CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter summarizes the physical, biological, social, and economic environments of the Kings River Project (KRP) area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in Chapter 2. The effects of the proposed alternatives are discussed in terms of direct, indirect, and cumulative impacts.

Direct effects are caused by the proposed activity and are immediate in nature. Indirect effects are caused by the proposed activity but are later in time or farther removed in distance, but are reasonably certain to occur (e.g. roads may increase sedimentation to streams). Interrelated effects are actions that are part of the proposed activity and are dependent upon that proposed activity for their justification (e.g. post-harvest activities such as tree planting). Interdependent effects are actions that have no independent utility apart from the proposed activity (e.g. new road construction). Cumulative effects are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Historically, the Kings River Project area has been disturbed for various reasons such as timber harvest, plantations, wildfire and prescribed fire. The area is open to hiking, camping, and other recreational activities and special uses such as mining and grazing.

Assumptions and Uncertainty

Sensitive Species: Species surveys, review of recent literature, and professional judgment have been incorporated into determinations of possible effects on species. Surveys provide information on species presence and habitat on a local scale, but there is an element of uncertainty for effects on species with distributions beyond the project or Forest boundaries. The Pacific fisher and Yosemite toad are Forest Service "sensitive species" that have also been designated by the U.S. Fish and Wildlife Service (USFWS) as "candidate species" for listing under the ESA. A candidate species is determined by the USFWS through a 12 month finding as warranted for listing, but the listing process is precluded by other priorities. To address uncertainty related to candidate species with distributions beyond Forest boundaries, the Forest requested and received technical advice from the US Fish & Wildlife Service (F&WS) on those two species. It is included as Appendix D.

Weather and Wildfire: Weather variables are environmental factors required to model fire on the landscape with the Forest Vegetation Simulator (FVS) and fire modeling programs. An assumption has been made that a severe wildfire would occur between the 90th and 97th percentile weather conditions. Fire weather assumptions are made based on fire weather information obtained from observation stations that coincide with National Weather Service forecast zones. The determination of the appropriate fire danger indicators and weather variables were derived from the National Fire Danger Rating System (NFDRS) outputs through the analysis of historical weather records. For KRP the

97th percentile variables were used to model a severe wildfire for the purpose of modeling and analysis of effects of the alternatives.

It is uncertain when drought or fire will return and what the severity of each will be. This uncertainty is due to the unpredictable nature of weather patterns that fluctuate between to major climatic oscillations. These weather patterns appear to control the severity and extent of fire (Swetnam 1993). The uncertainty concerning drought makes predictions for the severity of insects, disease, and fire mortality uncertain. However, since drought and weather patterns that lead to severe fire have occurred in the past (North and others 2005) it is certain that drought will return and weather conditions that can lead to severe wildfire or insect attack will follow.

Each of the three alternatives incorporate the concept of wildfire entering the landscape ten years after the record of decision is signed for the purpose of modeling and analysis of effects. The ten year period was chosen not as a prediction but because it would test the three alternatives after all treatments have been accomplished to display a comparison to the decision maker of the indirect and cumulative effects of the alternatives.

Computer simulation: Computer models attempt to display the complex reality of vegetation. However, modeling results fall short of a perfect depiction of the variability of real forest vegetation (Shifley 2000) so this is also true within the KRP. This short coming is due to the variability associated with measuring vegetation, the variability in locating plots, the errors associated with drawing boundaries around vegetation, the ability of algorithms used in the computer models to assign plot data to polygons and the effective reduction of natural variability by algorithms. Each measurement of vegetation (diameter, height or quantity) carries inherent error because error prone humans do them. These errors coupled with the tendency of algorithms to reduce variability in natural systems result in model results that are representative but fail to capture the exact nature or the highly variable natural world. Thus the several methods used to measure the acreage of habitat (photo-interpretation, GIS or plot calculated) each produce results that are similar but not the same. Each method carries the potential for error and uncertainty.

Forest Vegetation Simulator Modeling: More than 1900 stand examination plots were collected and used to describe the vegetation and fuels in the Kings River Project. The data was also used to feed computer models that simulated the growth of the trees and change in wildlife habitat over time, with and without a wildfire entering the landscape as described above. A detailed description of modeling methods is contained in Appendix H.

Table 3-1 – FVS Modeling

FVS Modeling	Simulation Units	Area covered	Scale of changes modeled	Uses
Phase 1	Plant Aggregation	Eight management units, 13700 acres	Plant aggregation, stand, management unit, and KRP landscape	Wildlife habitat, fire severity, tree numbers, other forest structure attributes.
Phase 2	Plant Aggregation	KRP landscape outside eight management units, 58,400, reasonably foreseeable actions	Plant aggregation, stand and management unit, KRP landscape	Wildlife habitat, fire severity, tree numbers, other forest structure attributes.
Phase 3	Plot and Stand	Eight management units and South of Shaver, 16500	Clump of trees, stand, and management unit	Fisher rest site potential, Insect mortality risk, forest structural attributes

This scaling was accomplished in three phases. Phase I and II model vegetation at the plant aggregation scale inside the first eight management units and outside the first eight management units. Phase III models vegetation at the stand and plot scale for the initial eight management units. Figure 3-1 depicts an example of the stands and plant aggregation within a stand. Phase I modeling was done at a very intense and detailed level to assess the affects within the first eight management units on vegetation at scales smaller than a stand (plant aggregation scale). Model simulations were conducted to evaluate the effects of alternatives on small units (plant aggregations) of land and using decision criteria that took into account the relationship of small portions of stands to the entire stand itself. This was important to capture the variability of vegetation and the effects of the uneven-aged silvicultural system including the creation of groups. Phase II modeling was done to examine the effects alternatives (first eight management units), present and reasonably foreseeable activities across a larger KRP landscape (approximately 72,000 acres). Phase I and II modeling was done to assess the indirect and cumulative affects of proposed, present and reasonably foreseeable activities. Phase III modeling was conducted to assess the affects of alternatives (initial eight management units and South of Shaver) at the both the stand level and scales closer to the individual tree or clump of trees. Phase III modeling used treatments at the stand level to disaggregate treatments back to each individual plot (approximately 1500). This fine scale modeling was done to assess the direct and indirect affects of the proposed action on the potential for insect mortality and the probability for fisher rest use. Fisher rest site modeling is described in Appendix H. Each modeling phase is used to assess the affects of treatments at scales that are relevant to the needs and issues. Landscape modeling can assess the cumulative affects of treatments or direct effects across a management unit. Fine scale modeling can assess the direct and indirect affects on species that use discrete structures that can only be described at the plot scale.

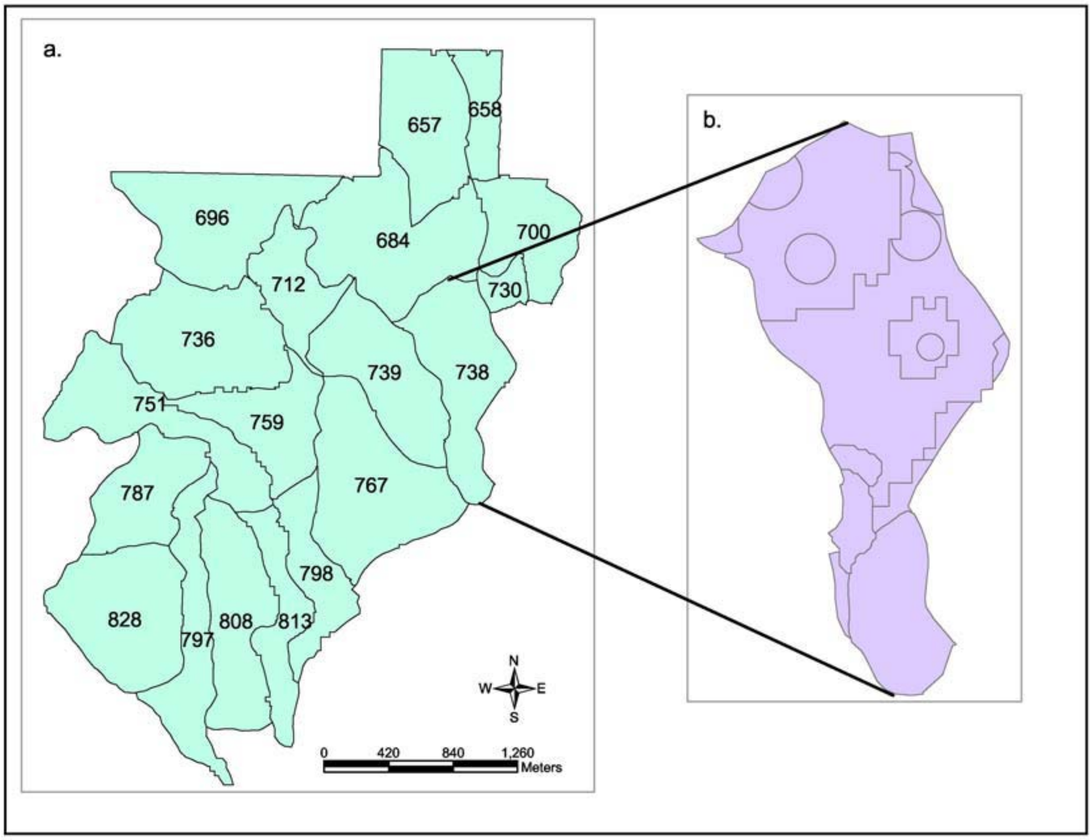


Figure 3-1 - Depicts of the bear_fen_6 management unit and its associated stands. Stand and plot level modeling was used to simulate effect in phase III modeling. Numbers represent a unique stand identifier used for planning (planid). Figure b - depicts plant aggregations used to simulate effects of treatments, fire and tree growth in stand 738 in the bear_fen_6 management unit in phase I and II modeling (Appendix H).

Fire Modeling: Fire weather data is necessary for modeling fires; and is required by all fire modeling programs (Behave, and FlamMap) and FVS. Using historical weather records for the month of August, data collected over a thirty year period (1973-2003) was averaged to find the 97th percentile conditions for temperature, humidity, fuel moistures, and winds[1]. Due to the size of KRP, no single weather station best represents the entire area.

Plant aggregation modeling at the landscape scale was used to model fire behavior and effects. Landscape fire modeling and fire effects runs were completed using the existing condition data taken from the Forest Inventory and Analysis plots. The Forest Vegetation Simulator (FVS-FFE) program with the Fuels and Fire Effects extension was used to model crown density, changes in stand structure, trees harvested and slash created under proposed action (Alternative 1) and the Reduced Tree Harvest Size (Alternative 3). FVS_FFE was used to determine the representative fuel model based upon stand thinning and growth over time. FVS-FFE was also used to model crown bulk density, percent

[1] Ninety-seventh (97th) percentile weather is the average weather for 97 percent of the days, over which only 3 percent of the days are hotter and drier.

basal area mortality, and the fire type (surface, passive, or active) if a severe fire occurred after all treatments were completed under all three alternatives.

Surface fire behavior was modeled using Behave Plus for all actual fires of occurrence that have been used as reference. Potential surface and crown fire behavior was modeled using FlamMap for all three alternatives. FlamMap modeled each alternative as if a severe fire occurred after treatments were completed in order to compare treatment alternatives and their effectiveness at reducing fire hazard.

Past, Present and Reasonably Foreseeable Activities in the KRP Area

The past activities are those that occurred in the past 30 years. The present activities are those that are ongoing at this time. The reasonably foreseeable activities that may affect the KRP are those that would be ongoing from the present or are expected to occur in the future and have a proposed action developed to the point it is reasonably possible to predict the effects. These activities contribute to effects on various resources in their own right and are included as cumulative effects with the initial eight management units. Which ones affect a specific resource depends on the scale of analysis for the resource and is described in the cumulative effects section for each resource. The following Table 3-2 displays the past, present and ongoing activities within the High Sierra Ranger District.

Table 3-2 - Past, Present and Reasonably Foreseeable Activities

Activity Type	Description	Year of Initial Implementation	Unit of Measure
Roads	Maintenance of existing roads (grading and cleaning of culverts)	ongoing	N/A
Veg. Mgt. – plantation maintenance	Thinning, hand release, chemical release, and planting in plantations <25 yrs old. Refer to description after Figure 3-2.	ongoing	3640 acres
Veg. Mgt. – SCE Pvt. Land	Uneven aged thinning and Rx burning. Refer to description after Figure 3-5.	1980 – 2005	1500 acres annually
Veg. Mgt. – Pvt. Land	Grand Bluffs National Fire Plan grant (shred brush and plant conifers)	2004 & 2005	80 acres
Veg. Mgt. – Helms/Gregg Transmission Line	Clearing dead trees within 100 ft of right-of-way from McKinley Grove west to the Forest boundary, brush and small trees from Ross' crossing to Fence Meadow Lookout, and chemical brush control. Refer to description after Figure 3-5.	2005 & 2006	about 1030 dead trees and other work on 399 acres
Private Land residential development	Wildflower subdivision, type conversion to housing tract. Refer to description after Figure 3-5.	2005	160 gross acres
Roadside Hazard Tree	Removal of damaged, rotten, dead trees	2002 +	~90 miles and

Activity Type	Description	Year of Initial Implementation	Unit of Measure
Removal	to abate roadside hazard using timber sale contracts. Refer to description after Figure 3-2.	2003 - present	~4400 trees across ~6500 acres
Prescribed fire	Underburn program to reintroduce fire, maintain DFPZ & reduce ground fuels. Refer to Table 3-3 and the description in the paragraphs preceding it	1994 – present and ongoing	17,300 acres
Timber Sales	Timber management projects. Refer to the description after Figure 3-2.	1978 - 1990	32,484 acres
Research	Teakettle thinning & Rx burning	1998	60 acres
Fuels Reduction	Jose 1, 10S18 and South of Shaver thinning & Rx burning projects	1996 – present	1687 thinned acres 3745 burned acres 156 planted acres
Livestock Grazing	Annual grazing on the Blue Canyon, Dinkey, Haslett, Patterson Mtn, and Thompson Allotments in the KRP area. Refer to Figure 3-3 and the description following it.	ongoing	Figure 3-3
Motorized Recreation	4X4, Off Road Vehicle (OHV), snowmobile travel on designated routes. Refer to Figure 3-4 and the description following it.	ongoing	Figure 3-4

The following maps below display general locations of activities.

The ongoing federal management activities (all of which have already had NEPA completed) that extend in time through the treatment of the initial eight management units and overlap them involve the High Sierra Ranger District prescribed burn program of work (Table 3-3), other Sierra National Forest timber and culture projects (Figure 3-2), active cattle allotments (Figure 3-3), and recreational activities and events (e.g. off-highway vehicle (OHV) and over-snow vehicles (OSV)) (Figure 3-4).

The underburning program schedule of work, displayed in Table 3-3, has approximately 17,300 acres planned under with current decisions. These underburns are proposed for maintenance of DFPZ, reducing surface fuel loads and reintroducing fire into the landscape. Burns are typically low intensity burns conducted in the spring. Scorch heights are typically less than 15 feet. Surface flame lengths are typically less than two foot.

The Kings River Project has a recorded fire history dating back to 1916. Since then, thirty fires larger than 40 acres have occurred (either entirely or a portion of the fire) within the project area. The average size of wildland fires in KRP in the last 35 years is 1866 acres. The majority of large fires (greater then 3000 acres) started in chaparral or in the grassy low lands of the Kings River drainage, and have run uphill into the forested areas; with the exception of the 1981 Rock Creek fire which started in the upper reaches of the Dinkey Creek drainage. The largest fire – the 1961 Basin fire started in the low elevation grass lands of the Dinkey Creek drainage and grew to 19,421 acres in four days before terrain moderated. The 1961 Haslett Fire grew to over 3000 acres in one burn period before hitting Fence Meadow ridge. Since 1916, ten fires were larger than 3000.

Table 3-3 - Displays the current fuels program that overlaps with the KRP area.

Prescribed Burn	KRP Management Unit	Year that next prescribed burn is proposed	Year of last entry(s)	Prescribed Burn acres
Irock	Irock_1	Complete in 2006	Partial in 2003	920
Barnes South	N_lost_1 N_lost_2	2011	2006	1185
10S18N Unit 5	N_up_big_3	2006		475
Haslett	Bear_fen_1	2007	1994/1998	900
Rush	N_soapro_1	2007	1998	215
Virginia's	N_duff_1 N_duff_2	2007	2000	1360
Turtle B2	N_ross_2	2007	1999	470
Turtle B1	Bear_fen_6 Bear_fen_7	2012	1996/2002	418
Turtle B5	N_turtle_3	2009	1999	523
Turtle B6	N_turtle_1 N_poison_1	2009	1999	418
Turtle B7	N_turtle_1, 2, 3 & 4	2009	1999	1692
Dinkey Unit 1	N_ross_1 N_ross_2	*	1999	883
Dinkey Unit 2 & 3	Bear_fen_6	*	Unit 2-2000	1454
Dinkey Unit 4	N_ross_4	*	1998	571
Dinkey Unit 5	N_ross_1	*	1999	632
Oakflat	Bear_fen_6	2012	1996/2002	125
Poison	N_poison_1			539
Reese	Reese_1 & 2 N_410_1 Exchequer_5	2012	1999/2002	922
10S18	10S18 N_duff_1	2011	2001	590
10S18North	Ten_S_18 N_summit_1 N_up_big_1 & 3	2014	2004	1071
Carls	N_carls_1 N_ross_2	2009	1997/1999	1024
Clarence	Ten_S_18 Providen_1 & 4 N_duff_2	2008	2001	889
Barnes North	N_duff_3	2015	2005	767
Bear Creek	N_bearcr_1	Not scheduled**	2000	395
Little Rush	N_soapro_1 & 2	2010	2002	288

*Under cooperative agreement with SCE and CDF (on hold). ** Mitigation unit for PG&E Lost Canyon rupture

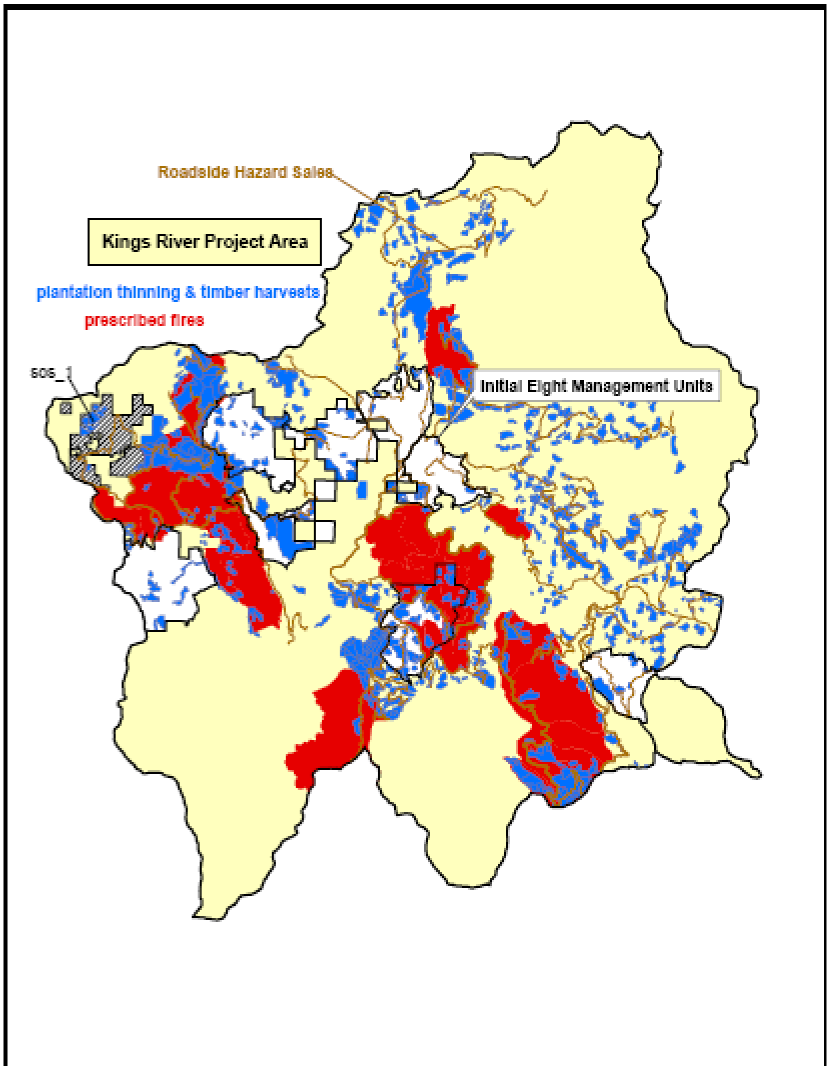


Figure 3-2 - Sierra National Forest ongoing activities in the KRP. Fuels projects are in red and timber harvest /plantation thinning projects in blue. Roadside hazard tree removal is in brown.

There are 10,106 acres of plantations across the KRP area. Approximately 2,319 acres have current treatments with decisions. Current plantation activities across the landscape are thinning, hand release, chemical release, and planting. The decisions include Power1, Nutmeg, Lost, Men, Bretz, Flat, Progeny Site and Fence. The proposed action would treat 1321 acres in 2006, 2007 and 2008.

Roadside hazard projects are scheduled to abate the hazard posed by damaged, dead, or weakened trees found along roads or travel ways used by the public or Forest Service personnel. Commercial timber sales are the tool used to abate hazardous trees. Removal takes place within 300 feet of a road surface. However the distance of tree removal or felling is dependent on the ability of hazardous trees to strike the road or block traffic. Tree removal is focused on weakened or dead trees.

Since about the mid 1960s, past timber harvest activities have included clearcutting and salvage logging (1960s to 1972), sanitation and salvage harvests (1972 through 1978), clearcutting, shelterwood cutting, and salvage harvests (1978 through 1992), and commercial thinning and salvage in recent times. The only fires to burn substantial amounts of timber were the Rock Fire in 1981 and the Big Creek Fire in 1995, with each fire burning about 3000 acres of forest. Clearcuts or burned areas that took place prior to 1972 are most likely successful plantations today exhibiting size class 3 and density class M stands. Other, more recent disturbances, while they may be reforested have probably not yet reached size class 3.

A good estimate of the acres of wildlife habitat changed by timber sales and recent fires would be the acreage of plantations created beginning with fiscal year 1978 as recorded in the FACTs Database. The results follow:

Table 3-4 Acres of wildlife habitat changed by timber sales and recent fires

Unit	Gross Acres	Acres Planted
KR Project	9,129	5,688
Old KR District	10,186	6,701
Old PR District	13,169	9,613

Overall, about 9000 acres of disturbance resulting from timber sales or fires have taken place within the KRP planning area and approximately 23,000 acres of disturbance have been documented for the larger area encompassing the old Kings River and Pine Ridge Ranger Districts since about 1972. Although these disturbances have caused notable changes in wildlife habitat, the amount of these changes over the last 30 years is not extraordinary compared to the total amount of suitable wildlife habitat that is available for species such as fisher, spotted owl and mule deer.

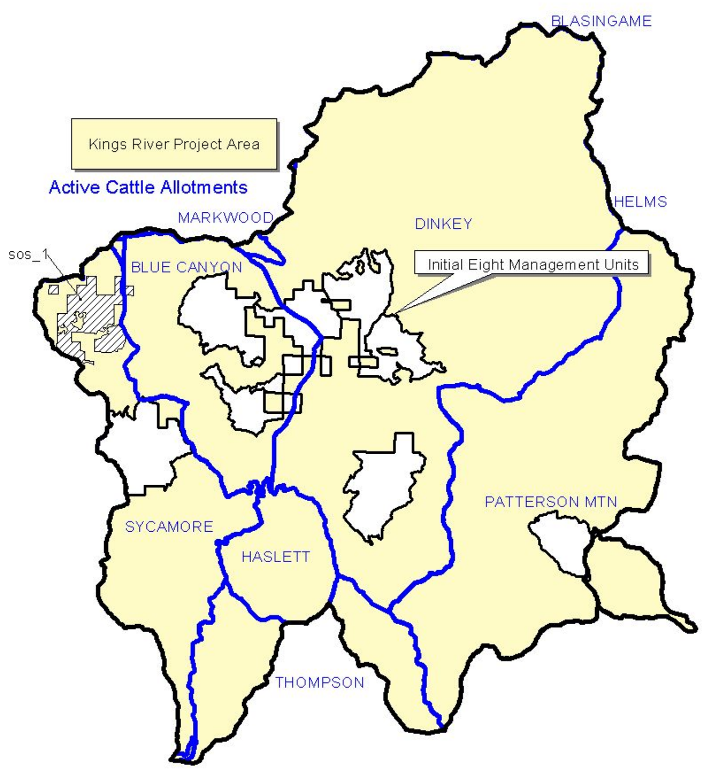


Figure 3-3 Active cattle allotments in the KRP

The Kings River Project includes mostly perennial range made up of plant communities that are naturally self-regulating and are composed of perennial forage species. These communities include meadows, perennial grass and riparian zones. They are generally above 5000' elevation and are scattered over a broad area. KRP has some transitory range created by timber harvesting or prescribed fire. The perennial range is in fair or better ecological condition. For more information, see the LRMP FEIS, page 3-36.

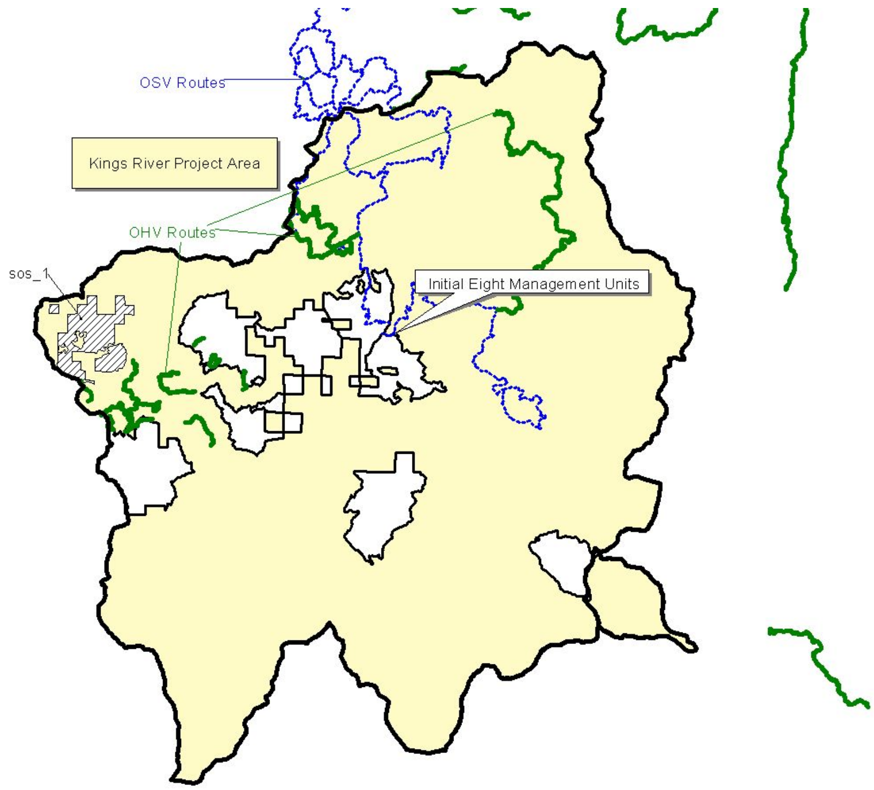


Figure 3-4 -The off-highway vehicle and over-snow vehicle routes that overlap the KRP area

The Off-Highway Vehicle Plan for the Sierra Forest has been in place since 1958. Over the years routes have been added and dropped to adjust to changing conditions and needs. For more information, see the FEIS for the LRMP, page 3-12.

There are few of the 209 miles of groomed and maintained snowmobile routes on the Sierra Forest within the Kings River Project. These trails are maintained for snowmobiles, ATVs and Nordic skiers.

Currently, a complete revision of the plans for vehicle management on the Sierra Forest is being initiated.

The only reasonably foreseeable federal activities within the High Sierra Ranger District that have a proposed action developed to the point it is reasonably possible to predict the effects.

The statistical probability (rare event occurrence – Poisson probability distribution) of a large fire occurring within the KRP area within the next 30 years is 11% and any fire occurrence within the next 10 years is 36% (District files 2001). A wildfire of stand replacing intensity (97th percentile conditions) would become an active crown fire from the first spark, the effectiveness of aerial suppression capabilities are limited due to existing stand densities and fuel loading.

The ongoing privately managed activities (Figure 3-5) within the Kings River Project area involve two timber sales near the n_soapro_2 management unit, a housing development north of the sos_1 management unit, Southern California Edison (SCE) timber management area, other non-industrial forest landowner thinning, and the Pacific Gas & Electric (PG&E) transmission line.

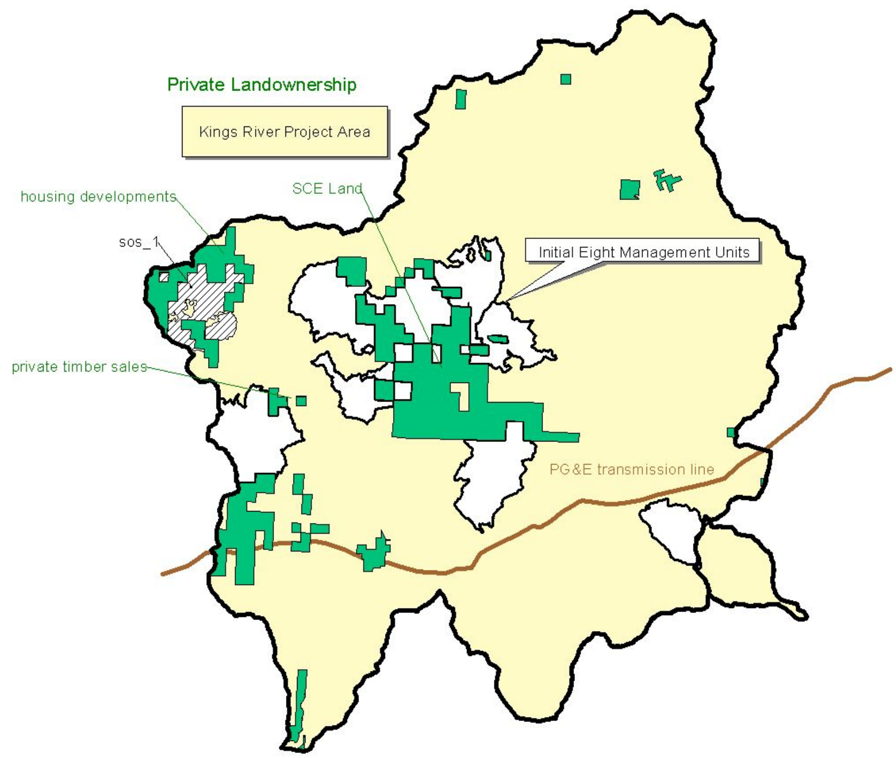


Figure 3-5 - Private land ownership within the KRP area

Southern California Edison and several private individuals own approximately 15,000 acres of land within the KRP boundary. These lands are managed for wildlife benefit, recreation and timber production. Southern California Edison lands are managed using an uneven-aged silvicultural system that conforms to the California's Forest Practice Act. Private individuals who manage their lands for scenic beauty and recreation own the Grand Bluffs and Twin ponds properties. The Grand Bluff property owners have a cooperative fuels reduction grant with the Forest Service and recently provided notification of 320 acres of timber harvest that is being planned. Grand Bluffs private holdings are adjacent to the Power1 Thinning, KREW_Prov1 and Providence 4 projects.

Approximately 1500 acres is harvested each year from Southern California Edison lands and approximately five million board feet is harvest across all diameter classes. Typical prescriptions remove approximately thirty percent of standing stem basal area. Tree removal has no size limit. However, requirements for the protection of “old growth” are part of timber harvest plans. Tree removal is accomplished using tractor logging on slopes less than 40 percent and using helicopter logging on steeper slopes.

The Helms/Gregg 230 kV Transmission Line right-of-way runs across the southern boundary of the KRP landscape. The right of way for this transmission line occupies approximately 371 acres. Maintenance of vegetation within this right of way includes the spraying of chemicals to reduce large vegetation, the felling of hazard trees, the cutting of vegetation. Vegetation objectives for the transmission line are to maintain a cover of low growing natural species that provide soil cover and early seral stage wildlife habitat. Tree hazard tree removal and right of way clearing have removed: about 500 trees <10", 324 trees from 10" - 29" and 206 trees 30"+. Herbicide spray, brush cutting and tree cutting occurred on 399 acres underneath the power line in 2005 and 2006.

Development on private lands (Wildflower Village) will create single-family homes across 160 acres. Homes will be over 2500 square feet with driveways. Homes could disturb as much as 1/3 acre per home. The areas have been logged in the past and home site construction will permanently remove trees from forest cover. Adjacent forests are typically left intact following construction.

Specialists Reports and Other Documents

The following reports and documents are incorporated by reference as part of the Environmental Consequences:

- Aquatics (BE/BA and MIS)
- Botany (BE/BA)
- Herbicide
- Soils
- Watershed (Cumulative Watershed Effects (CWE) Assessments and Riparian Conservation Objectives (RCO) Consistency Analysis)
- Wildlife (BE/BA and MIS)
- Vegetation

Resource Areas Discussed in Chapter 3

The following resource areas are analyzed in detail in Chapter 3:

- Vegetation including Fire, Historical Forests, and Reforestation
- Transportation
- Fuels – Fire Behavior
- Air Quality
- Botanical Resources (including noxious weeds)
- Wildlife Species
- Soils
- Watershed (including CWE assessment)
- Aquatic Species

- Heritage Resources and Tribal Relations
- Economics
- Human Health and Safety
- Research

VEGETATION including Fire, Historical Forests, and Reforestation

Affected Environment

The KRP is composed of approximately 131,500 acres. The initial eight management units identified for treatment in the proposed action encompass approximately 13,700 acres. Stands within KRP were identified for their suitability for the uneven-aged silvicultural system (Appendix C). The South of Shaver project, plantation maintenance, vegetation treatments on private land, hazard tree removal, and residential construction are analyzed as part of the cumulative effects of past, present and reasonably foreseeable activities as described near the beginning of Chapter 3.

Factors Used to Assess Environmental Consequences

These factors were used to assess the consequences of the no action, proposed action and the reduction of harvest tree size alternative.

Conifers, vegetative competition, regeneration and planting,

- The influence of treatments, brush and grass on tree survival and growth
- The influence of treatments on brush, grass and noxious weed growth
- The need for herbicides

Canopy cover

- Proportion of landscape over 50% tree canopy cover.
- Proportion of fisher home ranges with tree canopy cover greater than or equal to 60%.
- Wildfire damage to tree canopy cover.

Density Related Risk/forest health

- Proportion of Plots over stand density threshold.
- Numbers of trees removed and retained
- Changes in stand attributes from wildfire and prescribed fire

Historical Forest Conditions

- Effects on attributes associated with the historical condition
- Resistance to wildfire.

Past Disturbance - Vegetation within the KRP project area is the result of past disturbances. These disturbances include harvests (1880s to 1920, 1920-1940, 1960-1970, 1970-1994 and 1994-present), wildfire, even-aged management, insect mortality, and underburning. Management disturbances from 1975 to present are detailed in management history in the project file. Harvests within the larger KRP landscape began in 1870s with removal of sugar pine and ponderosa pine typically in small groups or single trees in the Rush creek drainage or on the ridges above the Big Creek drainage (Sudworth 1900a, Flintham 1904, Hurt 1940). Extensive steam donkey and railroad logging began in the 1890's to 1910. The period from 1890 to 1910 resulted in large clear cuts in the Rush Creek (n_soapro_2), Summit Creek (providen_1) and Big Creek (providen_4) drainages. Scattered remnants of pre-settlement stands are found throughout. Some of these stands regenerated naturally from the seeds of these scattered trees. Most stands harvested in this early period are now dominated by white fir or incense cedar that hand been in the understory. Similar encroachment of white fir has been documented in the Teakettle Experimental Forest adjacent to the KREW_Bull management unit found at 7000 feet elevation (North and others 2004). Management units that exemplify this regeneration pattern are el-o-win-1, krew_prv_1 and bear_fen_6. However, other areas logged during the turn of the century, such as those in the Summit Creek area or lower Rush Creek drainage remain in dense brush fields.

Many of these early cut over stands were burned by wildfire in 1918, 1931, 1932, and 1947. These fires affected the South of Shaver Project and the n_soapro_2, providen_1, providen_4 and krew_prov_1 management units. Stand replacing fires in 1961, 1981 and 1989 resulted in areas dominated by brush species in many stands to this day. These areas dominated by montane brush and disturbed by fire or early 1900's harvests are consistent with observations made by Skinner and Chang (1996) for the Sierra Nevada. Reforestation efforts in fire areas (1947 to 1989) used tractor site preparation and herbicide release to reforest some of these cut over and burned stands.

Recent Management - The uneven-aged management strategy with group regeneration and underburning has been practiced in the KRP area since 1994. These treatments have focused on the uneven-aged management strategy creating regeneration in groups, prescribed fire and defensible fuel profile zones (Smith and Exline 1998). Projects include the 10S18 project (1,647 acres), I-rock project (885 acres) and the Reese project (1,244 acres). Underburning has been used in the KRP to both consume fuels created from harvests and maintain desired fuel loads and reduce fuel ladders (McCandliss 1998).

Existing Vegetation - Vegetation within the KRP is described using the California Wildlife Habitat Relationship model (CWHR (Mayer and Laudenslayer 1988)). This model describes vegetation by forest type, quadratic mean diameter, and canopy density. Existing acres of vegetation type were determined by using vegetation mapping completed by Rojas in 2004. Existing structure was determined from more than 1900 stand examination plots collected from 1996 to 2004.

The acres of different forest types across the initial eight management units are displayed in Table 3-5. Ponderosa pine (28%) and Sierra mixed conifer (43%) are the dominant forest types within the initial eight management units. Forest types that occur less frequently include mixed chaparral (5%), montane chaparral (2%), montane hardwood (8%), montane hardwood conifer (3%), red fir (3%), barren (7%), and other CWHR types (1%). Medium size class trees and moderate to dense canopy cover classes dominate the landscape. These medium size class trees originated following disturbances of 1880 to 1961. Scattered older trees are found across conifer dominated types individually and in clumps. Shade intolerant species (incense cedar, white fir, and red fir) have invaded forest understories. Ponderosa pine, Jeffrey pine and California black oak are found at lower frequencies than 75 years ago and 150 years ago (Bouldin 1999, Taylor 2004, North and others 2005). Brush is also a dominant component in the understory. This is especially true in the ponderosa pine and mixed conifer stands. Bear clover is found throughout all ponderosa pine stands and accounts for forty percent cover. Mixed conifer stands average 24 percent brush cover. Brush cover ranges from 0 to 100 percent with approximately half the plots containing greater than fifty percent brush cover.

Table 3-5 - Displays the acres of forest types for the current condition for each management unit.

CWHR_TYPE	bear_fen_6	el_o_win_1	glen_mdw_1	krew_bul_1	krew_prv_1	n_soapro_2	providen_1	providen_4	Grand Total
Annual Grass Land		7						4	11
Barren	1	115	216	81	107	304	93	5	921
Lodgepole Pine		18	7						24
Mixed Chaparral					1	490	63	104	658
Montane Chaparral	34	10	10	9	8	5	128	29	232
Montane Hardwood Conifer	29				4	132	217	12	394
Montane Hardwood						657	279	107	1,044
Ponerosa pine	1,043				246	833	1,105	698	3,925
Red fir				428					428
Sierra Mixed Conifer	1,094	1,184	1,341	587	1,504		129	87	5,926
Urban			29						29
water		1	1		0				2
Wet Meadow	3	25	15	47	29				120
Grand Total	2,204	1,359	1,619	1,152	1,899	2,421	2,014	1,047	13,715

Table 3-6 - Displays the acres of plantations proposed for treatment in the initial eight management units, the year of creation developed from photo interpretation and GIS. Acres with overstory removal contain acres with residual young trees left behind after the previous overstory harvest. These acres are some what different then those developed from the FACTS database.

MANAGEMENT UNIT	1948	1950	1962	1963	1964	1966	1968	1969	1970	1972	1977	1980	1981	1982	1984	1987	1989	1990	1991	1992	1993	1994	1996	1997	Origin Overstory removal	Shelterwood	Grand Total
bear_fen_6	0	0	0	0	5	7	69	4	25	0	0	0	0	6	0	0	0	0	88	107	0	26	0	0	68	0	404
el_o_win_1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	39	34	0	0	25	100
glen_mdw_1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	3
krew_bul_1	0	0	0	0	0	0	0	0	0	40	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	94	150
krew_prv_1	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	11	0	0	0	148	0	45	21	0	268
n_soapro_2	0	0	24	0	0	0	0	26	0	0	31	26	56	0	0	0	0	0	0	0	0	0	0	0	72	0	235
providen_1	0	47	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	27	0	0	61	0	152
providen_4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	9
Grand Total	0	59	24	0	5	7	69	30	25	40	31	26	73	6	16	2	32	14	88	107	0	239	43	45	221	119	1,321

Plantations - Plantations and shelterwoods occur on 2162 acres in the initial eight management units. Plantations and shelterwoods with current decisions or with no proposed treatments occur on 852 acres. Plantations proposed for thinning, the uneven-aged management strategy and release treatments in the initial eight management units occur on 1310 acres. These plantations and shelterwoods were created from even-aged management from 1975 to 1994, brush field conversion and fire recovery. Table 3-6 displays the acres by management unit for plantations by year of origin or planting for plantations and the acres of shelterwoods. Acres with undetermined year of origin are acres not yet planted or were removal of overstory trees have left trees of undetermined age. Plantations are dominated by small sapling to pole size ponderosa pine, Jeffrey pine, and sugar pine less than 10 inches diameter at breast height (DBH). Red fir, white fir and incense cedar are minor components of most existing plantations and shelterwoods. Red fir saplings dominate one shelterwood in the KREW_Bull management unit. Density of plantations proposed for treatment exceeds 300 trees per acre. Some plantations have as many as 900 trees per acre. Scattered trees greater than 10 inches diameter breast height are found within plantations as part of the shelterwood or left for diversity in "clumps and holes" prescriptions. Brush species found in the understory include *Ceanothus* *cordulatus* (whitethorn), *Ceanothus integermis* (deer brush), *Arctostophylos patula* (green leaf manzanita), *Arctostophylos vicida* (white leaf manzanita), *Chamaebatia foliolosa* (Bear clover), and *Ribes rombifolia* (gooseberry). Cover of the understory brush in proposed treatment plantations varies from 0 to 140 percent cover. Values over 100 indicate overlapping canopy cover. Average brush cover for plantations is 52 percent total cover.

Brush fields and Canopy Gaps - Areas disturbed by fire, insects or harvest create conditions suitable for secondary succession. Secondary succession is a process of reinvasion by plant species following disturbance (Barbour and others 1980). The response to disturbance is determined by the availability of seed and the competitive advantage of the first species to arrive following that disturbance. While conifer and oaks can survive or establish after disturbance the pattern of response is often dictate by the available seed, conditions suitable for tree growth and treatments (McDonald and Fiddler 1995). While disturbance can change the proportion of species succession, succession will result in predictable combinations of species that form vegetative communities; this tendency for vegetation to form communities is often referred to as potential natural community or potential natural vegetation (Potter 1994).

Areas with existing understories of brush tend to become occupied by these existing brush species following fire and harvests. Treatments that create conditions for tree growth are often needed to establish tree cover (McDonald and Fiddler 1995). Brush fields within the initial eight management units are dominated by a complex of brush species: deer brush, white leaf manzanita, bear clover, whitethorn, gooseberry, and green leaf manzanita. Brush fields are areas large enough to be visible and easily distinguished from aerial photographs, generally larger than three acres (Table 3-5). These brush fields are identified as chaparral (found on soils not suitable for conifer growth) or montane chaparral (better soils suitable for conifer growth). The proposed action and reduction of harvest tree size alternatives proposed to plant trees on montane chaparral areas as part of existing openings and gaps. Gaps are by nature small openings in the forest canopy. Some are distinct and can be mapped, most however are small and only found after field review. Gaps are subject to the same effects of secondary succession as brush fields; however because of the small size gaps have more forest edge relative to the opening. This results in the neighboring intact forests having a strong influence on the growth of vegetation in the gap (York and others 2004).

Competing Vegetation and Reforestation - Plantations, brush fields or existing openings proposed for reforestation and release treatment have a combination of montane brush types (grasses, bear clover, *Ceanothus* and manzanita). The canopy cover of brush species across the initial eight management units is displayed in Figure 3-6. A description of the vegetation aggregations is displayed for each stand in the project prescriptions. The complete set of brush data is in the project record. The competition from brush cover that exceeds 20 percent severely curtails seedling survival and growth (McDonald and Oliver 1984). This effect of decreasing survival and growth with increasing brush cover has been noted by other studies (Powers and others 2004, Wagner and others 1989, Oliver 1984, McDonald and Fiddler 1989, Fiske 1984). The past 20 years of survival and growth data on plantations on the Sierra National Forest shows that areas dominated by brush limit conifer survival. Aggressive control of competing vegetation in previous uneven-aged reforestation groups have averaged 92 percent of acceptable stocking with less than 10 percent brush cover and sixty-eight percent grass cover. This experience is in strong agreement with the large body of reforestation knowledge that indicates that release treatments within the first five years have significant effects on survival and growth of conifers (Fiske 1981, Tappenier and McDonald 1996).

