N09D	3.67	2
27N09E	0.49	2	27N34	0.58	2
27N42	2.46	2	27N56	1.25	2
27N57	2.84	2	27N72	1.40	2
27N77	0.97	2	28N17	2.31	2
28N26X	0.97	2	28N30	1.41	2
28N30B	1.81	1	28N30B1	0.76	1
28N37	0.66	2	28N52	0.91	2
Total miles: 33.2					

Table 4-42. Diamond Project proposed road reconstruction under alternative D.

Road Number	Miles	Maintenance Level	Road Number	Miles	Maintenance Level
26N46	1.04	2	26N45	4.91	2
27N09A	0.42	1	26N99	2.02	2
27N09E	0.49	2	27N09D	3.67	2
27N57	2.01	2	27N34	0.58	2
27N77	0.97	2	27N56	1.25	2
28N26X	0.97	2	27N72	1.40	2
28N30B	1.81	1	28N17	2.31	2
28N37	0.66	2	28N30	1.41	2
			28N30B1	0.76	1
Total miles: 26.7					

Table 4-43. Diamond Project proposed road reconstruction under alternative F.

Road Number	Miles	Maintenance Level	Road Number	Miles	Maintenance Level
26N46	1.04	2	26N45	4.91	2
27N09A	0.42	1	26N99	2.02	2
27N09E	0.49	2	27N34	0.58	2
27N57	2.01	2	27N56	1.25	2
27N77	0.97	2	27N72	1.40	2
28N26X	0.97	2	28N17	2.31	2
28N30B	1.81	1	28N30	1.41	2
28N37	0.66	2	28N30B1	0.76	1
Total miles: 23					

Approximately 22 miles of temporary roads in alternative B and C, 19.3 miles in alternative D, and 16.9 miles in alternative F would be needed to implement the proposed treatment activities. These roads would be decommissioned upon completion of the project. Existing harvest landings in Group Selection Units and DFPZs would be reconstructed, or new landings would be constructed.

The road improvements proposed in the action alternatives would provide access needed for the DFPZ and Group Selection Units. The proposed improvements would also provide access needed for fire suppression and fuels management to reduce the chance of catastrophic fire through intensive vegetation manipulation at a lower cost because of the improved access. The action alternatives would generate traffic from log trucks, chip vans, and support vehicles. Traffic-related safety problems would be mitigated with standard contract requirements.

Indirect Effects. No rights-of-way are needed for this project.

Cumulative Effects. A net reduction of approximately 7.53-8.83 miles of classified and unclassified roads in the action alternatives would occur after proposed road decommissioning and road construction is completed. Once decommissioned, roads would be available for reforestation and conversion back to a natural landscape.

4.6.4 Past, Present, and Reasonably Foreseeable Future Actions

Other than ongoing routine road maintenance, the past, present, and future projects in the vicinity of the Diamond Project have not impacted nor are they expected to impact the transportation system in the Project Area.

4.7 Heritage Resources

Heritage resources have been considered in all aspects of the Diamond Project, including all alternatives analyzed in this document.

4.7.1 Introduction

Archaeological sites, historic buildings and structures, landscapes, and objects are the fabric of our national heritage. Collectively known as heritage or cultural resources, they are our tangible links with the past. The Plumas National Forest is responsible for, and committed to, protecting and managing these important resources in a spirit of stewardship for future generations to understand and enjoy.

Consultation with the tribes and local Native American communities and/or interested parties was initiated in accordance with the Forest Service Region 5 Programmatic Agreement, *National Historic Preservation Act*, and other laws and regulations.

The Forest Service acknowledges that contemporary Native American interests include traditional cultural properties (sites associated with cultural practices or beliefs that are rooted in history and important in maintaining cultural identity) and plant gathering sites for basket materials, medicines, and food resources. To date, the tribes have not identified any traditional cultural properties within the Diamond Project boundaries.

Cultural properties identified during literature reviews, inventories, or surveys were assessed to determine potential effects associated with implementation of the project. Results of the analysis are discussed below.

Heritage resource surveys resulted in the identification of 94 previously recorded sites. The majority (85 percent) of the 94-recorded sites are historic, with 14 percent prehistoric, and 1 percent multi-component (containing both prehistoric and historic features and artifacts). The historic sites, dating between the 1850s and the early 1950s, consist of mining complexes, Basque arborglyph (aspen carving) sites, artifact scatters, and trails. The prehistoric sites consist of campsites, food processing stations, tool production stations, and artifact scatters.

A total of 23 newly recorded sites were recorded in 2005 during the pedestrian survey conducted by SWCA under contract for this project. The majority of new sites recorded are historic (65 percent). Prehistoric sites comprise 31 percent of the new sites recorded, and multi-component sites comprise 4 percent. Also in 2005, an additional 590 acres were surveyed by Forest Service archaeologists at the Mt. Hough Ranger District. One new historic mining site and three isolated finds were recorded as a result of this survey (report number 02-40-2005).

4.7.2 Guiding Regulations

Section 110 of the *National Environmental Policy Act* (NEPA) requires the federal government to preserve important historic, cultural, and natural aspects of our national heritage. To accomplish this, federal agencies use the Section 106 process associated with the *National Historic Preservation Act* (NHPA). Passed by Congress three years before NEPA, the NHPA sets forth a framework for identifying and evaluating historic properties and assessing effects on these properties. This process has been codified in 36 *Code of Federal Regulations* (CFR) 800 Subpart B. The coordination or linkage between the Section 106 process of the NHPA and the mandate to preserve our national heritage under NEPA is well understood and is formally established in 36 CFR 800.3b and 800.8.

NEPA includes reference to ". . . important historic, cultural, and natural aspects of our national heritage." This terminology includes those resources defined as "historic properties" under the NHPA (36 CFR 800.16(l)(1)). Therefore, agencies use the NHPA Section 106 process to consider, manage, and protect historic properties during the planning and implementation stages of federal projects. The Plumas National Forest uses the Programmatic Agreement between Forest Service Region 5, the California State Historic Preservation Office, and the Advisory Council on Historic Preservation to implement the Section 106 process.

4.7.3 Methodology for Assessing Impacts on Heritage Resources

4.7.3.1 Geographic Area Evaluated for Impacts

The Analysis Area used for heritage resources is the same as the Diamond Project Area (refer to figure 1-1 in chapter 1).