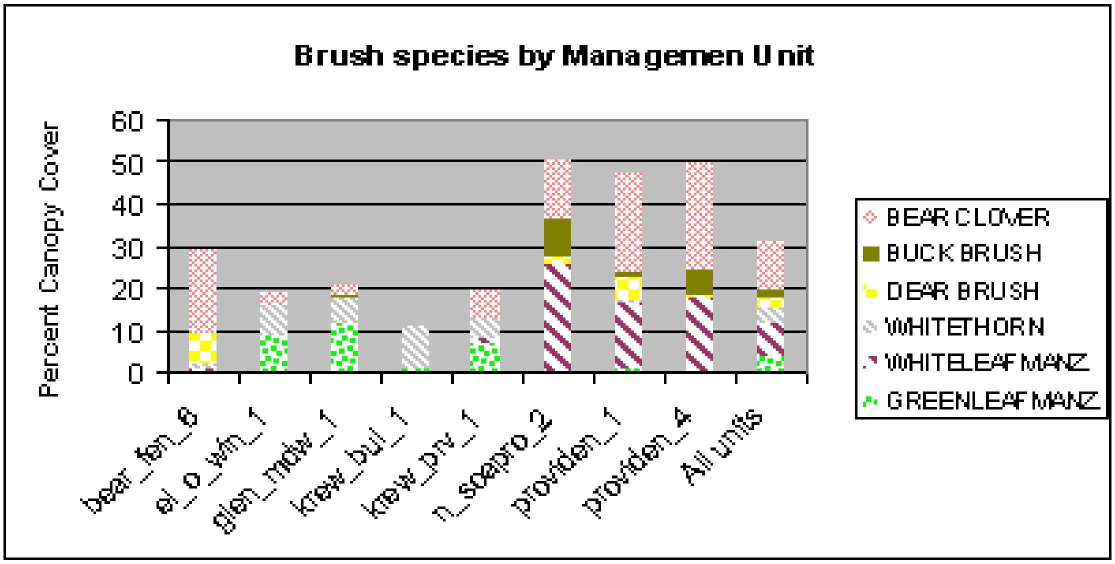


Figure 3-6 - Displays the average canopy cover of brush species by management unit and combined for all units

Secondary succession, brush competition and conifer survival have long been recognized as an important consideration in forest regeneration (Isaacs 1956). The practice of "high grading" or economic selection was conducted throughout western forests from 1920s through the early 1960's. This is also true for the KRP. This practice of high grading was criticized for the lack of control of competing regeneration, the resulting lack of adequate regeneration, and the removal of important phenotypes (Isaacs 1956). Later studies would confirm the importance of controlling competing vegetation within the first five years of conifer establishment (Fiske 1981, Powers and others 2004). Other studies have quantified the reduction in seedling survival and growth as a result of competing vegetation and overstory tree density. The proposed alternatives can be compared on how they meet the need to maintain plantations and carry out reforestation.

- **Grasses -** Grass is one of the groups of vegetation that initiate growth prior to conifers in the spring, making it very competitive for available soil moisture with its subsequent effects on tree survival and growth. Grasses cause mortality and reduced growth of conifers; this is especially true of cheat grass (McDonald and Fiddler 1989, McDonald 1986, Larson and Schubert, 1969). In the past, monitoring of reforestation site preparation and release units has determined that the control of brush species provides additional soil moisture for both grasses and conifers. Grasses can successfully compete with conifers as well as oaks for soil moisture because they begin and end growth prior to conifers. Grasses and forbs make up approximately 5 percent cover. Grass and forbs cover averages from less than one percent to as much as ten percent for management units. Maximum grass cover does exceed more than 40 percent. A population of cheat grass is found in management unit providen_4.

- **Bear clover** – This species is found across all management units dominated by ponderosa pine and mixed conifer. In dense stands, bear clover is found at low densities beneath the forest canopy or fully occupying openings. In addition, bear clover is found in understories of existing brush fields. Fire, hoeing, and machines have been used on the Sierra National Forest to remove the above ground portion of bear clover; but due to the rhizome type root system sprouting of plants occurred soon after treatment. Sprouts quickly reinvaded these treated areas. Survival of planted seedlings was well below desired stocking levels. Herbicides application has proven the only effective means to control bear clover on the Sierra National Forest. These results agree with reforestation research that indicates that after three years, only 13 percent of the conifers planted were alive in a study area with bear clover cover of less than 40 percent (Tappenier and Radosevich 1982). This contrasts with 71 percent survival in areas with temporary control of bear clover. Over a 19-year span, only nine percent of the trees planted in an area with no vegetation control survived. Growth of the surviving seedlings is also impacted. In the same study, three-year-old seedlings with no bear clover competition were twice as tall as the seedlings with no vegetation control. A review of bear clover control measures by McDonald and others (2004) also indicate that treatments that kill bear clover rhizomes such as herbicides are the only effective control measure, while other treatments have been failures.

- **Ceanothus -** Deer brush (*Ceanothus intergerrimus*) is the most abundant species, but buck brush (*Ceanothus cuneatus*), whitethorn (*Ceanothus cordulatus*), and little leaf (*Ceanothus parvifolious*) are also found in many units. Ceanothus species dominate with in different management units. Deer brush (*Ceanothus intergerrimus*) is found in providen_1, providen_4, bear_fen_6 and n_soapro_2. Whitethorn (*Ceanothus cordulatus*) is found across krew_prv_1, glen_mdw_1, krew_bul_1 and el-o-win_1. Buck brush is found on the drier sites in n_soapro_2 and providen_4. The existing deer brush is four to twenty-five feet tall and the buck brush and whitethorn is averaging three to six feet in height. Ceanothus species in existing openings are well established and have deep root systems. Deer brush is found in combination with bear clover in the bear_fen_6 management unit. These two species are often found dominating the understory of mixed conifer stands and pine plantations.

- **Manzanita** -. Manzanita (both white leaf and green leaf) is another major competitive species found in the KRP area. White leaf manzanita (*Arctostaphylos viscida*) germinates from seed; sometimes reaching densities of 4,000 stems per acre. Green leaf manzanita (*Arctostaphylos patula*) is a sprouting species as well as germinating from seed. Greenleaf manzanita is found in el-o-win 1, krew_prov_1 and glen_mdw_1. It is often found in combination with ceanothus species dominating openings and understories. White leaf manzanita dominates n_soapro_2, providen_1 and providen_4. This species is often found in combination with bear clover. These two species often form two storied stands of brush with bear clover under dense canopies of white leaf manzanita.

Canopy Cover – Canopy cover is the measure of crown area that occupies the ground as seen from above a forest stand. Canopy cover is combined with average tree size and vegetation type to describe wildlife habitat. The California wildlife habitat relationship model is used to categorize habitat (Mayer and Laudenslayer 1988) across the KRP area. Canopy cover is also a factor in crown fire. Agee (1996) and Van Wagtentock (1996) have both described forty percent canopy cover as a threshold for sustaining crown fires. Canopy cover alone is not a predictor of crown fire (Van Wagner 1977). Ground fuels, ladder fuels, species, topography and overstory canopy cover are all factors in the initiation and movement of crown fires (Scott and Reinhardt 2001, Agee and Skinner 2005). However, modeling efforts for the Sierra Nevada indicate that increasing canopy cover increases the potential for crown fire initiation (Van Wagtentock 1996, Holfenstien and others 2002).

Design criteria in the proposed action plan to maintain canopy density at the landscape scale above 50 percent canopy cover on 50 percent of the acres capable of supporting dense large and medium size trees. Criteria for the reduction of harvest tree size alternative plan to leave 60 percent canopy cover on 50 percent of the acres capable of supporting dense large and medium trees outside the WUI. These acres would exclude chaparral, rock or soils not capable of supporting dense tree stands. The design criterion is proposed to balance the need for fuels treatments and restoration with protection and sustainability of spotted owl, fisher and other wildlife habitat. Alternatives are compared against the two standards for the retention of canopy cover.

Density Related Risk - Resilience is the ability of a forest to undergo disturbance and change and return to the same structure, function, forest type and ecological processes. A healthy forest is one that has the ability to rebound from disturbance and maintain important forest structures after the disturbance (Kolb and others 1995). Alternatives that resist changes to canopy cover; large trees and variable structures following wildfire or drought events are more resilient.

Western Pine beetle (WPB) is the primary cause of mortality in ponderosa pine (Oliver 1995, Oliver and Uzoh1997). In fir mortality is typically linked to a combination of fir engraver, density induced stress and disease (mistletoe and root disease) (Oliver 1995, Oliver and Uzoh 1997). While these insects and pathogens are native to the KRP, insect attack and mortality has increased (relative to the historical forest) due to the higher forest densities and reduced tree vigor resulting from many decades of fire suppression (Kilgore 1973, Savage 1994, Ferrell 1996, North and others 2005). More trees in dense forests are susceptible to insect and pathogen attack because there is increased competition for resources, particularly during extended drought.

The range in stand density for the transition from endemic insect attack and epidemic insect attack has been identified on the basis of stand density index (SDI). Stand Density Index is a relative measure of tree density based on the Self-Thinning Rule, also known as the –3/2 rule (Drew and Fleweling 1979) and first described in the Sierra Nevada (Rieneke 1933). "*Very simply, it proposes that all environments with finite resources whether that be a goldfish pond or an acre of ground can support a finite amount of* *liming biomass. Therefore, as individuals grow in size the number of individuals decline - an intuitive relationship* (Oliver and Uzoh 1997)." Maximum densities have been determined for Sierra tree species based on plot data (Dixon 1994, Oliver 1995). The transition from endemic insect mortality occurs well before the maximum SDI is reached (Oliver 1995, Oliver and Uzoh 1997).

Increasing the resistance to bark beetle attack and increased tree vigor is an objective of this project. Stand structures conditions that lead to attacks by western pine beetle and other insects that kill conifers are not completely understood. However, studies indicate that stand density is one important factor in insect mortality and tree vigor (Miller and Keene 1960, Oliver 1995, Smith and others 2005). Other factors important for insect mortality and tree vigor are prolonged drought or injury and the presence of other diseases (Larsson and others 1983, Ferrel 1996). Tree density at the local tree or clump plays an important role in creating conditions suitable for insect attack (Miller and Keene 1960, Ferrel 1996). However, some studies indicate that well established trees in the Southern Sierra Nevada use water held in rock fissures or water deep in the soil (Hubbert and others 2001). An inference that can be made from this research is that large trees are more resistant to drought and its effects.

SDI allows for comparisons of tree density between different species and different site quality. Stand density index compares density to a reference maximum density. While SDI has been shown to have an ecological basis for site occupancy by tree species, recent information for intermountain and cascade conifers indicates that it may underestimate the site occupancy by large trees and overestimate the occupancy by small trees in uneven-aged stands (Woodall, Fiedler, and Milner 2003). Never the less SDI has been shown empirically to have implications for tree competition for site resources (Rieneke 1933, Drew and Fleweling 1979, MacCarter and Long 1986, Dean and Baldwin 1996). In addition others (Oliver 1995) have described threshold levels for insect attack and tree vigor in the Sierra Nevada.

As SDI increases beyond 35% of maximum insect mortality is possible (Oliver 1995, Oliver and Uzoh 1997). When stand density increases beyond approximately 60% of maximum insect mortality is imminent. These zones for the on set of tree stress do not predict when a tree or clump of trees will be attacked. This uncertainty of when a tree or clump will be attacked is due in part to the unpredictable nature of drought and the random dispersal of insects. Stand density index at the plot level is used to display effects of alternatives on reducing the potential for insect mortality and reducing tree stress. Approximately 25% of measured plots currently exceed the threshold for epidemic insect attack. Approximately 70% of plots exceed values for endemic insect attack and reduced resistance to insect attack.

Another measure used to compare the effects of alternatives is the numbers of trees removed from stands and the numbers of trees that remain. Comparisons are made at different diameter size classes for each alternative. While absolute numbers of trees do not reveal the relative dominance of trees, they can describe the direct effects of treatments on stand structure and large trees.

White pine blister rust (*Cronartium ribicola*) is found in the KRP area and is responsible for the death of sugar pine and western white pine (white pines). This introduced disease infects and kills white pines that lack the major gene that provides natural resistance.

White pine blister rust is found in all eight management units. Infection rates are highest in the KREW-prov_1, glen_mdw_1 and el-o-win_1.

Historical Forest Conditions

Sources of data

The EIS use various data sources to describe the historical condition within the KRP. Historical conditions were examined at the landscape scale and the stand scale. The landscape scale represents the how stand tree canopy varied across the large King River Project area. Landscape scale data is not available for the 1850 forest. The analysis of the landscape variability relied on literature that described the process that likely controlled stand structure. Canopy cover varied across the KRP landscape based on aspect, site quality, slope, forest type and fire return interval. Determinations of historical canopy were made using potential natural vegetation, site quality, historical descriptions, early photographs of KRP, aerial photographs (1940), early cruise data 1914 to 1926 (USDA 1926), and historical data sets. These determinations were inherently subjective

The stand scale examines the variability of individual stand characteristics (trees per acre, basal area, and tree distribution). The analysis of historical conditions examined many data sets to determine historical conditions: existing **unmanaged**[2] stands at the Teakettle Experimental Forest (adjacent to the KRP), **historical** data from the turn 19th century and the 1930s (Bouldin 1999, Hasel 1931, Minnich 1995, Sudworth 1900a, Sudworth 1900b Stephens and Fiske 1998), **reconstructed** stands (North and others 2006, Taylor 2003, Covington and others 1997), analogous **relic** mixed conifer forests at the Sierra San Pedro Martir in Baja California (Stephens and Gill 2005, Minnich 2000), and existing **relic** Sierra Nevada forests not subject to fire suppression (Oliver 2000) at the Beaver Creek Pinery. In addition, the analysis compared the data sets listed above to data sets for **reconstructed** ponderosa pine found in Montana (Arno and others 1995) and the Southwest (Covington and others 1997). Each type of data has limitations and short comings (Swetnam and others 1999, Stephenson 1999).

[2] Bold text refers to types of quantitative data used in the analysis of historical conditions

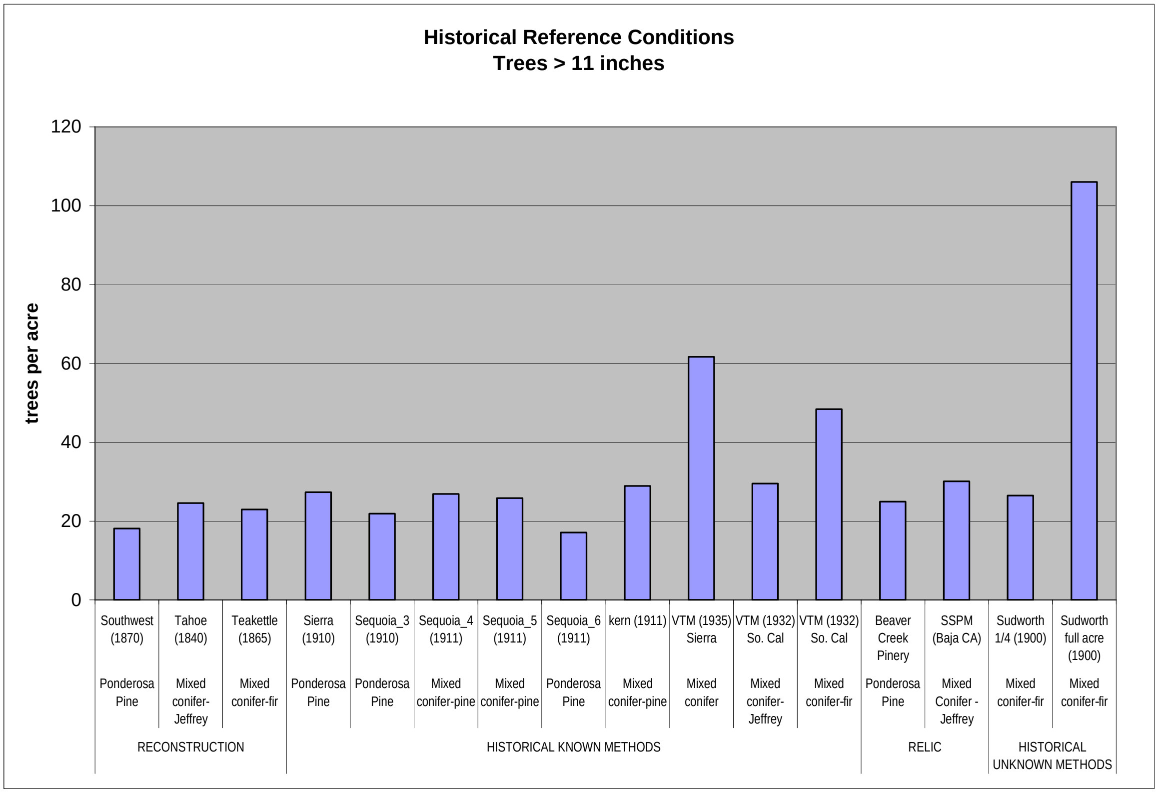


Figure 3-7 - Displays the number of trees per acre greater than 11" for reconstructed forests, relic forests in the Sierra Nevada and Baja California, and historical data sets with known and unknown collection methods. These data sets indicate that historical forest structures had relatively few trees. In addition they compare Sudworth's ¼ acre plots collected in 1900 to other data sets representing the historical condition. The comparison clearly shows that Sudworth's plots expanded to the full acre are not representative of the average historical condition.

Historical data sets used in this analysis are those with known methods of collection and those with unknown methods of collection. Historical data with known methods include VTM data from the 1930s for the Sierra Nevada and the transverse ranges of Southern California, and early 1900 data measured by Show and Dunning for the methods of cut studies (Hasel 1931). George Sudworth's ¼ acre plots from 1900 are a historical data set with unknown methods of collection (Mckelvey and Johnston 1992). The inter-disciplinary team struggled with how to represent Sudworth's data set. The literature indicates that these plots were likely biased and also that there is no clear understanding of the methodology used to collect them (Bouldin 1999, Stephenson 1999, Mckelvey and Johnston 1992). In Stephens and Fiske (1998) the authors narrowly describe the data at the full acre as representative of the sampled acres and not the broader Sierra. The analysis looked at the many other data sets to determine historical conditions and compared Sudworth's plots. This comparison of data by the most casual observation indicates that Sudworth's data expanded to the full acre does not represent the average historical forest vegetation structure. Figure 3-7 displays the various data sources on an equal basis and illustrates the difficulty with using Sudworth's 1900 ¼ acre plots.

Since Sudworth described the data as representative, observers are left with three options: expand the data to the full acre(Stephens and Fiske 1998), which is clearly not representative, only use tree population characteristics of his trees (Mckelvey and Johnston 1992), or leave the data unexpanded (Sudworth 1900a). The third option is how Sudworth himself displayed a portion of his Southern Sierra data set in his USGS paper (Sudworth 1900b). In the EIS, we choose to use his data at the population level and as unexpanded ¼ plots. Sudworth's data expanded to the full acre are shown for comparative purposes.

General Character

Six conclusions about the pre-1850 historical forest prior to the influence of fire suppression and grazing can be made from available sources (Appendix A):

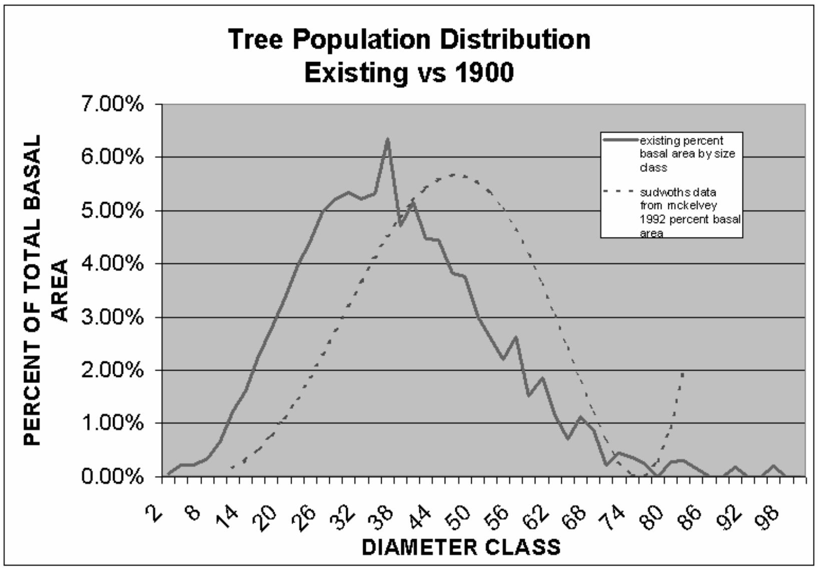


Figure 3-8 displays the proportion of stem area (basal area) by diameter class for the population of measured trees in the initial eight management units (existing) and those measured by Sudworth (1900a and 1900b) as analyzed by Mckelvey and Johnston (1992; 11J & 11L). This indicates an excess of trees below the 38" diameter class in the existing distribution compared to the 1900 distribution.

- The historical ponderosa/Jeffrey pine and mixed-conifer forests of the Kings River Project had relatively low tree densities.
- Large trees dominated the historical forests of the Kings River Project. Open stand conditions lead to the growth of very large trees (>40").
- The historical forest was greatly affected by frequent low intensity fire.
- The historical forest had high heterogeneity within forest types and between forest types.

- Historical forest stand structures were uneven-aged and found in groups. Groups could be even-aged (Bonnickson and Stone 1982) or uneven-aged ages (North and others 2004).

- The historical mixed-conifer and pine forest had a lower frequency of shade intolerant individuals than current forests.

Current Condition vs. Historical Condition

The desired condition is to move the landscape distribution of trees closer to the historical distribution. No landscape data describing the distribution of tree sizes for the historical pre-1850 Kings River Project exist. McKelvey and Johnston (1992) described the distribution of trees measured in 1900 (Sudworth 1900b) for several ¼ plots in the Southern Sierra Nevada. Figure 3-8 displays the existing sample population of trees by percent of basal area across the initial eight management units and the population of trees described by McKelvey and Johnston (1992) of trees measured by Sudworth in 1900. Figure 3-8 indicates that trees smaller than those found in the historical forest dominate the growing space as measured in basal area and that an excess of trees below 38" exists compared to Sudworth's measured trees. The existing condition was determined from combining all plots and determining frequency by diameter class.

Figure 3-9 displays current conditions (tree numbers) for ponderosa pine and mixed conifer plots, proposed minimum and maximum range of trees per acre defined by the inverse J-shaped curve and reconstructed, historical data sets, and relic forests. The figure shows that current conditions for pine exceed all historical, reconstructed and relic forest structures. Mixed conifer stand data indicates that all but the Sudworth at the full acre currently exceeded.

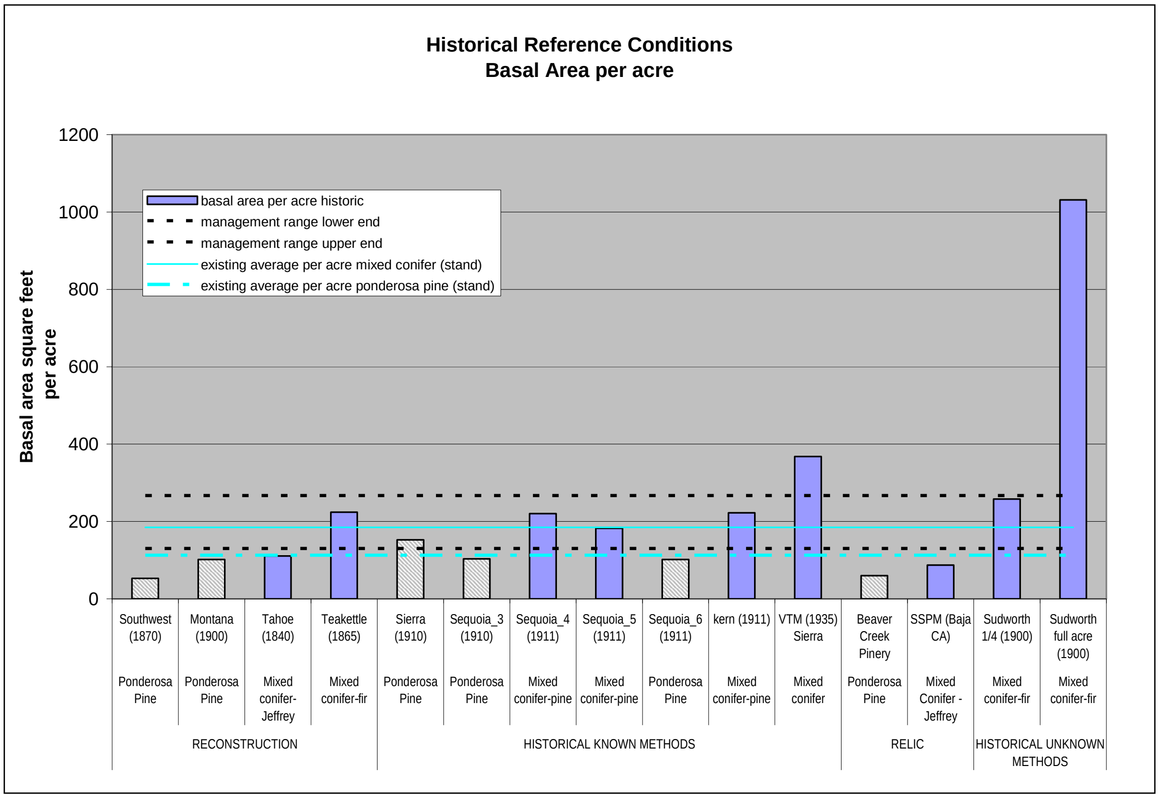


Figure 3-9 - Displays the basal area in square feet for trees greater than 4" of reconstructed historical forests, historical data sets with known and unknown methods, and relic forests of the Sierra Nevada and Baja California. The graph displays the basal area management range for uneven-aged stands in the KRP. In addition, the graph compares the existing average plot condition for ponderosa pine and mixed conifer stands in the eight management units. The graph shows that the management range is higher than most of the historical data sets. The graph also shows that the current condition for ponderosa pine is higher than all but one of the historical data sets. This illustrates that while stem area remains similar to historical conditions stem numbers are much higher than historical conditions. (See Figure 3-11)

Comparisons of basal area of the existing condition to several historical data sets indicate that existing basal area (stem area at 4.5 feet) varies by forest type. Current mixed conifer management units (krew_bull_1, el-o-win_1, glen_mdw_1, krew_prov_1, and bear_fen_6) contain about the same amount of basal area as the historical data sets, but with many more small trees than are represented in the historical data sets shown in Figures 3-9 and 3-11. Ponderosa pine dominated management units (n_soapro_2, providen_1 and providen_4) contain slightly more basal area than the historical data would indicate and also has more small trees.

Comparison of population level data shown in Figure 3-8 and stand level data in Figure 3-9 and Figure 3-11 would indicate that current conditions are denser than historical conditions. Management range is set some what higher than the historical condition. This is especially true for ponderosa pine. The higher range was adopted to maintain canopy cover for spotted owl and Pacific fisher.

Large Trees

Large trees dominated the historical KRP landscape. However, trees of all size classes were represented. Alternatives that increase the dominance of large trees and maintain their persistence in the face of disturbances such as wildfire or insect attack represent the historical forest condition. Trees that are both large and old are important legacies. These large and old trees provide forest structure and have natural resistance to both fire and bark beetles. These trees occur at low frequencies across the KRP than the historical forest.

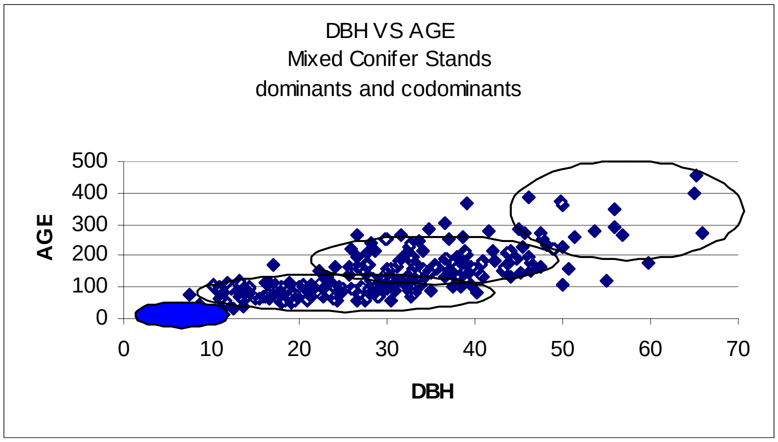


Figure 3-10 – The graph shows age vs dbh and the relative abundance of trees in the age sub-samples, with four cohorts represented, with the youngest age class a solid color.

The frequency distribution of the population of sample trees indicates that trees decline in frequency with increasing size as would be expected across such a large landscape as the KRP (O'Hara 1998). Figure 3-10 displays the age and size relationship in the initial eight management units. Trees over thirty-five inches and certainly over forty inches are both old (> 130 years) and occur at much lower frequencies than younger and smaller trees. However, there is a large cohort of sampled trees under thirty-five inches and greater than 30 inches in DBH and younger than 100 years. These trees have many replacements and have the potential to grow much larger with more growing space (Meyers 1938, Dunning 1942, Assmann 1970). The objective for the KRP is to increase the dominance of trees over thirty five inches by tree removal in the population of trees less than thirty-five inches in the case of the proposed action.

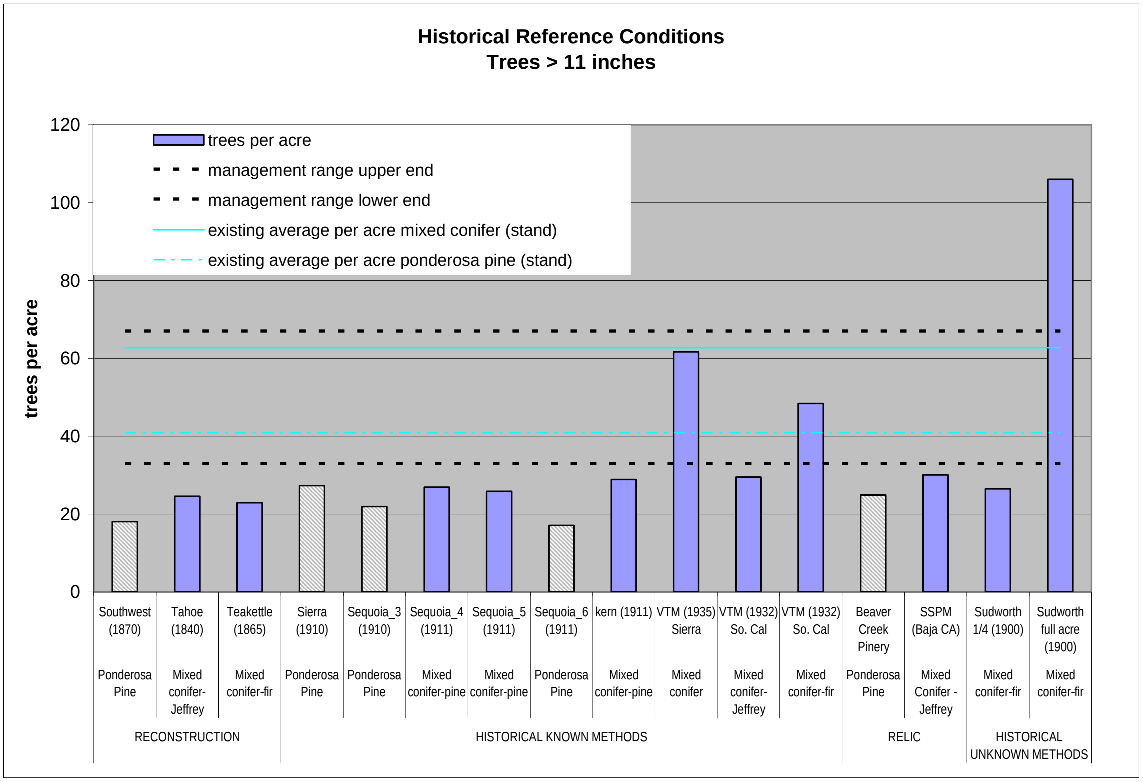


Figure 3-11 - Displays the trees per acre greater than 11" of reconstructed historical forests, historical data sets with known and unknown methods, and relic forests of the Sierra Nevada and Baja California. The graph displays the trees per acre management range for uneven-aged stands in the KRP (bold dash lines). In addition, the graph compares the existing average plot condition for ponderosa pine (thin dashed one) and mixed conifer stands (thin solid lines) in the eight management units. The graph shows that the management range is higher than most of the historical data sets. The management range was set purposefully higher than the historical condition to maintain tree density for Pacific fisher and California spotted owl.

A measure used to compare the effects of alternatives is the numbers of trees removed from stands and the numbers of trees that remain. Comparisons are made at different diameter size classes for each alternative. While absolute numbers of trees do not reveal the relative dominance of trees, they can describe the direct effects of treatments on stand structure and large trees.

Tree Distribution

Creating uneven-aged stand structures that have a minimum of three age classes is an objective of the KRP. Disturbance and succession drive all forests. The frequent low intensity disturbance of the 1850 forest also set the stage for stand initiation and understory re-initiation[3] (Oliver and Larson 1996) and maintained stands in the stem exclusion phase. That is low intensity ground fire and occasional torching of crowns resulted in crown openings that saw the initiation of seedlings. In partial or low disturbance areas, this left an overstory and allowed for invasion of the understory or

[3] Stand initiation is caused by a disturbance that kills all large trees typically caused by fire or insects.

understory re-initiation[4]. This is the case in which disturbance leads to the regeneration of more shade intolerant species (pines and oaks) and can result in an inverse J-shaped curve (Oliver 1995). However, other distributions are possible (Oliver 1995). Scale is important in defining the distribution. If you look at only the opening you may see a normal distribution. If one looks only at a portion of the stand with partial disturbance one might find one of many distributions including the inverse J-shaped curve. However, when one steps back and looks at both the opening and the partially disturbed area stands are more likely to produce an inversed J-shaped curve. This is because young trees invading the understory fill in the lower end of the inverse J-shaped curve and older trees left after a disturbance fill in the upper end. This pathway of frequent low intensity disturbance is the pathway associated with the silviculture strategy for KRP resulting in the inverse J-shaped curve.

[4] Understory re-initiation occurs when understories are invaded by shade tolerant brush or trees.

Table 3-7 – Displays historical data types describing tree size distribution of forest conditions prior to the removal of frequent fire and logging.

Data type	Forest Type	Data Set	Distribution
RECONSTRUCTION	Ponderosa Pine	Montana	modal, flat
	Mixed conifer-Jeffrey	Tahoe	skewed modal
	Mixed conifer-fir	Teakettle	flat
HISTORICAL KNOWN METHODS	Ponderosa Pine	Sierra-methods of cut	inverse J-shaped
	Ponderosa Pine	Sequoia_3-methods of cut	inverse J-shaped
	Mixed conifer-pine	Sequoia_4-methods of cut	inverse J-shaped
	Mixed conifer-pine	Sequoia_5-methods of cut	inverse J-shaped
	Ponderosa Pine	Sequoia_6-methods of cut	inverse J-shaped
	Mixed conifer-pine	Kern-methods of cut	inverse J-shaped
	Mixed conifer	Sierra VTM (1935)	various mostly inverse J-shaped
	Mixed Conifer - Jeffrey	So Cal VTM (1932)	flat
	Mixed conifer-fir	So Cal VTM (1932)	inverse J-shaped
RELIC	Ponderosa	Beaver Creek Pinery	skewed modal
	Mixed Conifer - Jeffrey	SSPM (Baja CA)	various mostly inverse J-shaped
HISTORICAL UNKNOWN METHODS	Mixed conifer-fir	Sudworth 1/4	skewed modal
	Mixed conifer-fir	Sudworth full acre	skewed modal

The Kings River Project proposed to use the inverse-J shaped curve for trees 11 inches or greater as a tool to achieve uneven-aged stands. Uneven-aged stand conditions were prevalent in the historical 1850 Sierra Nevada forest (Bouldin 1999, Bonnickson and Stone 1981, North and others 2004). Several tree distributions have been suggested as representative of this historical condition. North (2005) has suggested the rotated sigmoid. Reconstruction of 1865 forest structures in the Teakettle Experimental Forest (adjacent to KREW-bull management unit) indicates that a relatively flat tree distribution existed after the last major fire (North and others 2006).

Mckelvey and Johnston (1992) display data collect by Sudworth in 1900 showing a highly skewed distribution with more small trees than larger trees. Bouldin's (1999) review of the earliest sierra wide data set (VTM 1935) suggests that distributions with decreasing numbers with increasing size were dominant. Minnich's (1999) review of similar VTM data in Southern California mixed conifer forest showed flat and inverse J-shaped distributions. Data from un-harvested mixed conifer and ponderosa pine stands (c1910) on the Sierra Forest Reserve (Hasel 1931) indicate an inverse-J shaped distribution was prevalent. Data from relic forest in Baja California Sierra San Pedro Martir (Stephans and Gill 2004) indicate that the dominant tree distribution was inverse-J shaped. Relic ponderosa pine forest in the Sierra Nevada structures had a flat distribution following high intensity fire (Oliver 2001), and an inverse J-shaped distribution prior to high intensity fire (Knapp 2006). Ponderosa pine stands across the western United States also show this variability (Arno and others 1995, Covington and others 1997). Table 3-7 displays the tree distribution of several reconstructed forests, historical data sets with known data collection methods and historical data with unknown methods. The table indicates that eleven of the fifteen data sets have an inverse-J shaped curve or a highly skewed distribution. That is they exhibit a generally decreasing numbers of trees with increasing tree size similar that proposed in the KRP uneven-aged management strategy.

Current stand structures range from uneven-aged to even-aged. They are the result of past disturbance (harvests, wildfire, prescribed fire, and insects). Graphs that display the distribution of trees by 2-inch diameter class of each stand are found in the project file. Most stands exhibit declining numbers of trees with increasing tree size. However, only a few stands exhibit balanced uneven-aged structures with trees found in each diameter class. Most stands exhibit a structure that has several diameter classes not represented. Several stands exhibit an even-aged distribution. Figure 3-12 compares tree distributions in each management unit to the desired management range.

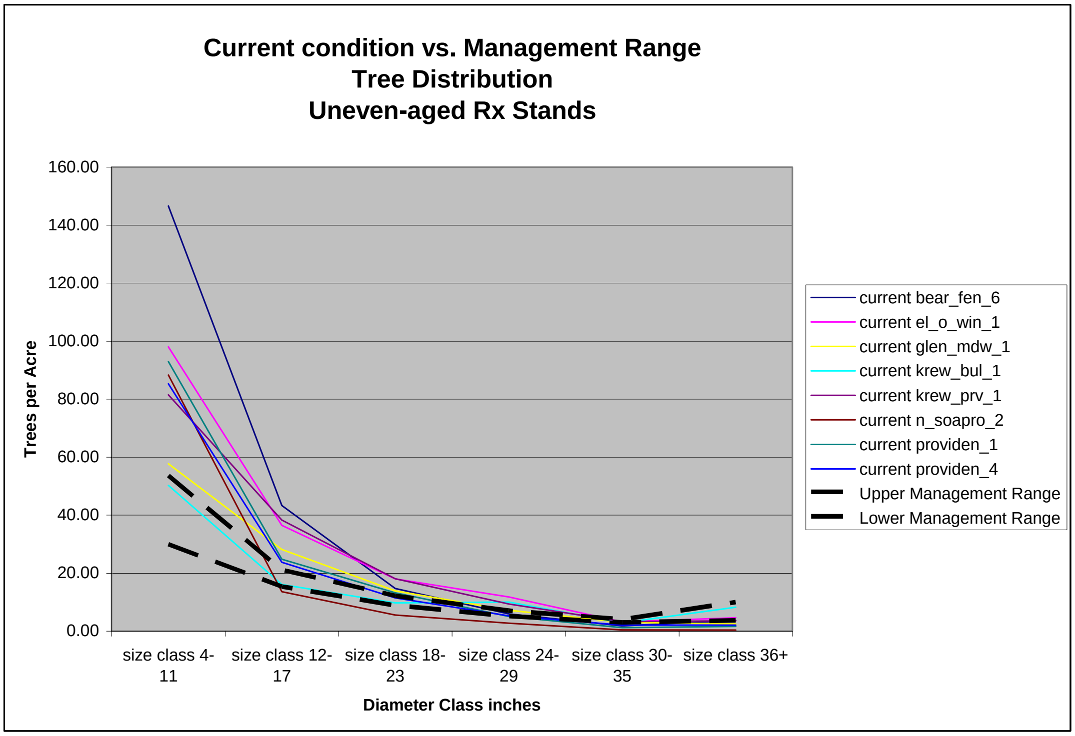


Figure 3-12 -Displays the current tree distribution for each management unit and the desired management range.

Landscape Variability

Canopy cover varied across the KRP landscape based on aspect, site quality, slope, forest type and fire return interval (Appendix C). Determinations of historical canopy were made using potential natural vegetation, site quality, historical descriptions, early photographs of KRP, aerial photographs (1940), early cruise data 1914 to 1926 (USDA 1926), data collect in the early 1900s. These determinations were inherently subjective. The proposed action and no action are compared against the desired landscape canopy cover heterogeneity and the creation of uneven-aged stand structures. These two attributes (uneven-aged and heterogeneity) describe the heterogeneity between stands and within stands that was typical of the historical forest.

Information from Appendix C on the variability of canopy cover for the historic forest indicates that dense and moderately dense canopy cover dominated 33% of ponderosa pine forests, 65% of mixed conifer forests, and the remainder of each type in open or sparse conditions. Information from Bonnickson and Stone (1982) indicates that approximately 30% of the mixed conifer forest they analyzed was dominated by grass, bare ground and brush with 70% in dense and moderately dense tree cover. The KRP values of mixed conifer pine are similar to that of Bonnickson and Stone (1982). Current mixed conifer forest is 90% dense and moderately dense canopy cover. Current ponderosa pine forest types have approximately 80% dense and moderately dense canopy cover.

Heterogeneity is also been described for reconstructed historical Sierra Nevada forests (Taylor 2004, North and others 2004) as well as described by early observers (Dunning 1923, Meyers 1939). Heterogeneity is achieved in the KRP by assigning variable residual canopy targets across the landscape that result in variable residual density and by creating single storied or multi-storied stands. In addition, since the uneven-aged management strategy maintains trees in all size classes it tends to create heterogeneous forest structures (Oliver and Larson 1996).

Implications for Management

These conclusions have several implications for management. Regeneration should be in groups, uneven-aged stands should be promoted, and fewer shade intolerant species and more species resistant to fire such as pines should be favored. Growth should be concentrated on large trees. Regeneration should occur episodically rather than continuously. Variability across the landscape should be promoted. Very large trees greater than 40" occurred often and developed in open stands, management to create open stand conditions can lead to the growth of these very large trees. Frequent fire should be utilized as an important process to maintain historical forest structures. Open and moderately dense canopy cover should dominate across the landscape.

Simply imposing an inverse J-shaped curve does not create uneven-aged structures or restore the historical condition. Uneven-aged structures as discussed above result from partial disturbance and the inclusion of different age classes after disturbance. The inverse J-shaped curve as defined by the BDQ method is a tool. Field application of the uneven-age silviculture prescription requires choices between species, crown position, age class, tree vigor and size (Guldin 1995). Crown position requires the recognition of different cohorts (age classes) in the matrix so that suppressed and intermediate trees are not left. This also results in accentuated age class division in the matrix or allowing layering in other areas. Minimum basal area retention is required to maintain structure and disperse removals across the stand. The J-curve supplies removal or retention targets by diameter class. Regeneration groups are applied to accentuate existing openings or cohort groups were they exist. The resulting stand is one that conforms to an inverse J-shaped curve that accentuates the age classes that currently exist and creates additional age classes in small openings consistent with the historical forest.

The KRP uneven-aged management strategy uses the inverse J-shaped curve for trees between 11" and 30" or 35" in diameter, depending on the alternative and regeneration in groups to promote heterogeneity and homogeneity were appropriate. Prescribed fire is then applied were appropriate and functions as a tool to reduce fuel accumulations, kill small trees and brush (mostly fir and cedar), and reinitiate frequent fire. The fire is important to the KRP uneven-aged management strategy because it tends to depress the number of small trees in the inverse J distribution. An important note is that planted openings are protected from prescribed fire by fire lines or by planting after the initial burns or both. Application of the inverse J-shaped curve does not explicitly manage trees below 11" inches, tree removal based on spacing and fire determine trees below 11". Trees in these lower diameters are managed to remove fuels ladders or provide layering for wildlife.

Environmental Consequences

The direct, indirect and cumulative effects of the proposed action, reduction of harvest tree size, and the no action alternatives are compared. Direct effects are analyzed on the bases of how treatments change existing conditions on approximately 13,700 acres. Indirect effects are those effects that occur as a result of growth or mortality (later in time). Cumulative effects are those that occur as a result of past, present and reasonably foreseeable activities. The spatial boundary for cumulative effects includes the approximately 72,000 acres where the initial eight and ten control management units, current and anticipated plantation maintenance and hazard tree removal projects occur. The temporal scale for analysis of indirect and direct effects is 30 years. The thirty year analysis period encompasses the time needed to recover stand density and tree cover.

Current Landscape Activities

Current landscape activities are those actions in the Kings River Project area that have current decisions or ongoing activities that contribute to cumulative effects on vegetation. These current projects include plantation maintenance, underburning, roadside hazard tree removal, and power line maintenance. In addition, residential development, timber harvesting and vegetation management is carried out on private land holdings inside the KRP area. For a complete description, see the section on past, present and reasonably foreseeable projects near the beginning of Chapter 3.

There are 10,106 acres of plantations across the KRP project area. Approximately 2,319 acres have current treatments with decisions. Current plantation activities across the landscape are: thinning, hand release, chemical release, and planting. The decisions include Power1, Nutmeg, Lost, Men, Bretz, Flat, Progeny Site and Fence.

Fuels reduction projects include the South of Shaver fuel reduction project. This project removes trees using a thinning from below across approximately 1800 acres. Tree removal is generally occurs in trees less than twenty inches in diameter. However, four stands remove trees up to a maximum diameter of thirty inches. Removal is scheduled for 2006 and 2007.

The proposed action will treat 1321 acres of plantations in 2006, 2007 and 2008. An additional 2,578 acres of plantation maintenance are planned for treatment in other decision documents 2006, 2007, and 2008. The remaining plantations are planned for future activities and are not yet included in NEPA decisions.

Roadside hazard projects are scheduled to abate the hazard posed by damaged, dead, or weakened trees found along roads or travel ways used by the public or Forest Service personnel. Commercial timber sales are the tool used to abate hazardous trees. Removal takes place within 300 feet of a road surface. However the distance of tree removal or felling is dependent on the likelihood of hazardous trees to strike the road or block traffic. Tree removal is focused on weakened or dead trees. Roadside hazard removals treated approximately 90 miles of road in 2003 and 2004 and removed 1734 trees from the KRP. Since rot or mortality is the primary causes for tree removal, trees larger than 24 inches in diameter are often removed. Trees with excessive rot or those with out commercial value are felled and left in place. A total of 629 trees greater than 30" inches were removed.

The Helms/Gregg 230 kV Transmission Line right-of-way runs across the southern boundary of the KRP landscape. The right of way for this transmission line occupies approximately 371 acres. Maintenance of vegetation with in this right of way includes the spraying of chemicals to reduce large vegetation, the felling of hazard trees, and the cutting of vegetation. Vegetation objectives for the transmission line are to maintain a cover of low growing natural species that provide soil cover and early seral stage wildlife habitat. Hazard tree removal and right of way clearing removed: 500+ trees cut <10", 324 trees cut 10" - 29", 206 trees cut 30"+. Herbicide spray, brush cutting and tree cutting occurred on 399 acres underneath the power line in 2005 and 2006.

Southern California Edison and several private individuals own approximately 15,000 acres of land within the KRP boundary. These lands are managed for wildlife benefit, recreation and timber production. Southern California Edison lands are managed using an uneven-aged silvicultural system that conforms to the California's Forest Practice Act. Private individuals who manage their lands for scenic beauty and recreation own the Grand Bluffs and Twin Ponds properties. The Grand Bluff property owners have a cooperative fuels reduction grant from the Forest Service and the State of California. Landowners are coordinating fuels reduction activities with the Forest. Grand Bluffs Private holdings are adjacent to the Power 1 thinning and krew_prov1, providen_4 projects.

Approximately 1500 acres is harvested each year from Southern California Edison lands yielding approximately five million board feet annually across all diameter classes. Typical prescriptions remove approximately thirty percent of standing stem area. Tree removal has no size limit. However, requirements for the protection of "old growth" are part of timber harvest plans. Tree removal is accomplished using tractor logging on slopes less than 40 percent, and using helicopter logging on steeper slopes.

Development on private lands (Wildflower Village) will create single-family homes across 160 acres. Homes will be over 2500 square feet with driveways. Homes could disturb as much as 1/3 acre per home. The areas have been logged in the past and home site construction will permanently remove trees from forest cover. Adjacent forests are typically left intact following construction.

Environmental Consequences of Current Landscape Activities Common to All Alternatives

Plantation treatments with current decisions reduce brush cover below 20 percent through directed chemical spray of glyphosate, hand release, tractor piling, and mastication. Thinning is accomplished using hand cutting and machines. Plantations younger than 15 years have slash lopped and scattered. Older plantations have thinned material piled, shredded or removed from the site. Current decisions remove plantation trees less than 55 years old. Spacing ranges from 18 feet to 24 feet in older plantations. Canopy cover is reduced in all plantations. However since canopy cover is composed largely of trees less than 12 inches, changes will not affect meeting the fisher canopy goal of 50 percent cover in CWHR size trees 4 and 5. The Bretz and Power 1 Thinning remove trees as large as 20 inches in diameter. These two plantation projects include reductions in tree density from sixty percent to 45 percent in CWHR size 2 and 3. The effects of treatments are to accelerate tree growth. Trees grow larger, but do not contribute to the pool of trees over 30" during the thirty year analysis period. The effects of severe fire are reduced due to lower surface fuels from fuels treatments, lower brush cover and increases space between trees. This increased space improves tree vigor and increased resistance to insect attack. Plantation treatments move stands along a growth trajectory that accelerates tree size. Larger trees are consistent with the historical condition.

The effects of the severity of underburns for the past eight years are displayed in Figure 3-16. This shows that underburns are typically cool and of low severity. Experience with the KRP underburn program indicates that prescribed fire will tend to reduce surface fuel loading after two burns. Few medium or large size trees are killed. However, the many small trees killed could increase the insect habitat and result in pockets of insect mortality. The reintroduction of fire into the ecosystem through the 17,300 acre burn program is consistent with the historical forest conditions.

Hazard trees removal result in the removal of approximately 250 trees greater than 30 inches each year. The scattered nature of these weakened or unstable trees produces no measurable effect on canopy cover. Trees typically are removed in groups of 1 to 3 trees. The net effect across the landscape is to reduce average trees per acre greater than 30 inches less than .01 trees per acre across the 72,000 acres expected to have the uneven-aged management strategy. Hazard tree removal does remove large fuel from the roadside that could increase fire intensity; however the over all effect to fire mortality is small due to the few trees removed. The removal of hazard trees will not lower tree density or remove disease vectors sufficiently to lower or increase the resistance to insect attack. The removal of large old trees that may contain rot moves the landscape further from the historical condition. However, since so few trees are removed the effect across the landscape on the historical condition is low.

The largest private landowner in the KRP area is SCE. The effect of implementing the SCE uneven-aged silvicultural system is to reduce canopy cover. Canopy cover typically remains above fifty percent. Thus private landowner treatments should not reduce the number of acres meeting the fisher goal. Reductions in surface fuels, ladder fuels and more open canopy density will reduce fire severity across approximately 1500 acres each year. The entire SCE property should be treated in 10 to 15 years. Reduced tree density will increase tree vigor and tend to reduce insect attacks. The uneven-aged management strategy used by SCE should increase the acres that meet the historical condition.

Power line treatments will continue to keep these areas dominated by early brush and grass. Power lines reduce the number of acres available to grow large trees and meet the historical forest conditions.

The South of Shaver fuels reduction project applies thinning from below to reduce tree densities. Treatments will keep treated stands below imminent risk of insect attack. No regeneration of openings occur in this project, however prescription favor keeping pine and oaks over incense cedar and white fir. Over time treated stands should experience small increases in pine and oak species, significant reductions in tree numbers (from more than 600 to less than 200 trees per acre), and increased resistance to severe fire. Underburns and tractor piling will result in lowered brush cover.

Alternative 1 - Proposed Action

Direct Effects to Canopy Cover: Both thinning from below up to a maximum diameter of 20 inches in the California Spotted Owl Study (CSOS) and up to a maximum diameter of 35 inches in the KRP uneven-aged management strategy are proposed to increase growing space and reduce fuel ladders. Reductions in canopy cover result from this process of removing trees during thinning. Canopy cover greater than 40 to 50 percent is an important habitat component for California spotted owls and Pacific fisher (Verner and others 1992, Zielinski and others 2004). Canopy Cover more than 50 percent in CWHR size classes 4 and 5 for 50 percent for potential fisher habitat is identified as a goal in the proposed action. In addition, canopy density has been shown to have a relationship to fire behavior and severity (Jain and Graham 2004). Changes in canopy cover resulting from mechanical and hand treatments are addressed in this section. Phase I and II modeled results from FVS are used to display changes in canopy cover (Figure 3-13). Critical levels of canopy cover seem to be at 50 percent for wildlife habitat and 40 percent for crown fire behavior modifications. The proportion of acres greater than 50 percent canopy cover and CWHR size class 4 and 5 are displayed in Figure 3-13 for each management unit. This figure shows that tree removal reduces the acres that meet the fisher goal in each management unit. These results include changes that occur as a result of the uneven-aged management strategy, prescribed fire and thinning in the CSOS.

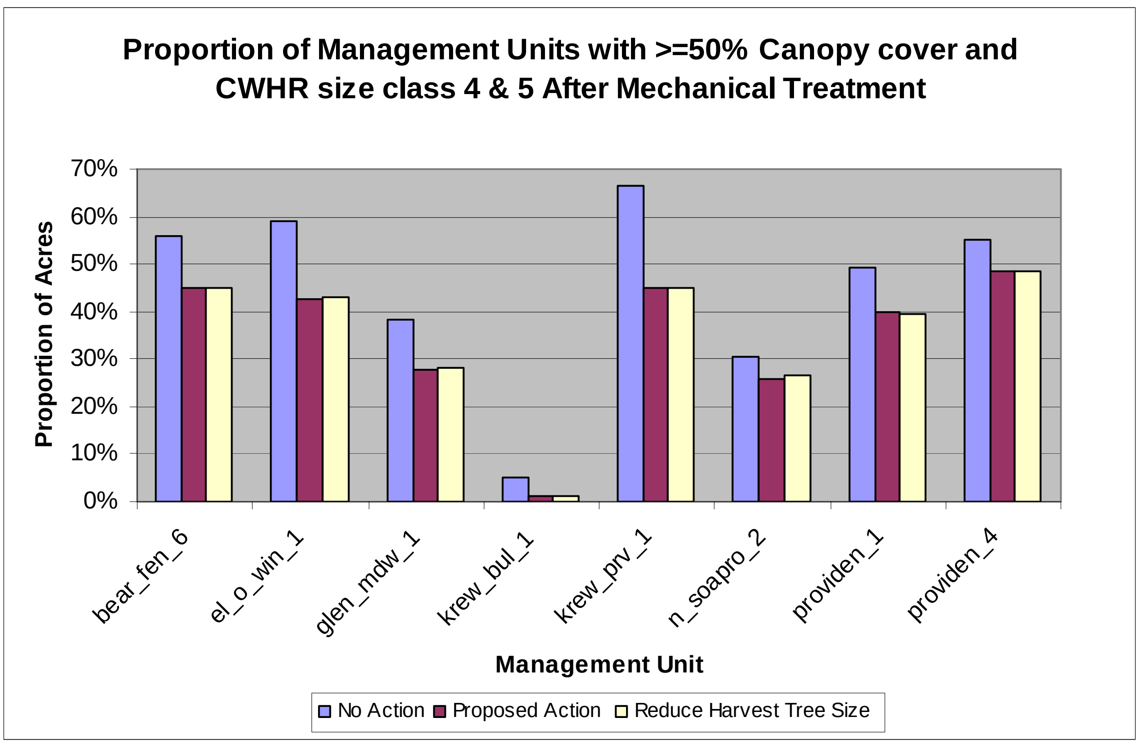


Figure 3-13 - The above graph displays the proportion of initial management units that meet the fisher habitat goal. The fisher goal is across the landscape; however data is present here by management unit to compare direct affect between management units.

Since the preference for regeneration groups is in areas of existing low stocking, such as brush fields or pockets of insect caused mortality, canopy reductions are minor so have little impact in attaining the fisher goal.

Direct Effects to Stand Density, Forest Health and Insect Attack: Mechanical and hand treatments have the direct effect of removing trees. In the California Spotted Owl Study PACs suppressed and intermediate trees are removed from the understory to provide for increased growing space for dominant and codominant trees in the overstory and remove fuel ladders. The dominant and codominant trees are those trees most likely to benefit from increased growing space. In the uneven-aged management strategy trees are removed consistent with J-curve for between 11" and 30" or 35" in diameter, depending on the alternative. The removal of commercial size trees would occur concurrently or prior to the removal of stems of pre-commercial size trees (less than 11 inches). Tree removal will be accomplished using skidders, mechanical harvesters, masticators or hand cutting (chainsaws). Cut trees will be transported to the landing, lopped and scattered or burned.

Stand density index is used to compare the risk of insect mortality between alternatives. Benchmarks that correspond with 35 percent of maximum stand density index (on set of increase insect mortality) and 60 percent (imminent risk) of maximum stand density index are identified as thresholds for insect activity (Oliver 1995, Oliver and Uzoh 1997). The more plots found during stand examination over the threshold the greater the potential for insect mortality. Plot level assessments of stand density index were conducted for approximately 1500 plots across the initial eight management units (phase III modeling) and the South of Shaver project.

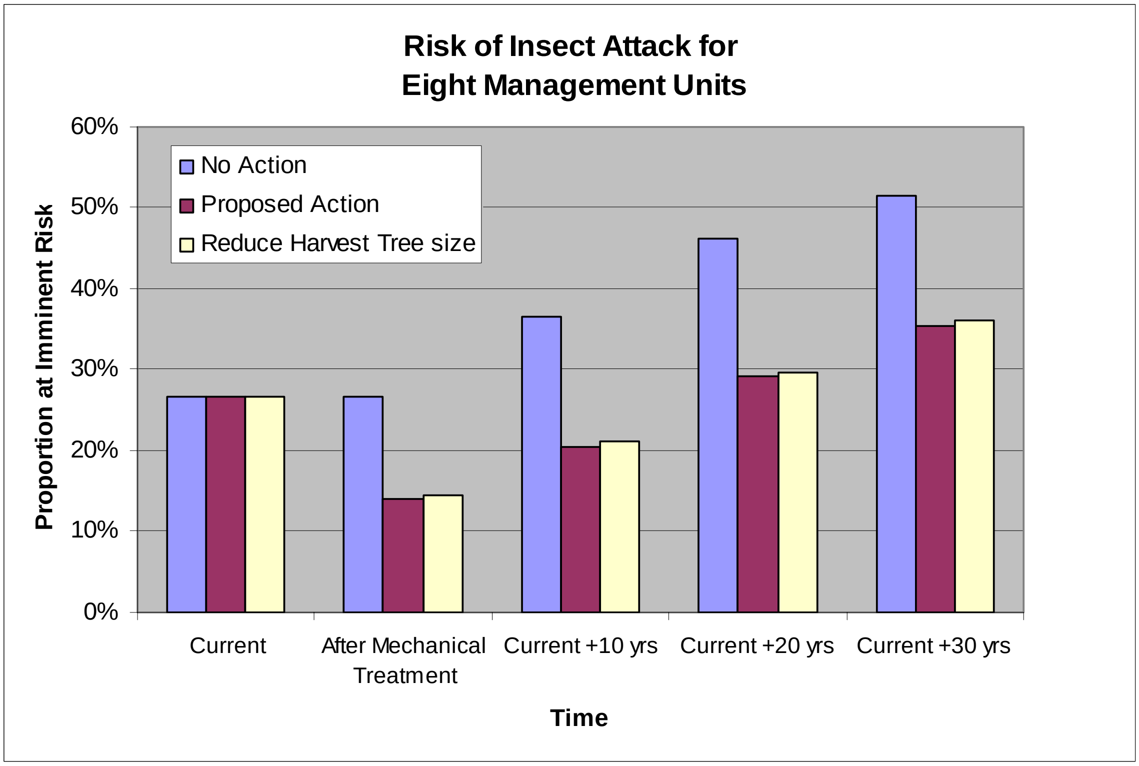


Figure 3-14 - Displays the proportion of plots that exceed the imminent (epidemic) threshold for insect attack and thus experience lower tree vigor. (Phase III model results)

The direct effects of Alternative 1 and Alternative 3 would be to reduce the number of plots above threshold, therefore, the portion of the initial eight management units above the upper stand density threshold would also be lowered (Figure 3-14). Lowering the number plots above the threshold reduces stand density. Trees at lower densities are under less competitive stress for site resources and have greater vigor. The resulting stand structures would be more resistant to bark beetle attack and less prone to large changes in the number of large trees and canopy density. Increased resistance to insect attack and subsequent changes in habitat structure will lead to healthy forest conditions. The action alternatives do not eliminate the potential for insect attack or disease. Under these alternatives opportunity for insect attack still exists in fifteen percent of treated plots. Modeled results would indicate that the creation of snags important for wildlife habitat would continue across the initial eight management units.

Proposed treatments reduce insect attacks by increasing resistance. A non-peer reviewed article by Black (2005) reviewed the literature on the effects of logging to control insects. Blacks review indicates that tree removal can increase tree vigor but is not effective in controlling infestations once a bark beetle outbreak occurs. Eighteen cited papers in Black (2005) report the effects of thinning on bark beetles, 14 of these clearly show a positive effect of thinning on preventing bark beetle attack and mortality of the residual trees. The Black report cites 42 papers under “Effectiveness of Thinning” but only 18 of these papers report the effects of actual “thinning” on bark beetles. The other 24 cited papers report the effects of stand density, salvage logging, tree physiology, fire, or other stand conditions but not thinning on bark beetle populations and dynamics. The benefits of reducing tree density and increasing resistance to insect attack is supported by studies that look at the stand structures that lead to insect attack in California (Oliver 1995, Oliver and Uzoh 1997) and studies that look at tree vigor (Miller and Keene 1960, Furniss and Carolin 1977, Larsson and others 1983).

Table 3- 8 – Displays the number of stands with tree removals in four diameter classes for the 8 management units

	No. stands w/ 0" to 10" trees thinned	No. stands w/ 10" to 20" trees thinned	No. stands w/ 20" to 30" trees thinned	No. stands w/ 30" to 35" trees thinned
0 trees thinned / acre	19	29	51	63
0 to 1 trees thinned /acre	3	4	32	67
1 to 2 trees thinned /acre	0	9	12	13
2 to 3 trees thinned / acre	1	4	11	2
3 to 4 trees thinned / acre	0	7	15	0
4 to 5 trees thinned / acre	1	8	6	0
> 5 trees thinned / acre	121	84	18	0
Total	145	145	145	145
Total acres	13715	13715	13715	13715
Total tree removals all management units	3,328,278	123,754	23,539	4,273

<u>Direct Effects to Large Trees, Diameter Distribution and Species Composition:</u> A direct effect of the uneven-aged management strategy is to reduce trees in excess to the desired J-curve distribution between 11" and 30" or 35" in diameter, depending on the alternative. Trees larger than 30 or 35 inches remain unchanged as a result of tree removals. Table 3-8 displays the number of stands that have twenty five to thirty five inch trees removed and the number of trees per acre removed. It is evident that few trees are being removed in these diameter classes (Table 3-8).

Canopy cover in medium size trees is reduced to meet the objective of reducing the potential for crown fire and increasing the growing space for remaining trees, especially large ones. In as much as the removal of small trees reduces the fuel ladders that threaten the persistence of large trees during a wildfire event or during underburning, the direct effect is to increase the likely hood that these large trees will survive (see Figure 3-20). This is consistent with published research that indicates that understory thinning and the uneven-aged management strategy benefits the protection of large trees (Agee and Skinner 2005).

The proposed action and the reduction of harvest tree size alternative favor the removal of incense cedar and white fir. Black oak, disease free ponderosa pine and sugar pine are preferred as trees to leave. While in some stands this results in higher percentages of preferred leave trees it generally does not change the dominance of the intolerant and less fire resistant incense cedar and white fir. This is largely due to the high numbers of these species in the existing structure.

<u>Direct Effects of Group Regeneration:</u> Gaps are by nature small openings in the forest canopy. Past experience indicates that some are distinct and can be mapped, most however are small and only found after field review. Gaps are subject to the same effects of secondary succession as brush fields; however because of the small size, gaps have more forest edge relative to the opening. This results in the neighboring intact forests having a strong influence on the growth of vegetation in the gap (York and others 2004). Gaps created from insect, disease or fire mortality are the emphasis for group regeneration. However in stands with few or no gaps, groups will create openings.

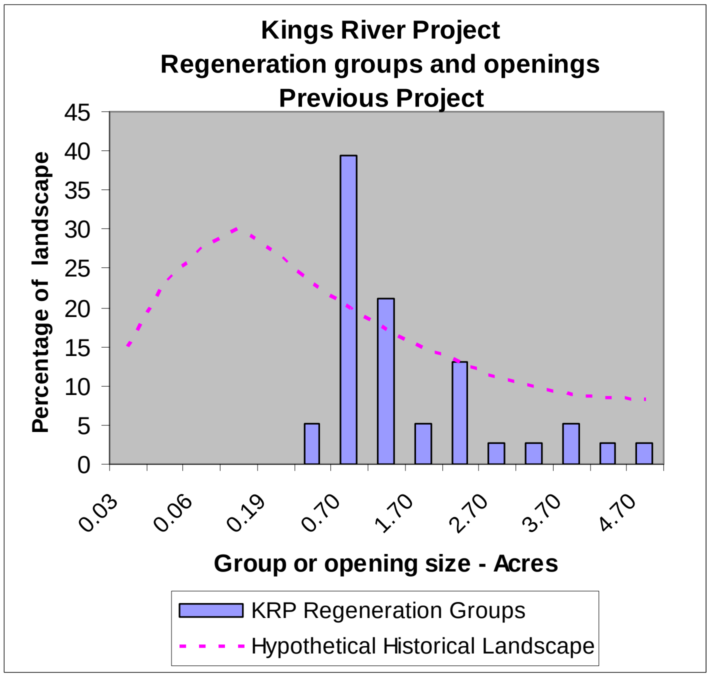


Figure 3-15 - displays the estimated canopy gaps for mixed conifer forest proposed by Stephenson (1996) and the size and frequency of regeneration groups created by the uneven-aged silviculture system in the KRP. Groups smaller than .7 acres occur, but these groups were not planted. Groups larger than 5 acres occurred but were created by fires or even-aged management

The direct effects of the proposed action are to located areas of low density and prepare these areas as groups for the regeneration of conifers and oaks. A maximum size of three acres is proposed for regeneration groups. The variability of existing openings or areas with low tree density results in a variable distribution of group sizes. The method of finding and creating groups in the proposed action is similar to the method used in creating groups in previous KRP work. The past treatments differ in that the maximum regeneration group is smaller in the proposed action. Figure 3-15 displays the distribution of regeneration groups and planted openings from a previous project in the KRP and the historical distribution of gaps proposed by Stephenson (1996). This figure displays those groups smaller than three acres dominated. The highest proportion of groups is composed of those approximately 1.25 acres. The smallest openings measured were .7 acres. Many smaller openings occurred as a result of the uneven-aged management strategy, but were not measured. Natural regeneration would be allowed to occur in these small gaps. Stephenson's (1996) proposed historical distribution of gaps is skewed to openings of 1/3 acre. Figure 3-15 indicates that the proposed action would result in higher average size of forest openings than the historical condition suggested by Stephenson (1996).

In the reduction of harvest tree size alternative, no groups would be created but existing openings would be reforested

Existing openings and/or created groups are planted with approximately 300 to 400 trees per acre. District records indicate that typical survival rates for bear_fen_6, krew_prov_1, el-o-win_1, glen_mdw_1, n_soapro_2, providen_1 and providen_4 management units are above eighty percent. Seedling survival for management unit krew_bull_1 would be approximately sixty percent. Rock and other obstructions reduce the total number of spots available for planting. Thus a planting spacing of ten feet apart yields 435 gross seedlings per acre inside groups. There are typically twenty percent obstructions and rock and eighty percent survival yields approximately 278 seedlings within groups. Groups and planted existing openings will occupy approximately ten percent of stands. Thus groups will contribute approximately 28 trees per acre across any stand. The reforestation contributes to filling the diameter classes below 11" in diameter in the inverse J-shaped curve. Spacing of planted seedlings will vary to achieve the approximately 300 to 400 trees per acre. In areas with lower expected survival seedling spacing would be as close as eight feet apart.

<u>Direct Effects of Groups and Competing Vegetation:</u> While overstory trees and edge trees around reforestation groups may reduce the growth of planted and natural seedlings, the reduced solar radiation from these trees may benefit the initial establishment of red fir, white fir and incense cedar (Erickson and others 2005). Other species such as shade intolerant Jeffrey pine may experience lower survival in these shaded conditions (Erickson and others 2005). In groups with few large trees the proposed action and the reduction of harvest tree size alternative will favor pine and oak species. In groups with more overstory trees the effect of these alternatives will be to favor the establishment of fir and reduce the survival of shade intolerant pine species. However, the reforestation of existing and/or created openings will be favored pine species over all.

The proposed action and the reduction of harvest tree size alternative treats bear clover where it competes with planted seedlings in existing plantations not meeting stocking requirements, brush fields and reforestation in existing and/or created openings. They treat competing bear clover by a directed backpack spray of glyphosate + surfactant. Two applications of glyphosate have been typically required to reduce bear clover cover below twenty percent. The direct effect of this treatment is to kill both the above ground stem and the below ground rhizomes. Bear clover is seldom eliminated from an area treated with glyphosate. Grasses often invade areas with reduced cover of bear clover and other brush species. Grasses are effective competitors for site resources. The second application of glyphosate will also control invading grass species.

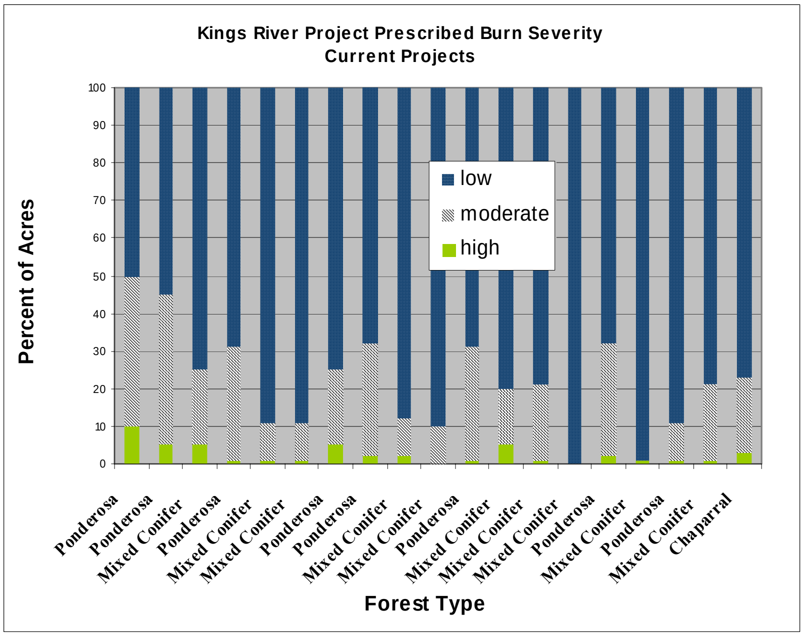
Green leaf manzanita and deer brush which sprout and whitethorn which does not sprout can also germinate from seed stored in the soil. Direct effects on ceanothus species and green leaf manzanita are reduction of above ground cover through mastication, tractor piling, and hand cutting (chainsaws and manual release) and underburning. Below ground root systems will be disrupted or killed through tractor piling (brush rake), underburning and chemical application. Each treatment has a differing effect on the species capable of sprouting. Treatments that remove only the above ground stems of sprouting species are ineffective in control. However, the above ground removal reduces the size of plants and reduces leaf cuticle thickness. Both these results make subsequent chemical treatments more effective. Tractor piling serves to disrupt below ground roots. It reduces the mass of roots, but stimulates sprouting.

Underburning can reduce both the above ground green leaf manzanita stems and below ground roots. Underburning however also stimulates sprouting (Kauffmann and Martin 1990). In a study of burning in the Sierra Nevada mixed conifer, results indicate that spring burning had the most sprouts, while fall burning results in the most plant mortality. Monitoring results from two underburns in the KRP indicate that 53 percent and 62 percent of existing brush canopy cover was killed in these burns. However, the spring burns typical in the KRP are not effective in killing the root systems of sprouting species. Similar results can be expected in the proposed action and the reduction of harvest tree size alternative.

Glyphosate spraying of ceanothus species is most effective when sprayed on small and tender plants. Hand cutting is planned for the control of whitethorn seedlings or where plants are less than 2 feet tall. Manual release of whitethorn is ineffective on large plants or large roots. Manual treatments on deer brush are ineffective and are not planned. The proposed action and the reduction of harvest tree size alternative treats existing large plants through cutting or shredding (mastication). A follow up spray of glyphosate + surfactant (R-11) are used to kill the large root systems.

Non-target plant species are likely to be killed by proposed treatments. This is true for both mechanical and chemical treatments. Both the mechanical and chemical treatments are proposed for stands that will contain a mosaic of both understory vegetation and logging residue. Mechanical treatments while directed at larger woody plants and removal of logging residue will tend to treat all brush species found in areas available for treatment (outside of streamside management zones, owl nest buffers). Chemical treatments may also kill non-target species in treated areas. This results from the intermixing of target and non-target species. However, past experience and research indicates that non-target species are not eliminated from treated stands (McDonald and Fiddler 1995).

<u>Direct Effects of Prescribed Fire on Vegetation:</u> Underburning is conducted to reduce the amount of fuels on the forest floor under a managed prescription. The burning prescription will be conducted so that low intensity fire will move through the stand. Flame heights should be less than one foot. Underburning will occur alone or after harvest material is removed from the stands, slash is piled or masticated.



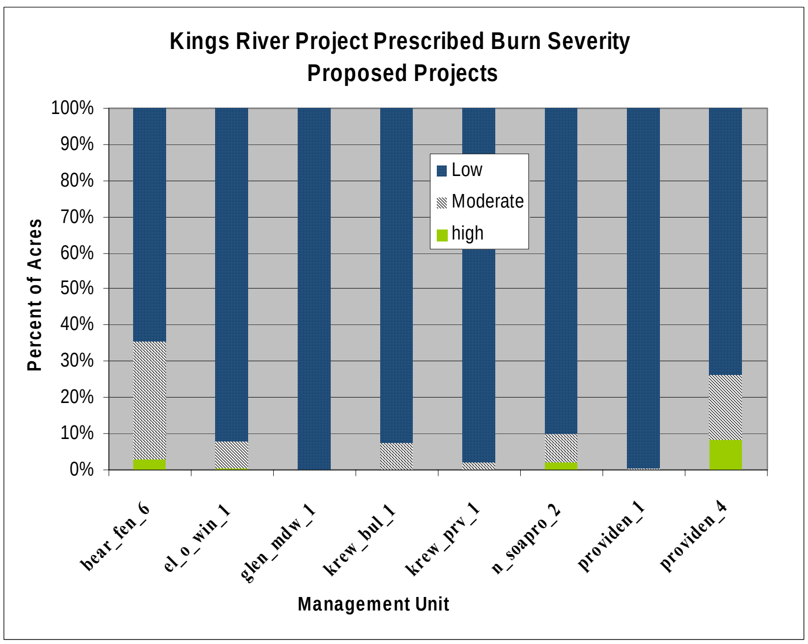


Figure 3-16 - Displays the severity of previous individual underburns by forest type. Each bar represents a singly underburn in the forest types displayed in the X axis. Figure b (lower) displays the severity of underburning simulated in the eight management units for the action alternatives. Burn severity is based on the change in basal area. 0-10%=low, 10-50%=moderate, and 50-100%=high severity.

Several stand structure components are affected by prescribed burning; overstory trees, understory trees, brush, snags, and logs. The direct effects of underburns on trees have been monitored for the KRP. Monitoring has been extensive with fuels management personnel classifying fire severity (high, moderate, low) across underburns and intensive with plots quantifying the amount of mortality of trees and brush. Prescribed underburns in the proposed action and the reduction of harvest tree size alternative are designed to have similar fire behavior as previous underburns across the KRP. Fire severity classes represent the direct effects from prescribed fire and not effects associated from insect mortality. Crown scorch and loss in basal area was used as the measure of fire severity. Scorch heights and thus the direct effects on vegetation should fall within the range of severity experienced during the last 8 years.

Model results indicate that underburns will kill less than one tenth of a tree per acre over 30 inches. The KRP has currently approximately 17,000 acres in an underburning program. Underburns (prescribed fire) have been accomplished in ponderosa pine, sierra mixed-conifer, montane hardwood conifer, montane hardwood, and montane chaparral CWHR types. Fire severity examined in terms of tree and brush mortality has been monitored intensively on one burn and severity categorized for other burns on the KRP using scattered monitoring plots and observations from burn bosses. Severity is divided into low, medium and high direct effects of fire mortality. Low fire severity is composed of fire scorch less than fifteen feet tall. Most trees taller than fifteen feet will survive. Low severity areas will experience less than ten percent reduction in basal area. Dominant tree crowns over fifteen feet will appear green or unburned. Medium severity fire will result in fifteen to fifty foot scorch height. Ten to fifty percent of existing basal area may be lost. Many trees will have brown needles. High severity areas will have scorch height greater than fifty feet. More than fifty percent of the basal area will be lost. High severity areas will have blackened crowns and brown crowns.

A detailed examination of the mortality experienced during the Barnes Mountain Burn (ponderosa pine type) indicates that 53 percent of existing brush was killed during burning (Ballard 1999). Tree mortality was largely confined to trees less than 5" inches in one portion and 11 inches in another portion, however, 1 tree over 43 inches died as a result of both fire and insect activity. The KRP underburn severity is in contrast to severity experienced during prescribed fire at Sequoia and Kings Canyon National Park that neighbors the Sierra National Forest. Intensive monitoring of one prescribed fire indicated that as much as ten percent of dominant trees were killed by both fire and insects (Mutch and Parsons 1998). The character of fire severity differs between the Forest and neighboring Parks for several reasons: 1) Park objectives are often to create openings and kill trees taller than fifteen feet and up to thirty inches in diameter, while the Forest objectives are to consume ground fuels and kill small trees and brush, 2) the Park objectives drive prescribed fire prescriptions with flame lengths over 2 feet, while Forest objectives drive fire prescriptions with flame lengths less than 1 foot. Shorter flame lengths reduce fire intensity and subsequent tree mortality.

Observations of underburn severity from previous underburns and proposed underburns are displayed in Figure 3-16. Results of past underburns displayed in Figure 3-16a indicate that past underburns experience less than 10 percent high mortality. Medium severity is more variable. Indirect effects result from subsequent western pine beetle attack. The severity experienced from the underburning program in the KRP is consistent with model results for the proposed action and the reduction of harvest tree size alternative. Results of past underburns (Figure 3-16a) indicate that some management units experience high understory mortality and little overstory mortality, while other management units experience some pockets of moderate overstory mortality. This moderate mortality could be seen as small pockets (less than 1 acre) of dead trees scattered across burn areas. Rarely larger pockets would result from the combination of both insects and fire.

Modeled results that show acres of high, moderate and low severity resulting from underburns are displayed in Figure 3-16b. Most management units tend to fall within the range of severity experienced in previous burns. However, modeled underburns in the bear_fen_6 management unit result in mortality and changes in stand structure not experienced during actual burning completed in bear_fen_6 (Oak Flat burns). The model results indicate that white fir severity is higher than monitoring in this area would indicate. This is likely due to underlying model equations that tend to kill fir trees and the high amount of fir in the bear_fen_6 unit. Never the less model results for all management units fall with in the range of results experienced across previous underburns in the KRP. That is that underburns tend to be of low severity for overstory trees, kill most trees less than 8”, and kill high proportions of above ground brush stems. Monitor results of the Barnes South and Barnes North Underburns indicate that less than three overstory trees (larger than 20”) were killed over several thousand acres.

Large woody debris provides important wildlife benefits. While KRP underburns consume ground fuels not all large logs are consumed in fires. The survival of logs during underburning varies based on fuel moisture, surface fuel loading, and topography. Monitoring results from the Barnes south underburn indicate that post burn; there were 16 logs per acre greater than 10” large end diameter after burning. Seven of these logs were greater than 16.0”. Underburns in the proposed action and the reduction of harvest tree size alternative should result in similar numbers of logs.

Broadcast burning is conducted to consume brush that has been crushed in chaparral stands. Broadcast burning is designed to create large wholes in chaparral stands and change the age class of brush. The direct effect of broadcast burning is to kill above ground portions of chaparral species. Most of these species are capable of sprouting or aggressively germinate from seed following broadcast fire.

Indirect effects

<u>Indirect Effects to Canopy Cover:</u> Indirect effects on canopy cover are those that occur as a result of growth or mortality following proposed treatments. The proposed action and the reduction of harvest tree size alternative do reduce canopy cover on several hundred acres. This reduction is the result of both tree removal treatments and underburning. However, trees that remain following thinning and the uneven-aged management strategy reoccupy growing space and increase canopy cover with time. Canopy cover increases over the thirty-year analysis period following thinning in the CSOS and applying the KRP uneven-aged management strategy due to growth

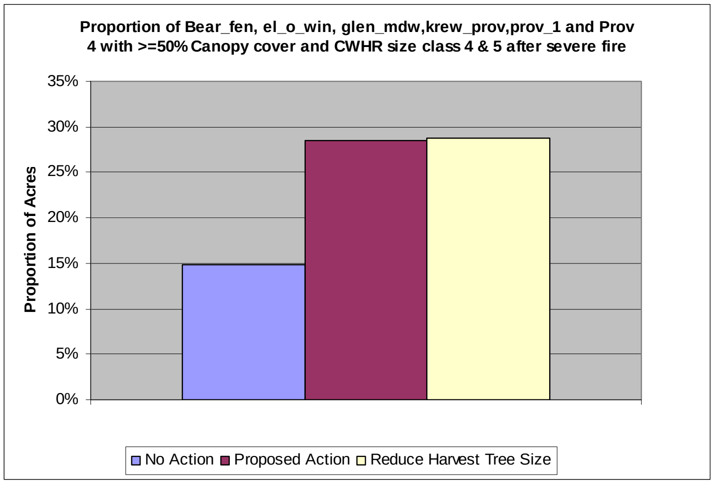
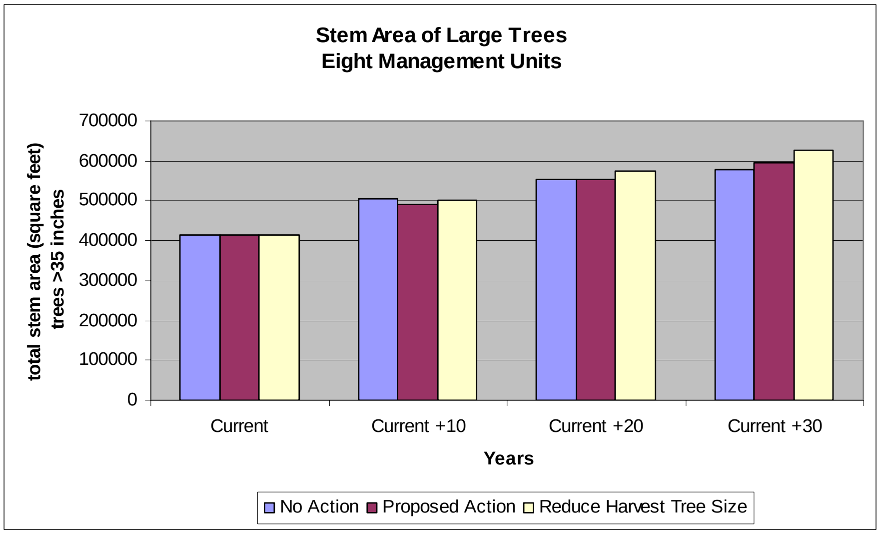


Figure 3-17 – Displays the effects of severe fire on canopy cover across all eight management units.

Indirect Effects to Stand Density, Forest Health and Insect Attack: The proposed action and the reduction of harvest tree size alternative reduce tree stress by increasing available water, and in so doing it also lowers the potential for insect attack. It does not eliminate the potential. Insects will continue to play a role in shaping stand structure. A study that compared thinned and un-thinned stands of ponderosa pine demonstrated an increased resistance to insect attack from thinning over a 32-year study period (Kolb and others 1995). While stand structures will be more open, dense portions of stands will exist across the initial eight management units (see Figure 3-14). These individual trees and pockets of trees will be prone to insect attack. Insects will cause mortality creating snags and habitat. This is consistent with what has been observed in mixed conifer stands analogous to the desired historical condition and desired condition for the KRP (Maloney and Rizzo 2002). In open mixed conifer stands that have continued to experience low intensity fire, similar to what occurred in the historical forest, insect activity was very low and tended to kill large old trees. This is because old trees are less vigorous, even though they are well established and have access to water held deep in the soil or bedrock.

Growth results in increases in stand density across all management units. Stand density in the initial eight management units increases following treatments and surpasses the current condition after 20 years. This would indicate that resilience lessens with time after treatment. However, the proposed action and the reduction of harvest tree size alternative have a lower portion of stands below the upper management threshold than the no action alternative throughout the first 30 years. The proposed action has slightly less (<1%) risk than the reduction of harvest tree size alternative.

Tree removal results in the creation of logging residue (slash) and can damage individual trees. Logging residue can result in the creation of habitat for pine engravers (Ips species) when young trees less than eight inches in diameter are thinned. If slash is created between January to June or when slash does not have time to dry, then bark beetles can breed in slash and latter emerge to damage or sometimes kill conifers (Furniss and Carolin 1977). Design criteria and forest policy seek to limit the availability of slash for habitat by limiting the time when slash is created. In addition, trees damaged during logging are removed to prevent vectoring disease and insects.



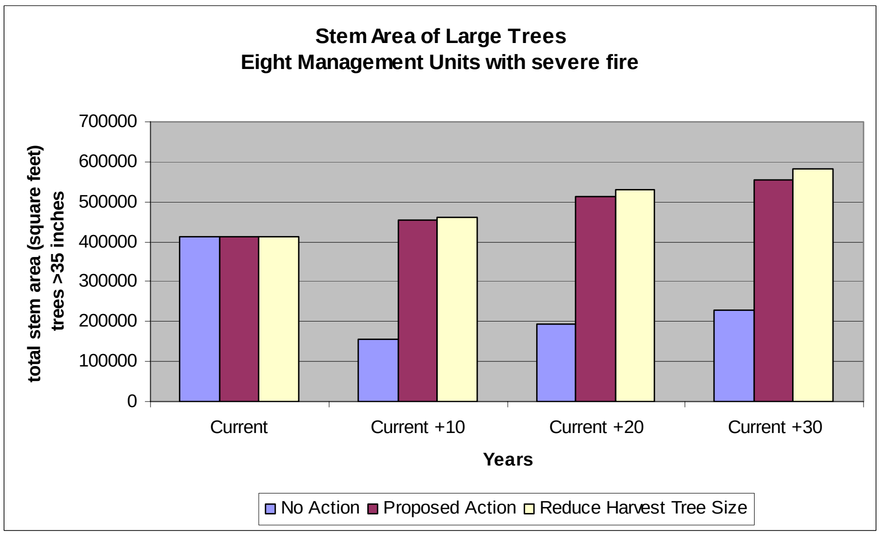


Figure 3-18 - Displays the total stem area for trees larger than thirty-five inches for eight management units without a wildfire and with a simulated wildfire over the thirty year analysis period.

Insect attack causing conifer mortality following fire is known to occur. This is true for both wildfire and prescribed fire. The relationship between fire and insect attack are not clearly understood. Research has most often been done on the interaction of wildfire damage and mortality. Less study has been completed on the relationship between prescribed fire damage and insect mortality (Mitchell and Martin 1980). Miller and Keen (1960) described the relationship between crown damage from fire and insect mortality. A greater percentage of crown damage results in a greater loss from insect mortality. This relationship between crown damage and attacks by western pine beetle has been described by others (McHugh and others 2003, Wallin and others 2003). The KRP proposed underburns will generally result in crown scorch in high severity portions of burns. Since crown scorch can lead to insect attack and mortality of pines, the underburn program can indirectly cause some reductions in canopy cover and the loss of pine larger than 24 inches. Model results indicate the loss of trees greater than 24 inches to be less than ½ trees per acre. Observed losses are less than 1/10 of a tree per acre in sampled underburns (Ballard 1999).

<u>Indirect Effects to Large Trees, Diameter Distribution and Species Composition</u>**:** The return to historical forest conditions requires time to develop. Thus the benefits of larger trees to the development of the historical forest are indirect benefits achieved latter in time. Historical forest conditions also require a period free of stand replacing events.

These stands replacing events kill all trees (larger and small) over dozens to potential hundreds of contiguous acres. Thus the reduction of trees through thinning and the uneven-aged management strategy meets several objectives; reduced potential for crown fire, increased resistance insect attack, and increases the number of larger trees. The proposed action and the reduction of harvest tree size alternative provide growing space allowing for tree diameter and crown expansion. Stand density and trees size are inversely related. Trees grown in low-density stands tend to be larger (Oliver and Larson 1996). In addition research by Poage and Tappanier (2002) would indicate that open stand conditions might be necessary to grow the large trees that dominated the historical forest of the 1850s

The indirect effect of the proposed action and the reduction of harvest tree size alternative is to provide fewer trees that occupy greater growing space after a period of growth. Model results at both the landscape scale (phase II) and the stand level (phase III) indicate that they result in more stem area in large trees. This is true for scenarios with wildfire and without wildfire. Management units in these alternatives maintain more stem area in larger trees following wildfire than the no action alternative. Figure 3-13 displays the change stem area of large trees in the initial eight management units. While all alternatives have similar amounts of large tree stem area, the proposed action and the reduction of harvest tree size alternative maintains more acres with large trees in the face of severe wildfire than the no action alternative.

The proposed action and the reduction of harvest tree size alternative keep tree densities lower in all diameter classes over the 30-year analysis period. The greatest difference in tree numbers between the no action and the action alternatives occurs in the smaller diameter classes. When severe fire enters the system the proposed action and the reduction of harvest tree size alternative maintain approximately sixty percent more large trees than the no action.

Figure 3-19 displays the tree distributions for management units. Stands manage using the uneven-aged management strategy are displayed. The graph compares post treatment tree distributions to the upper and lower management ranges. This graph indicates that management units generally conform to management ranges. The current condition displayed in Figure 3-19 shows current distributions well outside these ranges.

Plantations and regeneration groups benefit from thinning in the CSOS and the uneven-aged management strategy by allowing for increased diameter growth and conditions suitable for restoration of historical conditions. Regeneration of historical forest occurred over a prolonged period, and trees grew at low density with little competition for water, nutrients and light that leads to competition based mortality (self-thinning); in contrast, after timber harvest or disturbance, young stands may develop with high density of trees with similar ages and considerable self-thinning. The results suggest that tree removal is needed in dense young stands where the management objective is to speed development of old forest characteristics (Tappeiner and others 1997).

The KRP has a need to increase the presence of shade intolerant pine and oaks. The achievement of this need is measured in the stem area (basal area in square feet) of ponderosa pine. The proposed action and the reduction of harvest tree size alternative

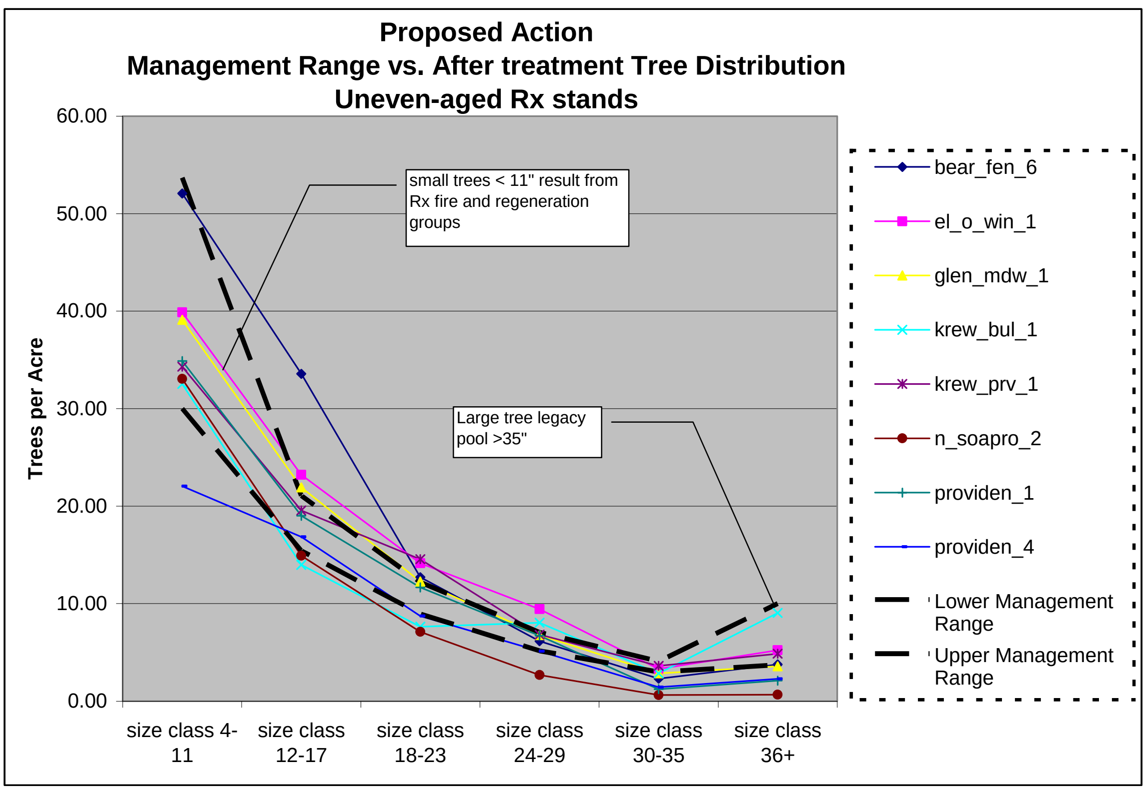


Figure 3-19 - Displays the tree distribution for each on the initial eight management units and lower and upper management ranges identified for the KRP. Stands managed with the uneven-aged management strategy are displayed.

achieve this goal in two ways: favoring pine and black oak over fir and incense cedar, and by planting pine in openings. These two actions result in only approximately a three percent increase in ponderosa pine stem area after 30 years compared to the no action. This small difference between the no action and the action alternatives is due to the time it takes for small seedlings to accumulate stem area. It is also due to the high proportion of overstory shade intolerant species across the landscape. Within the analysis time frame the species composition does not make large shifts toward pine species measured in basal area. The continued persistence of species more susceptible to fire such as fir and incense cedar will lower resilience. The proposed action maintains slightly more stem area in ponderosa pine than the reduction of harvest tree size alternative (less than 1 percent)

_Comparing composition of seedlings less than 30 years of age in mixed conifer stands growing on highly productive sites in northern California; Lilieholm and others (1990) found that ponderosa pine was not present under a heavy overstory in unmanaged stands. However, active management to favor shade intolerant species in small openings did allow ponderosa pine (intolerant) and sugar pine (intermediate) to persist in stands having an 8 to12 year re-entry cutting cycle. This finding indicates that where relatively high stocking is retained on highly and moderately productive sites, some active management is needed to encourage recruitment of shade intolerant species for future stand development. The direct effect of group cutting is an environment suitable for establishment and growth of intolerant species.