4.7.3.2 Scope of the Analysis

Three levels of analyses were completed to understand the significant themes and extent of heritage resources associated with the Diamond Project. First, research into the greater history of the Project Area was conducted to understand historic themes or events that have transpired in time and space (refer to the "Heritage Resources" section in chapter 3). Second, a heritage resource survey was conducted for the Project Area to identify cultural properties associated with these themes. Please note that approximately 64 percent of the survey was accomplished in 2005, with the remaining 36 percent of the survey to be completed in 2006. The survey will be completed by the signing of the Record of Decision, as stipulated in the Forest Service Region 5 Programmatic Agreement. Lastly, cultural properties were assessed to determine potential effects associated with implementation of the project. The results and relevant rationale for each of these analyses are presented below.

4.7.3.3 Analysis Methods

Heritage resource data for the Diamond Project is based on information available in the heritage resource files at the Mt. Hough Ranger District. The heritage resource files include literature pertaining to prehistory and history, site records, and atlases that show recorded site locations, previously surveyed areas, and other heritage resource data. As indicated above in the "Introduction" section, approximately 64 percent of the proposed Treatment Areas in the Diamond Project Area were surveyed for archaeological sites in 2005. The remaining 36 percent of the Project Area will be surveyed in 2006. All heritage resource sites located during surveys will be protected from project activities.

4.7.4 Environmental Consequences

4.7.4.1 Alternative A (No Action)

No project treatment activities would occur under the no-action alternative; hence, there would be no effects on heritage resources.

4.7.4.2 All Action Alternatives (B, C, D, and F)

The treatments proposed under the action alternatives would have no direct or indirect effects on heritage resources, since all archaeological sites would be protected using Standard Resource Protection Measures.

4.7.5 NHPA Section 106 Assessment

The effects of the project on heritage resource sites were assessed in compliance with Section 106 of the *National Historic Preservation Act.*

No effects are anticipated because the following Standard Resource Protection Measures (the Region 5 Programmatic Agreement) would be implemented, as appropriate, for all heritage resources within the Project Area that could potentially be affected by project implementation. The application of the following Standard Resource Protection Measures would result in the project having “no effect” on heritage resources:

- All proposed activities, facilities, improvements, and disturbances shall avoid heritage resource sites. Avoidance means that no activities associated with the project that may affect heritage resource sites shall occur within a site’s boundaries, including any defined buffer zones. Portions of the project may require modification, redesign, or elimination to properly avoid heritage resource sites.

- All heritage resource sites within the area of potential effect shall be clearly delineated prior to implementing any associated activities that have the potential to affect heritage resource sites.

- Buffer zones may be established to ensure added protection where the Forest or District Archaeologist determines that they are necessary. The use of buffer zones in conjunction with other avoidance measures are particularly applicable where setting contributes to the property's eligibility under 36 CFR 60.4, or where it may be an important attribute of some types of heritage resource sites (e.g., historic buildings or structures; historic or cultural properties important to Native Americans). The size of buffer zones needs to be determined by the Forest or District Archaeologist on a case-by-case basis.

- When any changes in proposed activities are necessary to avoid heritage resource sites (e.g., project modifications), these changes shall be completed prior to initiating any activities.

- Monitoring during project implementation, in conjunction with other measures, may be used to enhance the effectiveness of protection measures.

4.7.6 Past, Present, and Reasonably Foreseeable Future Actions

4.7.6.1 Past Conditions

There are numerous archaeological sites and features in the Diamond Project Area, as indicated in the general history discussion in the “Heritage Resources” section of chapter 3). Prehistoric sites generally date from 150 to 7,500+ years before present. There are remains of prehistoric habitation sites, camps, and artifact scatters.

Since the landscape is never static, it is difficult to predict the impact Native Americans had on the land. Current studies on fire ecology suggest that Native Americans used fire as a tool to control vegetation. Based on ethnographic data, these studies are suggesting that vegetation control occurred primarily within close proximity to larger villages and was used to reduce brush, control insects, and enhance certain desirable species of plants. A local example of this is the burning of beargrass to enhance the plant’s qualities for basket weaving. Based only on ethnographic data, it is impossible to know the true extent of the vegetative control measures used.

Historic land uses did have major impacts on the landscape during the gold rush, the settlement and industry of post gold rush, and the impact of logging and ranching. Evidence of the magnitude of European settlement is found in numerous mining features such as ditches, reservoirs, and hydraulic pits. Early photographs of historic town sites provide a glimpse of landscapes almost completely barren of trees. All trees were removed for building houses, town sites, heat sources, and the shoring of mining adits (tunnels).

Logging mills were built in the Project Area during the 1850s, and by the 1890s, the denuding of timbered land on the East Coast brought lumber companies west. These companies bought up millions of acres of timbered lands. As the easily accessed trees were cut, logging railroads were built to acquire more timber. Archaeological sites and features associated with lumbering include logging camps, lumber mills, railroad grades, and artifacts.

The first archaeological reconnaissance reports date to the mid-1970s. At that time, there were few protection measures for archaeological resources. In fact, digging and collecting in archaeological sites was a common practice. By the early 1980s, cultural resource surveys and site protection measures were in place. Today, all archaeological sites are protected from project activities.

4.7.6.2 Present Conditions

As indicated previously, in 2005, approximately 64 percent of treatment areas in the Diamond Project Area have been surveyed for archaeological sites. The remaining 36 percent of the Project Area will be surveyed in 2006. All heritage resource sites located during surveys will be protected from project activities.

Some of the heritage resource sites that were monitored during project surveys show damage as a result of natural deterioration over time, vandalism, and from inadvertent effects from previous projects and activities.

4.7.6.3 Future Conditions

The Forest Service will continue to protect heritage resource sites from project activities in the future. Nevertheless, as more and more people are drawn to National Forests to recreate, and with the ever-increasing use of motorized vehicles, it becomes a difficult challenge to protect archaeological resources. The Forest Service is in the process of designating off-highway vehicle (OHV) routes in order to control use and avoid impacts on all resources. OHV routes would not be designated through known archaeological sites. The likelihood and extent of illegal off-road use and the looting of archaeological sites is unpredictable.

Future impacts on heritage resource sites may increase due to increased access to the Forest, although the likelihood and intensity of the impacts are unknown. The Diamond Project itself would not impact archaeologist sites because the sites would be protected from project activities.

The protection of heritage resource sites involves more than merely flagging and avoidance, as is the standard prior to project activities. Educating the public about the fragile, finite nature of heritage resource sites is paramount to site protection. Public education can be accomplished by the development of interpretative signs, lectures, and brochures that provide information on the history of the sites, as well as heritage resource site protection measures.

4.7.7 Summary of Cumulative Effects

Heritage resource sites will be protected using Standard Resource Protection Measures as outlined in the Forest Service Region 5 Programmatic Agreement; therefore, no cumulative effects on heritage resources are expected.

However, by protecting heritage resource sites from fuel treatments under all action alternatives, there may be a cumulative effect of creating islands of unthinned and unburned fuels. These islands may burn hotter and longer that treated areas in the event of a fire.

Under the no-action alternative, the exclusion of fire and other treatments across the landscape would lead to continued natural accumulation of organic litter (duff, branches, and large branches) due to future tree mortality from insects, fire, or drought. This may result in the production of more intense burning through heritage resource sites in the event of a wildfire.

In general, past, present and foreseeable future events have had cumulative effects of varying degrees on heritage resources. There is no substantive difference in cumulative effects predicted for heritage resources between the alternatives.

4.7.7.1 Native American Consultation

Consultation was initiated with the following tribes: Honorable Lorie Jaimes (Chairperson, Greenville Indian Rancheria), Honorable Stacy Dixon (Chairman, Susanville Indian Rancheria), Honorable Glenda Nelson (Chairwoman, Estom Yumeka Tribe of Enterprise Rancheria), Honorable Jim Edwards (Chairman, Tyme Maidu Tribe of Berry Creek Rancheria), Honorable Gary Archuleta (Chairman, Concow Maidu Tribe of Mooretown Rancheria), and Honorable Steve C. Santos (Chairman, Mechoopda Indian Tribe of Chico Rancheria).

4.8 Recreation and Mining

4.8.1 Regulatory Framework

The 1988 *Plumas National Forest Land and Resource Management Plan* (the "Forest Plan") provides goals, objectives, and management direction for recreation activities on the Forest. The 1988 Forest Plan was amended by the 1999 Record of Decision on the *Herger-Feinstein Quincy Library Group Forest Recovery Act Final Environmental Impact Statement* (EIS) and the 2004 Record of Decision on the Sierra Nevada Forest Plan Amendment final supplemental EIS. The Forest Plan identifies standards and guidelines for the Antelope Recreation Area, Thompson Peak Roadless Area, and Diamond Mountain Restricted Vehicle Access Area. The actions proposed for the Diamond Project would need to meet Forest Plan standards and guidelines in order to maintain recreational opportunities.

Management direction for mining activities is also found in 1988 Forest Plan, as amended; the 1872 Mining Law; the Multiple-Use Mining Act of 1955; and Locatable Minerals Surface Management Regulations (36 CFR 228, subpart A).

4.8.2 Methodology for Assessing Impacts on Recreation and Mining

4.8.2.1 Geographic Area Evaluated for Impacts

The geographic area analyzed for effects on recreation and mining is the Diamond Project boundary, plus the portion of Antelope Lake Recreation Area that lies outside of this boundary. The analysis boundary incorporates campgrounds, dispersed recreation areas, roads, trails, lakes, creeks, and vegetative landscape that could be affected by the alternatives. The Recreation Opportunity Spectrum (ROS) is used as an indicator to measure beneficial or adverse effects on recreation. The ROS class for areas within the Project Area boundary is identified in the "Recreation and Mining" section in chapter 3. There would be no effects on recreation resources if recreation opportunities under an ROS class were maintained or improved.

4.8.2.2 Analysis Methods

The duration of potential cumulative effects is based on past vegetation management activities dating back to 1971 and past wildfires dating back to 1977 (see appendix B). The "Forest Vegetation and Fire, Fuels, and Air Quality" section of chapter 3 describes the past management activities that have contributed to the current landscape where existing recreation and mining activities occur. Future activities are also considered (see appendix B), but there is potential for unanticipated future wildfires and other treatments that could occur in the Project Area prior to project completion.

4.8.2.3 Design Criteria

The Design Criteria for contract specifications would include placing signs on forest roads and in recreation areas to alert the public of project activities. Prescribed burning days would be coordinated in concert with Recreation Special Use Events. Contracts would also include specifications to protect mining claim monuments and improvements found during project implementation.

4.8.3 Environmental Consequences

4.8.3.1 Alternative A (No Action)

Direct Effects. There would be no direct effects on recreation or mining under this alternative because there would be no change in current opportunities.

Indirect Effects. Alternative A would not cause any short-term indirect effects on recreation opportunities. However, taking no action could result in long-term effects on recreation opportunities from the increased risk of a large-scale fire, which could degrade scenic landscapes within recreation areas. Without aspen stand enhancement, scenery viewing opportunities in aspen stand areas could be reduced over time.

Cumulative Effects. A large-scale fire could have adverse effects on recreation opportunities for several years. Past hazardous fuel conditions likely contributed to the severity of the 2001 Stream Fire near Antelope Lake. The areas that burned in this fire can still be seen from forest roads and campgrounds at the lake. Vegetation in these areas has been slow to return and has created a barren-looking landscape. Snags from the fire still pose a safety hazard to recreation users and are prevalent at Lone Rock Campground and the Antelope-Taylor trail and trailhead. Corrals at the trailhead were burned by the fire, and fallen snags along the trail prevent equestrians and mountain bikers from using the trails.

4.8.3.2 Alternatives B, C, D, and F

Direct Effects. The four action alternatives are very similar in their effects on recreation and mining resources. The only difference between alternatives is the use of herbicides in alternatives B, D, and F. Forest visitors are not at substantial risk from direct contact with herbicides under normal conditions. The Human Health Risk Assessment (appendix E) demonstrates that application of the herbicides glyphosate and clopyralid, as proposed by the Diamond Project, is expected to present a low risk to human health and safety of forest visitors.

Developed Recreation—All action alternatives would result in minor direct effects on developed recreation areas at Antelope Lake. Treatment activities would require an increased presence of heavy equipment and logging trucks on National Forest roads, but signs would be placed to alert visitors of potential safety hazards. Heavy equipment and logging trucks may cause excessive noise at times, which could have a minor effect on a visitor's opportunity for a peaceful recreation experience.

Dispersed Recreation—Alternatives B, C, D, and F would result in minor direct effects on dispersed recreation activities. There is a DFPZ and an Area Thinning Unit that intersect with the Antelope to Taylor trail. The placing of warning signs as a safety precaution would help avoid any potential impacts on recreation users. DFPZ maintenance and area thinning activities would have beneficial effects on the Antelope to Taylor trail by helping to reduce fuels buildup and debris along the trail.

Treatment Units that occur in or near dispersed camping areas could displace visitors during treatment activities. This is considered a minor effect since visitors could use other areas of the Forest. The mitigation measures proposed under alternative D would likely have more short-term effects on dispersed camping opportunities than the other three action alternatives.