Indirect Effects to Conifers from Competing Vegetation and the Resulting Necessity of using Glyphosate: Thinning in the CSOS and the uneven-aged management strategy will tend to reduce overstory canopy cover. This will results in increased resources for remaining trees and understory shrub production. Studies in the KRP area of understory deer brush and whitethorn (Ceanothus spp.) volume and overstory canopy cover indicate that brush production is related to both the amount of overstory tree canopy cover and the amount of understory brush volume (Kie 1985). Equations developed by Kie (1985) indicate ceanothus brush growth will increase by 35 percent for reductions in canopy cover from 60 percent to 40 percent. Ceanothus species growth will increase by 200 percent in regeneration groups. Increases in growth and cover of manzanita, bear clover and other brush species can be expected following the creation of groups or the reduction of overstory canopy cover with thinning in the CSOS and the uneven-aged management strategy. Site preparation, and release treatments planned for the KRP have proven effective in the control of competing vegetation that developed in groups. Maintenance of understory brush cover in defensible fuel profile zones (DFPZs) will be accomplished through repeated burning in the initial eight management units. Site preparation, release treatments, burning and DFPZ maintenance will create conditions suitable for the invasion of plants that do well in disturbed sites or open canopies. These plants that arrive following disturbance include grasses (including cheat grass) and other noxious weeds (McDonald and Fiddler 1989, McDonald 1986, Larson and Schubert 1969, Keeley 2001). While treatments reduce the cover of site competitors, treatments also make conditions for the dominance of sites by conifers (McDonald and Fiddler 1995).

- **Conifers** - Regeneration groups and plantations would contain scattered large trees (>24”). The planted seedlings and large remaining trees would eventually grow large enough to shade out many of the competing brush and grass species in approximately 15 to 25 years. Reforested montane brush fields would be single storied even-aged stands. Existing 5 to 15 year old plantations would continue to be single storied. Older plantations found in the providen_2 and bear_fen_6 management units (30 to 45 years old) would have regeneration groups. This would create a second or third age class and begin to move these older single storied plantations into an uneven-aged condition. Species composition would include a mix of planted conifers (ponderosa pine, Jeffrey pine, sugar pine, white fir, and red fir) and natural regeneration. Natural regeneration would include incense cedar and oaks. Stand development from early brush dominance to conifer dominance would be accelerated over natural stand succession rates.

- **Bear clover** - Research indicates that effective treatments are those that kill bear clover rhizomes, and herbicides such as glyphosate are effective, while hand, fire and mechanical methods are not effective control treatments (Tappenier and Radosevich 1982, McDonald and others 2004). In local environments, treatments such as the winged subsoiler and perhaps repeated fire at the time of flowering have been suggested to control bear clover. Fire, hoeing, and machines have been used on the Sierra National Forest to remove the above ground portion of bear clover, but due to the rhizome type root system sprouting of plants occurred soon after treatment. Sprouts quickly reinvaded the treated areas. Survival of planted seedlings was well below desired stocking levels. Herbicides application has proven the only effective means to control bear clover on the Sierra National Forest. These results agree with reforestation research that indicates that after three years, only 13 percent of the conifers planted were alive in a study area with bear clover cover of less than 40 percent (Tappenier and Radosevich 1982). This contrasts with 71 percent survival in areas with temporary control of bear clover. Over a 19-year span, only nine percent of the trees planted in an area with no vegetation control survived. Growth of the surviving seedlings is also impacted. In the same study, three-year-old seedlings with no bear clover competition were twice as tall as the seedlings with no vegetation control. A review of bear clover control measures by McDonald and others (2004) also indicate that treatments that kill bear clover rhizomes such as herbicides are the only effective control measure, while other treatments have been failures.

- **Ceanothus and Manzanita** - Experience on the Sierra National Forest has shown that large plants 2 to 6 feet tall cannot be controlled using hand methods. This is due to the size of the rooting system. Whitethorn seedlings have been successfully controlled using hand methods. However, once growth of above ground whitethorn plants exceeds 2 feet, rooting systems are beyond the effectiveness of hoes or axes used to remove brush seedlings. In addition, the removal of deer brush and whitethorn result in the dominance of grasses and forbs that also compete for site resources. These same results have been observed in other forests where repeated hand release treatments have resulted in limited control of ceanothus seedlings, impractical control of well established (>2 feet tall) ceanothus, and ineffective control of plants that establish from burls or roots (Click and others 1994, McDonald and Fiddler 1996).

- In one study, ponderosa pine growing in the middle of deer brush and manzanita had a diameter and height growth of 60 to 90 percent when compared to trees free to grow from competing brush species (Oliver 1979; McDonald and Oliver 1984). Also, the influence of competing vegetation was strongest at wider tree spacing. In another study, without release from deer brush, conifers are at a disadvantage in capturing adequate resources and establishing dominance. In the control plot (without vegetation management), McDonald and Fiddler (1989) noted that the average height of deer brush was 184 percent greater than that of conifer seedlings. Though seedlings may persist under a canopy of *Ceanothus*, growth would be very slow. The experience on the Sierra National Forest controlling deer brush has been consistent with published information. On stands within part of the Big Sky Timber Sale and Big Creek Fire Recovery (not in the KRP), hand and mechanical means failed to control deer brush. In the case of the Big Creek Recovery efforts forest stands were severely burned, salvage logged, planted and hand released. Hand release areas are dominated by sprouting ceanothus species with more than 50 percent cover in brush and planted and natural seedlings not meeting stocking standards. In the case of the Big Sky treatments large deer brush (> 4ft tall) was cut with chainsaws. Observations in the following year showed ceanothus sprouts to be 2 and 3 feet tall.

- Deer brush and whitethorn is usually found on sites that are not as dry as manzanita sites. Ceanothus and manzanita have many morphological and physiological adaptations that allow them to capture resources, growing rapidly after major disturbances. One adaptation is the ability for some *Ceanothus* species to fix nitrogen. While soil nitrogen is beneficial for seedling growth and varies beneath Sierra Nevada vegetation gaps (Erickson and others 2005), brush cover removes soil moisture needed for seedling survival (Gray and others 2005). Brush cover may benefit the establishment of shade intolerant species (white fir, incense cedar and red fir), however the over all benefit for growth of these species was undetermined by Erickson and others (2005) in the Teakettle Experimental Forest. Results from Teakettle suggest that reductions in shrub cover may benefit tree establishment, but increasing understory light and decreasing surface soil moisture through canopy cover reductions may not. After conifer establishment the effect of increased growth with brush removal may be different for pine and fir.

- Green leaf manzanita (*Arctostaphylos patula*) sprouts from the roots in response to disturbance similar to ceanothus. The indirect effect of the proposed action and the reduction of harvest tree size alternative on this sprouting species is to free site resources for the growth of conifers. Manzanita plants in brush fields, openings and plantations exceed 3 feet in height. The size of these plants makes hand removal impractical. Manzanita and *Ceanothus* competition were responsible for a 58 percent reduction in growth in a 20 year old Sierra Nevada ponderosa pine stand

(Oliver 1990). Once manzanita seedlings begin to grow, they can rapidly occupy a site after disturbance. Ground disturbing activities will affect green leaf manzanita similar to deer brush.

- When mechanical methods (mastication and tractor piling), hand methods (chainsaw cutting and hoeing) or underburning are not effective, as described in this section and the section on Direct Effects of Groups and Competing Vegetation, the use of chemical methods (glyphosate + R-11) are necessary to accomplish the need to create reforestation groups and control competing vegetation.

<u>Indirect Effects to Vegetation from Wildfire and Prescribed Fire</u> **-** Model results (Figure 3-20) indicate that the proposed action and the reduction of harvest tree size alternative reduce the proportion of the initial eight-management units at risk of high mortality during severe wildfire fire. (Mortality class for wildfire and prescribed underburns are the same.) This effect on high mortality risk lessens with time. Figure 3-20 displays that n_soapro_2 and krew_prv_1 have small reductions in acres with risk of high severity damage. These model results reflect the dominance of these management units by multi-layered stands, brush and live oaks. While the proposed action and the reduction of harvest tree size alternative replace brush with conifers, the benefits of reduced brush and increased conifers are not realized until conifers become larger and more resistant to fire. The fire resistance for young conifers occurs when crowns lift from the forest floor and bark becomes thicker. Model results reflect the relatively similar burning conditions between brush and young conifers in these two management units.

Several types of information describe effects of stand structure on fire behavior and fire severity: computer modeling results, post wildfire reviews and anecdotal information (Pollet and Omi 2002, Graham 2004). Research indicates that reducing crown fire and subsequent fire severity can be accomplished by altering surface, ladder and crown fuels (Graham 2004, Agee and Skinner 2005). The results of post wildfire measurements across the western United States indicate fuels treatments can reduce fire severity. However, severity reductions are dependent on treatments and fire behavior and do not always result in reductions of fire severity (Pollet and Omi 2002). Fuel loading, topography, and weather are keys in determining subsequent fire intensity and severity. Research dealing with the effect of a lopping and scattering of logging residue in combination with uneven-aged management strategys often results in more mortality than other treatments such as thinning from below and lopping and scattering fuels (Stephens and Moghaddas 2005). This is due to the number of small stems and the proximity of surface fuels and ladder fuels. Uneven-aged stands have more ladder fuels and thus a greater opportunity for crown fire. The action alternatives propose to treat understory fuels through underburning, mastication (shredding), pile and burn or gross yard (removal). However, a study by Perry and others (2004) points to a difference in fire behavior and the potential for crown fire resulting from different methods used to model fire behavior. The method used by the forest vegetation simulator in this analysis may over estimate the potential for crown fire in the uneven-aged stands created by the proposed action and the reduction of harvest tree size alternative. Thus model results may overestimate the effect of small trees in the understory.

The removal of small understory incense cedar and white fir breaks the link between understory fuels and upper canopies (fuels ladders). These fuels ladders increase the potential for torching and crown fire. Reductions in fuel ladders will benefit the continued presence of large trees.

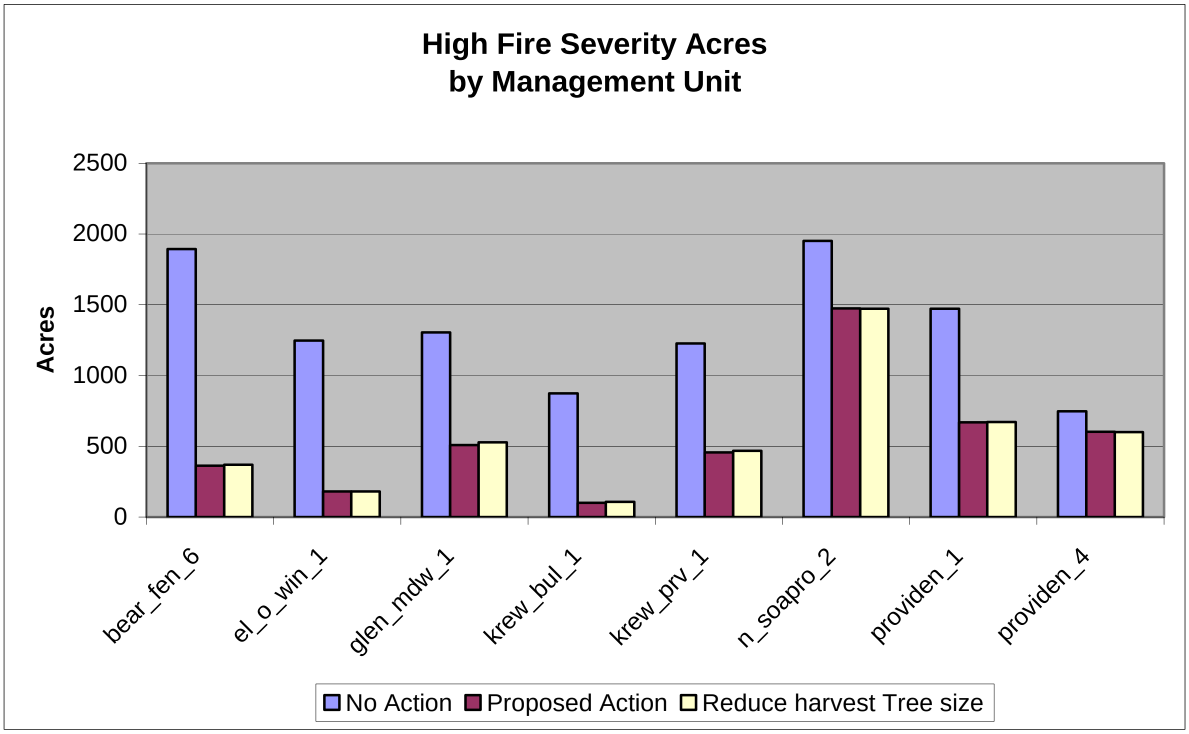


Figure 3-20 - Displays the acres experiencing high severity fire for each of the eight management units after mechanical treatment. The graph displays the acres for the proposed action, reduction of harvest tree size, and no action alternatives. High fire severity is basal area loss greater than 50%. (Figure developed from phase I modeling).

Indirect Effects on the Historical Forest Conditions: Treatments that mimic variability in tree canopy cover and increase the dominance of large trees across the landscape help create historical forest conditions. In addition, alternatives that increase the dominance of shade intolerant species, create open stands, and reintroduce fire as a process create stands resistant to stand replacing fire. These attributes are consistent with historical conditions. Table 3-9 compares the indirect effects on the historical condition of alternatives with each other.

Within the analysis time frame, canopy reductions change the stands from moderate and dense canopy cover to open and moderately dense stands that are closer to the historical pre-1850 forest conditions described for the KRP (Appendix A). Exceptions are stands in spotted owl PACS, old forest linkages and Class I Stream Management Zones. These stands generally remain in moderately dense conditions throughout the analysis period.

Mixed conifer acres moved from approximately 90% dense and moderately dense canopy cover to approximately 80% dense and moderately dense canopy cover after mechanical treatments. Ponderosa pine forest moved from approximately 80% dense and moderately dense canopy cover to approximately 70% dense and moderately dense canopy cover after mechanical treatments. These values are closer to those described as historical conditions in Appendix C and by Bonnickson and Stone (1982)

Large trees are an important characteristic of the historical forest (North and others 2005, Taylor 2003, Mckelvey and Johnston 1992). Even with severe fire, large tree dominance is maintained in the proposed action and the reduction of harvest tree size alternative. These alternatives maintain approximately sixty-percent more large tree stem area than the no action alternative following fire. The numbers of large trees increase overtime. The proposed action creates approximately four percent and the reduction of harvest tree size alternative six percent more trees greater than thirty-five inches than the no action alternative. However, large tree numbers remain below those shown in historical data sets with known methods (Hasel 1931) and reconstructed stands in the Teakettle Experimental Forest adjacent to the Krew_bull_1 management unit (see Figure 3-21).

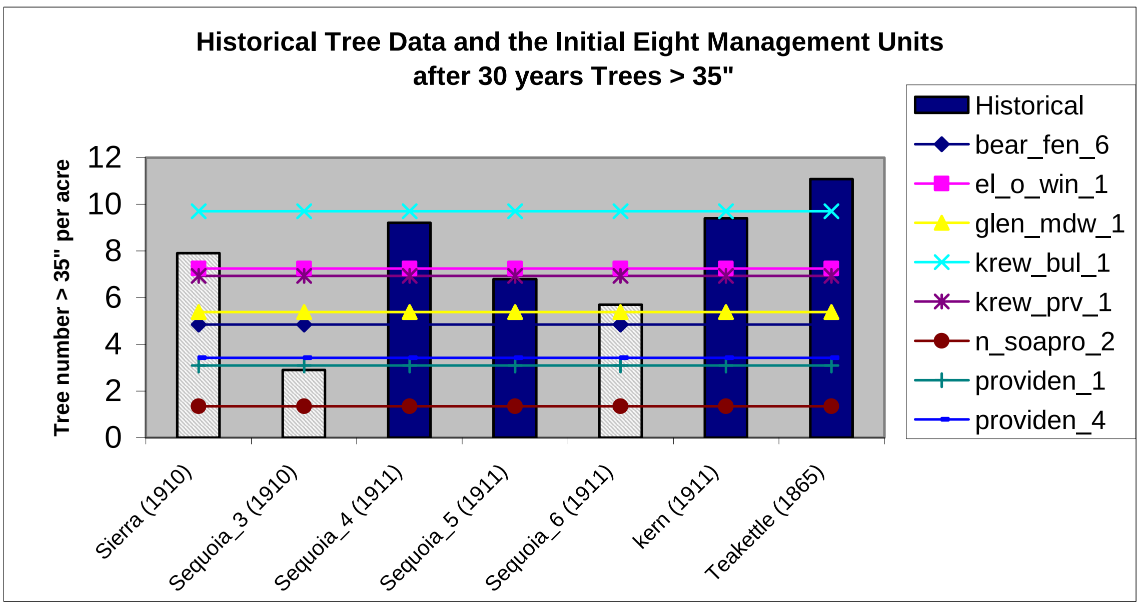


Figure 3-21 - Displays tree numbers for trees greater than 35 inches. Historical data from the southern Sierra Nevada and reconstructed historical forest at the Teakettle experimental forest are shown in bars. Hatch bars represent ponderosa pine and solid bars represent mixed conifer types. Lines represent average tree number larger than 35 inches at the end of the thirty year analysis period. While large tree numbers increase they are generally less than the historical data represented. n_soapro_2, providen_1 and providen_4 are ponderosa pine dominated. The other management units are mixed conifer.

The historical forest was highly variable (North and others 2004). This variability existed at a fine scale. That is if a person were to walk a distance of 150 to 500 feet in the historical forest that person would see many sizes of trees and those trees arranged in different ways. The literature indicates two dominant tree arrangements were found in the KRP: either arranged in groups of even age and size (homogenous) (Bonnickson and Stone 1982), or in many ages and sizes (heterogeneous) (North and others 2004). Even-aged regeneration groups and planted openings represent homogenous structures. The inverse J-shaped curve in the matrix creates the heterogeneous structures. Leaving large trees in regeneration groups also creates the heterogeneous structures. Thus the application of the KRP uneven-aged management strategy at the stand level results in creating a variable structure. The overall structure will approximate an inverse J-shaped curve, especially between 11" and 30" or 35" in diameter depending on the alternative, and high fine scale variability. Landscape variability is achieved by varying two of the three parameters used to describe the inverse J-shaped curve: basal area and maximum diameter. Eight different residual basal area levels and two maximum diameters are used in developing stand prescriptions. The residual basal area and maximum tree diameter were assigned based on forest type.

Figure 3-15 compares the range in crown openings or gap sizes found in the historical forest (Stephenson 1996) to past regeneration groups and planted openings. Regeneration groups were placed in existing openings first (created by past fire or mortality) then in areas of higher canopy density or disease. The comparison indicates that regeneration in the proposed action will have some what larger openings than the historical forest.

The strategy proposes to increase pine through reforesting groups and leaving pine that exhibit characteristics of good growth potential. These "good growers" will grow into larger trees. The group regeneration objectives are subordinate to maintaining trees over 35" and leaving additional trees for heterogeneous structures. The proposed action results in a slight increase (approximately 4%) in the dominance of pine compared to the no action over the 30 year analysis period.

The uneven-aged nature of the historical forest is described in different ways in the literature, groups of even-aged trees (Bonnickson and Stone 1982), or groups of uneven-aged trees (North and others 2005). The inverse J-shaped curve is used as a tool to achieve the tree distributions often described in the literature: inverse-j and number of trees declining with increasing size. The KRP uneven-aged management strategy creates the variable structures and tree distributions described for the historical forest (heterogeneous and homogenous). The KRP uses a mixed approach to achieve the regeneration goals, uneven-aged condition, and representative tree distribution. Regeneration groups serve to create a new age class dominated by pine species. Both the inverse J-shaped curve and the regeneration groups help create the uneven-aged condition. The inverse J-shaped curve serves to accentuate existing age class distributions by leaving trees in different canopy layers capable of growing into the next size class. Existing age class structures in the matrix generally have at least two age classes represented and often more (Appendix A). Thus judicious retention of good growers in the matrix based on the inverse J-shaped curve maintains existing age classes and creates variable stand structures.

The application of low intensity underburns creates additional variability. Since fire intensity and mortality vary, the resulting structures will also vary. Fires will tend to kill small trees and change the final distribution of trees. Figure 3-23 displays the tree distribution for each management unit and the upper and lower management range.

Stands move closer to historical tree distributions and numbers following the activities described in this section on indirect effects on the historical forest conditions. A comparison of various treatments in the Teakettle experimental forest found that thinning from below and overstory removal treatments (similar to a shelterwood) removed too many trees in the approximate size classes 20-30 inches (North and others in press).

Thinning from below is proposed for stands in the California spotted owl study. However these stand limit removals to trees less than 20 inches. A similar comparison of thinning and burning found that thinning in combination with burning moved existing Sierra Nevada forest structures closer to those in analogous relic forests (Knapp 2006).

Tree removals above twenty inches are proposed in the uneven-aged management strategy for both action alternatives. North and others (2006) indicates that the thinning from below treatments removed many trees need for the “next generation of large old trees”. Simulations indicate that the uneven-age management strategy provides sufficient medium size trees to provide for this next generation (Figure 3-23). Both action alternatives show improvements the dominance of large trees over the no action alternative.

Cumulative Effects

Cumulative effects are those activities that have the potential to contribute to cumulative impacts on canopy cover, large trees, conifer establishment, resistance to crown fire, resistance to insect attack, and historical forest conditions from the proposed action and past, present and reasonably foreseeable activities as described near the beginning of Chapter 3.

Cumulative effects on vegetation occurring across the large landscape (72,000 forested acres) are examined for a 30-year time period. Fluctuations in vegetation composition and structure result from treatments, growth and wildfire. The modeling attempts to reflect the dynamic nature of ecosystems by tracking changes for each simulation unit, stand or plot. While one management unit may be treated others are continuing to accumulate or decrease in biomass continuously across all analysis area.

<u>Cumulative Effects on Canopy Cover:</u> The current landscape condition is at forty six percent of all acres with medium and larger trees greater than 50 percent canopy cover.

Wildfire tends to effect dense multi-layer stands more than less dense ones or single storied stands. Dense stands with multi-layers are predisposed to burn with more torching and experience more crown fire. Model results indicate the potential for loss of canopy cover is greatest in these stands. The cumulative effect of treatments in the initial eight management units is to reduce the potential loss of trees (stand density) from the expected wildfire in these units and across the 72,000 acres of forested landscape.

<u>Cumulative Effects to Stand Density, Forest Health and Stand Density:</u> Plot level analysis of stand density was conducted for all plots in the initial eight management units, results indicate that thinning in the CSOS and the uneven-aged management strategy will reduce stand density and increase tree vigor for these units. The cumulative effect across the landscape of this reduction in tree density from approximately 13,700 acres is to increase the resistance to insect attack on about 19% of the forested portion of the landscape.

<u>Cumulative Effects to Large Trees, Diameter Distribution and Species Composition:</u> After implementation of the proposed action and present activities, trees in all diameter classes will be reduced but those larger than thirty inches are only reduced by approximately one percent across the landscape compared to the no action. Current hazard tree, residential development and power line maintenance treatments remove approximately one thousand trees greater than thirty inches across the 72,000-acre

forested landscape. The effect of growth in the initial eight management units and the expected results of present activities is an increase in large tree numbers after thirty years. The South of Shaver fuel reduction project and plantation maintenance do not remove trees over thirty inches.

Only treatments on Southern California Edison lands would reduce tree numbers of trees larger than thirty-five inches. While it is unclear how much these treatments on private lands would reduce large tree numbers, typical prescriptions can remove as much as one third of each tree size. The cumulative effect of all these treatments would likely be less than a one percent change in large tree numbers across the 72,000 acre analysis area.

When severe fire enters the KRP landscape, the proposed action and the reduction of harvest tree size alternative would results in maintaining more large trees on the landscape. Thinning from below that reduces fuel ladders, the uneven-aged management strategy that spaces tree crowns, and proposed fuel treatments that reduce surface fuel loads reduce the severity of the expected wildfire in the initial eight management units and across the 72,000 acres of forested landscape. These treatments maintain more acres of large tree cover than the no action. The cumulative effect of the proposed action and the reduction of harvest tree size alternative is to maintain more trees in the face of wildfire.

Tree distribution across the landscape experiences change as a result of the uneven-aged prescriptions. The proposed action and the reduction of harvest tree size alternative make dramatic changes in the numbers of small trees in the understory of the initial eight management units and would be expected across the landscape. The most notable changes occur in trees less than 24 inches in diameter.

The cumulative change to species composition across the analysis area would be small. The stem area with in the eight management units would increase by small amounts (less than 4 percent). Similar or smaller changes would occur in current, recent past and reasonably foreseeable actions. Plantations treatments would change tree composition little, and thinning on private and federal lands would favor pine. However, these small increases across the landscape would result in very little cumulative species changes. Stands dominated by fir would continue to accumulate stem area and favor the production of incense cedar and fir.

<u>Cumulative Effects to Conifers and Competing Vegetation:</u> No landscape model exists for brush and grass growth and response to treatment. Cumulative effects are surmised from stand level effects. Brush cover in the 371-acre power line right of way will remain unchanged for the analysis period. Brush cover in the housing developments and private forestlands will change along with the adjacent KRP project area as a result of overstory growth. However, it is undetermined what future activities private landowners will take to control brush. The cumulative effects on conifers and competing vegetation relate to the potential for reductions in age classes of brush and more open canopy cover under the proposed action and the reduction of harvest tree size alternative. Young brush seedlings may see an increase across the landscape as more acres have space between crowns. As crowns open existing brush will grow taller and new seedlings will be stimulated to grow. As trees recapture growing space made available after thinning and the uneven-aged management strategy, trees crowns will grow closer together. The increased crown canopy cover that results from growth will tend to reduce understory brush cover. This

opening of crowns with treatment and closing due to growth will occur across the landscape at different times based on the expected treatment schedule for the landscape.

Existing and/or created openings will tend to be invaded by brush. Proposed site preparation, and release treatments are designed to reduce the competitive effects of brush species on regeneration. The cumulative effect of reforesting these openings will be a shift to species that grow best in full sun. These sun loving species include planted pine, black oak sprouts and brush species.

The frequent underburning will tend to favor brush species that reproduce through sprouting (deerbrush or green leaf manzanita). Frequent underburning will favor those species that arrive first on a site such as grasses. The frequent underburning will tend to reduce the cover of obligate seeders such as white leaf manzanita. The cumulative effect on understory is likely to be a shift in species composition and a lowering of the amount of understory cover because underburns, release and site preparation will tend to reduce brush cover even while thinning and the uneven-aged management strategy may stimulate a temporary increase in brush cover before tree crowns re-close.

Cumulative Effects to Vegetation from Wildfire and Prescribed Fire: Treatments across the landscape reduce the potential effects of severe wildfire. As more management units are treated across the landscape a leveling off of the reduction occurs. This is likely due to the effects of growth and the time since treatment. These acres of reduced mortality would shift across the landscape as treatments are completed and re-growth occurs. The cumulative effect of treatments to restore the historical condition (reduce stand density, increase the dominance of large trees, re-introduce fire, and increase the number of ponderosa pine) is to increase the resistance and resilience of stands across the landscape. This resilience comes at the expense of high canopy density.

The cumulative effects of large-scale treatments, like one management unit, are not completely understood (Agee and Skinner 2005). While the proposed action or the reduction of harvest tree size alternative alone may create stand conditions that result in lower severity across stands or the whole management units, these relatively low severity conditions could be overwhelmed by high intensity fire in adjacent stands or management units. Model results indicate that results expected from proposed and reasonably foreseeable activities will lower severity. These results are consistent with observed wildfire effects for treated verses untreated stands (Agee and Skinner 2005).

Alternative 2 - No Action

Direct Effects to Stand Density, Large Trees, Tree Distribution, Species Composition, Competing Vegetation, and Vegetation from Wildfire and Prescribed Fire: There are no direct effects because the No Action alternative does not implement specific activities.

Indirect Effects to Canopy Cover: Since the Alternative 2 (No Action) does not implement specific activities to reduce stand canopy cover, unplanned events play the greatest role in controlling canopy cover. Indirect effects would occur as a result of growth, insect mortality, density induced mortality or unplanned fire events.

Without any unplanned events such as fire or insect attack, growth would result in stand canopy cover increasing for conifer-dominated stands. Modeled growth results indicate that crown canopy continues to increase for the 30-year analysis period. Acres of canopy cover greater than 50 percent for CWHR size class 4 and 5 trees continue to increase for the analysis period. The fisher goal of achieving 50 percent of the landscape in canopy cover greater than 50 percent in size class 4 and 5 and habitat canopy objectives for spotted owl are sustained for the analysis period. Only the most dense stands lose canopy cover as a result of mortality due to competition for water, nutrients and light.

Unfortunately, a wildfire is a reasonably foreseeable event and can be expected to burn one or a couple of the management units on a hot windy summer day as described at the beginning of Chapter 3. Stands with dense and moderate canopy cover of greater than 50 percent suffer severe damage. Wildfire effects are most pronounced in bear_fen_6 and el-o-win_1 management units. Any management unit that is struck by a wildfire under the No Action alternative would contribute little to accomplishing the fisher goal and any owl or goshawk PAC would be severely damaged.

Indirect Effects to Stand Density: The No Action alternative allows stands to increase in stand density. This increase is due to both the increase in size of existing trees and the growth of new trees filling in canopy gaps. New trees would be mostly those trees that do well in shade such as incense cedar and white fir. They also create fuels ladders that invade understories. Model results (phase III) indicate that the current number of plots, thus the stands, that exceed the upper benchmark (60 percent of maximum stand density index) in the initial eight management units exceeds 25 percent (Figure 3-14). At the end of the thirty year analysis period more than 50 percent of the initial eight management units are at stand densities that fully occupy the site and insect mortality is imminent. As stands begin to exceed the benchmark densities for imminent mortality (35 percent of stand density index) individual stress and disease weakened trees will begin to die. While the death of individual trees will provide some increased growing space for neighboring trees, the dying trees will provide additional bark beetle habitat.

Historical weather data indicates that the Sierra Nevada experiences periodic droughts (SNEP 1996, North and others 2005). In below normal precipitation years, lack of water will weaken tree resistance and allow bark beetles to begin causing mortality in pockets. The mortality will likely exceed the periodic growth rate of stands (Oliver 1995). Dead trees will eventually contribute to the fuel load and secondary succession will result in the early dominance of created openings by brush species.

Epidemic mortality from bark beetles observed in the area in the late 1980s exceeds modeled density induced mortality within the analysis area. Since 1930 each decade has seen significant occurrences of bark beetle mortality within the Kings River Project area. No clear risk model for western pine beetle in the Sierra Nevada exists. However it is certain that stand and weather conditions as described in the previous paragraph that result in stand replacing insect mortality will persist in the analysis area under the No Action alternative.

Indirect Effects to Large trees **-** Historical forest characteristics, especially the number of large trees, require time to develop and a period free of stand replacing stand replacing events. The no action alternative maintains trees in dense stands providing limited growing space for diameter and crown expansion. Stand density is highest under the No Action alternative with many stands that exceed fifty percent cover and have many small stems. The no action alternative retains slightly more trees across the initial eight management units than both action alternatives. This is true for all diameter classes including those larger than 35 inches. Trees larger than 35 inches increase in number for each growth period with out the wildfire. Small to medium CWHR size classes (3 and 4) and canopy density classes greater than 40 percent dominate the initial eight management units. Low intensity wildfire and insect attack could benefit the accumulation of large snags and reduce understory vegetation. However, stand conditions lend themselves to high intensity disturbance when the reasonably foreseeable event of a wildfire occurs as described in the previous section. Acres expected to burn with low severity could experience some benefits from fire, while acres that burn with high and moderate severity would experience loss of large trees and in turn result in more losses of large trees than the action alternatives.

The current dominance of mixed conifer stands by white fir and incense cedar continue under the no action alternative. This difference between the no action and proposed action is largely due to reductions of fir in the proposed action and the continued dominance of fir in the no action.

Indirect Effects to Conifers from Competing Vegetation - No existing and/or created openings are reforested under the action alternative. Unplanned events such as wildfire and bark beetles create openings in the forest canopy. No planting of these openings or existing openings created from unplanned events would occur. Reforestation would rely on secondary succession to reforest following unplanned events. These openings would likely continue to be dominated by brush similar to untreated stands examined in research (McDonald and Fiddler 1995). McDonald and Fiddler (1995) found that Sierra Nevada forest areas dominated by brush species required treatment to return conifer dominance. In another study, McDonald and Fiddler (1997) found that areas that lacked treatment to reduce manzanita or ceanothus had changes in the dominance of brush species through time, but brush continued to dominate and increased in dominance over 31 years. Many studies have shown clearly that brush competition slows the growth of conifers (Tappeiner and Radosevich 1982, McDonald and Fiddler 1990, McDonald and Fiddler 1995, McDonald and Fiddler 1997, McDonald and Fiddler 2001, McDonald and others 2004, Powers and others 2005). Conifers that do become established in the no action alternative could be up to two times shorter and thinner where bear clover, ceanothus, and green leaf manzanita compete with conifers (Tappeiner and Radosevich 1982, McDonald and Fiddler 1997, McDonald and Fiddler 2001).

Thus conifer establishment under the no action would result in very sparse numbers of trees and openings dominated by bear clover, manzanita, or ceanothus. In those openings that favor conifer establishment high tree density will occur (McDonald and Reynolds 1999). New conifer establishment would continue to be dominated by shade tolerant species, incense cedar and white fir, as these species grow under the shade of brush and other trees. Growth of conifers that will occur in these small openings would be slow (McDonald and Reynolds 1999) but dependent on site factors. It is not that conifers will not become established under the no action alternative, but rather that conditions that promote the establishment of shade intolerant and lower fire resistant incense cedar and fir will continue. The growth of these shade intolerant trees will be slow due to brush and high tree density.

Understory brush will be reduced in cover and height in the no action alternative. In the absence of disturbances such as insect attack or wildfire trees will continue to grow. As overstory tree canopy cover increases over the analysis period brush growth will slow and brush cover will reduce. When full crown closure occurs brush species will be reduced to scattered individuals or small clumps of brush. With out fire the closed canopies found in the dense stands of the no action alternative could inhibit the spread of noxious weeds.

<u>Indirect Effects to Vegetation from Wildfire and Prescribed Fire:</u> Indirect effects occur as a result of the reasonably foreseeable event of a wildfire. Under the existing condition and the no action alternative, approximately 90 percent of acres are at risk of sustaining high and moderate mortality. Acres in high mortality lessen with time as crown canopies rise higher from the forest floor, but stay well above both action alternatives.

While model results provide one means to assess the potential loss in habitat from wildfire a comparison to actual fire mortality is useful. The Big Creek Fire occurred on the High Sierra Ranger District in 1994 and burned 5600 acres of chaparral, ponderosa pine, mixed conifer and red fir forest types similar to those found in KRP. The Big Creek fire resulted in: eighty four percent mortality in high intensity areas, fifty percent mortality in moderate intensity areas and seven percent mortality in low intensity areas. The fire resulted in a mosaic pattern in which half the conifer stand received moderate or high mortality. Using the KRP severity classes, half the stands in the Big Creek Fire would have been classified as high mortality. Model results for the no action alternative indicate that the high mortality varies in time from fifty percent to as much as seventy percent. The Musick Fire burned in August of 2001. This fire burned 200 acres. The Musick Fire resulted in thirty percent of acres in high mortality (KRP classification). Model estimates are consistent with measured mortality from similar stands on the High Sierra Ranger District subjected to severe fire. In addition the structural changes observed from both modeled results and observed changes from local fires are consistent with published results from several untreated stands subjected to wildfire in 2000 (Omi and Martinson 2002). The indirect effect of growth and severe wildfire is that management units under the no action alternative have a potential for dramatic stand structure changes during the analysis period.

<u>The Indirect Effect on Historical Forest conditions:</u> The no action alternative moves the initial eight management units further from the historical forest conditions. This is true for both scenarios with severe wildfire and without. Management units in the ponderosa pine type and mixed conifer continue to increase in stand density and increase in canopy cover. This increase is out of character with the open nature of the historical forest. Reconstructed Sierra Nevada forest structures (North 2004, Taylor 2004), analogous forest under repeated low intensity fire (Stephens and Gill 2004), descriptions of the KRP landscape in the early 1900s (Sudworth 1900a , Flintham 1904), and historical photos of the KRP all indicate that stand structures varied across the landscape by forest type and topography. Open canopy conditions dominate ponderosa pine stands, while mixed conifer stands varied from open to dense. However, existing stand density is greater than the historical forest of the 1850s (Bouldin 1999, North and others 2005). Stands dominated by trees continue to increase in density across all eight management units. Brush fields will continue to be dominated by brush. While trees will grow, growth will occur on many small to medium size trees. The increases in stand density, continued dominance of small trees, and brush are out of character with historical conditions.

While large trees will persist in scenarios without wildfire or drought, these scenarios seem highly unlikely based on past weather and fire risk as described at the beginning of Chapter 3. The no action alternative accumulates and maintains large amounts of small trees that result in ladder fuels. The increasing stand densities above the imminent threshold for insect attack indicate that resistance to insect attack decreases during the analysis period. Lower resistance to insect attack will result in more tree mortality due to insects. This mortality will eventually find its way to the forest floor and result in more accumulation of fuels. Accumulations of fuels and small trees result in wildfire conditions that kill many large trees over hundreds of acres. Both the severe stand replacing fire and the loss of large trees across so many acres is out of character with the historical forest condition (Weatherspoon and Skinner 1995). While the historical forest structures were driven by repeated low severity fire, the no action promotes structures that are driven by high severity events such as wildfire and stand replacing insect attack.

The historical forest was dominated by shade intolerant pine species (North and others 2004). The no action makes condition less favorable for the establishment of shade intolerant species. Conditions suitable for the establishment of species that can regenerate under shade persist and increase as stands across the landscape become denser. Pine and mixed conifer forest types that were historically dominated by pine species continue to be dominated by incense cedar and fir. This continued dominance of incense cedar and fir is out of character with the historical forest.

Cumulative Effects to Vegetation

The cumulative effect of growth across the entire landscape is increased density. The landscape will accumulate more acres susceptible to bark beetle attack. As the areas that exceed the level of imminent insect attack grow larger, these areas will begin to form large patches at risk to epidemic bark beetle attack. These large continuous acres with low resistance to bark beetle attack will make the effects of inevitable drought more pronounced. This cumulative effect of high density stands across large landscapes is to create low resilience and thus a landscape with poor forest health.

The continued persistence of stands dominated by understory incense cedar and white fir provide fuels ladders. Within the analysis time frame the species composition does not make large shifts toward pine species or black oak. The continued persistence of species more susceptible to fire such as fir and incense cedar contribute to the generally poor resistance of the landscape to wildfire and damage to more acres in any one event.

Alternative 3 – Reduction of Tree Harvest Size

Direct effects

<u>Direct Effects to Canopy Cover:</u> The reduction of harvest tree size alternative has the same direct effects meeting the landscape canopy desired condition of maintaining 50% of the landscape in tree canopy cover greater than or equal to 50% in CWHR tree size classes 4 and 5 as the proposed action.

The desired condition outlined by the 2004 SNFPA is to maintain high quality fisher habitat in known female fisher home ranges outside the WUI with tree canopy cover greater than 60% over 50% of a female home range. If female fisher home ranges are not known, HUC 6 watersheds are to be used in the analysis. Outside of Mazzoni's work (2002), female fisher home ranges are largely un-known for the analysis area; therefore HUC 6 watersheds were analyzed. The management intent is to retain suitable habitat to the extent possible, recognizing that treated areas may be modified to meet fuels objectives (2004 SNFPA). The analysis displayed in Figure 3-22 indicates that for the HUC 6 watersheds, canopy cover greater than 60% is reduced in the lower Dinkey Creek watershed. Within the Big Creek watershed reductions also occur but this watershed is below the elevational range of the fisher (3500 feet). Reductions in canopy cover occur as a result of mechanical treatments in both action alternatives. These same treatments increase the resistance of home ranges to wildfire. Both action alternatives reduce the acres with greater than or equal to 60% tree canopy cover. Alternatives 1 and 3 maintain similar amounts of the dense tree canopy acres.

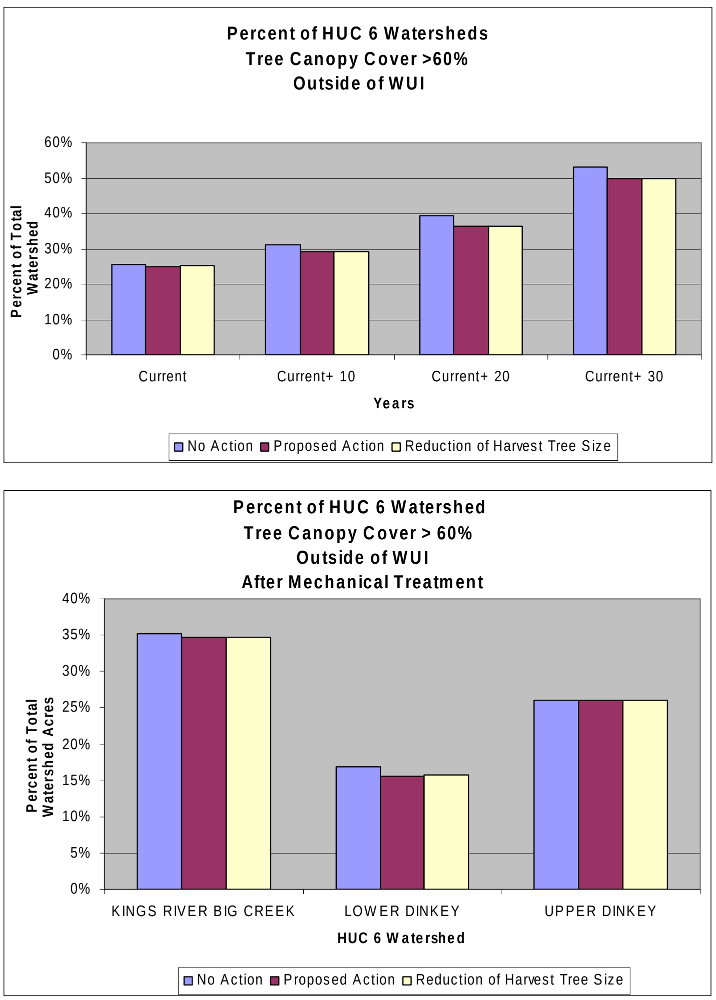


Figure 3-22 - Displays the change in the proportion of HUC 6 watersheds with greater than 60% canopy cover outside of the WUI.

Fisher home ranges were identified by Mazzoni (2002) using radio collared fishers. Considerably amount of overlap occurs among home ranges.

Direct Effects to Stand Density, Forest Health and Insect Attack:

There are slight differences in effects to stand density, increased resistance to insect attack and forest health in the reduction of harvest tree size alternative compared to the proposed action. There is slightly more area at risk to insect attack under Alternative 3 (Less than one percent more plots). Figure 3-14 compares all three alternatives based on risk of insect attack based on the number of plots over the imminent stand replacing threshold. The reduction of harvest tree size alternative provides similar benefits from increased resistance to insect attack and increased tree vigor as the proposed action.

Direct Effects to Large Trees, Diameter Distribution and Species Composition:

The reduced harvest tree size alternative limits removals of trees in the uneven-aged management strategy to trees less than thirty inches in diameter. This has no effect on the CSOS thinning from below because that prescription is limited to 20". There are thirty-four stands that have more than one tree larger than thirty inches removed in the proposed action (Table 3-8). Both the proposed action and the reduction of harvest tree size alternative remove approximately 10% of trees between twenty-five and thirty inches. This results in approximately 0.5 trees per acre removed and keeps approximately 4.5 trees per acre (25-30" dbh) after harvest for both action alternatives. Both action alternatives remove approximately sixty percent of trees less than eleven inches.

Additional measures too protect large trees and structures important for Pacific fisher are implemented in this alternative. The identification and protection of clumps of trees that potentially provide fisher resting sites is implemented in this alternative. This will have the result of limiting the acres available for tree removal compared to the proposed action. As a result the reduction of harvest tree size alternative will keep more large trees than the proposed action. Since fisher rest site structures are the result of on the ground evaluation and scoring, no fixed number of these trees can be determined prior to implementation.