The proposed road treatments in the action alternatives would decommission 9.6 miles of existing forest roads. Most of these roads are spurs and show minimal recreation use, but they may access campsites or areas that a Forest visitor may consider important to their recreation experience. As a proposed treatment, Forest Service Road 2709E would be decommissioned, but then relocated; therefore, the effects of decommissioning the road would be negligible. The reconstruction of existing system roads would have an overall beneficial effect on the Forest road system, which is used by off-highway vehicle (OHV) users and as access to recreation activities within the Project Area boundary.

Mining—The proposed road treatments may have a short-term effect on the forest roads that provide access to mining claims. Miners may have to access their claims using alternative roads during reconstruction activities, or their access could be temporarily prohibited until project work is complete. Mining claimants were notified during the public scoping process for the Diamond Project. Conflicts with mining access would likely be minimal. The placing of signs in treatment areas would help to reduce conflicts.

Indirect Effects. The proposed treatments that would reduce hazardous fuels and create a more diverse and fire-resilient forest would have an overall beneficial effect on recreation opportunities, by helping to maintain and preserve the landscape of existing recreation sites and areas. Reducing hazardous fuels adjacent to Antelope Recreation Area would likely reduce the risk of catastrophic fire that could threaten existing improvements. Reducing the risk of wildfire would help ensure that recreation opportunities for developed and dispersed recreation would be maintained at existing conditions.

Underburning in DFPZ Units could cause short-term negative effects on viewsheds in developed and dispersed recreation areas. Smoke caused by underburning could also affect recreation events such as the Indian Valley Century Ride, but these effects would be avoided by coordinating prescribed burning around these events.

Herbicide applications would not cause any indirect effects on recreation users or miners. Herbicide applications are expected to present a low risk to human health and safety as demonstrated in the Human Health Risk Assessment (appendix E).

Decommissioning existing forest roads could prohibit access to nonsystem roads that OHV users may value. The OHV users can use system roads to access OHV routes that are not part of the existing road system in the Project Area. Approximately 2 miles of nonsystem roads and trails would be closed by decommissioning 9.6 miles of existing roads. The effects would likely be negligible since many of these nonsystem trails are dead-end spurs, and they do not appear to provide any significant recreation opportunities.

The action alternatives would not cause any indirect effects on mining resources.

Cumulative Effects. Alternatives B, C, D, and F would have no long-term cumulative effects on recreation and mining resources in the Diamond Project Area. Although effects of past vegetation management activities (see appendix B) are common in the Diamond Project Area, the proposed area thinning and fuels treatments would have minor long-term beneficial effects on meeting the desired conditions for recreation opportunities. There may be minor short-term effects on viewsheds from campgrounds, trails, or roads, but long-term effects would meet forest standards and guidelines for identified ROS classes. Future vegetation management projects (see appendix B) in the Diamond

Project Area would likely reduce hazardous fuel conditions that could threaten recreation areas, facilities, and viewsheds. Reasonably foreseeable future projects (identified in appendix B) that would close or fence off abandoned mine shafts would help reduce safety risks to Forest visitors.

4.9 Scenic Resources

4.9.1 Regulatory Framework

The 1988 Forest Plan (*Plumas National Forest Land and Resource Management Plan*) established goals, policies, and objectives for the management of the forest (pages 4-3 to 4-11 and 4-13 to 4-20). The following is the specific Forest Plan goal that applies to scenic resources:

- Maintain high visual quality on lands committed to other uses or readily apparent from recreation developments, major travel routes, and other high use areas.

4.9.2 Methodology for Assessing Impacts on Scenic Resources

4.9.2.1 Geographic Area Evaluated for Impacts

The geographic area analyzed for effects on scenic resources (the Analysis Area) is the Diamond Project Area plus the portion of Antelope Lake that lies outside the Project Boundary. The Analysis Area was bounded in this manner in order to incorporate scenic views from campgrounds, lakes, and forest roads. This boundary also incorporates Antelope Lake Recreation Area, Taylorsville-Antelope Road, and Thompson Peak Roadless Area, which are discussed in the "Visual Quality Objectives" section (3.9.2) of chapter 3. The landscape in these areas should be "naturally appearing."

4.9.2.2 Indicator Measures

The indicators analyzed in detail for scenic resources are the Visual Quality Objectives (VQOs). Aesthetic identity (landscape character) and natural appearance (scenic integrity) are two indicators used to measure scenic quality changes and effects.

4.9.2.3 Analysis Methods

The Visual Management System (which includes the VQOs) presents a vocabulary for managing scenery and a systematic approach for determining the relative value and importance of scenery and associated recreation in a National Forest. High-quality scenery, especially scenery with naturally appearing landscapes, enhances people's lives. Ecosystems provide the environmental context for this Visual Management System. The system is used in the context of ecosystem management to inventory and analyze scenery in a National Forest, assist in the establishment of overall resource goals and objectives, monitor the scenic resource, and ensure high-quality scenery for future generations.

4.9.2.4 Duration

The timeframe considered for cumulative effects is based on past and present vegetation management activities dating back to 1971 and past wildfires dating back to 1977 (see appendix B). As discussed in the "Forest Vegetation and Fire, Fuels, and Air Quality" section (3.1) of chapter 3, past management activities have contributed to the existing scenic landscape. Future activities were considered (see appendix B) in this analysis but only until the time that Diamond Project implementation has been completed. Unanticipated future wildfires and other treatments could occur prior to completion of the Diamond Project, which could affect the scenic character.

4.9.3 Environmental Consequences

4.9.3.1 Alternative A (No Action)

Direct Effects. There would be no direct effects on scenic resources in the Analysis Area under this alternative because no actions are proposed that would change the landscape character. Scenic quality, however, could be directly affected without area thinning and group selection treatments because lack of treatments would perpetuate existing dense forest canopy and even-aged stand conditions throughout the Analysis Area.

Indirect Effects. The no-action alternative would likely not cause any short-term indirect effects and possibly no indirect effects for years to come. However, without hazardous fuels reduction treatments in the Analysis Area, the continued risk of a catastrophic fire would increase the potential for long-term adverse effects on the scenic quality of the landscape.

The existing aspen stands could be further reduced in the absence of aspen enhancement treatments. Forest visitors enjoy viewing fall colors, and if aspen stands were reduced over time, the scenic quality near aspen stands would be adversely affected.

Cumulative Effects. Past activities (grazing, mining, and vegetation management) in the Analysis Area have cumulatively helped shape the scenic landscape character of the Analysis Area. The no-action alternative would perpetuate adverse cumulative effects on the scenic quality of the Analysis Area over time because the existing conditions (dense, even-aged stands) would continue, thus increasing the risk of wildfire.

A large-scale fire could have adverse effects on scenic quality for several years. Past hazardous fuel conditions likely contributed to the severity of the 2001 Stream Fire near Antelope Lake. The effects from this fire can still be seen from forest roads and campgrounds at the lake where burned areas are visible.

4.9.3.2 All Action Alternatives (B, C, D, and F)

Direct Effects. Area thinning, group selection, and aspen enhancement would all have a minor beneficial effect on the landscape character. Scenic quality would be improved, and the desired landscape character of a more open and diverse forest would be achieved.

Underburning, group selection, and area thinning activities may have a short-term negligible effect on the scenic integrity of the landscape where burned areas, skid trails, and tree stumps would be visible from forest roads in the Analysis Area. The desired Visual Quality Objectives (VQOs) for areas in the Treatment Units may not be met initially after treatments due to project activities, and burning may cause color contrasts between green and brown needles. These effects would diminish over time as VQOs are achieved, and scenic quality would eventually be improved.

Indirect Effects. Fuels treatments in the Analysis Area would likely have long-term beneficial effects on scenic resources by reducing the risk of a wildfire destroying the existing landscape. Reducing hazardous fuels in the Analysis Area would likely help ensure that existing scenic landscapes are preserved.

Aspen enhancement treatments could have a beneficial effect on the scenic integrity of areas where fall colors are visible from forest roads. This would help maintain scenic quality because fall color viewing opportunities would be improved.

Cumulative Effects. Past activities (grazing, mining, and vegetation management) in the Analysis Area have all had minor cumulative effects on the landscape character. These past activities have played a part in creating the landscape that forest visitors identify with. Implementation of area thinning, group selection, and underburning treatments in any of the action alternatives would not drastically change this landscape but would help improve and maintain the desired landscape character that has been shaped by past activities. Future risks of catastrophic fire would likely be reduced by implementing area thinning and underburning treatments proposed in the action alternatives. Any future vegetation management projects and DFPZ maintenance (see appendix B) would slightly benefit the scenic quality of the landscape over the long term.

4.10 Range Resources

4.10.1 Regulatory Framework

The guidance for range management is provided in the 1988 *Plumas National Forest Land and Resource Management Plan* (the "Forest Plan"), as amended by the 1999 Record of Decision on the final environmental impact statement (EIS) for the *Herger-Feinstein Quincy Library Group Forest Recovery Act*, the 2004 Record of Decision on the final supplemental EIS for the Sierra Nevada Forest Plan Amendment.

4.10.2 Methodology for Assessing Impacts on Range Resources

4.10.2.1 Geographic Area Evaluated for Impacts

The Analysis Area for direct, indirect, and cumulative effects on range resources includes the six active allotments that are in or partially within the Diamond Project Area as shown on figure 3-7 in the "Range Resources" section of chapter 3. Effects were not considered for the two vacant allotments (Taylor Lake and Hungry Creek) within the Project Area boundary. The range effects Analysis Area was bounded in this manner because (1) all range permits are organized by "allotment" and referred to in the Forest Plan by the allotment name; and (2) prescribed burning and area thinning activities could displace livestock to other portions of allotments outside of the Diamond Project Area. Past, present, and reasonably foreseeable future projects (see appendix B) were considered in the analysis of cumulative effects on range resources. The duration of cumulative effects evaluated is based on the period of time required to complete implementation of the Diamond Project and the present and reasonably foreseeable future projects that may occur prior to project completion.

4.10.2.2 Indicator Measures

Suitable range land is used as an indicator measure for the analysis of effects on range resources. Suitable range is land that produces or has inherent capability to produce 50 pounds or more of palatable forage per acre per year, can be grazed at a sustained yield basis, and is accessible or can feasibly be made to be accessible.

4.10.2.3 Design Criteria

The Design Criteria for prescriptions involving timber falling and prescribed burning would require coordination between the Forest Service range specialist and the permittee prior to contract preparation. Contracts would ensure that livestock are kept away from active timber falling operations, haul routes for logging trucks, and underburning treatments. Range improvements would be protected from damage caused by treatments such as underburning or timber falling, and contracts would include clauses that require rebuilding of range improvements if they are damaged during implementation. Maps of range improvements and range improvement building and maintenance standards are contained in the project record.

4.10.3 Environmental Consequences

4.10.3.1 Alternative A (No Action)

Direct Effects. There would no adverse direct effects on range resources under the no-action alternative. The six active allotments in the Diamond Project Area would continue to be managed under current direction and guidelines contained in the Forest Plan.

The short-term beneficial effects of taking no action would be that permittees or their livestock would not be stressed by project activities, and there would be no risk of damaging range improvements in allotments.

Indirect Effects. There could be minor short-term indirect effects on suitable habitat without the underburning treatments, since burning helps encourage growth of available forage (grasses). Without implementing proposed Area Thinning Treatments, there could be long-term minor effects on range resources through decreased suitable habitat.

In the absence of noxious weed treatments (herbicides, flaming, and pulling), it is possible that noxious weed populations could spread and have long-term minor effects on available native foraging species. However, without herbicide use, there would be no risk of exposing cattle to herbicide spills or vegetation that has been treated with herbicides.

Cumulative Effects. Alternative A would not implement DFPZs, area thinning, or underburning, which could increase the potential for short-term minor cumulative effects on range resources. In 2001, the Stream Fire in the Project Area (see appendix B) caused damage to fences in the Antelope Lake Allotment (S. Lusk, Forest Service, personal communication, 2006). The Forest Service has still not rebuilt fences damaged on the Antelope Allotment during the Stream Fire. The risk of future fires causing damage to range improvements could increase without implementation of DFPZs and Area Thinning Units. After catastrophic wildfires, livestock must be temporarily removed for one to three years until new vegetation is established and soils are better stabilized. It is likely this would only be a short-term effect on grazing areas because forage (grasses) would return after a fire.

4.10.3.2 Alternatives B and F

Direct Effects. Alternatives B and F would have minor short-term direct effects on range resources. Active allotments under alternatives B and F would continue to be managed at current levels. Area thinning, group selections, and DFPZ Units that involve timber falling and prescribed burning would require coordination between the Forest Service range specialist and the range permittee to ensure that livestock are kept away from active timber falling operations, truck haul routes, and prescription burns. Direct effects on the permittee and their cattle could be minimized through Annual Operating Instructions, where the permittee schedules livestock to move to grazing areas not affected by treatments.