Direct Effects of Group Regeneration: The proposed action and reduction of harvest tree size alternatives propose planting of shade intolerant species. However, the reduction of harvest tree size alternative does not create openings to accomplish this task. That is existing openings with scattered trees or ones dominated by brush are the focus of reforestation efforts. While in the proposed action openings are looked at first and then additional openings are created from intact canopy areas creating reforestation groups, the proposed action limits openings to three acres and implements a brush field strategy to create multiple age classes. The reduction of harvest tree size alternative will reforest existing openings regardless of opening size. Thus while no openings will be created, existing openings regardless of size will planted to increase the dominance of pines and oaks. The direct effects of planting existing openings only in the reduction of harvest tree size alternative results approximately 15% fewer acres treated or 521 acres of planting than the proposed action. The direct effect is still similar to past projects that focused on existing openings displayed in Figure 3-15. The operational environment for planted seedlings and the growth of competing vegetation are the same for both alternatives. The reduction of harvest tree size alternative treats brush (bear clover, manzanita, and ceanothus) and grass where it competes with planted seedling in existing plantations, brush fields and existing openings. The direct effect of mechanical, hand, chemical and prescribed fire on competing vegetation is the same as the proposed action.

Direct Effects of Prescribed Fire on Vegetation:

The direct effect of underburns on overstory trees, understory trees, brush, snags, and logs are the same as the proposed action. The results of past prescribed fire treatments displayed in Figure 3-16 were conducted in areas treated with the uneven-aged silvicultural treatments, no harvest limits and areas with planted openings and regeneration groups. There are few differences between the fuels created in either the proposed action or the reduction of harvest tree size alternative and the conditions in the underburns presented in Figure 3-16. Thus the effects of past underburns represented in Figure 3-16 and described for the proposed action are the same for the reduction of harvest tree size alternative.

Indirect effects

Indirect Effects to Stand Density, Forest Health and Insect Attack: The indirect effects described for stand density and forest health are the same for both the proposed action and the reduction of harvest tree size alternatives. Simulation results presented in Figure 3-14 show less than 1% more plots, thus stands, at imminent risk to insect attack at the end of the thirty year analysis period for the reduction of harvest tree size alternative. This is an unimportant difference.

Reducing tree size or planting only within existing openings does not change the indirect effects on logging residue promoting secondary insect attack or the effects of underburns on post burn insect mortality. Since the effects of logging residue on pine engraver attacks is affected by the timing of slash creation and not the amount, the reduction of harvest tree size alternative has similar effects on secondary insect attack. The same is true for the indirect effects of underburns on tree crowns and the potential for western pine beetle attack. That is western pine beetle attack following underburns is affect by scorch height and not by tree removal.

Indirect Effects to Large Trees, Diameter Distribution and Species Composition**:**

Both action alternatives have similar indirect effects relative to large trees, Diameter distributions and species composition. The number of trees larger than thirty-five inches ten years after mechanical treatment is less than two percent more in the reduction of harvest tree size alternative than the proposed action. Following severe fire entering the eight management units approximately two percent more trees over thirty five inches remain in the reduction of harvest tree size alternative than the proposed action. Both the alternatives maintain approximately sixty percent more trees greater than thirty five inches than the no action alternative following severe fire. While severe fire is not likely to enter all eight management units at once, the total number of large trees remaining after a simulated fire serves as and indicator of resistance to fire for each alternative.

The indirect effects of thinning on existing plantations and planted openings are the same for both action alternatives. Both action alternatives propose to care for planted seedling with release and thinning treatments that promote accelerated growth. Thus the effects are the same.

The tree distribution for each management unit are displayed below and compared to the upper and lower management range. Mechanical treatments move structures closer to the desired condition. Simulation result display little difference in distribution between the action alternatives. Results of both action alternatives are similar.

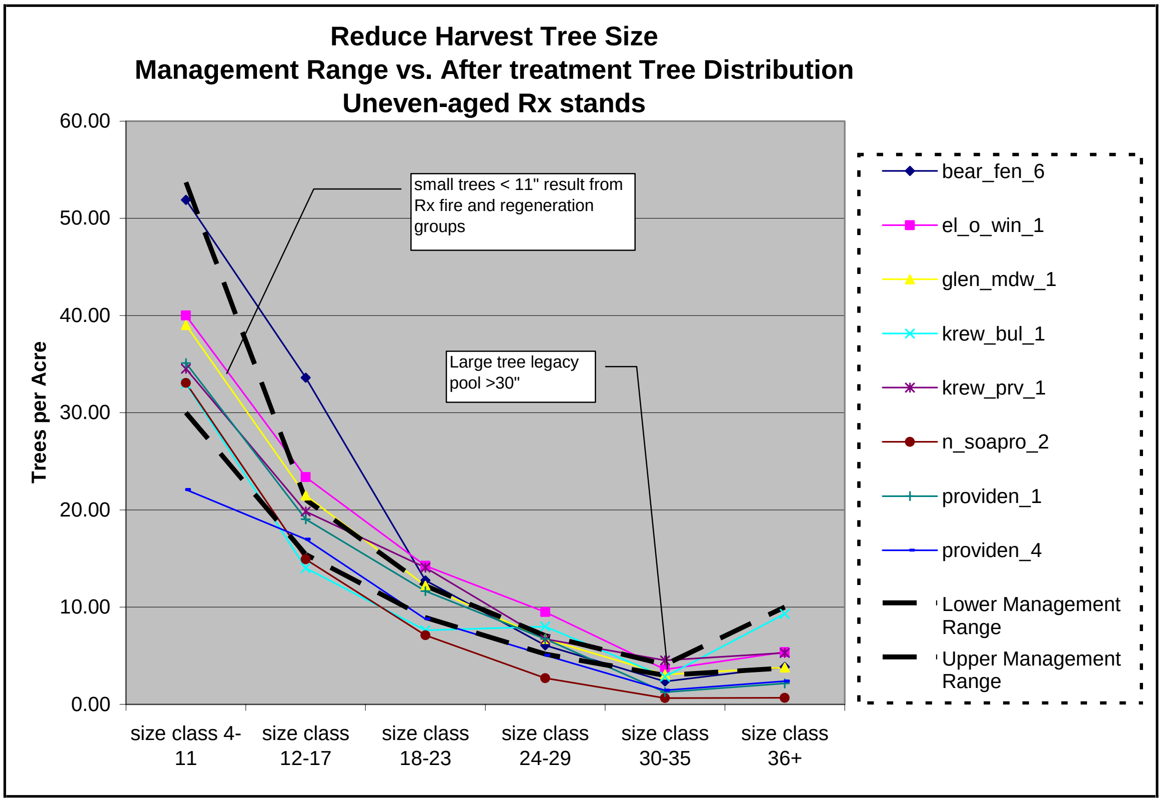


Figure 3-23 - Displays the tree distribution for each management unit and lower and upper management ranges identified for the KRP. Stands managed with the uneven-aged management strategy are displayed.

<u>Indirect Effects to Conifers from Competing Vegetation and the Resulting Necessity of using Glyphosate:</u>

Tree removal in the reduction of harvest tree size alternative removes approximately the same number of trees per acre. As discussed earlier the main difference is the removal of approximately half of one tree per acre larger than thirty inches in diameter. Thus there is no difference in effect on competing vegetation as result of tree removals between the action alternatives. While regeneration groups are not created, the seedling environment is the same for existing openings between the two alternatives. The seedling environment would be the same in brush fields and existing canopy openings between the reduction of harvest tree size alternative and the proposed action. Tree removal due to the uneven-aged management strategy and thinning from below in the CSOS and subsequent reduction in canopy cover and increase brush growth will be the same for both action alternatives. The effect of DFPZ maintenance will also be the same in both action alternatives. The potential for the invasion of noxious weeds will also be the same to slightly less in the reduction of harvest tree size alternative. This is due to no regeneration openings.

- **Conifers** – The effects on conifers will be the same for both action alternatives.

- **Bear clover** – The effects from bear clover on conifer growth and survival would be the same for both alternatives. The effectiveness of hand, mechanical, fire and chemical treatments would be the same for both action alternatives.

- **Ceanothus and Manzanita** – The effects of ceanothus and manzanita on the growth and survival would be the same as in the proposed action. The effectiveness of hand, mechanical, fire and chemical treatments would be the same for both action alternatives.

<u>Indirect Effects to Vegetation from Wildfire and Prescribed Fire</u>: Simulation results indicate that both action alternatives result in essential the same (the reduction of harvest tree size alternative has one percent more) number of high mortality acres during a severe fire. Maintaining additional trees between thirty and thirty-five inches has essential no effect on fire severity. Observed effects of wild and prescribed fire are thus expected to be the same as those described in the proposed action.

<u>Indirect Effects on the Historical Forest Conditions</u>: The reduction of harvest tree size alternative has three differences that effect achievement of desired conditions compared to the proposed action: reforesting existing openings only, identifying potential fisher rest sites, and limiting harvest to trees less than thirty inches in diameter. These differences result in slightly more large trees over the thirty year analysis period (approximately two percent), slightly more areas subject to insect mortality (approximately one percent more), slightly more acres subject to severe fire (approximately one percent more), and slightly less stem area in ponderosa pine (less than one percent) and the same reduction in small tree numbers. Both alternatives reforest existing openings, but the reduction of harvest tree size alternative eliminates regeneration in groups. It creates homogeneous and heterogeneous stand conditions in planted openings. Since both alternatives emphasis planting in existing openings, very little difference exists between the two alternatives. Fire is also reintroduced in both alternatives. Based on the small differences described above the indirect effects of the reduction of harvest tree size alternative towards meeting the historical conditions are the same as the proposed action.

Table 3-9 - Compares each alternative against meeting desired historical conditions.

Desired Historical Condition	Proposed Action	No Action	Reduction of harvest tree size
Reduce tree densities, create open to dense stand conditions	Densities of trees < 11" are reduced by approximately 60%. Tree densities > 11" are higher than most historical data sets.	Tree densities remain high and increase with time. Densities are substantially higher than historical conditions.	Same as proposed action
Increase dominance of Large Trees	Trees larger than 35" are kept. This pool of trees increases over time. When severe fire enters stands this alternative maintains 60% more large tree stem area than no action. Large tree numbers are less than reconstructed Teakettle data or data sets with known methods from southern Sierras.	While increases in trees over 35" occur with time. The alternative is less resistant to fire and experience huge loss of large trees to severe fire.	Reduces tree harvest to less than 30". Results slightly more trees >35" following a severe fire than proposed action. Other wise the same as proposed action.
Reintroduce low intensity fire	Prescribed fire is scheduled to reduce existing fuels and maintain low fuel loads. Expands current underburn program. Frequency of proposed fire is less than historical fire return interval.	Continues current underburn program. Fire return interval is substantially higher than historical conditions (20 times higher)	Same as proposed action
Uneven-aged and in groups	The inverse J-shaped curve and the uneven-aged management strategy promote uneven-aged structures maintaining existing age classes, creating new age classes in groups, maintaining large trees in some groups. And even-aged classes in other groups. The inverse J-shaped curve is most often described for the historical forest.	Lack of disturbance results in closed stands with fewer age classes as a result of self thinning.	The indirect effects are similar to proposed action except that only existing openings are planted.
Increase the dominance of shade intolerant pine	Results in a slight increase in the dominance of pine compared to the no action over the 30 year analysis period. Pine regenerates in groups and openings	Dominance of pine species remains same for 30 year period. Regeneration in understory dominated by incense cedar and fir creating fuels ladders.	Results in slightly less dominance of pine than proposed action otherwise the same. Pine regenerates in opening
Promote heterogeneity within stands and between stands	Heterogeneity increases following treatments.	Heterogeneity remains same.	Same as proposed action.

Cumulative Effects

Cumulative Effects to Canopy Cover, Stand Density, Forest Health and Stand Density: The cumulative effect of Alternative 3 in combination with current, recent past and reasonably foreseeable activities are the same as the proposed action. Cumulative effects are the same because reduction of tree numbers, stand density, potential for insect attack, and resistance to fire are similar or the same. Cumulative effects are the same because the current, recent past and reasonably foreseeable activities remain unchanged across the 72,000 acre landscape and difference between each alternative are small compared to the entire landscape.

Cumulative Effects to Large Trees, Diameter Distribution and Species Composition: The cumulative effect of Alternative 3 in combination with current, recent past and reasonably foreseeable activities are the same as the proposed action. Cumulative effects are the same because the number of large trees, diameter distribution, and species composition are similar or the same. Cumulative effects are the same because the current, recent past and reasonably foreseeable activities remain unchanged across the 72,000 acre landscape and differences between each action alternative are small compared to the entire landscape.

Cumulative Effects to Conifers and Competing Vegetation: The cumulative effect of Alternative 3 in combination with current, recent past and reasonably foreseeable activities are the same as the proposed action. Cumulative effects are the same because the direct and indirect effects on conifers and competing vegetation are similar or the same. Cumulative effects are the same because the current, recent past and reasonably foreseeable activities remain unchanged across the 72,000 acre landscape and difference between each alternative are small compared to the entire landscape.

Cumulative Effects to Vegetation from Wildfire and Prescribed Fire:The cumulative effect of Alternative 3 in combination with current, recent past and reasonably foreseeable activities are the same as the proposed action. Cumulative effects are the same because the direct and indirect effects on conifers and competing vegetation are similar or the same. Cumulative effects are the same because the current, recent past and reasonably foreseeable activities remain unchanged across the 72,000 acre landscape and difference between each alternative are small compared to the entire landscape.

TRANSPORTATION

Affected Environment

Existing Transportation System

The arterial and collector roads within and adjacent to the Kings River Project area include State Highway 168, Fresno County Roads 2440 (Dinkey Creek Road) and 2070 (Peterson Mill Road), and various Level 3, 4 and 5 National Forest System Roads (NFSR). Most of the Level 3, 4 and 5 roads will only require pre-haul maintenance. Many of the local roads within the Project area vary in degree of condition ranging from good, requiring pre-haul maintenance, to poor, requiring reconstruction to meet access needs and eliminate resource concerns. Following is a summary of the transportation situation for each of the initial eight management units:

- Bear_fen_6 Management Unit - Access to this management unit is provided by Fresno County Roads 2440, Dinkey Creek Road, in addition to NFSR 10S024 and 10S069. These roads provide the primary access route for the management area and are in good condition. NFSR 10S024 and 10S069 are aggregate. Access for project activities will require approximately 16.5 miles of road reconstruction. There is no new road construction planned. This road system is not suited for wet weather use due to rutting and high potential for off-road damage and degradation of water quality.

- El_o_win_1 Management Unit – Access to this management unit is provided by Fresno County Roads 2440, Dinkey Creek Road, in addition to NFSR 10S024 and 11S040. These roads provide the primary access route for the management area and are in good condition. NFSR 10S024 is aggregate and 11S040 is paved. Access for project activities will require approximately 12.4 miles of road reconstruction. There is no new road construction planned. This road system is not suited for wet weather use due to rutting and high potential for off-road damage and degradation of water quality.

- Glen_mdw_1 Management Unit - Access to this management unit is provided by Fresno County Road 2440, Dinkey Creek Road and National Forest System Roads (NFSR) 9S009, 10S007, and 10S069. These roads provide the primary access route for the management area and are in good condition. NFSR 9S009 and 10S007 are paved and NFSR 10S069 is aggregate. Access for project activities will require approximately 12.2 miles of road reconstruction. This road system is not suited for wet weather use due to rutting and the high potential for off-road damage and degradation of water quality. There is no new road construction planned.

- Krew_bul_1 Management Unit - Access to this management unit is provided by Fresno County Roads 2440, Dinkey Creek Road, in addition to NFSR 10S024 and 11S040. These roads provide the primary access route for the management area and are in good condition. NFSR 10S024 is native surface and 11S040 is paved. Access for project activities will require approximately 10.8 miles of road reconstruction and 0.2 miles of new construction. This road system is not suited for wet weather use due to rutting and high potential for off-road damage and degradation of water quality.

- Krew_prv_1 Management Unit - Access to this management unit is provided by Fresno County Road 2440, Dinkey Creek Road and NFSR 10S017 and 10S069. These roads provide the primary access route for the management area and are in good condition. NFSR 10S017 is paved and NFSR 10S069 is aggregate. Access for project activities will require approximately 13.0 miles of road reconstruction and 0.9 miles of new construction. Road rights of way will need to be acquired for NFSR 10S010, 10S012, 10S017B, 10S017C, 10S017D, 10S017M, 10S025A and 10S069. This road system is not suited for wet weather use due to rutting and high potential for off-road damage and degradation of water quality.

- N_soapro_2 Management Unit - Access to this management unit is provided by Fresno County Road 2070, Peterson Mill Road, in addition to NFSR 10S002, 10S043, and 10S004. These roads provide the primary access route for the management area and are in good condition. NFSR 10S002 is paved. NFSR 10S004 and 10S043 are aggregate. Access for project activities will require approximately 4.3 miles of road reconstruction. There is no new road construction planned. A high water ford will need to be constructed on NFSR 10S004 to cross Rush Creek. No significant change in traffic quantity is expected as a result of the ford. This road system is not suited for wet weather use due to rutting and high potential for off-road damage and degradation of water quality.

- Providen_1 Management Unit - Access to this management unit is provided by Fresno County Roads 2440, Dinkey Creek Road, and 2070, Peterson Mill Road in addition to NFSR 10S017, 10S018, and 10S002. These roads provide the primary access route for the management area and are in good condition. NFSR 10S002 and 10S017 are paved and NFSR 10S018 is aggregate. Access for project activities will require approximately 7.6 miles of road reconstruction and 0.6 miles of new construction. Road rights of way will need to be acquired for NFSR 10S017A, 10S017B and 10S087. This road system is not suited for wet weather use due to rutting and high potential for off-road damage and degradation of water quality.

- Providen_4 Management Unit - Access to this management unit is provided by Fresno County Roads 2440, Dinkey Creek Road, and 2070, Peterson Mill Road in addition to NFSR 10S017 and 10S002. These roads provide the primary access route for the management area and are in good condition. NFSR 10S002 and 10S017 are paved. Access for project activities will require approximately 6.8 miles of road reconstruction. There is no new road construction planned. Road rights of way will need to be acquired for NFSR 10S037. This road system is not suited for wet weather use due to rutting and high potential for off-road damage and degradation of water quality.

Table 3-10 - Road mileage and construction cost summary

Management Unit Name	Year	Miles of Road Maintenance	Miles of Road Reconstruction	Miles of New Road Construction	Project Construction Costs	Costs Borne by the Project
Krew_prv_1	2006	23.5	14.1	0.9	$441,000	Yes
El_o_win_1	2006	23.9	12.4	0	$135,000	Yes
Providen_4	2006	19.1	6.8	0	$189,000	Yes
Krew_bul_1	2007	22.2	10.8	0.2	$163,000	Yes
Glen_mdw_1	2007	24.2	12.2	0	$262,400	Yes
Providen_1	2007	23.4	7.6	0.6	$202,475	Yes
Bear_fen_6	2008	41.5	16.5	0	$301,400	Maybe
N_soapro_2	2008	12.9	4.3	0	$306,103	No
Totals		**190.7**	**84.7**	**1.7**	**$2,000,378**	

Inventoried National Forest System Roads accessing the proposed project area are shown on the Project Area Map and are summarized in the Road Data Summary that is on file at the High Sierra District Office.

Effects of Alternative 1 and Alternative 3

These alternatives include 84.7 miles of road reconstruction to repair existing substandard road conditions and 1.7 miles of new construction. Design standards for road reconstruction reflect use during normal operating season, dry weather access, and to repair roads that are causing resource damage. The reconstruction will reduce the erosion from unsurfaced roads and will be especially important to reducing soil sedimentation into streams in sub-watersheds that have the potential for a cumulative watershed effect (See Watershed Section for further details.). In addition, a high water ford will be built on NFSR 10S004 across Rush Creek for access to the n_soapro_2 management unit. Road maintenance such as additional rocking of the road surface, grading, subgrade repair and subgrade drainage will be needed to support wet weather activities if project activities take place outside the normal operating season. However the Proposed Action does not contemplate wet weather operation.

The cost of road reconstruction and new construction for this project will be approximately $2,000,378 to provide access for log trucks, fire engines, and other work crews. The cost of construction, reconstruction and maintenance of specified roads will be borne by the project to the extent possible. Appropriated funds may be utilized if available. See Economics Section for more information.

Water is typically not plentiful enough for extensive dust abatement. Restrictions from use of alternative dust abatement products in riparian conservation areas for specific aquatic species on some roads may limit hauling operations and increase the cost. Limiting hauling operations may delay completion of scheduled treatments. Trip restrictions or speed reductions may be considered in lieu of water. The District Aquatics Biologist or Hydrologist should be consulted for water source availability.

Approximately 3.0 miles of unclassified roads would be decommissioned for the purpose of improving water quality and enhancing wildlife habitat.

All road maintenance/reconstruction/new construction would follow the Sierra Forest Land Resource Management Plan Standards and Guidelines and Best Management Practices. Roads will be maintained to provide access for equipment needed for project access. Roads will not be upgraded beyond the standards consistent with the LRMP and project access requirements.

Effects of Alternative 2

Existing road reconstruction needed to eliminate resource damage and support equipment access will not take place. No road reconstruction activities will take place on local roads and no new road construction will be needed. Soil erosion from unsurfaced roads will continue to occur at the current rate. The transportation system for the area will not be updated and improved by this project to meet current access management direction. No road decommissioning will take place.

FUELS- FIRE BEHAVIOR

Affected Environment

Striking changes in structural and functional components of Sierran ecosystems have occurred since 1860, largely due to alternations in the pre-Euro-American settlement fire regime. Today unnatural fuel accumulations occur in many fire-dependent forest ecosystems along with associated increases in forest stand densities. With these shifts have come changes in fire regime characteristics including large stand-destroying fires (Caprio and Graber 2000). Altered fire frequencies caused by successful fire exclusion over the past 60 to 70 years in ponderosa pine forests characterized by a frequent low-intensity fire regime, coupled with prolonged drought and epidemic levels of insects and diseases have coincided to produce extensive forest mortality and the eventual increase in forest fuels and has contributed to greater stand densities and an increase of crown fire potential (Mutch and Cook 1996). The occurrences of such severe large fires are well outside the natural range of variability and thus considered detrimental to Sierra Nevada Ecosystems (Weatherspoon and Skinner 1995). According to Scott Stephens (2005) annual wildfire acres in the western US have increased in the last 60 years, where California has experienced the highest amount of acres burned from 1940-2000.

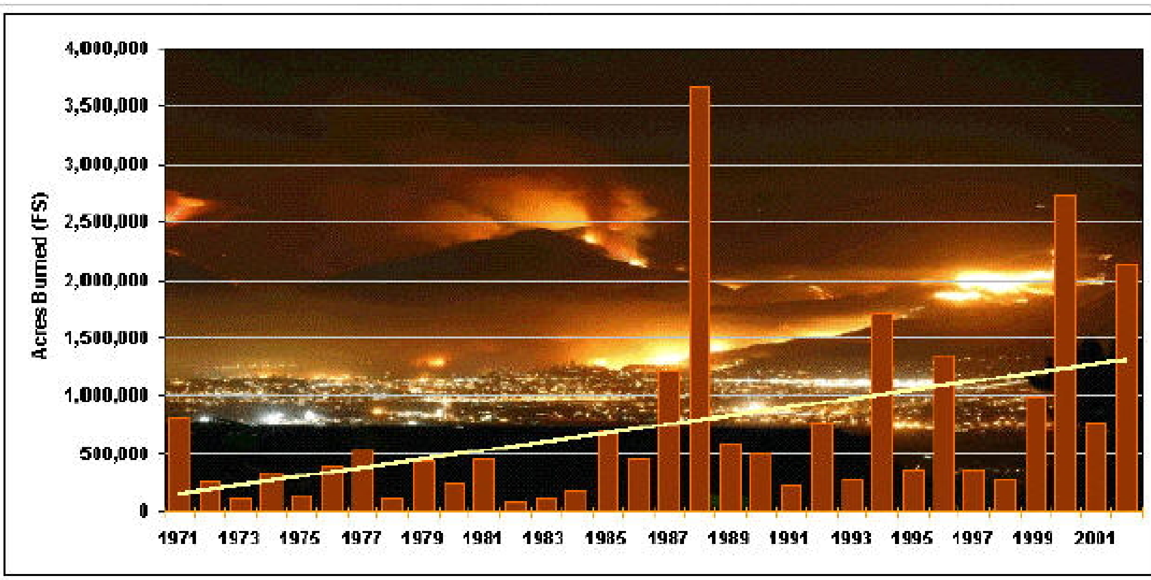


Figure 3-24 - Escalating Wildland Fire acres Burned (Forest Service Only) (www.fireplan.gov, 2004)

"The best general approach for managing wildfire damage seems to be managing tree density and species composition with well-designed silvicultural systems at a landscape scale that includes a mix of thinning, surface fuels treatments, and prescribed fire with proactive treatments in areas with high risk to wildfire," (Graham and others 1999) and the maintenance of those treatments.

Forests have changed from fire adapted to fire intolerant species; fire intolerant species tend to form unhealthy stands prone to large-scale wildfires, as well as increased outbreak of disease and insects (Graham and others 1999). Dry site, low elevation ponderosa pine forests in the Sierra Nevada are classified as fire regime[5] I, mid-elevation mixed conifer forests are typically fire regime III and high elevation true fir forests are characterized as fire regime IV. Seventy-two percent of the KRP is classified as condition class 2 and 3 have uncharacteristic conditions that are a moderate or high departure from the natural fire regime (see Table 3-11).

The historical low-severity fire regime which dominated the project area was one of high frequency – low intensity fire in the ponderosa pine forest, transitioning to mixed severity in the mixed conifer forest and one of low frequency – mixed intensity in the true fir forest (Brown and Smith 2000). Fire suppression efforts in the last century have changed the landscape and the historical fire regime. Fire history and tree ring studies in the Kings River Project suggest a historical fire return interval of every 3-5 years (Drumm 1996, Phillips 1998). The Kings River Project has missed several fire entries, possible as many as 20 low intensity fires; and due to the lack of frequent-low intensity fires, has become overstocked with fire intolerant trees and shrubs converting it to a fire susceptible forest type in which high intensity fires are prevalent.

Table 3-11 - Current fire regime condition class

Fire Regime	Condition Class	Acres	Percent land area
I	1	3731	2%
I	2	38288	22%
I	3	74419	44%
III	1	15767	9%
III	2	20331	12%
III	3	8	0% (.004%)
IV	1	17065	10%
IV	2	823	1%
IV	3	0	0

The risk of ignition is increasing within the WUI of the KRP with the intensified development of private land adjacent to and within the forest and within the project boundary. Dense stands of trees, choked with an understory of fire intolerant thickets of incense cedar, fir and manzanita exist within feet of homes in the WUI (see property layer - district files). The radiation and heat exposure from a wildland fire in the WUI would threaten homes and increase their likelihood of becoming a fuel source. Cohen identifies homes as potential fuel and indicates the distance between the wildland fire and the homes is an important factor for structure ignition (Cohen 1999, Cohen and Stratton 2003). Where as we have no control over the ignitability of homes in the WUI, we can change the landscape directly adjacent to homes in the WUI and influence the resulting fire behavior in the event of a wildfire.

Fire and Fuels Existing Condition

[5] A natural fire regime is classified as the role fire would play across a landscape in the absence of modern human mechanical intervention and is a generalized description of the fire's role within a vegetation community. "Three condition classes are described for each fire regime and are based on a relative measure describing the degree of departure from the historical natural fire regime.

Existing vegetation – Predominate vegetation types and acres are discussed under Vegetation Section. Ponderosa pine (28%) and Sierra mixed conifer (43%) are the dominant forest types within the initial eight management units. Forest types that occur less frequently include chaparral (5%), montane chaparral (2%), montane hardwood (8%), montane hardwood conifer (3%), red fir (3%), barren (7%), and other CWHR types (32%). Brush is a dominant component, this is especially true in the ponderosa pine and Sierra Mixed conifer stands. Mixed conifer stands average 24 percent brush cover; in ponderosa pine stands brush cover ranges from 0 – 100 percent with approximately half the plots containing greater than fifty percent brush cover.

Fire Behavior – Ponderosa Pine Type - This vegetation type occurs primarily in the Providence 1, Providence 4, and N Soaproot 2 management units, small pockets also occur in the Bear_fen_6 management unit. As described near the beginning of Chapter 3, one or more of these management units could burn on any hot windy summer day.

Figure 3-25- Ponderosa Pine/Brush Existing Condition

Figure 3-26- providen_1 Existing Condition

Figure 3-27 - Ponderosa pine/Brush Thinned

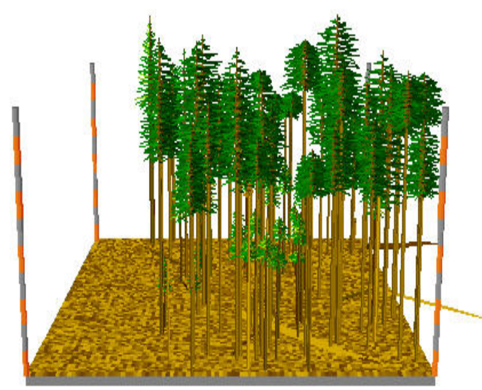


Figure 3-28- Ponderosa Pine/Brush Year 2025

Figures 3-25 -3-28 Are examples of treated and untreated ponderosa pine stands in providen_1, providen_4, and n_soapro_4. 28% of the KRP project area is represented in stands like this.

Heavy surface fuels (16 to 50+ tons per acre) coupled with dense brush (bear clover and manzanita) provide for a continuous fuel bed in ponderosa pine; large brush (white leaf manzanita and deer brush) and dense pockets of sapling size incense cedar and white fir make up the understory vegetation. This dense understory canopy is termed ladder fuels and the crown base height ranges from 0- 5 feet. Ponderosa pine and black oak predominate in the overstory with canopy cover ranging from 30-70%.

In untreated stands, fire behavior can be characterized by high intensity surface fires, torching of trees (passive crown fire) is likely, with some active crowning possible depending on wind conditions. Fires of this type will result in mixed to lethal mortality in both moderate and severe fire conditions (modeling estimates percent basal area loss ranges from 10 to 95% loss in both moderate and severe fire weather conditions). Potential fire behavior in this vegetation type was modeled using Behave (surface fires), FlamMap(crown fire risk) and in the Fire/Fuels Extension of FVS (surface and crown fires). All three models use established published methodologies for computing crown bulk density, fire behavior and predicted scorch and mortalities. Flame lengths range from 2 to 24 feet in height when fine fuel moistures are 3 percent, and mid flame (eye level) wind speeds range between 8 -14 miles per hour (with gusts to 20 mph), rates of spread ranged from 22 to 93 chains per hour. Modeling showed passive to active crown fires possible under severe fire weather conditions (97th percentile).This fire behavior is likely to occur over 80 percent of the time during the summer months (Fire Family Plus *Mountain Rest weather station*).

Two recent wildfires within the same vegetation type on the Sierra National Forest have exhibited these outcomes. Both wildfires occurred in August 2001 under 90th percentile (high fire weather) conditions in the wildland urban intermix of Sierra National Forest. The Musick Fire started on August 17 and the North Fork Fire on August 21, 2001. Weather conditions for August 17 and 21 matched the historical 90th percentile conditions for the Mountain Rest weather station and the vegetation type for both fires was ponderosa pine with a brush understory, very similar to ponderosa pine types the Kings River Project. The Musick Fire experienced 80 foot flame lengths after the humidity dropped to below 12 % with no wind at 3:00 am on the morning of the August 18. Active and rapid crown fire spread made suppression of the fire hazardous and all crews were pulled from the line (personal communications). The North Fork fire became an active crown fire within minutes of ignition and was 100 acres+ in size within an hour. One home was lost and hundreds were threatened over the several days the fire burned (Moore, 2001). High fire intensity levels were experienced over 27% or 1,106 acres of the fire area. Timber mortality was severe in these areas. Strong hydrophobic conditions (soil water repellency) were also created in the high intensity burn areas. The consequences of this high intensity fire are the loss of habitat, the potential for strong overland water flows and debris slides in the South Fork of Willow Creek and in Peckinpah Creek (Roath and Prentice, 2001). Similar consequences are predicted in the Kings River Project if a fire were to start under similar conditions.

Rick Moore

Figure 3-29 – North Fork fire, 08/01

Mike Pasillas

Figure 3-30 –North Fork Fire 12/18/01

In treated stands, fire behavior can be characterized by low intensity surface fire, torching of trees is infrequent, and only where fuels were left untreated for topological reasons or habitat concerns. Fires of this type will result in low to mixed mortality in both moderate and severe fire conditions (modeling estimates percent basal area loss ranges from 0 to 30% loss in both moderate and severe fire weather conditions). Flame lengths range from 0-7 feet in height when fine fuel moistures are 3 percent, and mid flame (eye level) wind speeds range between 8 -14 miles per hour (with gusts to 20 mph), rates of spread ranged from 0-4 chains per hour. Modeling showed surface to passive fires possible under severe fire weather conditions (97th percentile).

Fire Behavior – Sierra Mixed Conifer

This vegetation type occurs primarily in the Krew_prov_1, glen_mdw_1, elo_win_1 and bear_fen_6 management units. As described near the beginning of Chapter 3, one or more of these management units could burn on any hot windy summer day.

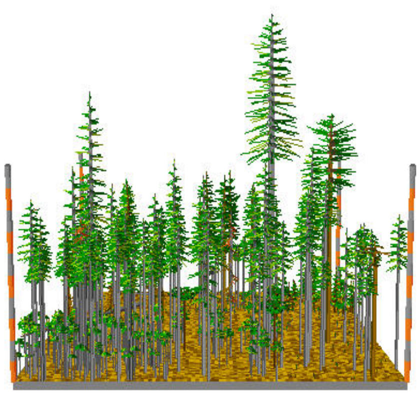


Figure 3-31 Sierra Mixed Conifer

Figure 3-32 bear_fen_6 Existing Condition

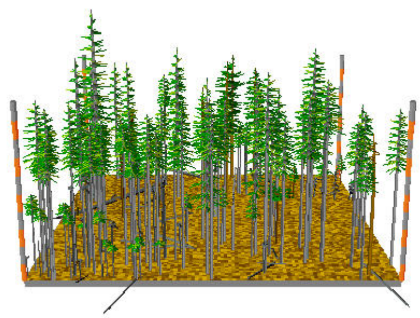


Figure 3-33 Sierra Mixed Conifer Thinned

Figure 3-34 Sierra Mixed Conifer Year 2025

Figures 3-31 through 3-34 Are examples of treated and untreated Sierra mixed conifer stands in Krew_prov_1, glen_mdw_1, elo_win_1 and bear_fen_6. 43% of the KRP project area is represented in stands like this.

Heavy surface fuels (16 to 50+ tons per acre) coupled with moderate brush growth provide for a continuous fuel bed in Sierra mixed conifer; large brush (green leaf manzanita and white thorn) and dense pockets of sapling size incense cedar and white fir dominate the understory and openings. The crown base height ranges from 0- 5 feet. The overstory canopy is a mix of white fir, incense cedar, ponderosa pine and sugar pine with canopy cover ranging from 10-70%.

In untreated stands, fire behavior can be characterized by high intensity surface fires, torching of trees (passive crown fire) is likely, with some active crowning possible depending on wind conditions. Fires of this type will result in mixed to lethal mortality in both moderate and severe fire conditions (modeling estimates percent basal area loss ranges from 6 to 60% loss in moderate fire weather conditions and 6-100% loss in severe fire weather conditions). Flame lengths range from 7 to 66 feet in height when fine fuel moistures are 3 percent, and mid flame (eye level) wind speeds range between 8 -15 miles per hour (with gusts to 22 mph), rates of spread ranged from 66 to 118 chains per hour. Modeling showed passive to active crown fires possible under severe fire weather conditions (97th percentile).This fire behavior is likely to occur over 90 percent of the time during the summer months (Fire Family Plus *Fence Meadow weather station*).

On August 18, 1981, the Rock Creek fire started in the upper portions of the Dinkey Creek drainage in mature mixed conifer forest. The fire narrative states that winds were upslope at 15-20 MPH, relative humidity was less than 20% and the temperature was 80 degrees Fahrenheit. These conditions are a near match for 97th percentile at the Dinkey Creek weather station (Temp-81F, Rh (min)-13%, winds – 15 mph). When district personnel arrived the rate of spread exceeded 80 chains per hour. The fire was crowning in mature timber and spotting up to ¾ miles ahead of the main front (District Records). The fire grew to over 1000 acres in the first day, the final fire size was 1155 acres. No records exist of the severity and timber loss, but this fire person arrived on the district the following year and over 90% of the area had 100% mortality.

Figure 3-35– Rock Creek Fire area 20 years later (2001)

In treated stands, fire behavior can be characterized by low intensity surface fire, torching of trees is infrequent, and only where fuels were left untreated for topological reasons or habitat concerns. Fires of this type will result in low to mixed mortality in both moderate and severe fire conditions (modeling estimates percent basal area loss ranges from 0 to 24% loss in both moderate and severe fire weather conditions). Flame lengths range from 0-7 feet in height when fine fuel moistures are 3 percent, and mid flame (eye level) wind speeds range between 8 -15 miles per hour (with gusts to 22 mph), rates of spread ranged from 0-4 chains per hour. Modeling showed surface to passive fires possible under severe fire weather conditions (97th percentile).

Fire Behavior – Red Fir

This vegetation type occurs primarily in the Krew_bull management unit. As described in the following paragraphs, this unit is the least likely to experience the fate of burning on a hot windy summer day.

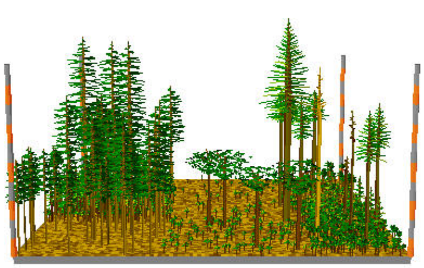


Figure 3-36 Red Fir Existing Condition **Figure 3-37 Krew_bul_1 Existing Condition**

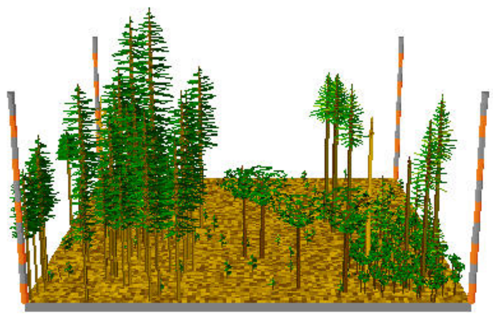


Figure 3-38. Red Fir Thinned

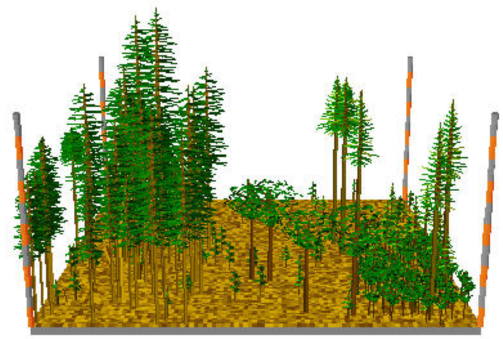


Figure 3-39. Red Fir Year 2025

Figures above are examples of treated and untreated red fir stands in Krew_bul_1 3% of the KRP project area is represented in stands like this.

Moderate to heavy surface fuels (16 to 34+ tons per acre) exist within this management unit, the brush understory is light compared with the other management units. White thorn and some green leaf manzanita exist. The crown base height ranges from 4- 40 feet. The overstory canopy is predominately red fir with canopy cover ranging from 10-60%.

In untreated stands, fire behavior can be characterized by high intensity surface fire, torching of trees (passive crown fire) is likely, though active crown fire is possible but unlikely. Fires of this type will result in mixed to lethal mortality in both moderate and severe fire conditions (modeling estimates percent basal area loss ranges from 10 to 20% loss in moderate fire weather conditions and 10-100% loss in severe fire weather conditions). Flame lengths range from 1 to 4 feet in height (up to 78 ft possible if passive crown fire occurs) when fine fuel moistures are 3 percent, and mid flame (eye level) wind speeds range between 8 -15 miles per hour (with gusts to 22 mph), rates of spread ranged from 80 to 118 chains per hour. Modeling showed surface to passive crown fires possible under severe fire weather conditions (97th percentile).This fire behavior is likely to occur over 50 percent of the time during the summer months (Fire Family Plus *Fence Meadow weather station*).

In treated stands, fire behavior can be characterized by low intensity surface fire, torching of trees is infrequent, and only where fuels were left untreated for topological reasons or habitat concerns. Fires of this type will result in low to mixed mortality in both moderate and severe fire conditions (modeling estimates percent basal area loss ranges from 8 to 55% loss in both moderate and 37-99% in severe fire weather conditions). Flame lengths range from 0-20 feet in height when fine fuel moistures are 3 percent, and mid flame (eye level) wind speeds range between 8 -15 miles per hour (with gusts to 22 mph), rates of spread ranged from 0-4 chains per hour. Modeling showed only surface fires possible under moderate and severe fire weather conditions (97th percentile).

Fire Behavior – Chaparral/Montane Chaparral/ Montane Hardwood/Montane Hardwood Conifer

This vegetation type occurs in the n_soapro_2 and two stands in the providen_4 management units.

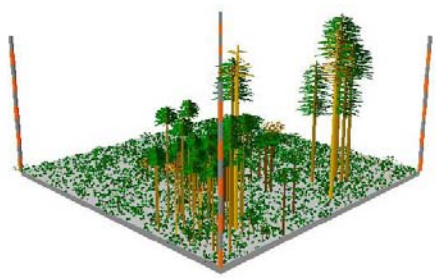


Figure 3-40. Chaparral/Hardwood Existing Condition

Figure 3-41 - providen_4 Existing Condition

Figure 3-42. Chaparral/Hardwood Thinned

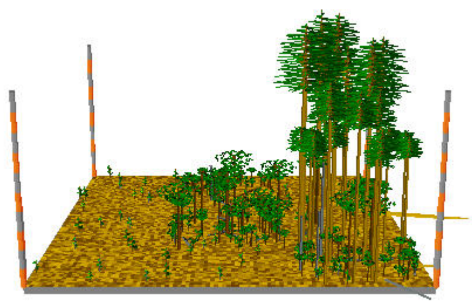


Figure 3-43. Chaparral/Hardwood Year 2025

Figures above are examples of treated and untreated chaparral/hardwood stands in n_soapro_2 and providen_4. 17% of the KRP project area is represented in stands like this.

Surface fuel loading is light (0-15 tons per acre) in the chaparral/hardwood stands. Brush fields in the n_soapro_2 and the providen_4 are dominated by a complex of brush species: deer brush, whiteleaf manzanita, bear clover, whitethorn, gooseberry and greenleaf manzanita. These brush fields are generally classified as chaparral or montane chaparral. The crown base height (though there is no appropriate term for brush fields) ranges from 0- 2 feet. The overstory canopy is a light scattering of ponderosa pine (conifer dominated stands are discussed under ponderosa pine) or black oak.

In untreated stands, fire behavior can be characterized by high intensity surface fires, torching of single or groups of trees (passive crown fire) is likely, crown fire cannot exist where no continuous crown canopy is present. Fires of this type will result in mixed to lethal mortality in both moderate and severe fire conditions (modeling estimates percent basal area loss ranges from 0 to 60% loss in moderate fire weather conditions and 0-100% loss in severe fire weather conditions). Flame lengths range from 4-15 feet in height when fine fuel moistures are 3 percent, and mid flame (eye level) wind speeds range between 8 -14 miles per hour (with gusts to 20 mph), rates of spread ranged from 22 to 60 chains per hour. Modeling showed surface to passive crown fires possible under severe fire weather conditions (97th percentile).This fire behavior is likely to occur over 90 percent of the time during the summer months (Fire Family Plus *Mtn. Rest weather station*).

In treated stands, fire behavior can be characterized by low intensity surface fire, torching of trees is infrequent, and only where fuels were left untreated for topological reasons or habitat concerns. Fires of this type will result in low to mixed mortality in both moderate and severe fire conditions (modeling estimates percent basal area loss ranges from 0 to 66% loss in both moderate and severe fire weather conditions). Flame lengths range from 0-8 feet in height when fine fuel moistures are 3 percent, and mid flame (eye level) wind speeds range between 8 -14 miles per hour (with gusts to 20 mph), rates of spread ranged from 0-4 chains per hour. Modeling showed surface to passive fires possible under severe fire weather conditions (97th percentile).

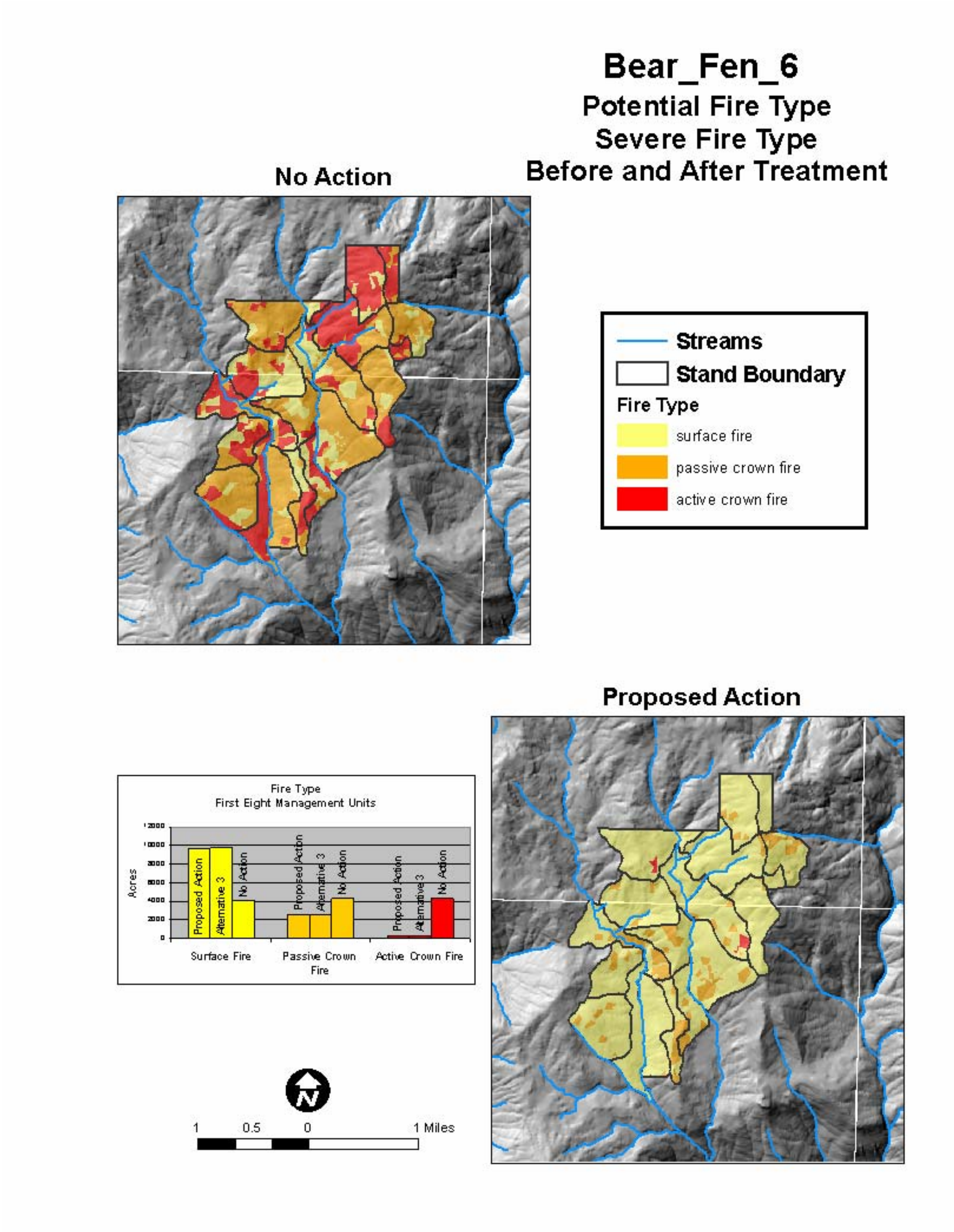
Environmental Consequences

Alternative 1 – Proposed Action

<u>Direct Effects:</u> Recent research has found that prescribed burning and mechanical thinning can lower spread rates and intensities within the treated area (Graham and McCaffrey, 2003), (Perry and others, 2004), (Agee and Skinner, 2005), (Stephens and Moghaddas, 2005). Landscape modeling of vegetation treatments (FVS) and fire behavior (FlamMap) show that in the initial eight management units, thinning effectively reduces flame length and fire type where treatments occur. Not all stands in each management unit are treated and a range of results occurs.