Since cattle often graze along Forest roads, there could be an increased risk of vehicle collisions with livestock on haul routes and access roads to the Treatment Units. Vehicle collisions could be avoided by ensuring that contracts contain safety specifications for vehicle speeds and by alerting contractors on where cattle may be present.

Herbicide treatments under alternatives B and F would have no adverse direct effects on livestock. Herbicide applications would likely only occur in the fall after livestock have been removed from the allotments. If livestock are still present during applications of clopyralid and glyphosate, the risk of direct spray or drift to livestock would be minimal. In the case of glyphosate applications, the proposed method of application is a wick, which would further minimize the risk of livestock exposure to direct spray or drift.

Indirect Effects. Alternatives B and F would result in minor or beneficial indirect effects on range resources. Minor short-term effects on range resources would be minimized by coordinating with grazing permittees prior to implementation of the Diamond Project. The area thinning and group selection treatments would open up crowded stands of conifers, which would likely have a short-term beneficial effect on range lands by increasing available foraging habitat for livestock. New areas of transitory range could also be created, which would improve livestock distribution and use patterns.

DFPZ treatments that involve prescribed burning in grazing areas may displace cattle to alternate grazing areas, depending on the severity of burn and time of year. GM-1 DFPZ Prescription Burn, from the HFQLG Scientific Analysis Team guidelines (described in chapter 3, section 3.1), would be followed. Rest from grazing would be implemented through Annual Operating Instructions to the permittee. Rest may include total rest, deferring grazing to later in the season, or reducing allowable forage use. This could create a financial hardship for the range permittee, and they may experience increased frustration with the Forest Service if grazing requirements were changed.

The minor indirect effects on livestock from area thinning and DFPZ treatments could be in the form of increased stress caused by altered grazing rotations. Increase stress levels in livestock could result in a reduction in weight gain in calves and a reduced conception rate in cows. Disturbance stress could also make cows more nervous, high strung, and harder to gather in the fall.

Underburning treatments in DFPZ Units could burn up range improvements such as fences and spring developments. Tree removal in Area Thinning and DFPZ Units could create openings for livestock where trees function like allotment fences and, in turn, create new travel routes for cows. New fences may be required as a result of tree removal; consequently, the range permittee may have more fences to maintain, which could potentially cause a reduction in profit margin. As long as Design Criteria for range resources are followed, treatments would cause minimal direct effects on range improvements.

The herbicide treatments proposed in alternatives B and F would have negligible adverse indirect effects on livestock. Although the potential is low (since livestock do not typically graze on noxious weeds, such as Canada thistle), it is possible that livestock could consume vegetation contaminated by glyphosate or clopyralid. In order to quantify the potential effect on livestock, a scenario was analyzed to examine chronic or longer-term exposure to contaminated vegetation with both proposed applications of pesticides for glyphosate and clopyralid (SERA 2003, 2004). The level of risk was determined by using a “Hazard Quotient,” which is calculated based on proposed application rates. A Hazard Quotient of less than one is considered to be a low risk. The results of this analysis are presented in table 4-44. These results indicate that the central and lower Hazard Quotients for applications of glyphosate and clopyralid would be less than one; therefore, the risk to livestock exposed over the long term to glyphosate or clopyralid would be low.

Table 4-44. Scenario involving long-term exposure of a large mammal to 100 percent contaminated vegetation.

Herbicide Scenario (long-term exposure to contaminated vegetation)	Hazard Quotient		
	Central	Lower	Upper
Clopyralid	.21	.01	1.1
Glyphosate	.02	.01	1.0

Sources: SERA 2003, 2004

Annual monitoring of allotments has indicated that livestock grazing on aspen is currently within the 20 percent incidence of use allowed in the Sierra Nevada Forest Plan Amendment. Livestock grazing in aspen enhancement areas would need to be monitored to ensure that livestock grazing on aspen seedlings does not exceed the 20 percent standards.

4.10.3.3 Alternative C

Direct and Indirect Effects. The direct and indirect effects from alternative C would be similar to alternatives B and F, except there would be no effects from herbicide treatments because alternative C does not propose using herbicides to treat noxious weeds. The mechanical treatments to control noxious weed treatments under alternative C would have no adverse direct effects on range resources. However, as discussed in the “Botanical Resources and Noxious Weeds” section (4.5) in this chapter, mechanical treatments are not an effective way of reducing Canada thistle populations; therefore, using mechanical treatments could have a minor indirect effect on suitable habitat by causing a reduction in available native foraging species.

4.10.3.4 Alternative D

Direct and Indirect Effects. The direct and indirect effects from alternative D would be similar to alternatives B and F; however, the mitigation measures proposed under alternative D for riparian restoration could cause additional short-term direct effects on range resources. Slope treatments and channel treatments proposed under this alternative could force permittees to change grazing rotations or use alternate grazing areas. The majority of the proposed channel and slope treatments would occur in the Antelope Allotment. Major short-term effects from the mitigation measures under alternative D could be minimized through coordination with the permittee prior to implementation of treatments.

4.10.3.5 All Action Alternatives (B, C, D, and F)

Cumulative Effects. Alternatives B, C, D, and F would not contribute to adverse cumulative effects on range resources. Range allotments would continue to be managed at current levels. Past, present, and future vegetation management activities (listed in appendix B) have and will continue to help maintain or improve transitory range. The proposed area thinning treatments in the Diamond Project Area, combined with future vegetation management projects, would help maintain transitory grazing opportunities for livestock. Future DFPZ maintenance would continue to allow short-term opportunities for openings and transitory rangelands.

The upcoming Range NEPA decision (the forestwide “Range NEPA Strategy and Implementation Plan” discussed in the “Range Resources” section of chapter 3) could affect future management of range resources before project implementation would be completed.

4.11 Short-term Uses and Long-term Productivity

The *National Environmental Policy Act of 1969* (NEPA) requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by Congress, this includes using "all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans" (NEPA, sec. 101[a]).

The action alternatives are expected to implement ground-disturbing activities through mechanical thinning, mastication, hand thinning, prescribed burning, roadwork, and activities associated with fuel treatments. Such activities would produce short-term effects on soil, water quality, and wildlife habitat, as described in the "Environmental Consequences" section for each resource topic analyzed. The long-term productivity of soil, riparian areas, and wildlife habitat would be improved because the action alternatives would reduce the severity of future wildfires by reducing the number of acres susceptible to fire and reducing flame length to less than 4 feet. Additionally, all action alternatives (particularly alternative D) would enhance long-term productivity in terms of forest health, riparian areas, and wildlife habitat because stand densities in the treated areas would remain in the desired condition for up to 30 years.

4.12 Unavoidable Adverse Effects

The action alternatives propose Design Criteria, mitigation measures (found in chapter 2), Standard Management Requirements, and Best Management Practices (found in appendix C) that would be applied to minimize potential adverse impacts on resources in the project area. However, to move resources toward desired conditions, some unavoidable adverse effects may result. The "Environmental Consequences" sections for each resource describe the risks associated with the potential of noxious weed spread. This effect is mostly associated with alternative C where no herbicide application is proposed. However, there may be some unavoidable adverse effects on native vegetation that could be displaced as weeds spread. The effectiveness of the design criteria and Standard Management Requirements for noxious weed spread would be monitored. The extent of detrimental soil compaction would increase due to mechanical harvest operations. Implementation of Standard Management Requirements would help reduce the amount of detrimental compaction. Treatment activities may lead to increased surface runoff and sedimentation. Implementation of Best Management Practices and Standard Management Requirements would help reduce the amount of detrimental compaction.

Smoke may affect air quality to some degree while prescribed fire activities occur. Prescribed fire activities would be accomplished with an approved smoke management plan.

Some unavoidable adverse effects may result during project activities, including immediate changes in habitat conditions and disturbance/harassment of individuals and possibly direct mortality. It is assumed in this analysis that all action alternatives would be implemented as proposed, in compliance with all rules and regulations governing land management activities, including the use of Limited Operating Periods. Direct disturbance, including mortality to individual Threatened and Endangered species addressed in this document, would be highly unlikely due to survey efforts for selected species, incorporation of Limited Operating Periods, where appropriate, and implementation of Forest Plan standards and guidelines.

In addition to habitat modification and related effects on Management Indicator Species (MIS) and Neotropical migratory birds, direct effects on MIS and nesting birds could occur as a result of tree removal, mastication, and prescribed burning. These activities have the potential to kill young-of-the-year birds in the nest that cannot fly and species confined to den sites, such as gray squirrels. Increased road use resulting from project implementation could result in increased road kills of various animals. It is recognized that the proposed project, when implemented during the breeding season (April-September) could directly impact nesting birds. It is unknown as to what the overall effect on populations of Neotropical migratory bird species might be. The Forest Service and the U.S. Fish and Wildlife Service entered into an interim memorandum of understanding (MOU) to strengthen migratory bird conservation. This interim MOU expired on January 15, 2003, yet the conservation measures that are contained in the MOU are still applicable for use in environmental planning (SNFPA final supplemental EIS 2004, chapter 3, page 172). The MOU recognized that direct and indirect actions taken by the Forest Service in the execution of duties and activities, as authorized by Congress, may result in the take of migratory birds, and that short-term negative impacts are balanced by long-term benefits. The loss of habitat or individuals is not expected to affect viability of wildlife species that occur in the Diamond Project Area.

4.13 Irreversible and Irretrievable Commitments of Resources ___

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time, such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line right-of-way or road.

New infection of stumps by *annosum* root disease in Group Selection Units and Area Thinning Units would be an irreversible effect. Once *annosum* infects stumps, root-to-root spread can continue (for up to 50 years) until the roots reach an area free of host roots. In the natural environment, no area remains free of conifer roots for 50 years; so regeneration of new hosts is inevitable. Some stumps would be treated with Borax (refer to the description of herbicide use in chapter 2).

Surface organic matter would be reduced by prescribed fire and underburning, which is an irretrievable effect. Soil porosity would be reduced, also an irretrievable effect, resulting in detrimental compaction. Detrimental compaction is described in the "Hydrology and Soils" section (4.2) of this chapter.

Alternatives B and C propose 2 miles of new road construction and alternatives D and F propose 0.7 mile of new road construction. There would be an irretrievable commitment of a resource in terms of lost timber productivity where road construction would occur.

Surface fuels, including coarse woody debris, may be removed directly by prescribed underburning and pile burning, an irretrievable effect. Coarse woody debris would be recruited over time via recruitment from existing snags and future tree mortality.

Snags, particularly "soft" or rotten snags, may be removed due to underburning; snags that pose a hazard to firefighters may be felled prior to conducting underburning or pile burning—an irretrievable effect. Snags would be recruited over time from future tree mortality.

Scorch due to underburning or pile burning may result in mortality of residual trees—an irretrievable effect.

4.14 Legal and Regulatory Compliance

The National Environmental Policy Act at 40 CFR 1502.25(a) states, "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with . . . other environmental review laws and executive orders."

4.14.1 Principle Environmental Laws

4.14.1.1 Endangered Species Act

Consultation with the U.S. Fish and Wildlife Service began in November 2005. One federally listed Threatened or Endangered species, the bald eagle, would be affected by the action alternatives. Approximately 400 acres in the Bald Eagle Management Area around Antelope Lake would be thinned. The *Antelope Lake Bald Eagle Management Plan* (Plumas 2006) encourages thinning treatments within these stands in order to accelerate growth that would result in suitable habitat. No impact on the nesting eagles at Antelope Lake is anticipated as a result of the proposed treatments. The Biological Assessment and Evaluation for Terrestrial Wildlife determined that the Diamond Project may affect but is not likely to adversely affect the bald eagle.

4.14.1.2 Clean Water Act

Clean Water Act of 1972, as Amended. Section 208 of the *Clean Water Act* requires states to prepare nonpoint source pollution plans that are to be certified by the state and approved by the U.S. Environmental Protection Agency (EPA). In response to this law, and in coordination with the State of California Water Resources Control Board (SWRCB) and EPA, Forest Service Region 5 began developing Best Management Practices (BMPs) in 1975 for water quality management planning on National Forest System lands in the state of California. This process identified the need to develop a BMP for addressing the cumulative off-site watershed effects of forest management activities on the beneficial uses of water.

Clean Water Act and Best Management Practices—Land management activities have been recognized as potential sources of nonpoint water pollution. By definition, nonpoint pollution is not controllable through conventional treatment plant means. Nonpoint pollution is controlled by containing the pollutant at its source, thereby precluding delivery to surface water. Sections 208 and 319 of the federal *Clean Water Act*, as amended, acknowledge land treatment measures as being an effective means of controlling nonpoint sources of water pollution and emphasize their development.