The combination of proposed treatments would reduce flame lengths and the potential for passive (torching) and active crown fires[6]. The fire behavior values were derived by using the FVS-FFE and FlamMap modeling programs. The year of treatment was modeled in 2007 and the year of probable wildfire was 2017 after all initial treatments were completed. Figures 3-44 and 3-45 show the change in fire type for the proposed action compared to the no action alternative. Krew_prv_1 and bear_fen_6 management units are shown as examples. Bear_fen_6 and Krew_prv_1 were chosen to represent a WUI management unit (Krew_prv_1) and a non WUI (bear_fen_6). The charts in Figures 3-44 and 3-45 show the total acres of change by fire type for all three alternatives.

[6] A passive crown fire, also called torching or candling, is one in which individual or small groups of trees torch out, but solid flame is not consistently maintained in the canopy. An active crown fire, also called a running or continuous crown fire, is one in which the entire surface/canopy fuel complex becomes involved, but the crowning remains dependent on heat from the surface fuels for continued spread.



Bear_Fen_6
Potential Fire Type
Severe Fire Type
Before and After Treatment
No Action
Streams
Stand Boundary
Fire Type
surface fire
passive crown fire
active crown fire
Proposed Action
Fire Type
First Eight Management Units
Acres
12000
10000
8000
6000
4000
2000
0
Proposed Action
Alternative 3
No Action
Surface Fire
Passive Crown Fire
Active Crown Fire
1
0.5
0
1 Miles

Figure 3-44.

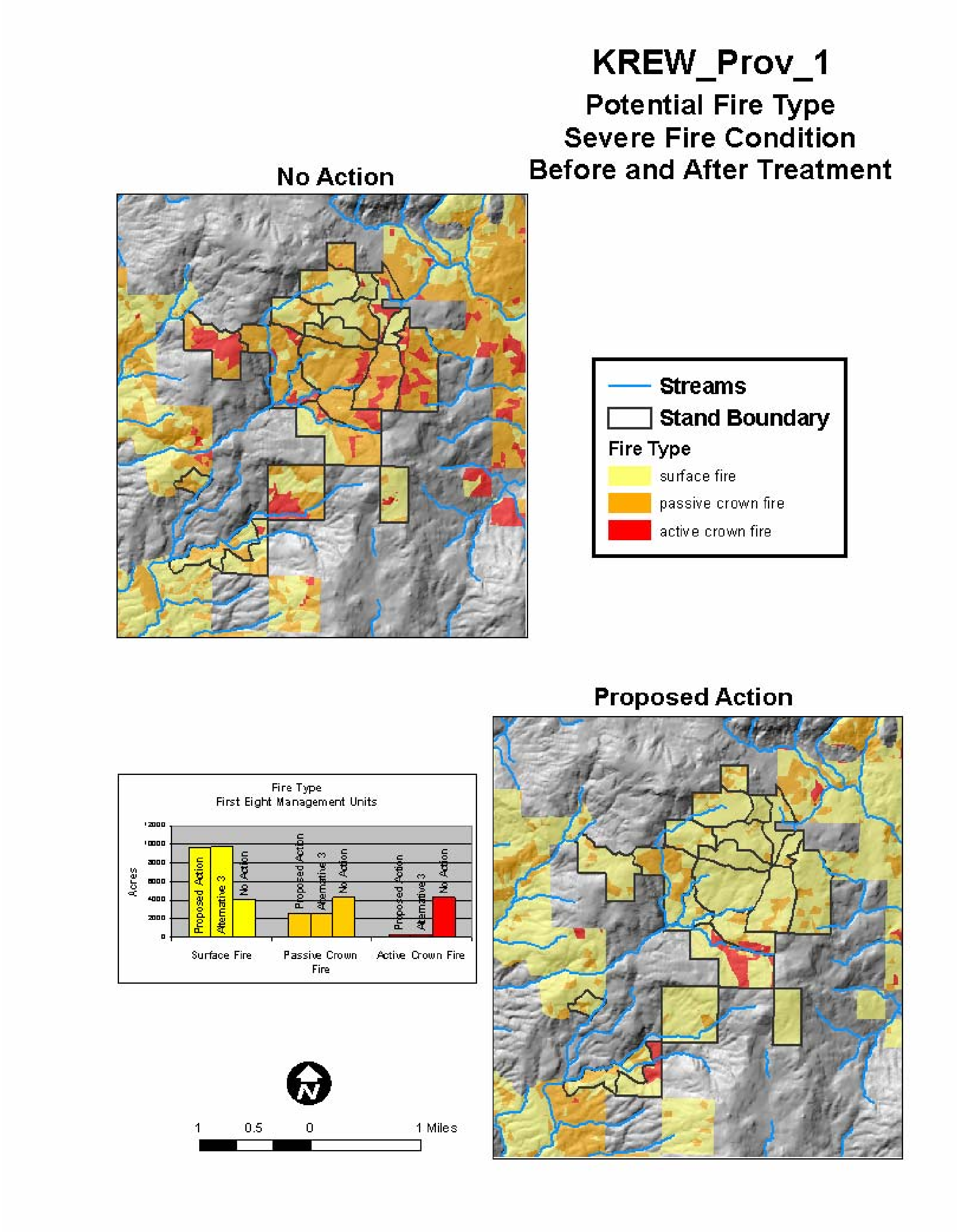

KREW_Prov_1
Potential Fire Type
Severe Fire Condition
Before and After Treatment
No Action
Streams
Stand Boundary
Fire Type
surface fire
passive crown fire
active crown fire
Proposed Action
Fire Type
First Eight Management Units
Acres
12000
10000
8000
6000
4000
2000
0
Proposed Action
Alternative 3
No Action
Surface Fire
Passive Crown Fire
Active Crown Fire
1
0.5
0
1 Miles

Figure 3-45

As a result of the proposed action, active crown fire potential decreases from 4296 acres (under no-action) to 322 acres of active crown fire under the proposed action. Potential surface fire acres increase from 4045 acres under the no action to 9705 acres under the proposed action. Only n_soapro_2 shows an overall change in fire type. Where active crown fires were present in the no-action alternative, in the proposed action and the Alternative 3– the hottest fire type potential is a passive crown fire. Since not all stands in every management units are being treated, the full range of fire types (surface fire to active crown fires) is still present in each management units (for a full presentation of changes in fire type by each management unit – refer to the Fire-Fuels Analysis). The Fire-Fuels Analysis is incorporated by reference.

As stands are opened through understory thinning and fuel reduction activities including the removal of brush and surface fuels, stands would become less sheltered. Mid-flame wind speeds increase, which increases the surface rates of spread in the presence of light flashy fuels. In all management units, wildfire flame lengths are reduced due to the treatment of surface and understory fuels. Flame lengths in treated less-sheltered stands with a grass and bear clover understory produce shorter flame lengths than in dense brush and trees. Figures 3-46 and 3-47 show the change in flame lengths between the proposed action and the no action alternatives (Bear_fen_6 and Krew_prv_1 are again used as examples). Figure 3-48.compares flame length changes across all three alternatives for Krew_prv_1 (for a full presentation of changes in flame length by each management unit – refer to the Fire-Fuels Analysis).

The removal of surface fuels, slash (activity and naturally created), and brush through thinning and piling, coupled with an increase in crown base heights dramatically alter post-treatment fire behavior and fire types in timbered stands. The reduction in height to live crown (crown base height) dramatically increases the torching index in all management units. The torching index values[7] were derived by using the FVS-FFE modeling program (the year of treatment was modeled in 2007 and the year of probable wildfire was 2017 after all initial treatments were completed). Modeling using FVE-FFE gives the potential torching index (the wind speed it would take to initiate torching), and actual recorded winds during severe fire effects have only been recorded to 35 mph. The figures given are only an index of the potential for torching to be initiated.

Table 3-12 – Results of Wildfire Simulation

Management Units	Fire Type			Flame Length			Torching Index		
	PA	NA	%Δ	PA	NA	%Δ	PA	NA	%Δ
Bear_fen_6	Surface	to Active	0	6	41	85	373	31	92
Elo_win_1	Surface	to Active	0	8	48	83	274	24	91
Glen_mdw_1	Surface	to Active	0	13	31	58	150	32	78
Krew_prv_1	Surface	to Active	0	11	29	61	341	115	66
Krew_bul_1	Surface	to Active	0	5	42	87	231	116	50
N_soapro_2	Surf	to Act	Surf-Pass	7	7	11	231	116	50
Provid_1	Surface	to Active	0	6	13	56	515	102	80
Provid_4	Surface	to Active	0	8	11	30	384	221	42

Numbers given are the average of the plant aggregations within each MU.
PA = Proposed Action
NA = No Action
%Δ = Percent change

[7] Crowning and torching indexes are based upon wind speed necessary to initiate that type of fire characteristic. A low number means that little wind is needed to initiate torching (passive crown fire) or an active crown fire.

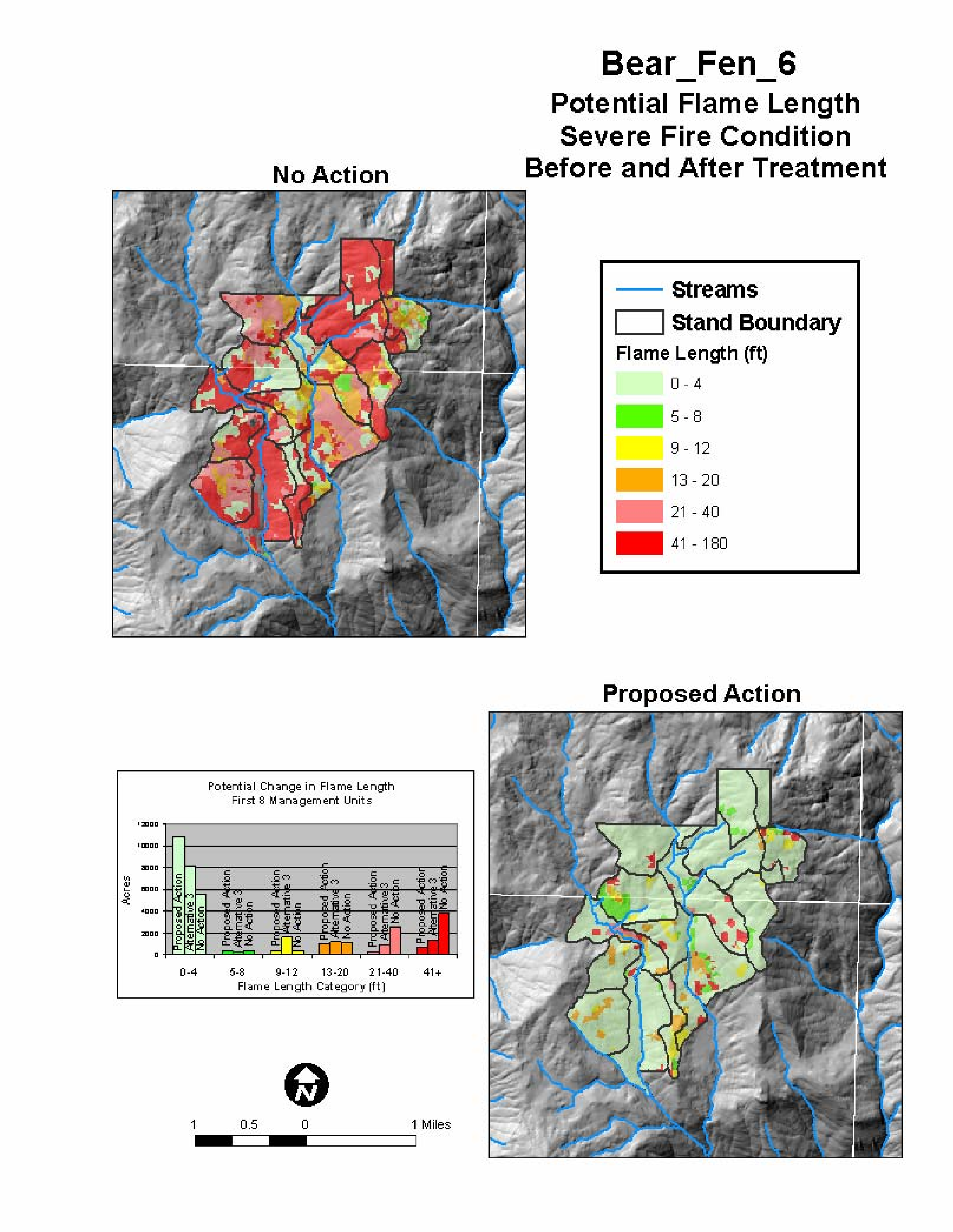

Bear_Fen_6
Potential Flame Length
Severe Fire Condition
Before and After Treatment
No Action
Streams
Stand Boundary
Flame Length (ft)
0 - 4
5 - 8
9 - 12
13 - 20
21 - 40
41 - 180
Proposed Action
Potential Change in Flame Length
First 8 Management Units
Acres
Proposed Action
Alternative 3
No Action
0-4
5-8
9-12
13-20
21-40
41+
Flame Length Category (ft)
1
0.5
0
1 Miles

Figure 3-46

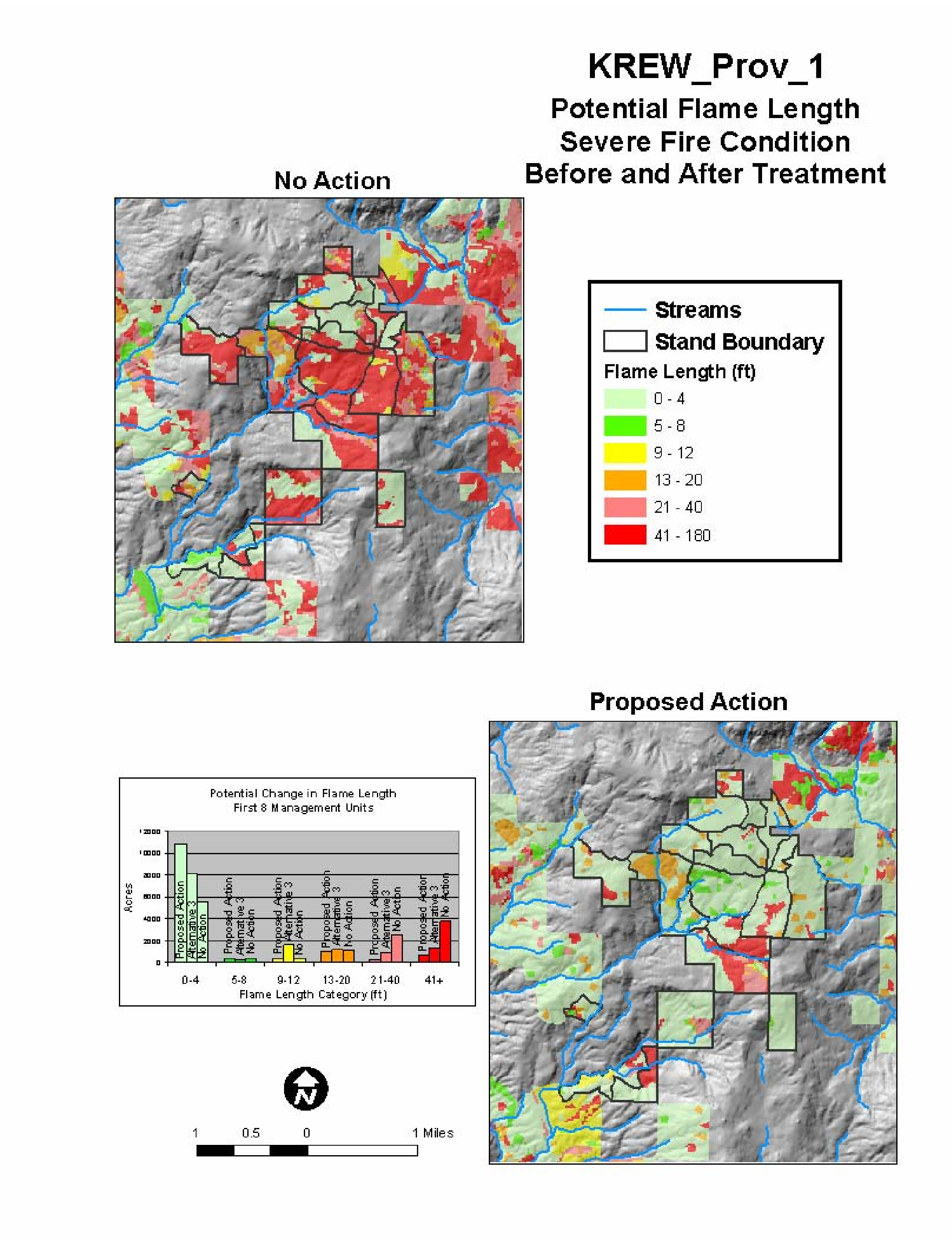

KREW_Prov_1
Potential Flame Length
Severe Fire Condition
Before and After Treatment
No Action
Streams
Stand Boundary
Flame Length (ft)
0 - 4
5 - 8
9 - 12
13 - 20
21 - 40
41 - 180
Proposed Action
Potential Change in Flame Length
First 8 Management Units
Acres
Proposed Action
Alternative 3
No Action
0-4
5-8
9-12
13-20
21-40
41+
Flame Length Category (ft)
1
0.5
0
1 Miles

Figure 3-47

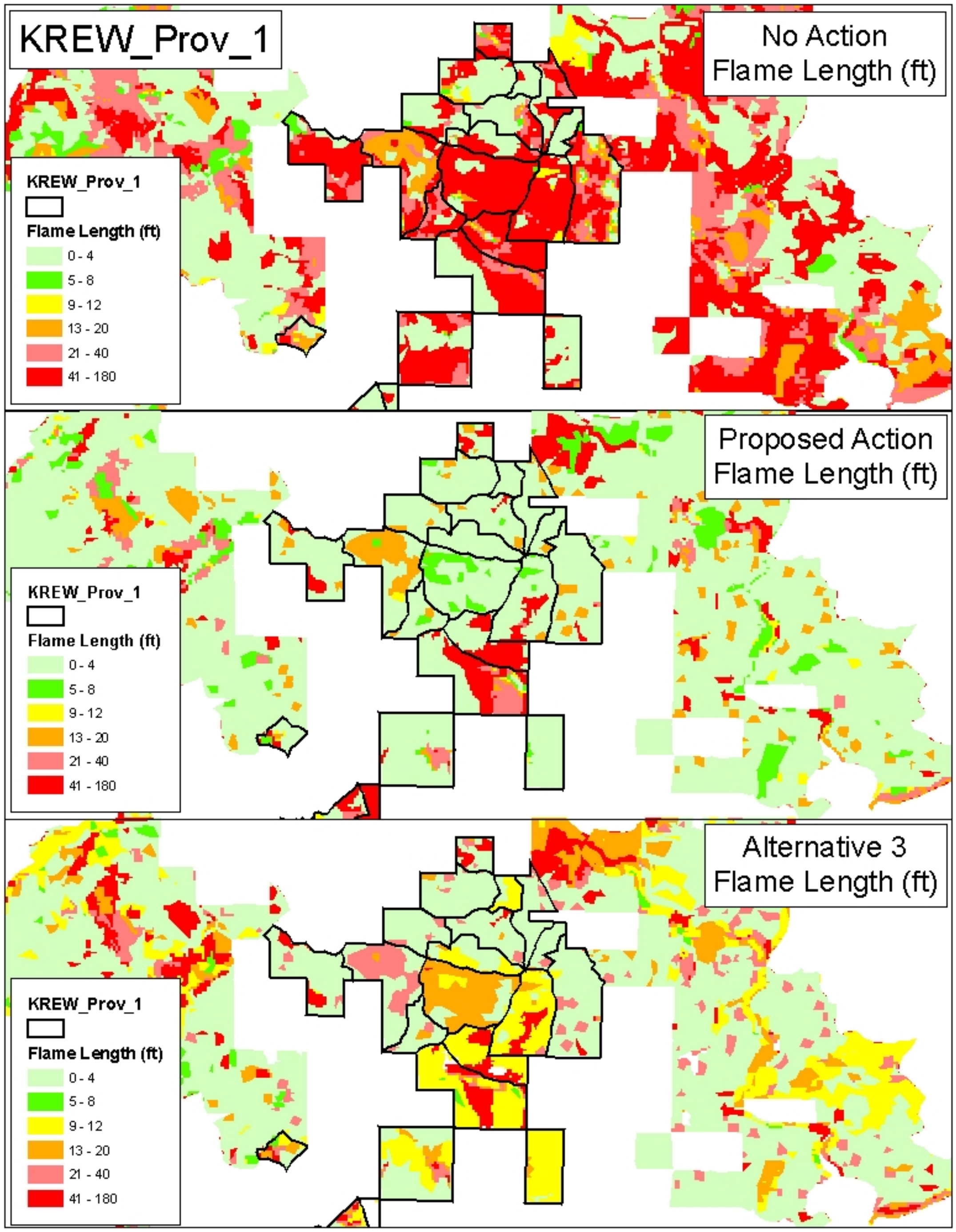

KREW_Prov_1
No Action
Flame Length (ft)
KREW_Prov_1
Flame Length (ft)
0 - 4
5 - 8
9 - 12
13 - 20
21 - 40
41 - 180
Proposed Action
Flame Length (ft)
KREW_Prov_1
Flame Length (ft)
0 - 4
5 - 8
9 - 12
13 - 20
21 - 40
41 - 180
Alternative 3
Flame Length (ft)
KREW_Prov_1
Flame Length (ft)
0 - 4
5 - 8
9 - 12
13 - 20
21 - 40
41 - 180

Figure 3-48

Figure 3-48 is a spatial comparison of the flame length changes for all three alternatives using the Krew_prv_1 management unit as an example. The difference between the Proposed Action and the Reduction of Harvest Tree size is from canopy bulk density, canopy base height and fuel model differences between the two alternatives. See Figure 3-49 for a spatial comparison of the crown bulk density for all three alternatives.

The biomass of trees removed during thinning treatments would have a significant increase in fuel loading and impact during a wildfire if left untreated (Pollet and Omi 2002, Omi and Martinson 2002). Thinning (activity created) slash, in combination with surface fuels, would have a major detrimental effect on fire behavior and intensity unless treated appropriately. This alternative is designed to thin crowns to the J-shaped curve for trees 11" and greater in diameter, treat surface fuels and slash, remove encroaching brush, and increase crown base heights (height to live crown) and clean up the activity created slash through piling, mastication, and underburning. Maintenance of the desired condition will be accomplished through repeat entries of underburning, herbicide spraying and/or hand thinning to control encroaching brush and natural accumulation of dead and down fuels.

Indirect Effects: Strategically placed treatments burn at lower intensities and at slower rates of spread compared to untreated areas, reducing damage to the treated stands from wildfire. An indirect effect is that adjacent untreated stands also benefit from the treatment this includes private property and communities in the WUI. Wildfires enter the untreated stands at lower intensities and rates of spread, reducing damage to these areas as well. The effectiveness of treatment on fire behavior outside the treated areas is assumed to have a 2:1 ratio (USDA 2001a), for every 2 acres treated, 1 acre of untreated vegetation will benefit from a reduction in fire behavior. The flame length is not only reduced on the treated acre but on the adjacent acre as well. The reduced flame length means lower mortality in the untreated adjacent acre. Fire will also promote sprouting and re-growth of brush species through scarification of the residual seeds, as well as increases in moisture and light. Maintenance burning, herbicide spraying, or hand cutting and piling would be required to maintain desired fire behavior in stands and keep the sprouting and re-growth of brush to a desirable level.

Cumulative Effects: In addition to the direct and indirect effects of Alternative 1, a cumulative effect is expected on fire behavior due to the past, present and reasonably foreseeable future activities of the High Sierra District in and around the Kings River Project area.

Past and present private landownership activities include vegetation management programs (including any combination of harvesting or thinning, masticating, piling and burning) of Southern California Edison Company (1500 acres annually), Grand Bluffs Demonstration Forest (80 acres completed and 160 acres proposed), and Wildflower and Granite Ridge Housing developments (160 acres). These vegetation management activities can contribute to desirable changes in fire behavior outcomes. Cumulative effects include further reductions in surface fuel loadings and brush understory that reduce the potential for high intensity wildfires, reduce flame lengths the and reduce the potential fire type from one of active or passive crown fire to surface fires.

Vegetation management activities on federal lands (can include any of the following activities: dead tree removal, thinning, hand release of competing vegetation, tree planting, prescribed fire, or herbicide spraying) include Plantation maintenance (3640 acres), Roadside Hazard Tree Removal (4400 trees in 3000 acres along 90 miles of road), Prescribed Underburn Program (17,300 acres), Hazardous Fuels Reduction projects – 10S18 (1,647 acres), Jose 1 (1263 acres), South of Shaver (1813 acres) and the Teakettle research burn (60 acres). Of these projects all but the hazard tree removal contribute to desirable fire behavior results.

Plantation maintenance, hazard reduction fuels projects and prescribed fires projects clear unwanted vegetation and reduce the potential for high intensity wildfires. The 10S18 and South of Shaver Fuels Reduction Projects, Jose 1 Project and the on-going prescribed fire program (Table 3-13) will have altered vegetation conditions at various levels of density and risk. Implementation of the South of Shaver project (scheduled to start summer 2006) will take 4-5 years to reach its initial desired condition in mechanical treated stands. Stands treated with prescribed fire alone will take 3-4 entries over the next 20 years to reach the desired condition. In combination with private landowner projects and the activities proposed in Alternative 1, the cumulative effect is to produce a more fire resilient forest with low surface fuels loading, increased height to live crown and reduced encroachment of brush in pine and mixed conifer stands reducing flame lengths. Wildfire rates of spread could increase where the forest canopy becomes more open and heavy surface fuel loading and dense brush is replaced with grass and bear clover (flashy fuels). Slash created from hazard tree removal; due to the dispersed nature of the tree removal, generally adds surface fuels in the vicinity of the sale. Where clumps of trees are removed the slash is piled and burned, leaving no effect to potential fire behavior, but where individual trees are removed, minimal amounts of slash are lopped and scattered. This increase in surface fuel loading is considered negligible.

Other projects (refer to beginning of Chapter 3 of this document for a full list of past, present and reasonably foreseeable future projects) include the commercial thinning of older plantations: Bretz (2005) and Power 1 (2006). Both projects reduce the surface fuel loading and height to live crown, and thin the canopy; reducing the fire hazard, including the reduced potential for severe wildfire induced mortality to destroy the plantation. Current vegetation management/plantation projects include the Nutmeg, Lost, Men, Flat, Progeny Site, 10S18 and Fence plantations. Of the proposed and on-going plantation activities, only the thinning portion have any potential to change fire behavior; both positively and negatively. The thinning of trees removes a portion of the canopy, reducing the potential for fire to carry through the crown of young trees, but residual slash will increase the surface fuel loading for about three years. Activity created slash from plantation thinning is generally masticated or piled, reducing the potential flame length but not the heat per unit area. Overall the cumulative effect of the plantation treatments has a positive effect on fire behavior making the plantations more resilient to severe fire by increasing the height to live crown, removing encroaching brush, treating activity created slash and opening the canopy to reduce the potential for torching and crown fires.

Past timber sales (such as Patterson, Deer, Snow Corral and Hall Mdw.) that have finished all treatment activities (thinning, piling, and burning) are considered part of the current condition in relation to fire behavior. There is no cumulative effect from these projects. The Reese and Indian Rock Timber sale are currently part of the Prescribed Burn Program of Work and are currently in either the initial phase of underburn treatments (Indian Rock) or in maintenance status (Reese). The Reese Timber Sale through thinning, mastication and multiple entry underburn treatments has reached the desired condition in terms of fire behavior and under severe wildfire conditions would experience a low intensity surface fire; a mimic of the historic condition. The Indian Rock Project is part of the district DFPZ network and has not been completed. All thinning and mastication work are completed, and is undergoing it's initial underburn entries. Under severe wildfire conditions the Indian Rock Project would experience a low to moderate intensity surface fire. Some torching would be possible in areas that have been thinned and masticated, but not yet burned. Burn treatments are scheduled to be completed in 2006/2007.

The Helms-Gregg 230 kV Transmission Line Right-of-way (PG&E) is currently undergoing widespread reestablishment (started in 2005). This power-line extends from Courtright Reservoir west to the Sierra National Forest boundary. Various clearing activities create slash underneath the transmission line. Though surface fuel loading increases; the depth of the previously live fuels has been compacted alleviating the potential for contact between high voltage lines and vegetation underneath. Potential flame lengths from a wildfire are reduced, reducing the potential for wildfire damage to the transmission lines and for the transmission lines to start a wildfire.

Cattle grazing allotments generally have a positive effect on fire behavior. The reduction of fine fuels and the amount of vegetation removed can vary between allotments. The Haslett, Sycamore and Thompson allotments are more open oak woodland with grass and the use of grazing reduces the availability of grass (fine fuels) in the event of a fire. The probability of ignition, flame lengths and rates of spread are significantly reduced on those allotments where grass is the predominate carrier of fire.

Motorized recreation in the form of Off-Highway Vehicles has little to no effect on fire behavior. They can pose a risk of fire starts but is considered a rare event.

Table 3-13 - Prescribed burn program of work under other existing or proposed decisions

Prescribed Burn	Management Unit	Year of next entry	Year of last entry(s)	Prescribed Burn acres
I-rock	Irock_1	Complete in 2006	Partial in 2003	920
Barnes South	N_lost_1 N_lost_2	2006	1997	1185
10S18N Unit 5	N_up_big_3	2006		475
Haslett	Bear_fen_1	2007	1994/1998	900
Rush	N_soapro_1	2007	1998	215
Virginia's	N_duff_1 N_duff_2	2007	2000	1360
Turtle B2	N_ross_2	2007	1999	470
Turtle B1	Bear_fen_6 Bear_fen_7	2012	1996/2002	418
Turtle B5	N_turtle_3	2009	1999	523
Turtle B6	N_turtle_1 N_poison_1	2009	1999	418

Prescribed Burn	Management Unit	Year of next entry	Year of last entry(s)	Prescribed Burn acres
Turtle B7	N_turtle_1 N_turtle_2 N_turtle_3 N_turtle_4	2009	1999	1692
Dinkey Unit 1	N-ross_1 N_ross_2	*	1999	883
Dinkey Unit 2 & 3	Bear_fen_6	*	Unit 2-2000	1454
Dinkey Unit 4	N_ross_4	*	1998	571
Dinkey Unit 5	N_ross_1	*	1999	632
Oakflat	Bear_fen_6	2012	1996/2002	125
Poison	N_poison_1			539
Reese	Reese_1 Reese_2 N_410_1 Exchequer_5	2012	1999/2002	922
10S18	10S18 n_duff_1	2011	2001	590
10S18North	Ten_S_18 N_summit_1 N_up_big_1 N_up_big_3	2014	2004	1071
Carls	N_carls_1 N_ross_2	2009	1997/1999	1024
Clarence	Ten_s_18 Providen_1 Providen_4 Providen_4 N_duff_2	2008	2001	889
Barnes North	N_duff_3	2015	2005	767
Bear Creek	N_bearcr_1	Not scheduled**	2000	395
Little Rush	N_soapro_1 N_soapro_2	2010	2002	288

*Under cooperative agreement with SCE and CDF, ** Mitigation unit for PG&E Lost Canyon rupture

Alternative 2 – No Action

<u>Direct Effects:</u> There are no treatments to reduce the potential for extreme fire behavior under the No Action alternative and therefore, no direct effects.

<u>Indirect effects:</u> If this alternative were chosen, the communities and recreation resorts within the project area would not benefit from hazardous fuels reduction treatments. Treatments that would not only better protect communities but also protect firefighters from the effects of extreme fire behavior in the event of a wildfire would be foregone. The forest habitat and urban communities would remain at risk from severe stand replacing fires created by the excessive fuel loading, and the dense tree and brush growth that exists.

Indirect effects would occur from a wildfire occurring in the project area. Surface and crown fire behavior was modeled using Behave, FVS –FFE and Flam Map fire modeling programs. The forest conditions necessary for the creation of historical forest conditions and the species dependent on the presence of large trees would be lost if such a wildfire occurred. A surface fire was modeled to occur with surface flame lengths averaging 38 feet and an overall flame length of 27 feet (tree crown included) that would kill approximately 87-100 percent of stands. While modeling provides one measure of assessing the potential loss in habitat from an unplanned wildfire event, a comparison using actual fire data is more illustrative. The Big Creek fire occurred on the Pineridge District in 1994 and burned 5600 acres, which resulted in mortality rates of eighty four percent in high intensity areas, fifty percent in moderate intensity areas, and seven percent in low intensity areas. The fire burned in a mosaic pattern across the conifer stands of which 50 percent received moderate or high mortality. The Musick fire burned in August of 2001 and burned 200 acres; mortality rates for conifers ranged between 55 and 81 percent. Comparatively, modeling results for the South of Shaver stands indicate that a wildfire of moderate to high intensity could kill up to 81 percent of standing basal area. Modeling estimates are consistent with measured mortality from similar stands on the High Sierra Ranger District.

On August 21, 2001, the North Fork Fire burned 4132 acres and started in the urban intermix of North Fork on the Sierra National Forest. Table 3-14 shows the results of simulating this event during the first 3 hours of ignition using BEHAVE. The modeled fire has flame lengths over 11 feet in length. Hand crews and engines are limited to flame lengths less than 4 feet tall. Dozers are limited to operating with less than 6 foot flame lengths. Only indirect attack and aerial fire fighting resources would be effective on this fire.

Table 3-14 - Fire simulation within the initial 3 hours

FIRE VARIABLE	FIRE OUTPUT
Flame Length	11.8-feet
Rate of Spread	43.3 chains/hour
Fire Area - 1 hour	37.4 acres
- 2 hours	149.5 acres
- 3 hours	336.3 acres
Scorch Height	Average 270 feet
Torching Index	0 mph (all stands)
Crowning Index	6.3-441.2 mph

Weather conditions for August 21st are similar to the historical 97th percentile conditions for the Fence Meadow weather station and the vegetation type (ponderosa pine with a brush understory) is very similar to the lower (high risk/high hazard) elevations of the Kings River Project. The North Fork Fire became an active crown fire within minutes of ignition. Its progression exceeded 100 acres in one hour with observed flames lengths and spread rates in excess of modeled flame lengths and fire behaviors (Moore 2002). Fire intensity was high in 27 percent of the area and mortality in conifer stands was severe and caused a portion of the habitat i.e., home range area core, for the spotted owl to be lost. Furthermore, hydrophobic conditions were created in the high intensity burn areas leading to the potential for overland water flows and debris slides in the South Fork of Willow Creek and Peckinpah Creek (Roath and Prentice 2001). Similar fire behavior and intensities would be predicted in the Kings River Project under these conditions.

Cumulative Effects – The cumulative effects are similar to those in Alternative 1. There are no cumulative effects to the initial 8 management units. The past timber sales, the 10S18 and South of Shaver Fuels Reduction Projects, the on-going prescribed fire and plantation management programs (Bretz and Power 1) and other private land management will have altered the vegetation conditions at various levels of density and risk. Implementation of the South of Shaver project (scheduled to start spring 2006) will take 4-5 years to reach its initial desired condition in mechanical treated stands. Stands treated with prescribed fire alone will take 3-4 entries over the next 20 years to reach the desired condition.

Alternative 3 – Reduction of Harvest Tree Size

Direct Effects and Indirect: The direct and indirect effects of Alternative 3 – the reduction harvest tree size on fire behavior are nearly identical to those of Alternative 1 – the proposed action with similar results to fire behavior. See Table 3-15 for a comparison of the no action alternative to Alternative 3.

Table 3-15 – Displays a wildfire after treatments: Alt 3 vs. Alt 2

Management Units	Fire Type			Flame Length			Torching Index		
	alt3	NA	%Δ	alt3	NA	%Δ	alt3	NA	%Δ
Bear_fen_6	Surface to Active	0		6	41	85	389	31	92
Elo_win_1	Surface to Active	0		8	48	83	279	24	91
Glen_mdw_1	Surface to Active	0		13	31	57	155	32	79
Krew_prv_1	Surface to Active	0		11	29	62	347	115	67
Krew_bul_1	Surface to Active	0		5	42	87	232	116	50
N_soapro_2	Surf to Act/ Surf-Pass			7	7	12	236	116	51
Provid_1	Surface to Active	0		6	13	56	526	102	81
Provid_4	Surface to Active	0		8	11	29	387	221	43

Numbers given are the average of the plant aggregations within each MU.
PA = Proposed Action
NA = No Action
%Δ = Percent change

FUELS- CROWN BULK DENSITY

Affected Environment

Crown bulk densities (CBD) in the Kings River Project range from 0.240 to 0.004 kg/m^3 and mid-flame winds used to predict surface fires range from 10-12 miles per hour. Given the existing crown conditions and wind speeds, crown fire spread rates would range from 22-118.6 chains per hour. Crown fires caused by excessive fuel accumulations are generally considered the primary threat to ecological and human values and are the primary challenge for fire management. Such fires kill large numbers of trees, damage soil, increase erosion and impair air quality, and degrade or destroy species habitat (Graham and McCaffrey 2003).

Assessing crown fire potential requires accurate estimates of canopy fuel characteristics. The three main characteristics of canopy fuels are canopy bulk density, canopy base height, and foliar moisture content. Crown (canopy) bulk density is the mass of available canopy fuel per unit canopy volume (Scott and Reinhart 1999). Decreased fire frequencies have resulted in a build-up of forest fuels creating ”fuel ladders” for wildfire to climb up to the tree tops and where overstory trees are densely packed, the fire spreads quickly from tree to tree in a phenomenon know as crown fire or “crowning”. Crowning and torching is a source of firebrands that have the potential to start spot fires ½ - 2 miles ahead of the main fire, and ignite homes in the WUI. The creation of firebrands by torching trees was a significant source of home ignition in the Siege of 2003 in Southern California (CDF and USDA 2004a). In the 2003 Haymen Fire; firebrands, tree torching and crown fires ignited and destroyed 17% of the 794 homes within the fire area (Cohen and Stratton 2003). Treatments to alter forest structure can be designed to influence fire behavior, burn severity and spotting potential (Cohen and Stratton 2003, Cohen 1999), additionally, thinning designed to reduce tree crown density will tend to reduce the probability that trees are killed or severely burned (Graham and McCaffrey 2003) . Current CBD levels in the Kings River Project coupled with severe drought in the 97th percentile will produce scorch heights of over 164 feet tall and have flame lengths over 16 feet tall. Modeling of forest inventory data shows that canopy base heights are close to zero in the current condition, and in the event of a wildfire, no wind is necessary to drive the fire up into the canopy of the forest (torching index) and a wind as low as only 6 miles per hour (crowning index) would be necessary to initiate an active crown fire (FVS-FFE modeling 2006). Foliar moisture content, of course, varies with the short and long term weather patterns.

Environmental Consequences

Alternative 1 – Proposed Action

Direct Effects: Recent research has found thinning designed to reduce tree crown density will tend to reduce the probability that trees are killed or severely burned (Graham and McCaffrey 2003).

Low intensity underburning would result in incidental mortality of overstory trees (<10% of trees > 5 inches dbh) from the accumulation of duff around the base of the trees, and trees (1-4” dbh) in the understory would be killed. This incidental mortality would occur across all stands. Underburning would also result in the mortality of 50-70% of understory brush species which is mainly white leaf manzanita. The predicted mortality of trees from a wildfire is reduced in the proposed action over the no action for all management units. The reduction of basal area loss occurs in all management units for the proposed treatments as is show in Tables 3-16 and 3-17.

Crown bulk density (CBD) values are representing the average of the plant aggregates in each management unit. CBD values were derived through the FVS modeling. The crowning index values were derived by using the FVS-FFE and FlamMap modeling programs (the year of treatment was modeled in 2007 and the year of probable wildfire was 2017 after all initial treatments were completed). These values represent the expected crowning index for the average CBD. The crowning indexes represent the wind speed necessary to initiate that type of fire. Where the crowning index is 26; this indicates that an active crown fire can be initiated with only a 26 mile per hour wind. The lower the CBD, the faster the wind speed needs to be to initiate crowning. The crowning index increases for all management units except the n_soapro_2. N_soapro_2 is a hardwood and chaparral unit, FVS modeling under-represents the changes to stand dynamics in brush-only stands or where brush predominates.

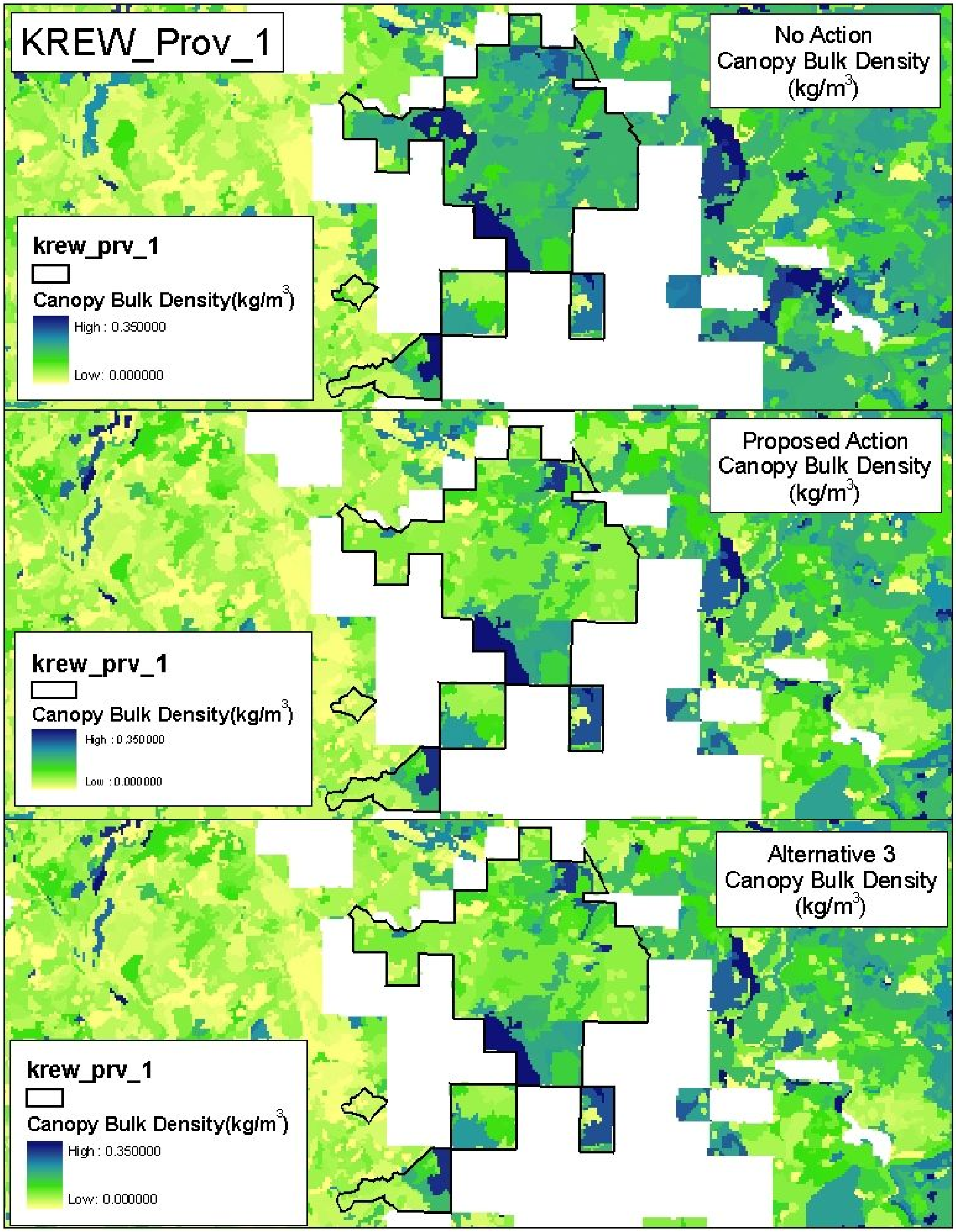

KREW_Prov_1
No Action
Canopy Bulk Density
(kg/m3)
krew_prv_1
Canopy Bulk Density(kg/m3)
High : 0.350000
Low: 0.000000
Proposed Action
Canopy Bulk Density
(kg/m3)
krew_prv_1
Canopy Bulk Density(kg/m3)
High : 0.350000
Low : 0.000000
Alternative 3
Canopy Bulk Density
(kg/m3)
krew_prv_1
Canopy Bulk Density(kg/m3)
High : 0.350000
Low: 0.000000

Figure 3-49

Figure 3-49 is a spatial comparison of the crown bulk density changes for all three alternatives using the Krew_prv_1 management unit as an example. The crown bulk density values in kg/m3 were derived by FVS and were part of the data layers that were used in Flam Map to model fire behavior across the Kings River Project landscape.