The most effective means to control nonpoint source pollution is through implementation of BMPs, which are defined as "methods, measures, or practices selected by an agency to meet its nonpoint source control needs. BMPs include, but are not limited to, structural and nonstructural controls, operations, and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters." BMPs are usually applied as a system of practices rather than as a single practice. BMPs are selected on the basis of site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility. BMPs are basically a preventive rather than an enforcement system. BMPs are a whole management and planning system in relation to sound water quality goals, including both broad policy and site-specific prescriptions.

4.14.1.3 Clean Air Act

All burning would be completed under approved burn and smoke management plans. Burning permits would be acquired from the Northern Sierra Air Quality Management District. The Air Quality Management District would determine days when burning is allowed. The California Air Resources Board provides daily information on "burn" or "no burn" conditions. Burn plans would be designed, and all fuels-reduction burning would be implemented in a way to minimize particulate emissions. Prescribed fire implementation would coordinate daily and seasonally with other burning permittees both inside and outside the forest boundary to help meet air quality standards.

4.14.1.4 National Historic Preservation Act

The Forest Service is complying with the provisions of the Programmatic Agreement among the USDA Forest Service, Pacific Southwest Region; California State Historic Preservation Officer; and Advisory Council on Historic Preservation regarding the identification, evaluation, and treatment of historic properties managed by the National Forests of the Sierra Nevada, California.

4.14.1.5 National Forest Management Act

The Forest Service is complying with the provisions of this law.

4.14.1.6 Executive Orders

Executive orders provide additional direction to federal agencies. The executive orders that apply to the Diamond Project proposed action and alternatives are presented below.

Consultation and Coordination with Indian Tribal Governments, Executive Order 13175 of November 6, 2000. Formal consultation was initiated with five federally recognized tribes (see "Chapter 5: Consultation and Coordination").

Indian Sacred Sites, Executive Order 13007 of May 24, 1996. There are no known sacred sites within the Diamond Project Area.

Invasive Species, Executive Order 13112 of February 3, 1999. This EIS covers botanical resources and noxious weeds. Project Design Criteria and standard management practices address the introduction and spread of invasive species.

Recreational Fisheries, Executive Order 12962 of June 6, 1995. In accordance with this Executive Order, the Diamond Project is designed to improve the quantity, function, sustainable productivity, and distribution of aquatic resources for increased recreational fishing by

1. Incorporating Scientific Advisory Team standards through implementation of Riparian Habitat Conservation Areas on all ephemeral, intermittent, perennial, and fish-bearing perennial streams in the Project Area.
2. Conserving and restoring aquatic systems that support recreational fisheries by replacing three culverts that currently prevent fish passage with new culverts that would allow for upstream fish passage.

Migratory Birds, Executive Order 13186 of January 10, 2001. Executive Order 13186 was issued in 2001 to outline responsibilities of federal agencies to protect migratory birds under the *Migratory Bird Treaty Act* (66 FR 3853-3856), including evaluating the effects of federal actions and agency plans on migratory birds through the NEPA process. Migratory birds have been addressed in this EIS and supporting "Management Indicator Species Report" (Rotta, March 10, 2005). This order also directs federal agencies to work with the U.S. Fish and Wild Service to promote conservation of migratory bird populations. The Forest Service and the U.S. Fish and Wild Service entered into an interim memorandum of understanding (MOU) to strengthen migratory bird conservation. The interim MOU expired on January 15, 2003, yet the conservation measures contained in the MOU are still applicable for use in environmental planning (SNFPA final supplemental EIS 2004, chapter 3, page 172). The MOU recognized that direct and indirect actions taken by the Forest Service in the execution of duties and activities, as authorized by Congress, may result in the take of migratory birds, and that short-term negative impacts are balanced by long-term benefits.

Floodplain Management, Executive Order 11988 of May 24, 1977, and Protection of Wetlands, Executive Order 11990 of May 24, 1977. These executive orders provide for protection and management of floodplains and wetlands. Compliance with these orders will be ensured by incorporating the project Riparian Management Objectives; adhering to the Scientific Analysis Team guidelines, as set forth in the HFQLG final EIS and Record of Decision; and implementing BMPs, Standard Management Requirements, mitigation measures (alternative D), and project Design Criteria.

Environmental Justice, Executive Order 12898 of February 11, 1994. In February 1994, President Clinton signed an executive order that requires federal agencies to conduct activities related to human health and the environment in a manner that does not discriminate or have the effect of discriminating against low-income or minority populations. Although low-income and minority populations live in the vicinity, activities proposed for the Diamond Project would not discriminate against these groups. Based on the composition of the affected communities and cultural and economic factors, proposed activities would have no disproportionately adverse effects on human health and safety or environmental effects on minorities, low income, or any other segments of the population. Scoping was conducted to elicit comments on the proposed action from all potentially interested and affected individuals and groups without regard to income or minority status.

Use of Off-Road Vehicles, Executive Order 11644 and 11989, amended May 25, 1977. The following paragraphs describe how the Diamond Project would comply with both executive orders.

1. A roads analysis was conducted by the Diamond Project Interdisciplinary Team during the project planning phase to determine disposition of system roads, resulting in a proposal to keep system roads open, as well as closing and/or decommissioning system roads. The designation of roads to be closed or decommissioned was based on a desire to minimize damage to soil, watershed, and vegetation resources; minimize harassment of wildlife or disruption of wildlife habitat; and minimize potential adverse effects on cultural or historic resources.
2. Throughout project planning, the public was given the opportunity to participate and comment on proposed road closures and decommissioning.

3. The off-highway vehicle (OHV) route designation process (Travel Management) currently ongoing on the Pumas National Forest would not be affected by the alternatives proposed in the Diamond Project, allowing for route designation, timeframes, and guidelines to be followed.

4.14.1.7 Special Area Designations

The selected alternative must comply with laws, regulations, and policies that pertain to the following special areas:

Research Natural Areas—The *Mud Lake Research Natural Area Management Plan* was approved by the Regional Forester, Region 5 and the Pacific Southwest Forest Research Station Director in April 2006. To implement the Diamond Project, the 1988 Forest Plan (*Plumas National Forest Land and Resource Management Plan*) would be amended to be consistent with the management direction identified in the establishment record developed in 1989 and the management plan approved in April 2006. This would be a nonsignificant amendment.

Inventoried Roadless Areas—None would be affected.

Wilderness Areas—There are no designated Wilderness Areas in the Diamond Project Area.

Wild and Scenic Rivers—There are no designated Wild and Scenic Rivers in the Diamond Project Area.

Special Interest Areas—None would be affected.