The thinning and follow-up treatments proposed under Alternative 1 would reduce the crown bulk densities to levels between 0.081 –0.016 kg/m^3 (Refer to Table 3-16). This reduction in crown fuels moves toward the openness and discontinuity of crown canopy, both horizontally and vertically, and results in a very low probability of crown fire initiation. Current direction recommends crown bulk densities in the wildland urban intermix be between 0.05-0.15 kg/m3 for the prevention of crown fire spread (SNFPA ROD 2004).

Table 3-16 shows the results of simulating a wildfire's effects on the tree canopy after treatments under the Proposed Action and compares it to wildfire's effects on the tree canopy under No Action.

Table 3-16

Management Units	**Crown Bulk Density (kg/m3)**			**Crowning Index**			**Percent Basal Area Mortality**		
	PA	**NA**	**%Δ**	**PA**	**NA**	**%Δ**	**PA**	**NA**	**%Δ**
Bear_fen_6	.064	.145	-125	52	26	50%	34	83	59
Elo_win_1	.069	.132	-93	47	27	43%	32	83	62
Glen_mdw_1	.081	.118	-45	41	32	22%	44	68	35
Krew_prv_1	.075	.115	-53	43	30	30%	38	62	38
Krew_bul_1	.074	.175	-138	41	24	42%	22	64	65
N_soapro_2	.016	.018	-12	121	131	-8%	66	72	9
Provid_1	.035	.047	-35	80	67	17%	43	68	36
Provid_4	.023	.032	-39	76	89	-17%	57	67	14

PA = Proposed Action
NA = No Action
%Δ = Percent change

Indirect Effects: The opening of the canopy will decrease the wind sheltering effects of the stand allowing more wind to reach the forest floor. Increases in wind can increase rates of spread if ground fuels and activity created slash were left untreated. By reducing the existing crown bulk density a decrease in activity crown fire spread will result. Where thinning is followed by sufficient treatment of natural and activity created surface fuels, the overall reduction in expected fire behavior and fire severity usually outweigh the changes in fire weather factors such as wind speed and fuel moisture (Weatherspoon, 1996). A decrease in crown fuels allows more moisture and sunlight to reach the forest floor, coupled with reduced competition for resources, the residual trees become more resistant to drought and increases the site's ability to sustain forest health during drought conditions.

Cumulative Effects: There are no cumulative effects from the initial eight management units and South of Shaver. The remaining Kings River project area would still contain high fuel loadings, highly dense and flammable vegetation, and would remain at high risk for severe wildfire. In the event of a severe fire in any of these stands the flame lengths, rates of spread, torching and crowning indexes would be similar to those of the initial eight management units in their existing condition.

Past timber sales (such as Patterson, Deer, Snow Corral and Hall Mdw.) that have finished all treatment activities (thinning, piling, and burning) are considered part of the current condition in relation to fire behavior and canopy density. There is no cumulative effect from these projects. The Reese and Indian Rock Timber sale are currently part of the Prescribed Burn Program of Work and are currently in either the initial phase of underburn treatments (Indian Rock) or in maintenance status (Reese). The Reese Timber Sale through thinning, mastication and multiple entry underburn treatments has reached the desired condition in terms of fire behavior and under severe wildfire conditions would experience a low intensity surface fire; a mimic of the historical condition. The Indian Rock Project is part of the district DFPZ network and has not been completed. All thinning and mastication work are completed, and is undergoing its initial underburn entries. Under severe wildfire conditions the Indian Rock Project would experience a low to moderate intensity surface fire. Some torching would be possible in areas that have been thinned and masticated, but not yet burned. Burn treatments are scheduled to be completed in 2006/2007. Any cumulative effect from past timber sales is that they contribute to a healthier more fire resilient forest as a result of the timber thinning and harvest, slash removal and fuels reduction treatments that have been completed.

The South of Shaver Fuels Reduction Project, the on-going prescribed fire program (Table 3-13) and plantation management programs, the private land management activities (the Wildflower and Granite Ridge subdivisions, Grand Bluffs demonstration site, and the Southern California Edison forestry program) including the treatment of the Helms-Gregg transmission line will have cumulative effects similar to those described in Fire Behavior Alternative 1 above. All projects listed with the exception of grazing will have altered vegetation conditions at various locations. Implementation of the South of Shaver project (scheduled to start late 2005) will take 4-5 years to reach its initial desired condition in mechanical treated stands. Stands treated with prescribed fire alone will take 3-4 entries over the next 20 years to reach the desired condition.

The uneven-aged management strategy retains the larger trees (greater than 30” or 35” depending on the alternative) in the stands and progresses toward creating a fire-resilient forest. In the long term, provisions are made for sufficient spatial variation in age classes to provide for replacement of the larger trees as they die. The uneven-aged management strategy, the use of regeneration areas and the treatment of canopy and surface fuels meet the fire resilient strategy outlined by Agee and Skinner, 2005.

Alternative 2 – No Action

Direct Effects: There would be no direct effects because the No Action Alternative undertakes no activities to reduce crown bulk densities.

Indirect Effects: The existing crown bulk density ranges from .240 to .004 kg/m^3. Crown bulk density is the measurement used to determine crown fire spread potential. A wildfire’s ability to move into the crowns of trees and the fire’s ability to maintain a crown fire run are both dependent on the density and the base height of the crown. There are no Indirect Effects from crown bulk density

Cumulative Effects: The cumulative effects would be from the high fire hazard that will remain since the forest canopy density will not be treated; thus leaving the forest at high risk in the event of a wildfire. A high intensity fire under severe fire weather conditions would pose the risk of losing key habitat of Forest Service threatened, endangered and sensitive species, and pose a threat to the urban communities, recreation resorts and visitors in the forest. Extensive areas of high severity and crown fire are out of character with historical forest conditions and fire regimes (Weatherspoon and Skinner 1995). The choice of no treatment leaves the forest vulnerable. Agee and Skinner (2005) conclude that watersheds at the landscape level should be the highest priority in drier forest types. The opportunity to create a fire resilient forest will be foregone. The past timber sales, the 10S18 and South of Shaver Fuels Reduction Projects and the on-going federal and private vegetation management activities including the prescribed fire program works toward a more fire resilient forest but on a limited spatial scale. The opportunity to expand on these projects is lost.

Alternative 3 – Reduction of Harvest Tree Size

Direct, Indirect and Cumulative Effects: The direct, indirect and cumulative effects of alternative 3 are nearly identical to the direct, indirect and cumulative effects of the proposed action. Refer to the effects section on crown bulk density in Alternative 1 and Table 3-17 below. Table 3-17 shows the results of simulating a wildfire after treatments under Alternative 3 and compares it to a wildfire under the Alternative 2 (No Action)..

Table 3-17

Management Units	Crown Bulk Density			Crowning Index			Percent Basal Area Mortality		
	Alt3	NA	%Δ	Alt3	NA	%Δ	Alt3	NA	%Δ
Bear_fen_6	.065	.145	-124	51	26	50%	34	83	59
Elo_win_1	.069	.132	-93	48	27	43%	32	83	61
Glen_mdw_1	.081	.118	-45	42	32	22%	46	68	33
Krew_prv_1	.075	.115	-53	43	30	30%	38	62	39
Krew_bul_1	.072	.175	-142	41	24	42%	23	64	64
N_soapro_2	.016	.018	-11	128	131	-8%	65	72	9
Provid_1	.035	.047	-35	81	67	17%	44	68	35
Provid_4	.023	.032	-38	78	89	-17%	57	67	14

PA = Proposed Action
NA = No Action
%Δ = Percent change

AIR QUALITY

Affected Environment

Fires are a natural disturbance process in the forest ecosystem (Agee 1993; Graham and McCaffrey 2003). The goal of land managers is to return fire as a process in a healthy forest ecosystem and to mimic pre-1850 forest conditions (Blackwell, 2004). The challenge to forest managers is to retain the ability to use prescribed fire as a tool to restore fire as a natural disturbance process and reduce the effects of smoke within the airshed. Certain tradeoffs between silvicultural and prescribed fire treatments are needed to improve the resiliency of the forest, reduce the potential for stand replacing fire and reduce the amount of smoke emissions (Brown and others, 2004).

The air quality in the San Joaquin Valley (Valley) is among the poorest in the state. On average the Valley experiences 35-40 days when it exceeds the federal health-based standards for ground-level ozone and more than 100 days over the state ozone standard. While levels of airborne particulates exceed the federal standard less than fives time annually, because the California standard is set at a lower and more protective level, the Valley exceeds this limit an average of 90-100 days per year (SJVUAPCD, 2003).

Currently the Valley is federally classified as severe non-attainment for the federal ground-level ozone and particulate matter less than 10 microns in diameter (PM_{10}) standard. Additionally, the valley is classified as severe non-attainment for the California ozone standard and non-attainment for the state's PM_{10} standard (attainment status for PM_{10} was requested from the Environmental Protection Agency (EPA) on April 25, 2006. www.valleyair.org, 2006).

Smoke is a limiting factor in how many acres of natural and activity fuels can be treated per project per year (the KRP Air Conformity Determination Document is incorporated by reference). By increasing forest utilization where possible and limiting the use of prescribed fire to reduce hazardous fuel conditions to those areas where other management treatments are not feasible, we can restore the forest to pre-1850 conditions, reintroduce fire as an ecosystem process (Blackwell, 2004) and limit the amount of wildfire and prescribed fire created emissions into the San Joaquin Valley.

Environmental Consequences

Alternative 1 – Proposed Action

Direct Effects: Post thinning burn treatments under this alternative would produce 3667 tons of particulate matter (PM_{10}), 1666 tons of nitrous oxide (NO_x) under dry burning conditions, compared to 48,000 tons (PM_{10}) that would be produced in the event of a wildfire of the same acreage; a reduction of 85 percent. The California State Implementation Plan (SIP) restricts emissions to a maximum of 70 tons per project per year for PM_{10} and 25 tons for NO_x for severe non-attainment areas (San Joaquin Valley Unified Air Pollution Control District 2003).

PM_{10} rather than NO_x would be the limiting factor for underburning and NOx would be the limiting factor for pile burning in the Kings River Project. This would restrict the number of treated areas for Kings River Project to 570 acres of underburning and 245 acres of piled slash per management unit per year. This would take from 2.7 to 4 years for completion if burning (depending on management unit, number of acres and type of prescribed fire treatment) were limited to autumn conditions. The number of acres allowed each year would be governed by the proposed amounts of activity created slash (0-10 inches in diameter) after thinning, which would be removed by prescribed fire, tractor and hand piling and the season in which the burns are conducted. Mechanical treatments of vegetation through the use of logging equipment also produce PM_{10}, exhaust hydrocarbons and fugitive dust. Total PM_{10} emissions produced from the use of mechanical equipment is 5.7 tons. Exhaust hydrocarbons emissions total 4.84 tons, nitrous oxides total 72.3 tons for the entire project, but fugitive dust is exempt from this project. Refer to the Air Quality Determination for this project for further details.

Indirect Effects: The potential for indirect and cumulative effects are from exposure to organic hydrocarbons (precursors to smog under high daytime temperatures), large particulate matter, and PM_{10} produced from prescribed fires. These emissions are easily inhaled and can cause respiratory and pulmonary distress.

The Fresno Metropolitan area, the community of Shaver Lake, the recreation residences, the Dinkey Creek Recreation Area and the private subdivisions within Providence Creek and Exchecquer are considered smoke sensitive areas. These areas could be affected by smoke if weather patterns produce a stable air mass and smoke is unable to vent into the upper atmosphere. Since PM_{10} and NOx are public health hazards, prescribed burns would be planned during periods of unstable air, which would allow for proper ventilation. However, since prescribed underburns could last for several days or weeks there is potential for recurring shifts in air masses towards more stable conditions. The production of PM_{10} is always a consideration and under conditions of poor ventilation could present problems throughout the year. All burning activities would be implemented under optimum conditions using Best Available Control Measures to prevent smoke concentrations from affecting local communities.

Cumulative Effects: Cumulative effects can be expected within the Kings River Project Area from current and foreseeable future projects. Within the Kings River Project are several prescribed underburns that would continue as part of the High Sierra Ranger District Program of Work. The KRP includes within its boundaries the Front Country and Turtle Underburn Programs. The combined acres of these underburn programs is 12,000 acres. All underburns are in ponderosa pine or mixed conifer forested areas, have been treated at least once, and are in maintenance status. Typically 2000 acres per year are burned as part of this program and would continue unaffected by the alternative chosen. An estimate of emissions for the underburn program is based on 2000 acres treated per year with an average of 3 tons per acre consumed (APCD Work Plan, 2005).

Table 3-18 - Tons of estimated pollutants, underburn program of work[8]

PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOCs	CO
73.5	66	10.5	.30	43.5	699.0

A cumulative effect could also be in the occurrence of respiratory or pulmonary distress when a wildland fire occurs in the area. The 4132 acre North Fork Fire in 2000 on the Bass Lake Ranger District produced nearly 2388 tons of PM_{10} emissions and a wildfire occurring in the Kings River Project area of the same size would produce nearly 48,000 tons of PM_{10} emissions (KRP EIS Air Conformity Determination). The San Joaquin Valley is classified in a severe non-attainment status for PM_{10} emissions and ozone and had expected to be elevated to an extreme non-attainment status by the Environmental

[8] **PM_{10}**: Particulate Matter greater than (>) 10 microns in size. **$PM_{2.5}$**: Particulate Matter > 2.5 microns in size, **NO_x** : Nitrous oxide, **SO_2**: Sulpher Dioxide, **VOCs**: Visual Organic Compounds (precursors to smog), **CO**: Carbon Monoxide.

Protection Agency and the San Joaquin Valley Unified Air Pollution Control District. Emissions from wildfires subside into the San Joaquin Valley during stable summer air patterns; smoke emissions from wildfires can cause air pollution alerts not only in local mountain communities but also in the central valley.

Other past, present and foreseeable future projects within the Kings River Project Area include the afore-mentioned Prescribed Burn Program of Work (including the South of Shaver Project), cattle grazing, the district plantation and vegetation management program, Off Highway Vehicle (OHV) use, the Helms-Gregg 230 kV Transmission Line Right-of-Way, and private land management activities and timber sales. Cumulative effects to air quality include any vegetation management program (public or private) in which vegetation will be burned, or where vehicle and heavy equipment use contributes to exhaust emissions or fugitive dust. The projects that could and possible will contribute to air quality cumulative effects from particulate matter PM_{10} include the Southern California Edison (SCE) Company's forestry and prescribed burn program, the High Sierra District plantation and vegetation management program, and the vegetation treatments in the Wildflower Subdivision type conversion. No burning will take place as part of the Helms-Gregg transmission line project. Cumulative effects to air quality from exhaust emissions and fugitive dust from can be expected from the SCE forestry program, the Helms-Gregg transmission line project, OHV use, and the vegetation management treatments on private and public lands including the district plantation management program. It is unknown how much heavy equipment use and or prescribed burning may take place as part of the SCE program or vegetation management activities on private land.

The past timber sales of Patterson, Deer, Snow Corral and Hall no longer have air quality direct or indirect effects and therefore no longer have any cumulative effects, as these timber sales no longer have any proposed activities. The Reese and the Indian Rock Timber Sales still have on-going underburn work and are part of the districts Prescribed Burn Program of Work; the cumulative effects to air quality are included with the discussion above.

Alternative 2 – No Action

Direct and Indirect Effects: There are no direct or indirect effects under Alternative 2. No treatments associated with the proposed action would take place.

Cumulative Effects: Within the Kings River Project are several prescribed underburns that would continue as part of the High Sierra Ranger District Program of Work. The KRP includes within its boundaries the Front Country and Turtle Underburn Programs. The combined acres of these underburn programs is 12,000 acres. All underburns are in ponderosa pine or mixed conifer forested areas, have been treated at least once, and are in maintenance status. Typically 2000 acres per year are burned as part of this program and would continue unaffected by the alternative chosen. An estimate of emissions for the underburn program is based on 2000 acres treated per year with an average of 3 tons per acre consumed (APCD Work Plan, 2005).

Table 3-19 - Tons of estimated pollutants, underburn program of work

PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOCs	CO
73.5	66	10.5	.30	43.5	699.0

Indirect or cumulative effects would also be the occurrence of respiratory or pulmonary distress when a wildland fire occurs in the area. The North Fork Fire in 2000 on the Bass Lake Ranger District produced nearly 2388 tons of PM_{10} emissions and a wildfire occurring in the Kings River Project area would produce nearly 48,000 tons of PM_{10} emissions. The San Joaquin Valley is classified in a severe non-attainment status for PM_{10} emissions and ozone and is expected to be elevated to an extreme non-attainment status by the Environmental Protection Agency and the San Joaquin Valley Unified Air Pollution Control District. Emissions from wildfires subside into the San Joaquin Valley during stable summer air patterns; smoke emissions from wildfires can cause air pollution alerts not only in local mountain communities but also in the central valley.

Other past, present and foreseeable future projects within the Kings River Project Area include the afore-mentioned Prescribed Burn Program of Work (including the South of Shaver Project), cattle grazing, the district plantation and vegetation management program, Off Highway Vehicle (OHV) use, the Helms-Gregg 230 kV Transmission Line Right-of-Way, and private land management activities. Cumulative effects to air quality include any vegetation management program (public or private) in which vegetation will be burned, or where vehicle and heavy equipment use contributes to exhaust emissions or fugitive dust. The projects that could and possibly will contribute to air quality cumulative effects from particulate matter PM_{10} include the SCE forestry and prescribed burn program, the High Sierra District plantation and vegetation management program, and the vegetation treatments in the Wildflower Subdivision type conversion. No burning will take place as part of the Helms-Gregg transmission line project. Cumulative effects to air quality from exhaust emissions and fugitive dust from can be expected from the SCE forestry program, the Helms-Gregg transmission line project, OHV use, and the vegetation management treatments on private and public lands including the district plantation management program. It is unknown how much heavy equipment use and or prescribed burning may take place as part of the SCE program or vegetation management activities on private land. Cumulative effects to air quality from all other projects outside of this decision are the same for Alternative 1 – the Proposed Action, Alternative 2 – the No Action and Alternative 3- The Reduction in Tree Harvest Size.

Alternative 3 – Reduction in Tree Harvest Size

<u>Direct, Indirect and Cumulative Effects:</u> The direct, indirect and cumulative effects of Alternative 3 are the same as those of the Proposed Action. Alternative 3 makes only negligible reductions in the amount of slash that will be treated.

BOTANICAL RESOURCES

Affected Environment

Botanical surveys were conducted during 2004, focusing on areas of suitable habitat for Threatened, Endangered and Sensitive (TES) plants, and on disturbed areas likely to be invaded by noxious weeds. Several occurrences of sensitive plants and invasive or noxious weeds are known to occur within the project area. See Biological Evaluation for further details of sensitive plant field surveys and effects analysis. It is on file at the High Sierra Ranger District office and is incorporated by reference. The following is a summary of survey results for each of the eight initial units:

- Bear_fen_6 Management Unit – No sensitive plants are known to occur in this unit. Spanish broom occurs on 10S67 where the road crosses Oak Flat Creek extending about 100' of roadside. Bull thistle occurs at the junction of 11S91 and 11S91B; along 11S55; along road 10A45 in about three places; and along 11S91. Noxious weeds or invasive plants: A few patches of cheatgrass occur on exposed road slopes along 10A45. Klamathweed (*Hypericum perforatum*) is present along 11S61 where it borders the southwestern side of the management unit.

- El_o_win_1 Management Unit - No sensitive plants are known to occur in this management unit. Noxious weeds or invasive plants: Bull thistle was found in the vicinity of Dinkey Meadow Creek near the gate of Camp El-O-Win, and in a moist area north of the tributary in T10S, R26E, NW ¼ section 20. An occurrence of common mullein (*Verbascum thapsus*) has been recorded in the el_o_win_1 unit near the Dinkey Creek day ride station.

- Glen_mdw_1 Management Unit - No sensitive plants are known to occur within this management unit. Noxious weeds or invasive plants: Bull thistle was found in several patches in this management unit: on the eastern half of the old sawmill site (T10S, R26E, NW ¼ section 17); along some of the day ride trails used by Clyde Pack Operation (CPO) (T10S, R26E, section 17); about 1.1 miles north on 9S09, west of "Trail's End" picnic area; in a meadow in T10S, R26E, NE ¼ section 13; and in the large gully approximately located on the boundary between private and Forest Service land in T10S, R26E, NE ¼ section 13. An occurrence of lens-podded hoary cress (*Cardaria chalepensis*) was found in front of the CPO horse corrals at the Dinkey day ride station. Cheatgrass is scattered throughout the old sawmill site, as well as on the banks of the large gully approximately located on the boundary between private and Forest Service land in T10S, R26E, NE ¼ section 13.

- Krew_bul_1 Management Unit - *Meesia triquetra*, sensitive plant is found in a meadow in southern branch of the Bull Creek drainage. The meadow falls partly within, and partially outside of the unit. The area of the *Meesia triquetra* occurrence appears to be a fen. Noxious weeds or invasive plants: No noxious weeds are known to occur within this management unit.

- Krew_prv_1 Management Unit - *Meesia triquetra*, a sensitive plant was found in Glen Meadow and in the meadow east of 10S25, about 1/5 mile north of the Southern California Edison property boundary. Both of the *Meesia triquetra* occurrences are in fen-like areas. Noxious weeds or invasive plants: Bull thistle was found on the northern end of Glen meadow, and scattered throughout the vicinity of Road 10S11.

- N_soapro_2 Management Unit - Golden annual lupine, a sensitive plant, occurs scattered throughout the gravelly soils of this unit. About 25% of the rock outcrops in the unit were surveyed, and most of them were found to support golden annual lupine. A patch of carpenteria is in the western, central part of the management unit. Noxious weeds or invasive plants: A patch of tocalote (*Centaurea melitensis*) about 60' by 60' in size is present on the roadside and downhill into a draw, west of 10S04. A small patch of foxglove (*Digitalis purpurea*) plants were found along 10S24, near the southern end of the unit. Cheatgrass is present near the plantation in the middle of the unit.

- Providen_1 Management Unit - Golden annual lupine a sensitive plant (*Lupinus citrinus* var. *citrinus*) is found on two rock outcrops within the unit. Habitat for the California red-legged frog, foothill yellow-legged frog, relictual slender salamander, resident trout species, and the western pond turtle occur within the management unit. Noxious weeds or invasive plants: Bull thistle (*Cirsium vulgare*) was found along Road 10S75 near the creek in T10S, R25E, SW ¼ Section 15, near the southern end of road 10S87. It is also known to occur along 10S39 in section 9; in two patches along 10S18 in section 16; and on the road that runs along the top of Grand Bluff in section 10. Spanish broom (*Spartium junceum*) is found just to the south of the management unit along 10S18.

- Providen_4 Management Unit - Golden annual lupine a sensitive plant was found on the edges of plantation units on 10S14 near the southern end of the unit. The southern edge of the unit may be *Carpenteria californica* habitat. Noxious weeds or invasive plants: Cheatgrass (*Bromus tectorum*) was scattered in patches through the plantations in this unit, mainly on old skid roads that have not been colonized with bear clover, manzanita, or *Ceanothus* spp. A patch of broom (Scotch and or Spanish) is recorded along 10S02, slightly north of its intersection with 10S55. Bull thistle was found near the broom.

<u>Species known to occur within the project area:</u>

Carpenteria californica (carpenteria) 1500'-4400'
Carpenteria is an evergreen shrub that mostly occurs in chaparral habitat, but some plants are found in the lower yellow pine belt. The entire distribution of this species is found within a total area of 225 square miles, south of the San Joaquin River and north of the Kings River (with one occurrence just north of the San Joaquin River). Shrubs tend to concentrate and grow most vigorously in draws and ravines in well-drained granitic soils where moisture is relatively abundant. The n_soapro_2 unit has one recorded occurrence of this species.

Lupinus citrinus var. *citrinus* (golden annual lupine) 1500'-5500'
This annual lupine occurs in the foothills and lower conifer forest of Fresno and Madera Counties. Most of the known populations occur on the Sierra National Forest south of the San Joaquin River. With approximately 82 occurrences and dozens of occurrences over 100 individuals, the metapopulation is considered robust (Clines and Symonds 2006). Typical habitat are edges and gravelly shelves of granite outcrops, openings in ponderosa pine forest, oak woodland, or chaparral. Several occurrences of this species are known to occur in the n_soapro_2 and providen_1 units.

Meesia triquetra (moss) 6000'-8000'
In California, *Meesia triquetra* is currently known from 6 Sierra Nevada national forests and Sequoia National Park. *Meesia triquetra* is known from about 19 meadows in the Sierra National Forest. This species is more common in other parts of its range. Few meadows in the southern Sierra have *Meesia triquetra*. Primary threats are activities that alter meadow hydrology. Some historical occurrences have been extirpated by changes in land uses. This species seems to prefer meadows with high acidity, indicated by the presence of associates such as blueberry (*Vaccinium*), peat moss (*Sphagnum*) and sundew (*Drosera*). Cold spring fed areas in the meadow seem to be preferred. This moss

requires permanent saturation and will not occur in meadows that dry out. This species is known to occur in three meadows within the krew_prv_1 and krew_bul_1 units.

Peltigera venosa (veined water lichen) 4000'-8000
This aquatic lichen (formerly known as *Hydrothyria venosa*) is known from only a few occurrences in California. It is found in cold, unpolluted streams on the west slope of the Sierra Nevada in mixed conifer forests on the Sequoia, Sierra, and Stanislaus National Forests. This aquatic lichen occurs submerged on rocks in clear, running, mountain streams. The species fixes nitrogen, is intolerant of pollution and sedimentation, and grows in clear, cool, moving water. The California occurrences are disjunct from the other U.S. populations (Hale & Cole, 1988). According to botanist Jim Shevock, this lichen has been in decline throughout its historical range although he states that the Sierra Nevada populations appear stable at this time (Sierra National Forest Sensitive Plant Files, Supervisor's Office, Clovis CA, 1998). The Pacific Southwest Research Station (PSW) botanist, Chris Dolanc surveyed the branch of Providence Creek that frames the west and north sides of T10S, R25E, section 13 in three places for this species, and he surveyed three creeks in the krew_bul_1 unit in several places for this species (the creek in the SE ¼ of T11S, R26E, section 12 and SW ¼ of T11S, R27E, section 7; the branch of Bull Creek that is in the southern section of T11S, R27E, section 7; and the branch of Bull Creek that follows the southwest boundary of the unit in T11S, R27E, section 18). No veined water lichen was found in any of these locations.

A recent survey (6/22/2006) has found veined water lichen in Summit Creek at T9S, R25 E, sections 2 and 3, within the KRP boundary and approximately .5 miles north of providen _1; it is assumed that it exists within providen_1 unit. Veined water lichen is known to occur in Teakettle Creek which is just east of the krew_bul_1 unit, and in n_422_1 and 2, about 0.5 mile north of krew_bul_1.

<u>Species for which suitable habitat may occur within the Initial Eight Management Units:</u>

Botrychium crenulatum (scalloped moonwort) 4875'-8125'
Scalloped moonwort has a wide range including both the northern and southern hemispheres, but is rare throughout its range. This fern occurs in meadows and marshes in the central Sierra, although there are no known occurrences in the Sierra National Forest at this time.

Botrychium lineare (slender moonwort) 8000'-9000'
Slender moonwort grows in rocky, moist sites in subalpine conifer forest. This species is found sporadically and infrequently throughout the northwestern United States, and is suspected to exist in California (Farrar, 2001). There is an historical location in Piute Canyon, thought to be approximately seven miles from the Hooper OHV route. The location data for this location is ambiguous, however, and may or may not be on the Sierra National Forest. Its habitat is similar to *B. crenulatum*. The very eastern edge of the krew_bul_1 unit falls between 8000' and 8080' – within the elevational range of slender moonwort. From orthoquads, however, it does not appear that any meadows fall within this strip, and the species is not expected to be within the management unit,

although it cannot be definitely ruled out, as not all appropriate habitat can be detected from an orthoquad.

Bruchia bolanderi (Bolander's candle moss) 5000'-7500'
Bolander's candle moss is known from fewer than 10 occurrences in California. It grows in meadows in mixed conifer forest from Yosemite National Park southward to the Sequoia National Forest in Tulare County. *Bruchia* occupies a specialized microenvironment within Sierran meadows. It tends to grow on vertical soil banks of small streams that meander through meadows. The closest known occurrence of Bolander's candle moss to the project area is about 2.4 miles from the krew_bul_1 management unit.

Camissonia sierrae ssp. *alticola* (Mono Hot Springs evening primrose) 4500'-8500'
Mono Hot Springs evening primrose occurs in gravelly areas associated with rock outcrops between 4000 and 9500 feet. Mono Hot Springs evening primrose is known from about 18 occurrences in Madera and Fresno Counties. Extensive populations of this plant occur in the vicinity of Florence Lake. The closest occurrence of Mono Hot Springs Evening Primrose to the eight initial management units is approximately 15.7 miles north of the glen_mdw_1 unit.

Epilobium howellii (subalpine fireweed) 6500'-8800'
Subalpine fireweed is known from meadows and seeps at approximately five sites on the Sierra National Forest in the vicinity of Huntington Lake. The species is thought to range from Sierra County at Yuba Pass to Fresno County. Potential for this species occurs in the glen_mdw_1 and krew_bul_1 units. The nearest known occurrence of subalpine fireweed is 9.7 and 17.5 miles north of these units, respectively.

Eriogonum prattenianum var. *avium* (kettle dome buckwheat) 4000'-9500'
Kettledome buckwheat occurs in gravelly areas associated with rock outcrops between 4000 and 9500 feet. It is known from about 33 occurrences, from the Sequoia National Forest up to the Minarets District of the Sierra National Forest (Fresno and Madera Counties only). The nearest known occurrences of this species are 15.3 miles northwest of providen_1, and 15.8 miles southeast of krew_bul_1.

Hulsea brevifolia (short-leaved hulsea) 5000'-9000
Short-leaved hulsea is a perennial herb. There are about 46 occurrences documented on the Sierra National Forest and others on adjacent forests and in Yosemite National Park. Short-leaved hulsea is quite abundant in some occurrences (4 occurrences have over 2000 individuals; several occurrences number over a 100 individuals) and the population overall is considered fairly robust (Clines, Tuitele-Lewis). Elevational range is 5000 to 9000 feet, from Tuolumne County south to Tulare County. Habitat for short-leaved hulsea is gravelly or sandy exposed areas as well as densely wooded sites in coniferous forest. The nearest known occurrence of short-leaved hulsea is about 1.75 miles from el_o_win_1 management unit.

Lewisia congdonii (Congdon's lewisia) 1900'-6900'
Congdon's lewisia occurs on granite or metamorphic talus, rocks, and cliffs in the Kings and Merced River drainages. This perennial herb occupies a disjunct distribution between the Kings River Canyon and the Merced River Canyon 50 miles to the north. All but one population are in the Merced River drainage. It is known from 6 occurrences. Population estimates range from < 100 plants to > 10,000. Most consist of at least several hundred plants. Plants are found on rock faces, cracks and ledges in rocky areas, on talus and scree, and on spoil piles of an abandoned barium mine. The Kings River population grows on granitics, the other populations are found on metamorphics. Plant communities range from chaparral to coniferous forest. The plant grows on the steep, seepy canyon walls of the Merced and Kings River Canyons. Potential habitat and elevational range exists for this species within the initial eight units of the project but the 6 known occurrences of Congdon's lewisia are not located within the project boundaries.

Lewisia disepala (Yosemite bitterroot) 4000'-7500'
Yosemite bitterroot occurs on granite domes from about 4400 feet to above 10,000 feet, from Mariposa County in the vicinity of Yosemite Valley, southward to Kern County. Approximately 13 occurrences of this species have been found on the Sierra National Forest. This perennial herb emerges in late winter in gravel flats and pans of granite outcrops and domes. Usually these are large, imposing geological features, but plants have also been found in small openings in pine forest where rock has yielded entirely to coarse gravel soil. Plants flower and disperse seed, and enter dormancy for the summer by early spring in many cases. Once plants have shriveled they are impossible to see, even by an experienced field botanist. This species is found in the South of Shaver unit that is covered under a separate NEPA document. The nearest known Yosemite bitterroot occurrence to the project area is about 0.5 mile north of the n_soapro_2 management unit.

Meesia uliginosa (moss) 7500'-9000'
Meesia uliginosa is also known from fewer than 10 herbarium collections in California, and from only two sites on the Sierra National Forest. It grows in saturated meadows and fens along buried logs at the upper reaches of the mixed conifer forest up to the subalpine zone. Some potential habitat for this species may occur in the krew_bul_1 unit. The nearest known occurrence of this moss to the project area is about 10 miles west of the krew_bul_1 unit.

Mimulus gracilipes (slender-stalked monkeyflower) 1500'-4225'
This monkey flower occurs in open gravelly areas in chaparral and ponderosa pine forest, often in burns and disturbed areas. It is an annual plant known from Mariposa, Tuolumne, and Fresno counties up to about 4500 feet. There are fewer than 20 known occurrences. The Jose Basin and Blue Canyon areas are known to support vigorous populations of this species. Potential habitat for this species may occur in the krew_prv_1, providen_1, providen_4, and n_soapro_2 units. The nearest known occurrence of slender-stalked monkeyflower to the project area is 2.9 miles west of n_soapro_2.

Trifolium bolanderi (Bolander's clover) 6800'-7300'
Bolander's clover occurs in montane meadows in coniferous forests, only on the Sierra National Forest and in Yosemite National Park. Bolander's clover is predictably found at about 6800 to 7300 feet (Ratliff and Denton 1993). Potential habitat for this species may occur in the Krew_bul_1 unit. The closest known occurrence to the project area is about 1.3 miles northeast of krew_bul_1.

Environmental Consequences

Alternative 1 - Proposed Action

Direct, Indirect, and Cumulative Effects to *Calyptridium pulchellum* (Federally Threatened species): No *Calyptridium pulchellum* occurrences are known to occur within the project area, but potential habitat may occur in up to three of the management units. Project design criteria are in place to protect the rocky/gravelly habitat for this species by prohibiting equipment and tree falling on rock outcrops or thin, sandy or gravelly soils. Herbicides are not to be used on shallow soils below 3800' in elevation without prior approval from the botanist, and botanical surveys are to take place before new road construction if the botanist determines that a survey in the area is necessary. Heavy equipment is to be free of soil and plant parts before being brought into a management unit, and the tocalote in the n_soapro_2 unit is to be treated before the adjacent area is disturbed by project activities. These design criteria should prevent the disturbance of *Calyptridium pulchellum* habitat by noxious weeds, which should prevent any indirect effects to the species. Because no direct or indirect effects are expected to this species, no cumulative effects to the species are expected to occur.

Direct Effects to Sensitive Plants and Noxious Weeds in General: Sensitive plants within the project area could be damaged or killed if equipment runs over them or parks on them, if logs are felled on or skidded over them, if they are trampled, if slash piles block their light, and if piles are burned directly over them and the heat intensity is too great for the plants to survive. For most of the sensitive plant species, these effects are not expected to occur, as their habitats will be protected as per the project design measures for botanical resources, aquatic resources, and watershed.

No effects of any kind are expected for unexpected larkspur, Tulare County bleeding heart, Hall's daisy, monarch golden aster, and Congdon's lewisia, which are outside of the geographical range of the species; for Tehipite Valley jewel-flower which is below the elevational range of the only unit that could be within its geographical range; and for grey-leaved violet for which suitable habitat was not found within the eight initial management units.

The noxious weed species described in the proposed action for each unit will be treated, and are expected to diminish over time as a direct result of chemical and manual control treatments. Eradication is likely for the lens-podded hoary cress in Glen_mdw_1.

Direct Effects to Sensitive Plant Species of meadows or streams: Species that occur in meadows require the maintenance of hydrologic function, and a general absence of noxious weed infestations. Because of project design measures that have been developed to protect these areas, project activities are not expected to alter hydrologic function, with one possible exception. The exception is in the Krew_bul_1 Management Unit, in the lower end of the meadow in the far southeastern corner of T11S, R26E, section 12. This lower end of the meadow is currently threatened by active headcuts. So as not to complicate Kings River Experimental Watershed Study data readings of sediment in the affected stream, it was decided by the District Ranger in 2002 that the headcuts will not be fixed during the data gathering which was already underway when fixing the headcuts was being considered. It is possible that the headcuts will migrate to the top of this section of meadow, where the meadow narrows to bedrock. The effects of the headcuts on the meadow cannot be predicted ahead of time, but the potential exists that they could contribute to quickening the flow of water, leading to the drying of the surrounding area, and consequently altering the vegetation. Mosses and other species could then become less effective in slowing the water flow, and the meadow/fen could cease to function properly. This area has been surveyed for sensitive plants, and none were found. This lower section of meadow appears to be a fen. It is spring-fed, and supports sundews, blueberry, and sphagnum moss (these species are indicators of acidic conditions). The Sierra Nevada Forest Plan Amendment (January 2004) refers to fens as special aquatic habitats and gives the following standard and guideline for them:

Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum moss (*Sphagnum* spp.), (2) mosses belonging to the genus *Meesia*, and (3) sundew (*Drosera* spp.).

Wet meadows, riparian areas, and potential fens have been located and marked within the initial eight units. Fen surveys have not occurred but any potential fens would be included in protected areas of wet meadows. The only known conflict with the riparian standards and guidelines is with Krew_bul_1 and as previously stated, this was done in order to ensure consistent data collection. No sensitive plants or mosses were found in Krew_bul_1 and no project work resulting from Kings River Project will affect this area. It is rather an existing condition that will not be remedied in the lifespan of data collection.

Scalloped moonwort, slender moonwort, Bolander's candle moss, *Meesia triquetra*, *Meesia uligniosa*, and bolander's clover occur in meadows and most occur within the project area, though only one of these species (*Meesia triquetra*) are known to occur within the initial eight managment units. Potential habitat for these species is in wet meadows. Meadows are not expected to be impacted by project activities, with the exception mentioned above, and none of these species were found in the meadow that comprises that exception.

Subalpine fireweed could have potential habitat in the glen_mdw_1 and krew_bul_1 management units. It can occur in meadows, in which case it would not be expected to be affected by project activities, as described above. It can also occur in moist, seepy, grassy areas. These areas tend to be associated with meadows or streams, and therefore would probably be protected by buffers around these features, although a slight possibility exists that they could be disturbed. The risk is thought to be negligable, especially as the closest known occurrence of the species is 9.7 miles miles to the north of glen_mdw_1 management unit, and 17.5 miles north of krew_bul_1 management unit.

Veined water lichen was found within the project area in the northern portion of Kings River Project, approximately .5 miles north of providen_1. The krew-bul_1 management unit is another likely unit to have veined water lichen, as it is close to a known occurrence in Teakettle Creek, just to the east of the unit. This is also the unit that received the most comprehensive surveys for the species, as it was looked for in 17 locations within the unit along the three main creeks that flow through the unit. Stream habitat is not expected to be directly disturbed by equipment (Streamcourse and Aquatic Protection, BMP 1-10). Veined water lichen is particularly sensitive to sediment increases (Davis, 1999), and some short term sediment input into creeks will occur. However, the potential for increase in sedimentation as a result of project activities is reduced by BMPs and project design measures described in Chapter 2, and habitat quality for veined water lichen is not expected to diminish. See watershed section in Chapter 3 for more information.

Direct Effects to Sensitive Plant Species of rocky outcrops: Mono Hot Springs evening primrose, Kettle Dome buckwheat, and Muir's raillardella probably do not occur within the geographic range of the project area. Potential habitat for these species, however, will be protected from equipment damage and tree felling by project design criteria.

Yosemite bitterroot was not found within the project area, but if it is present, its habitat is protected by project design criteria, by its inaccessibility, and because its general habitat (large granite domes) does not need to be treated as part of the project.

Golden annual lupine is scattered throughout the n_soapro_2 unit and is found in isolated patches in providen_1 and providen_4 management units. Its habitat is protected by project design criteria. If a few individuals of these occurrences are killed by project activities, it is not expected to lead to a trend to listing or a loss in viability of that species, given the relative abundance and vigor of the occurrences (Clines- *pers. com*. 2006; Symonds- *pers. com*. 2006). Fire is a natural component of the golden annual lupine ecosystem, and low intensity, prescribed fire is not expected to have a negative effect on the species.

Potential habitat for slender-stalked monkeyflower may occur in the krew_prv_1, providen_1, providen_4, and n_soapro_2 units. It occurs on thin soils which are partially protected by design criteria, and partially protected by the soils being too thin to support trees. Fire is a natural component of the slender-stalked monkeyflower ecosystem, and the species is throught to behave as a "fire follower" (fire annual) (Region 5 USDA Sensitive Plant Species Evaluation and Documentation Form for *Mimulus gracilipes*, 4/9/1998).

Direct Effects to Sensitive Plant Species of forest habitats: Short-leaved hulsea is a species of forest openings that could be affected by project activities. It primarily grows in openings in red fir forest, and is likely to only have potential habitat in the krew_bul_1 unit, although most of the other units have some ground within the elevational range of the species. No short-leaved hulsea was found during project surveys. Available habitat in krew_bul_1 is limited to the acres of red fir forest that were not surveyed. If individuals are disturbed in these areas, it is not expected to lead to a trend to federal listing or to a loss in viability for the species because it grows abundantly and robustly in other parts of the Forest, and many of the areas where it is known to occur (outside of the project area) have been logged in the past (Clines *pers. com*. 2005).

Direct Effects to Sensitive Plant Species of chaparral habitat: One occurrence of carpenteria is known to occur in the n_soapro_2 unit. Further potential habitat is present in that unit. Carpenteria is partially protected by project design criteria, as well as by its natural abilities. Carpenteria sprouts back after branches are cut, and fire is highly important for its seeds to be able to germinate. If a few individuals are damaged by project activities, its near-by abundance would prevent the damage from leading to a trend to listing or a loss of viability to the plant (Clines *pers. com*. 2005).

Indirect Effects

A possible indirect effect to TES species is the degradation or loss of habitat resulting from the introduction or spread of noxious or invasive weeds. Noxious weeds are plant species that can spread rapidly and compete with native plants for water and other resources, in some cases forming solid stands of plants that may crowd out sensitive plant species. Vehicles can transport noxious weeds when equipment passes through soil in contaminated areas and carries weed seeds to new areas. Risk of noxious weed introduction and spread can be greatly reduced by cleaning all heavy equipment of soil and plant parts before bringing it onto the project site, as recommended by the USDA Forest Service "Guide to Noxious Weed Prevention Practices" (2001). Noxious weed mitigation has been incorporated as design criteria in the EA for the project.

Noxious weeds may place a higher risk to Forest Service sensitive plants of certain habitats than to those of other habitats. Those plant species of **riparian and wet meadow habitat (***Meesia triquetra*, veined water lichen, Bolander's clover**)** are at less risk from the invasive species found in the project units due to saturated conditions and elevation. Sensitive plants found in **rock outcrops and openings (**orange lupine**,** Yosemite bitterroot**,** slender-stalked monkeyflower**)** are at slightly higher risk due to the lack of canopy cover, which favors weedy species, and generally a higher disturbance factor. **Forest understory species** (short-leaved hulsea) comprises the third habitat and sensitive species found in these areas are at a low to moderate level of risk from potential invasive plants. The high amount of canopy cover generally deters weedy species, but disturbance of the canopy or forest floor can lead to the establishment of ruderal plants. Plants of **chaparral habitats (**Carpenteria**)** are perhaps at most risk to invasive plant establishment and competition due to the high availability of light and high disturbance regime that is naturally found in chaparral areas.

Soil disturbance from project activities may allow some spread of these weeds within the areas of soil disturbance, as these species are good colonizers of disturbed soil. Although undesirable, this weed spread is not expected to significantly negatively affect sensitive plants, as most known rare plant habitats will not be disturbed.

Several invasive species occur within the project area, as have been listed in the Existing Environment section of this document. Two of the weed occurrences were thought to be particularly likely to spread as a result of project activities: the bull thistle at the north end of Glen Meadow, and the tocalote in the n_soapro_2 unit. Chemical and mechanical treatment of these weeds before project activities take place has been specified in the project design criteria. Both bull thistle and tocalote infestations are to be sprayed with glyphosate unless within 100 ft of a water course, in which case they would be hand pulled. These treatments are intended to control the spread of these weeds and in some isolated, smaller populations, eradication of those particular plants. The intent of these chemical and mechanical treatments are to decrease the risk of spread of bull thistle and tocalote, resulting from any project activities, including logging, masticating, vehicular traffic, prescribed fire, and other associated project treatments.

The lens-podded hoary cress in glen_mdw_1 is not expected to be disturbed by project activities, as it is in a relatively open area between Dinkey Creek Road and the corrals for the CPO Dinkey Creek day ride station. No project activities are planned for this area (Rojas, *pers. com*., 2004).

In most of the units where bull thistle was found (providen_1, el_o_win_1, krew_prv_1, glen_mdw_1, providen_4), it occurs in small, infrequent patches. These have potential to spread if they are disturbed, or if the ground adjacent to them is disturbed. The spread is not expected to affect sensitive plants, as no sensitive plants were found near these thistle occurrences, and the thistle does not appear to share habitat with sensitive species of rock outcrops.

Bull thistle in the bear_fen_6 unit is more extensive. It is found in several of the plantation units in the area, along roadsides, and on landings. Bull thistle in this management unit is likely to spread with project activities. No known sensitive plants occur in this area.

A roadside occurrence of Spanish broom was found in the bear_fen_6 unit. This has the potential to spread throughout the area of disturbance if the adjacent ground and canopy cover is removed.

Cheatgrass is present in scattered patches within the project area, but does not seem to be in a position to form dense stands, as it generally seems to be out-competed by other species. This is a contrast to the eastern Sierra Nevada where cheatgrass is able to form monocultures covering whole hillsides. Cheatgrass infestations are light within the project area, and have not required control efforts in the past. It was found scattered in providen_4 plantations; in glen_mdw_1 at the old sawmill site and a disturbed meadow/gully; in bear_fen_6 along 10A45; and in n_soapro_2 near the plantation in the middle of the unit. Soil disturbance and decreased canopy cover from the project activities may cause some increase in the amount of cheatgrass in the project area.

A few foxglove plants were found in n_soapro_2. These grow in moist areas and were not encroaching on the near-by golden lupine habitat.

Cumulative Effects

Cumulative effects are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7).

The 60 management units within the Kings River Project that are not covered in this document are expected to be treated over the next 30 years. Some of these units are known to have sensitive plant occurrences in them, and future surveys will be necessary to find currently unknown occurrences, guide future activities and NEPA decisions. At this time, *Bruchia bolanderi* is known from unit n_420_2; *Hulsea brevifolia* is known from unit n_420_1; *Peltigera venosa* is known from unit n_422_2 and n_422_1; *Meesia triquetra* is known from units n_420_2, and n_421_2; *Trifolium bolanderi* is known from units n_421_2, and n_421_3; *Carpenteria californica* habitat or occurrences have been identified in units n_duff_3, n_lost_1, providen_4, n_lost_3, n_lost_4, and n_lost_2; *Lewisia disepala* is known from unit n_duff_1; and *Lupinus citrinus* var. *citrinus* is known from units n_up_big_1, n_duff_1, n_duff_2, and n_saopro_1.

No significant cumulative effects to sensitive plant occurrences are expected from past, present and foreseeable actions that will take place in and near the KRP boundary. A small number of occurrences (Table 3-20) could be at low to moderate risk from the accumulated actions of such projects. None of these occurrences are expected to be extirpated from these accumulated actions but may be reduced in number or health. In some activities, certain individual plants that were not marked or overlooked could be directly impacted; i.e. a dozer cutting line or OHV use. Other activities may cause indirect effects, such as removal of canopy or increased sedimentation in streams from equipment.

The boundary for this cumulative effects analysis was considered to be known sensitive plant occurrences located within the Kings River Project area and not for any located outside of the boundary. Monitoring of known sensitive plant occurrences within the initial eight units will be done when feasible to ensure that populations are not being affected significantly; if observations reveal that significant impact is taking place, then treatments are expected to be modified to reduce impact and subsequent effects evaluations will take this into account.

Carpenteria is also largely protected by design criteria and natural attributes. Short-leaved hulsea is not specifically protected in this project, but available habitat for it is limited, and the abundance of the species elsewhere on the Forest ensure that if individuals are damaged in this project, it will not lead to a trend to listing or loss of viability to the species. Golden annual lupine is protected through project design measures for botanical resources on rocky outcrops and shallow soils. Veined water-lichen habitat is protected by Standard and Guidelines associated with Riparian Conservation Objective (RCO) #2 and #5 in the SNFPA ROD (2004). Therefore, negative effects to sensitive plants are expected to be minimal for the Kings River Project, and should not add to any cumulative effects to sensitive plants in the project area.

Table 3-20 - Cumulative effects of projects past, present, and future on sensitive plant species in the Kings River Project area, Sierra National Forest.

Project or Activity	Description	Forest Service Sensitive plant species and number of occurrences affected by project [a]	Past, present, or future action	Expected effect on occurrences [b]
Existing road maintenance	In Kings River Project area	*Carpenteria californica* (1), *Lupinus citrinus ssp. citrinus* (1), *Mimulus gracilipes* (2), *Peltigera venosa* (1)	Past, present	Low to moderate
Vegetation management - plantation maintenance	Thinning, chemical release, planting; plantations <25	*Carpenteria californica* (1),	Past, present	Low

Project or Activity	Description	Forest Service Sensitive plant species and number of occurrences affected by project [a]	Past, present, or future action	Expected effect on occurrences [b]
	yrs			
Vegetation management	Grand Bluffs National Fire Plan- shred brush/plant conifers	*Peltigera venosa* (1)	Present	Unknown
Vegetation management	Helms/Gregg transmission line right-of-way	Possibly *Trifolium bolanderi* (No known occurrences)	Present	Low
Vegetation management	Helms/Gregg brush and small tree removal	Possibly *Trifolium bolanderi* (No known occurrences)	Past, present	Low
Roadside Hazard Tree Removal	Removal of hazard trees along roads: Strawberry, Oak, Glen, and Repeater hazard sales	Possibly *Hulsea brevifolia* or *Epilobium howellii* (No known occurrences)	Past, present	Potentially low to moderate
Prescribed fire	Underburning, maintain DFPZ's, and reduce ground fuels	Out of season burning- *Carpenteria californica* (1), *Hulsea brevifolia* (unknown)	Past, present	Low
Private Land residential development	Wildflower subdivision (Shaver Lake)	*Lewisia disepala* (1), *Lupinus citrinus* ssp. *citrinus* (4)	Past, present	Moderate
Vegetation management	SCE uneven-aged silvicultural activities	*Lupinus citrinus ssp. citrinus* (2*), Peltigera venosa* (1)	Past, present	Unknown
Vegetation management	Grand Bluffs/ Twin Ponds thinning	*Peltigera venosa* (1)	Past, present	Unknown
Vegetation management	Thinning and brush removal in Bretz and Power 1 &2	*Lupinus citrinus ssp. citrinus* (1)	Present	Low
Fuels reduction	South of Shaver- thinning, prescribed fire, brush removal	*Lupinus citrinus* ssp. *citrinus* (3), *Lewisia disepala* (2)	Present, future	Low
Motorized recreation	4x4, OHV, and snowmobile	Unknown but potentially every sensitive species found within project boundaries	Present, future	Unknown
Livestock grazing	Grazing in Blue Canyon, Dinkey, Haslett, Patterson Mt., and Thompson allotments	*Bruchia bolanderi* (1), *Carpenteria californica (2)*, *Meesia triquetra* (3), *Mimulus gracilipes(2), Trifolium bolanderi (4)*	Present, future	Low (moderate for *Meesia triquetra* and *Bruchia bolanderi*)

Project or Activity	Description	Forest Service Sensitive plant species and number of occurrences affected by project [a]	Past, present, or future action	Expected effect on occurrences [b]
Wildlife Enhancement	Barnes South Wildlife Burn	*Mimulus gracilipes* (2)	Future	Low

Total occurrences affected by activities [c]	***Percentage of total occurrences affected***	***Estimated potential cumulative impact of activities on occurrences* (including KRP)**
Bruchia bolanderi (1),Carpenteria californica (2), Lupinus citrinus ssp. citrinus (6), Lewisia disepala (1-3), Meesia triquetra (3), Mimulus gracilipes (2),Peltigera venosa (1), Trifolium bolanderi (2-5)	*Bruchia bolanderi* (25%),*Carpenteria californica* (24%), *Lupinus citrinus ssp. citrinus (8%), Lewisia disepala (23%), Meesia triquetra (9%), Mimulus gracilipes* (15%),*Peltigera venosa (8%), Trifolium bolanderi (5-13%)*	*Bruchia bolanderi*- moderate, *Carpenteria californica*- low, *Lupinus citrinus* ssp. *citrinus*- low to moderate, *Lewisia disepala*- low, *Meesia triquetra*- moderate, *Mimulus gracilipes*- low to moderate, *Peltigera venosa*- moderate, *Trifolium bolanderi*- low

[a] *This includes the Kings River Project area as a whole (79 units), and only accounts for effects on documented TES plant occurrences known to exist within that boundary.*
[b] *Expected effect on sensitive plant occurrences is estimated for negative impacts; positive impacts are not listed here.*
[c] *Many sensitive plant occurrences are affected by more than one project, which is reflected in the summation of total occurrences in this column. The total occurrences, therefore, are not strictly additive across the project matrix.*

Table 3-21 - Displays the determinations for the Proposed Action and Alternative 3.

Species	Status	Determination for the Initial Eight Management Units of the Kings River Project
Calyptridium pulchellum	Federal Threatened	***no effect***
Erigeron aequifolius, Delphinium inopinum, Dicentra nevadensis, Heterotheca monarchensis, Lewisia congdonii, Streptanthus fenestratus, and Viola pinetorum* ssp. *grisea	Forest Service Sensitive	

Meesia triquetra, Meesia uliginosa, Botrychium crenulatum, Botrychium lineare, Bruchia bolanderi, Peltigera venosa, Epilobium howellii, Trifolium bolanderi, Lupinus citrinus var. citrinus, Camissonia sierrae ssp. alticola, Eriogonum prattenianum var. avium, Carlquistia muirii, Lewisia disepala, Hulsea brevifolia, Carpenteria californica, and Mimulus gracilipes	Forest Service Sensitive	***may affect individuals but is not likely to cause a trend to federal listing or a loss of viability***

Alternative 2 – No Action

Direct Effects: No Direct effects would occur to threatened, endangered, or Forest Service sensitive plants if the no-action alternative is chosen because project activities would not take place.

Indirect and Cumulative Effects: Indirect and cumulative effects have the potential to occur to TES plants if the no-action alternative is chosen. If fuels are not treated effectively in the project area, a stand replacing wildfire in the area is a possible outcome. Wildfire has the potential to cause significant disturbance to soil, ground cover, and canopy cover, placing at risk Forest Service sensitive riparian species that normally do not regenerate from high-intensity fires; additionally, carpenteria and short-leaved hulsea do not benefit and may be impacted by out-of-season burning. Fires can also allow the opportunity for the spread of invasive weeds, which can affect Forest Service sensitive species through competition of resources.

Determination for the No Action Alternative Forest Service Sensitive Plants (BE): It is my determination that the Kings River Project, No Action Alternative **will not affect *Botrychium crenulatum, Botrychium lineare, Bruchia bolanderi, Camissonia sierrae* ssp. *alticola, Carpenteria californica, Delphinium inopinum, Dicentra nevadensis, Epilobium howellii, Erigeron aequifolius, Eriogonum prattenianum* var. *avium, Heterotheca monarchensis, Hulsea brevifolia, Hydrothyria venosa, Lewisia congdonii, Lewisia disepala, Lupinus citrinus* var. *citrinus, Meesia triquetra, Meesia uliginosa, Mimulus gracilipes, Carlquistia muirii, Streptanthus fenestratus, Trifolium bolanderi,* and *Viola pinetorum* ssp. *grisea*** because project activities will not take place.

Alternative 3- Reduction of Harvest Tree Size

Direct, Indirect, and Cumulative Effects to *Calyptridium pulchellum* (Federally Threatened species): Similar to that of the Proposed Action; see Table 3-21.

Direct Effects to Sensitive Species: Direct effects will be similar to the Proposed Action with the following exceptions: that sensitive species of forest habitats (short-leaved hulsea) would benefit from retention of >60% canopy cover in fisher habitat outside of the WUI; plant species of riparian/special aquatic features including *Botrychium* spp., Bolander's candle moss, *Meesia triquetra*, *M. uliginosa*, subalpine fireweed, and veined water lichen would benefit from equipment exclusion within 50 feet of these features.

Indirect and Cumulative Effects to Sensitive Species: Similar to those of the Proposed Action with the exception that alteration of prescribed burns to avoid fisher denning season may impact tree anemone and short-leaved hulsea if not done in the fall.

Determination for the Reduction of Harvest Tree Size Alternative Forest Service Sensitive Plants (BE): Similar to that of the Proposed Action; see Table 3-21.

WILDLIFE

Affected Environment

There are eight Forest Service sensitive species (FSS) (California spotted owl, marten, fisher, wolverine, Sierra Nevada red fox, Northern goshawk, Great gray owl, and Pallid bat) that may be affected by activities occurring within the initial eight management units and one FSS species Townsend's big-eared bat would not be affected. Mule deer, a Management Indicator Species (MIS), are also present within the management units. For further detail on all threatened, endangered and Forest Service Sensitive species see the Biological Assessment/Evaluation (BA/BE). A specialist report has been written for MIS (Robinson 2006). Another specialist report has been written for Effects on Migratory Birds (Robinson 2006). All three documents are incorporated by reference.

If the species are identified as Threatened, Endangered or Forest Service Sensitive species, they are addressed in the Biological Assessment/Biological Evaluation as well as in the MIS Report.

Selection of Management Indicator Species to be analyzed: There are 13 Management Indicator Species or species groups that were identified in the Land and Resource Management Plan (LRMP) for the Sierra National Forest, adopted in 1992. The objective was to select species that through monitoring of populations and habitat relationships, the effects of management activities on the fish, plants, and wildlife could be evaluated.

Following is a complete list of MIS for the Sierra National Forest, broken out by the category of analysis that will be presented in this section and the type of monitoring that is required in the LRMP (USDA Forest Service 1992) (Table 3-22). Four species (Peregrine Falcon, Bald Eagle, Osprey, and Willow Flycatcher) have no habitat within the planning area or are not expected to be affected by any of the alternatives; for this reason, these species will not be addressed further.

Species with an Analysis Category of "No Habitat – No Effect" do not have habitat in or adjacent to the project area and will not be discussed further because the Kings River Project is not expected to directly or indirectly affect them; some of these species may occasionally be seen flying over the project area, however no further analysis will be performed due to the lack of supporting habitat in the project area. The two fish species groups are addressed in a separate MIS specialist report for aquatic species and the results summarized in the Aquatics Section of this chapter. Those species whose habitat is present and may be either directly or indirectly affected by the alternatives are identified as "Habitat Present – Possible Effects" and will be analyzed hereinafter. The type of monitoring required in the LRMP for each species/species group is also shown.

Under the LRMP for the Sierra National Forest, habitat and/or population monitoring is required for each of the MIS identified (USDA Forest Service 1992). The specific type of monitoring that is applicable to each species is shown in the third column of Table 3-22. This information is a summary of pages 5-6 through 5-9 of the Sierra National Forest's LRMP (specifically, Table 5.01 – Monitoring and Evaluation) that pertains to MIS.

Table 3-22 - List of MIS on the Sierra National Forest

Name of Species	Category of Analysis	Monitoring Required by LRMP
Lahontan and Paiute Cutthroat Trout (*Oncorhynchus (=Salmo) clarki henshawi* and *O. c. seleniris*)	Addressed in aquatic MIS specialist report	Habitat
Resident Trout – brown trout, Eastern brook trout, and rainbow trout (*Salmo trutta*, *Salvelinus fontinalis*, and *Oncorhynchus mykiss*)	Addressed in aquatic MIS specialist report	Habitat Populations
Northern Goshawk (*Accipiter gentiles*)	Habitat Present – Possible Effects	Habitat
Peregrine Falcon (*Falco peregrinus*)	No Habitat – No Effect	Population
Bald Eagle/Osprey (*Haliaeetus leucocephalus*/*Pandion haliaetus*)	No Habitat – No Effect	Populations
California Spotted Owl (*Strix occidentalis occidentalis*)	Habitat Present – Possible Effects	Populations
Willow Flycatcher (*Empidonax traillii*)	No Habitat – No Effect	Populations
Mule Deer (*Odocoileus hemionus*)	Habitat Present – Possible Effects	Populations
Riparian Avian Species	Habitat Present – Possible Effects	Populations
Oak Woodland Avian Species	Habitat Present – Possible Effects	Populations
Meadow Edge Avian Species	Habitat Present – Possible Effects	Populations
Mature Mixed-Conifer Avian Species	Habitat Present – Possible Effects	Populations
Pacific Fisher/American Marten (*Martes americana*/*Martes pennanti pacifica*)	Habitat Present – Possible Effects	Populations

<u>Species Presence:</u> The following is a summary of species known to occur within the eight initial management units and included in the analysis:

- **Bear_fen_6** - There are three Protected Activity Centers (PACs) (FR130, FR160 and FR161) for the California spotted owl within the management unit boundary. All three PACs are within the California spotted owl study (owl study) conducted by Pacific Southwest Research station (PSW). There are fisher and goshawk sightings. There is also research that has been conducted in this unit from Jordan and Mazzoni's work. Mazzoni (2002) did live-trapping and attached radio transmitters. Jordan and others (2005) did camera traps and genetic tagging of hair samples. There is also a goshawk PAC (SIEGH10) within the management unit boundary. There is one deer holding area (Oak Flat #12) within the management area and a few migration corridors.

- **El_o_win_1** - There are two PACs (FR027 and FR162) within the management unit. FR162 is within the owl study conducted by PSW. There is also research that has been conducted in this unit from Jordan and Mazzoni's work. Mazzoni (2002) did live-trapping and attached radio transmitters. Jordan and others (2005) did camera traps and genetic tagging of hair samples. There is a historical pair of nesting goshawks and a PAC SIEGH6 has been delineated for the area. There is a deer population center (Dinkey #13) and deer holding area (BigFir-Dinkey-Lower Dinkey #11) within the management unit.
- **Glen_mdw_1** - There is one PAC (FR039) within the management unit. FR039 is within the owl study conducted by PSW. There are fisher and goshawk sightings within the unit. There is also research that has been conducted in this unit from Jordan and Mazzoni's work. Mazzoni (2002) did live-trapping and attached radio transmitters. Jordan and others (2005) did camera traps and genetic tagging of hair samples. FR039 is within the owl study conducted by PSW. There is a portion of deer holding area #10, Blue Canyon-Providence and migration corridors within the management unit.
- **Krew_bul_1** - There is one Home Range Core Area (HRCA) (FR188) for the California spotted owl within the management unit. There are migration corridors for mule deer within the unit.
- **Krew_prv_1** - There are two PACs (FR021 and FR122) for the California spotted owl within the management unit boundary. FR122 is within the owl study conducted by PSW. There are incidental sightings of bald eagle, goshawk, great gray owl, marten and fisher. There is also research that has been conducted in this unit from Jordan and Mazzoni's work. Mazzoni (2002) did live-trapping and attached radio transmitters. Jordan and others (2005) did camera traps and genetic tagging of hair samples. There are two deer holding areas (Summit #9 and Blue Canyon-Providence #10) within the management unit and a few migration corridors.
- **N_soapro_2** - There is one PAC FR167 for the California spotted owl within the management unit. It is within the owl study conducted by PSW. There is also research that has been conducted in this unit from Jordan and Mazzoni's work. Mazzoni (2002) did live-trapping and attached radio transmitters. Jordan and others (2005) did camera traps and genetic tagging of hair samples.
- **Providen_1** - There are two PACs, FR119 and FR147 for the California spotted owl within the management unit. PAC 119 is within the owl study conducted by PSW. There are incidental sightings of goshawk and fisher. There is also research that has been conducted in this unit from Jordan and Mazzoni's work. Mazzoni (2002) did live-trapping and attached radio transmitters. Jordan and others (2005) did camera traps and genetic tagging of hair samples. There is a portion of a deer holding area (Summit #9) and a few migration corridors within the management unit.
- **Providen_4** - There are no PACs for the California spotted owl within the management unit. There is also research that has been conducted in this unit from Jordan and Mazzoni's work. Mazzoni (2002) did live-trapping and attached radio transmitters. Jordan and others (2005) did camera traps and genetic tagging of hair samples. There is a small portion of winter range and migration corridors for the deer.

Environmental Consequences – All Alternatives

This section summarizes analyzes of the effects of the three alternatives on nine FSS and the Sierra NF MIS terrestrial species and their habitats. The effects of the alternatives are discussed in terms of their direct, indirect, and cumulative impacts. Only a brief discussion is presented in this section for each of the alternatives. More detailed information can be found in the BA/BE and the Management Indicator Species Specialist

Report – Kings River Project (Robinson 2006) which are incorporated by reference. Animations of spotted owl and fisher habitat before and after initial treatments based on Parks and Rojas 2006 are provided on the Sierra National Forest website: http://www.fs.fed.us/r5/sierra/projects/

There were two significant issues detailed in Chapter 1 that relate to terrestrial species:

1) the use of herbicide/surfactant will create an adverse risk of harmful effects to people and wildlife (issue #2);

2) the proposed action will threaten the viability and cause degradation of habitat of the spotted owl, marten, fisher, and goshawk and will lead to high short-term risks on aquatic management (issue #3).

In Table 3-23 through 3-25 are a summary of habitat acres by CWHR size and density class showing habitat currently and directly after treatment by either Alternative 1 or Alternative 3.

Table 3-23 - Current CWHR habitat acreage, Alternative 1 without wildfire

Alternative 1 no fire									
Year	Current								
Sum of ACRES	PROJECT								
b_cwhr	bear_fen_6	el_o_win_1	glen_mdw_1	krew_bul_1	krew_prv_1	n_soapro_2	providen_1	providen_4	Grand Total
3D	51	10	9	10	71	386	140	31	709
3M	2	5		1	1	33	40	30	113
4D	506	535	66	39	509	563	648	472	3,338
4M	1,256	567	946	427	1,043	247	501	293	5,280
5D		6			6	20	25	21	77
5M	72	15	132	47	29	3	28	31	355
Grand Total	1,887	1,138	1,153	524	1,659	1,251	1,383	878	9,873

Table 3-24 – CWHR habitat acreage directly after proposed action, Alternative 1 without wildfire

Alternative 1 no fire after									
Year	Directtly after proposed action								
Sum of ACRES	PROJECT								
a_cwhr	bear_fen_6	el_o_win_1	glen_mdw_1	krew_bul_1	krew_prv_1	n_soapro_2	providen_1	providen_4	Grand Total
3D	24	7	9	10	66	383	110	31	641
3M	28	3			1	31	60	49	173
4D	385	340	26	15	211	552	463	389	2,382
4M	1,173	672	892	327	1,197	205	577	313	5,356
5D						18	15	4	36
5M	64	23	131	8	40	3	55	37	361
Grand Total	1,674	1,047	1,058	361	1,516	1,191	1,279	824	8,949

Table 3-25 – CWHR habitat acreage directly after treatment, Alternative 3 without wildfire

Alternative 3 no fire									
Year	Directly after treatment								
Sum of ACRES	PROJECT								
a_cwhr	bear_fen_6	el_o_win_1	glen_mdw_1	krew_bul_1	krew_prv_1	n_soapro_2	providen_1	providen_4	Grand Total
3D	24	7	9	10	66	366	110	31	624
3M	28	3			1	31	60	49	173
4D	391	348	34	15	231	569	461	410	2,460
4M	1,167	665	879	335	1,176	205	593	307	5,327
5D	19					18	15	4	56
5M	44	23	136	12	44	3	55	44	360
Grand Total	1,674	1,047	1,058	373	1,519	1,191	1,293	844	8,998

There is a minimal difference between the two action alternatives for wildlife species; therefore, they are discussed together in this section. The main difference is the protection measures listed from technical advice by US Fish and Wildlife Service (F&WS) for the fisher and Yosemite toad.

California Spotted Owl, FSS and MIS

General Information

Stand treatments may directly affect owls in any of three areas of primary behavior: nesting and roosting, foraging, and dispersal. Typical buffers applied to known owl sites protect owls from most direct impacts and are likely to minimize disturbance. It is not known, however, how stress may affect owls. Although they may not flush from a site, continued disturbance in the area may trigger stress responses that could increase foraging time or decrease foraging efficiency and disturb typical behavioral patterns.

A limited operating period and limitations on activities in the WUI threat zone in the design measures for California Spotted Owl are incompatible with the California Spotted Owl Study (CSOS) as described in the Design Measures section of Chapter 2. The study is designed to treat some protected activity centers (PAC) using the management direction for the defense zone of the WUI from the SNFPA Record of Decision of 2001 in whatever land allocation the PAC are located. The design measures for the WUI threat zone would be more limiting and the limited operating period would not allow for concentrating the effects in time so they would not be applied within the CSOS. Inherently, the study would determine the effects of treatments specified in the design

To some extent, the same limited operating period is incompatible with the KREW Studies in Management Units krew_bul_1 and krew_prv_1. The KREW Studies require the activities intended to address several questions posed in the SNFPA 2004 Record of Decision to take place in as few years as possible to concentrate the effects in time and provide the greatest opportunity for accomplishing the objectives of the Studies. Without the limited operating period the direct effects may be prolonged noise disturbance which could increase or decrease foraging efficiency and disturb typical behavioral patterns as mentioned above or if the owls are nesting, they may leave the area or fail at nesting attempts.

Evaluative Criteria

The action alternatives will be analyzed against the criteria shown in Table 3-26. These criteria were chosen to clearly display and quantify effects to the California Spotted Owl and its habitat; and to address elements critical to the owl's viability.

Table 3-26 - Criteria used to evaluate and measure effects on the California Spotted Owl and its habitat resulting from implementation of the action alternatives.

Evaluative Criterion	How it Will be Measured
Total suitable habitat acres in planning area	Figures for current condition will be compared to estimated numbers post-project and for 10, 20, and 30 years after project implementation
Acres of suitable habitat within PACs	Figures for current condition will be compared to estimated numbers post-project
Percent of California Spotted Owl home range containing suitable habitat	Figures for current condition will be compared to estimated numbers post-project; threshold of 30-50% based on Bart (1995)
Percentage of 1000 acres surrounding PACs that contain canopy cover of greater than 40%	Figures for current condition will be compared to estimated numbers post-project; threshold of 44% representing optimum conditions is based on Lee and Irwin (2005)
Effects of Stand Replacing wildfire	Effects of Stand Replacing fire will be displayed for all alternatives, starting with present-day conditions and ranging 30 years into the future
Five factors under Section 4(a)(1) of the ESA comprising threats which may contribute to a species being listed as Threatened or Endangered	Whether the cumulative effects are within the scope of effects described in the USFWS' 12-month finding (U.S. Dept. of Interior 2006)

Direct Effects to California Spotted Owl

<u>Silvicultural and Hazardous Fuels Reduction Treatments:</u> Wolcott (2006:36-41) summarized direct effects such as noise or fire/smoke disturbance, availability of nest trees, canopy cover, and dispersal resulting from proposed (Alternative 1) silvicultural and hazardous fuels reduction treatments; those descriptions of effects are hereby incorporated by reference. Under Alternative 3, these effects would be slightly reduced in scope and magnitude because: the uneven aged management strategy is modified to reduce vegetation treatments to trees 30" dbh and smaller; protection measures for the Pacific fisher are adopted; and all treatments outside of the research areas will be consistent with the standards and guidelines in the SNFPA ROD (USDA 2004).

<u>Total Suitable Habitat Acres in Planning Area:</u> Currently, 47,464 acres of suitable California Spotted Owl habitat exist within the planning area, of which 9051 are within the initial eight management units. Under Alternative 2, the amount of suitable habitat in the planning area could increase to over 57,000 acres in 30 years assuming no wildfires occurred during that time. Implementation of Alternatives 1 or 3 would result in suitable habitat increasing to about 56,500 acres or more in 30 years, again assuming no wildfires occurred during that time period (Table 3-27). Based on this analysis alone, it may appear that the alternatives do not differ considerably in overall effects on the California Spotted Owl. However, it is reasonable to assume one or more wildfires could occur within the planning area, perhaps as early as within the next 10 years. Taking this into account

substantially changes the impacts of the various alternatives on the California Spotted Owl and its habitat. The effects of such a fire event are modeled below in a later section titled, Effects of Stand Replacing Fire.

Table 3-27 - Total suitable habitat acres for the California Spotted Owl within the planning area under all alternatives.

Alternative	Time Frame	Acreage Total	
		Initial Eight Mgmt Units	Planning Area
NA	Current	9051	47,464
1	Post-Project	8135	46,549
	10 Years After	8914	51,476
	20 Years After	9364	54,595
	30 Years After	9893	56,555
2	Post-Project	----	47,464
	10 Years After	----	52,632
	20 Years After	----	55,753
	30 Years After	----	57,598
3	Post-Project	8202	46,615
	10 Years After	9030	51,592
	20 Years After	9421	54,652
	30 Years After	9938	56,600

Acres of Suitable Habitat within PACs: The 300-acre size of Protected Activity Centers is derived from a sample of 148 California Spotted Owl nest trees in the Sierra Nevada; analysis of these data showed that the mean size of stands containing nest trees was about 100 acres and that the mean cumulative size of each nest stand plus all adjoining stands that were in "Selected" strata[9] was about 300 acres (Verner *and* others 1992). Nesting sites, one or more suitable roost sites, and areas supporting a substantial portion of the owl's foraging activities are all found within the activity center (Verner *and* others 1992: 87).

Because of the important role that PACs play in the life history of the California Spotted Owl, we displayed the amount of suitable habitat currently within PACs compared to the amount of such habitat that would be present immediately after implementation of the action alternatives (Table 3-28). Of the 11 PACs in the project area, six would be affected by the proposed treatments as part of the Spotted Owl study. Loss of habitat across all PACs would range from one acre up to 36 acres per individual PAC, with an average loss of 6.6 acres of suitable habitat. The amount of suitable habitat would not change under the proposed activities (Alternatives 1 and 3) for five PACs. The reader should note that PAC FR122 currently has 162 acres on Forest Service lands (of which 138 is suitable); the remaining 143 acres is on private land.

Because of the uncertainty involved in estimating, with precision, the amount of suitable habitat that would be present within PACs over a period of 10 years or longer, we did not attempt to display habitat totals for PACs for the 10- to 30-year period following implementation of the proposed action.

[9] Selected strata refers to a timber type used equal to or greater than its availability.

Percent of California Spotted Owl Home Ranges Containing Suitable: Nine of the 12 owl home ranges analyzed herein contain more than 50% suitable habitat; and all of them contain more than 30% suitable habitat. Only one of the home ranges (owl FR021) drops below 50% suitable habitat as a result of the proposed treatments in Alternatives 1 or 3. No home range would drop below 30% suitable habitat in Alternatives 1 or 3. Based on Bart's (1995) findings, the capability for owls to replace themselves exists throughout the entire project area, and that condition would be maintained under both action alternatives. The amount of habitat available to owls FR122, FR167, and FR119 is close to (but not below) the threshold defined by Bart (1995). All of these calculations were made based on the assumption (U.S. Dept. Interior 2003:7589) that home range size for owls on the Sierra National Forest is 2500 acres (Table 3-28).

Because of the uncertainty involved in estimating, with precision, the amount of suitable habitat that would be present within individual home ranges over a period of 10 years or longer, we did not attempt to display habitat totals for home ranges for the 10- to 30-year period following implementation of the proposed action.

Table 3-28 Changes in the percent of suitable habitat within California Spotted Owl home

PAC ID Number	Current Conditions (No Action – Alt 2)		Proposed Action (Alt 1) Post Project		Alternative 3 Post Project	
	Total Acres	% Suitable	Total Acres	% Suitable	Total Acres	% Suitable
FR130	1627	65.1%	1451	58.0%	1451	58.0%
FR160	1416	56.6%	1319	52.8%	1319	52.8%
FR161	1628	65.1%	1459	58.4%	1459	58.4%
FR027	1353	54.1%	1312	52.5%	1312	52.5%
FR162	1993	79.7%	1917	76.7%	1917	76.7%
FR039	1610	64.4%	1497	59.9%	1497	59.9%
FR021	1297	51.9%	1158	46.3%	1161	46.4%
FR122	1055	42.2%	998	39.9%	1017	40.7%
FR167	942	37.7%	899	36.0%	909	36.4%
FR119	1175	47.0%	1104	44.2%	1104	44.2%
FR147	1266	50.6%	1262	50.5%	1262	50.5%
FR188	1293	51.7%	1292	51.7%	1292	51.7%

Percentage of 1000 Acres Surrounding PACs That Contain 40% or Greater Canopy Cover: Verner and others (1992:158) recommended that suitable habitat include the criterion of canopy closure greater than or equal to 40% based on habitat use studies which showed that such habitat was used by many California Spotted Owls more than expected relative to its availability across the landscape.

Optimum conditions for reproduction in California Spotted Owls may exist when at least 44% of the 430-ha (1063 ac) area surrounding the territory center contains forested habitat with canopy cover greater than 40% and a suitable nest tree is present in the activity center (Lee, *in litt*. 2005; Lee and Irwin 2005).

Because of the importance that this metric appears to play in the viability of California Spotted Owl populations, we displayed the percentage of the 1000 acres surrounding the PAC that contains forested habitat with greater than 40% canopy closure; these data are reflected for current conditions and for the period immediately after implementation of the proposed activities (Table 3-28). In brief, more than 44% of the 1000 acres surrounding all owl sites currently contain forested habitat with > 40% canopy closure and that condition would be maintained under both action alternatives, with the exception of owls FR122 and FR167. Both Owl FR122 and FR167 are slightly below the threshold defined by Lee and Irwin (2005), and so the potential for successful reproduction may be at risk at these sites. Based on the data concerning forested habitat with >40% canopy cover the potential for reproduction continues at all of the remaining nine sites.

Because of the uncertainty involved in estimating, with precision, the amount of forested habitat with greater than 40% canopy cover that would be found within the 1000 acre circle surrounding activity centers over a period of 10 years or longer, we did not attempt to display habitat totals for this metric for the 10- to 30-year period following implementation of the proposed action.

Indirect Effects to California Spotted Owls

Silvicultural and Hazardous Fuels Reduction Treatments: Wolcott (2006:38, 41-43) summarized how prey, the in-growth of larger, suitable nesting trees, and the probability of stand-replacement fire events taking place would be indirectly affected by the alternatives; those descriptions of effects are hereby incorporated by reference. The indirect effects of silvicultural and hazardous fuels reduction treatments to the California Spotted Owl under Alternative 3 are expected to be similar as those described by Wolcott (2006) for Alternative 1 since the only key differences between the alternatives are: reducing vegetation treatments to trees 30” dbh and smaller; adopting protection measures for the Pacific fisher; and making all treatments outside of the research areas consistent with the standards and guidelines in the SNFPA ROD (USDA 2004).

Under Alternative 2, if no action is taken and a wildfire occurred in the area, there would be greater effects of the habitat loss because it would be harder to control due to dense ladder fuels and high surface fuel loading that is currently in the area. Tree density would remain high and present continued effects of crown fire (see Fuels section of this chapter). As a result of the No Action Alternative, stands would have higher tree density, and less growing space; therefore, leading to smaller diameter clumped trees, less foraging and nesting habitat, and restricted flight space.

Effects of Stand Replacing Fire: As described in the Environmental Impact Statement, each Alternative incorporates the concept of wildfire entering one or a couple of the initial eight management units ten years after the record of decision. Fire records for the KRP indicate it is likely one or a couple of the management units could be significantly affected by a stand replacing fire on a hot windy summer day, but it is unlikely numerous management units or an entire watershed would be affected at one time. There would be a greater loss of habitat if no treatments occur because the trees are denser and there is a higher likelihood of a stand replacing fire destroying habitat within the wildfire.

It is easier to demonstrate this by assuming all eight management units burn over the span of a few years as shown in Figure 3-50. It could be argued that it is unlikely all eight management units would burn within a few years; however, the depiction of the impacts in this manner is intended to simplify the reader’s interpretation of the data by creating an index which merely shows that regardless of the amount of fire that occurs over time, there would be a greater loss of habitat if no treatments occur versus implementing the treatments called for in the action alternatives, all other things being equal.

Immediately after wildfire, there would be approximately 7200 acres of spotted owl habitat remaining with the action alternatives (Alternative 1 and Alternative 3) versus 2900 acres for Alternative 2. The best scenario among the alternatives is to implement Alternative 1 or Alternative 3 because it reduces the effects of fire and after 30 years there would be approximately 8100 acres, if wildfire occurs (and approximately 9400 acres, if no wildfire occurs) of spotted owl habitat in the initial eight management units.

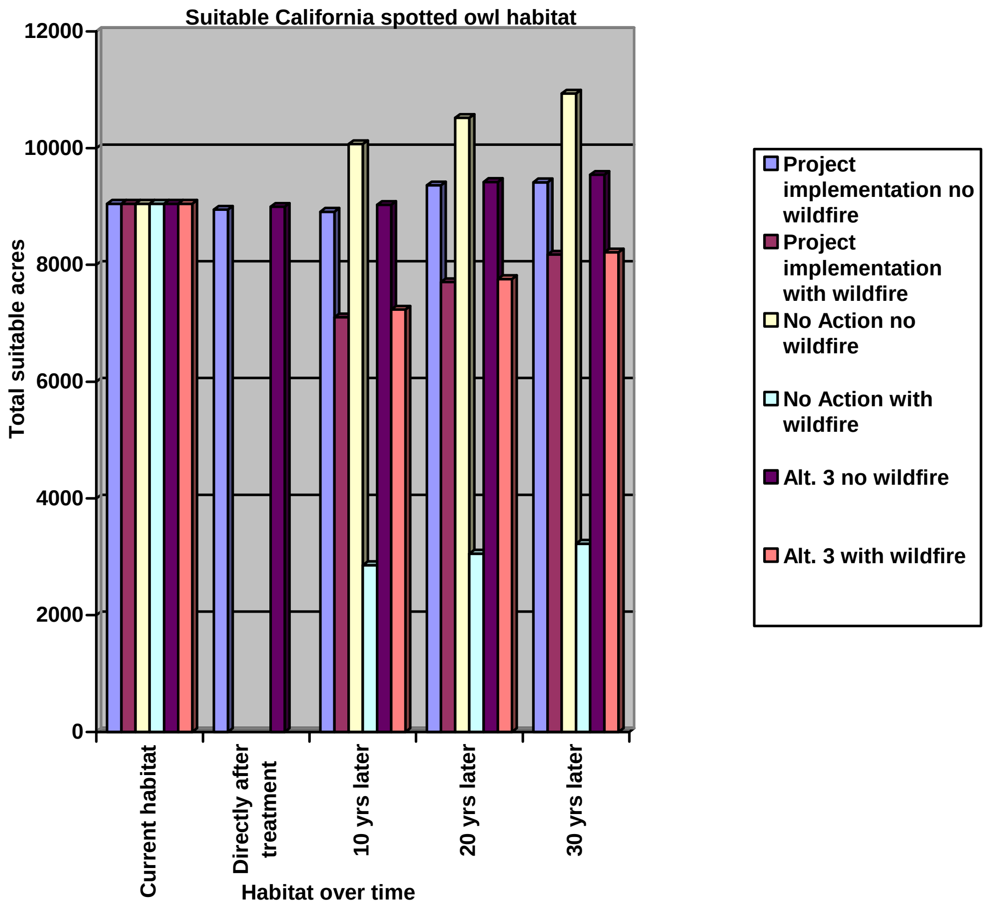


Figure 3-50 - Suitable Spotted Owl Habitat

Cumulative Effects for California Spotted Owl

In general, the area considered in determining the cumulative effects of the proposed action is bounded by the San Joaquin River on the north, the Kings River on the south, and the elevation range for Spotted Owls on the east and west. This area is appropriate for analysis of cumulative effects, because the total size of the KRP (approximately 131,500 acres within two watersheds of the Kings River drainage) is considered sufficient to facilitate replication of experiments and also "represents the heterogeneity of southern Sierra ecosystem types" (USDA Forest Service 2004:81). Wilderness areas and national park land, where limited land management occurs, further define the boundary on the east. The two rivers course through steep, rugged canyons that are dominated by chaparral or rock at lower elevations, have no habitat, and are inhospitable (although by no means impenetrable barriers) for north to south movement. Depending on the scale of analysis, the boundary for cumulative effects as described above may be enlarged or condensed as necessary.

At a larger scale, human population growth and increasing use of wild land areas may affect the California spotted owl and its habitat, including activities such as California's fast growing (1982-1995) recreational activities such as OHV use, (+44%), hiking (+94%), backpacking (+73), and primitive camping (+58%).

Again at the larger scale, over the past 28 years, timber harvest from Federal lands in California has declined from 1,725 MMBF in 1978 to 230 MMBF in 2005 (average of 906 MMBF) (Board of Equalization 2005). At the same time, harvest on private lands has remained relatively stable with a high of 2,766 MMBF in 1978 to a near low of 1,495 MMBF in 2005 (average of 2,028 MMBF). An upward trend in these numbers in the near future would further fragment habitat on private land. Declines in timber harvest affect the owl in several ways. Declining harvest frequently means fewer disturbances in the woods and a greater opportunity that any given owl will breed and fledge its young without substantial interference or disturbance. On the other hand, declining timber harvest also reduces the available funds for forest restoration and habitat management.

Present and reasonably foreseeable activities were described at the beginning of Chapter 3 of the KRP Environmental Impact Statement and are listed, in part, in Table 3-2. In addition to the site-specific analysis of the eight management units, the EIS includes an analysis of the cumulative effects of establishing 10 management units as no treatment-controls, and the treatment of one unit (South of Shaver) under an existing decision.

The ongoing federal management activities (all of which have already had their NEPA completed) that extend in time through the treatment of the initial eight management units and overlap them involve the High Sierra Ranger District prescribed burn program of work (Figure 3-2, Chapter 3 of the FEIS), other Sierra National Forest timber and culture projects (Figure 3-2, Chapter 3 of the FEIS), active cattle allotments (Figure 3-3, Chapter 3, FEIS), and recreational activities and events (e.g. off-highway vehicle (OHV) and off-snow vehicles (OSV); (Figure 3-4).

The ongoing privately managed activities (Figure 3-5) within the Kings River Project area involve two timber sales near the n_soapro_2 management unit, a housing development north of the sos_1 management unit, Southern California Edison (SCE) timber management area, other non-industrial forest landowner thinning, and the Pacific Gas & Electric (PG&E) transmission line.

At a forest-wide scale, there currently are 321 designated Home Range Core Areas and 258 Protected Activity Centers encompassing over 113,000 acres. Over 450,000 acres of suitable habitat currently exist on the Forest. Considering the proposed activities, ongoing actions, and reasonably foreseeable activities, less than one percent of suitable habitat on the Sierra National Forest would be adversely affected.

Since about the mid 1960s, past activities have included clearcutting and salvage logging (1960s to 1972), sanitation and salvage harvests (1972 through 1978), clearcutting, shelterwood cutting, and salvage harvests (1978 through 1992), and commercial thinning and salvage in recent times. The only fires to burn substantial amounts of timber were the Rock Fire in 1981 and the Big Creek Fire in 1995, with each fire burning about 3000 acres of forest. Clearcuts or burned areas that took place prior to 1972 are most likely successful plantations today exhibiting “size class 3” and density “class M” stands. Other, more recent disturbances, while they may be reforested have probably not yet reached “size class 3”. Overall, about 9000 acres of disturbance resulting from timber sale activity or fires have taken place within the KRP planning area and approximately 23,000 acres of disturbance have been documented for the larger area encompassing the Kings River and Pine Ridge Ranger Districts (now known as High Sierra Ranger District) since about 1972 (Smith, *pers. comm.*2006). Although these disturbances have caused notable changes in wildlife habitat, the amount of these changes over the last 30 years is not extraordinary compared to the total amount of suitable Spotted Owl habitat that is available: i.e., over 450,000 acres across the Forest, and 47,464 acres within the KRP planning area.

The ROD for the SNFPA FSEIS amends the Sierra National Forest LRMP and incorporates the Kings River Project (USDA 2004:p. 15 of ROD; pp. 81-82 of FSEIS). As mentioned in the KRP DEIS, the intention of the SNFPA ROD was to allow existing studies and research projects such as the KRP to continue even though it might result in deviation from direction specified in the SNFPA ROD. In summary, the KRP direction may include variations of: a) the SNFPA ROD “Appendix A: Management Direction” described in the design measures in this proposal or subsequently in the EIS alternatives and associated mitigation measures; b) the remaining unmodified “Appendix A: Management Direction”; c) the SNFPA ROD land allocations; and d) the remaining operational LRMP standards and guidelines.

In its 12-month finding in which it decided to not list the California Spotted Owl as Threatened or Endangered, the USFWS concluded that the scale, magnitude, or intensity of effects on the California Spotted Owl resulting from fire, fuels treatments, timber harvest, and other activities did not rise above the threshold necessitating protection of the species under the Endangered Species Act (U.S. Dept. of Interior 2006). The USFWS reached this conclusion after considering the impacts of the Forest Service’s implementation of the SNFPA ROD, which includes the KRP as proposed and described herein. The USFWS’ (U.S. Dept. of Interior 2006) conclusion is supported by:

Data which indicate that California Spotted Owl populations in the Sierra Nevada are stable and comprise 81% of the species’ known territories

The anticipation that current and planned fuels-reduction activities throughout the range of the species will have a long-term benefit by reducing the effects of stand replacing wildfire; these activities embrace those described by the SNFPA ROD, including implementation of the KRP

Barred Owls represent only about 2% of California Spotted Owl numbers in the Sierra Nevada

Protection measures are being implemented for the California Spotted Owl on private lands, including the largest private landholder within the range of the species.

Based on the above analysis, the activities proposed in the KRP are within the scope of effects considered and described by the USFWS in its 12-month finding to not list the

California Spotted Owl. As a result, the KRP would not result in any cumulative effects that are greater than those already analyzed by the USFWS when it determined that listing of the California Spotted Owl as Threatened or Endangered is not warranted at this time. For all of these reasons, viability of the owl in the KRP planning area is not a concern.

Great Gray Owls, FSS and Northern Goshawk, FSS and MIS

Direct and Indirect Effects to Great Gray Owls and Northern Goshawk

In the initial eight management units, great gray owls have been sighted in only one unit (KREW_prv_1) but goshawks occur in five of the eight units. The great gray owls utilize the project area for foraging. The nearest area where great gray owls have been known to nest is east of the KRP where they are utilizing a meadow on private land. In addition to the sightings of goshawks, they are nesting in the bear_fen_6 and el_o_win_1 management units. When trees are being removed with mechanical equipment (tractor, masticator, etc.) there may be a direct effect due to the noise disturbance involved with project activities. Short term disturbance may occur from prescribed fire because the birds may leave the area due to smoke or noise disturbance associated with the activities. The long term effects are a benefit to the species because high quality nesting habitat will be created when the smaller trees are removed which in turn will allow growing space for medium and large size trees.

If the action alternatives are implemented and there is a wildfire the habitat for these birds will decrease after the fire then recover through a ten year period and what was lower quality habitat will move toward higher quality habitat. A wildfire under any alternative results in habitat loss. However, more habitat is lost if Alternative 2 (No Action) is selected and a wildfire occurs, all other things being equal. Under Alternative 2 without wildfire there would be more habitat over time, but this scenario is unlikely. Model results in the Fuels and Vegetation Sections of this chapter indicate that under the no action alternative the occurrence of wildfire would lead to substantial loss of habitat.

Smoke from either a wildfire or prescribed fire could move into the area where the birds are nesting or foraging and they could potentially leave the area for a while and return at a later time. The affects to prey species for goshawk would be they may be killed through the fire if they do not leave the area. Those that leave the area and return would have higher quality habitat in the long run. The great gray owl's prey base is primarily within the meadow; therefore, there would not be an effect to them because meadows are not included in prescribed burns.

A limited operating period for goshawk is incompatible with the KREW Studies in Management Units krew_bul_1 and krew_prv_1. The KREW Studies require the activities intended to address several questions posed in the SNFPA 2004 Record of Decision to take place in as few years as possible to concentrate the effects in time and provide the greatest opportunity for accomplishing the objectives of the Studies. Without the limited operating period the direct effects may be prolonged noise disturbance which could increase or decrease foraging efficiency and disturb typical behavioral patterns.

Currently, 585 acres of suitable habitat for great gray owl exist in the KRP planning area. Implementing Alternative 1 or Alternative 3 would result in a minor loss of suitable habitat. This short-term loss of habitat is offset by the benefit of a greater reduction in wildfire effects over the long-term, compared to the Alternative 2.

The following chart shows the affect of the alternatives with and without a wildfire occurring on goshawk habitat over time.

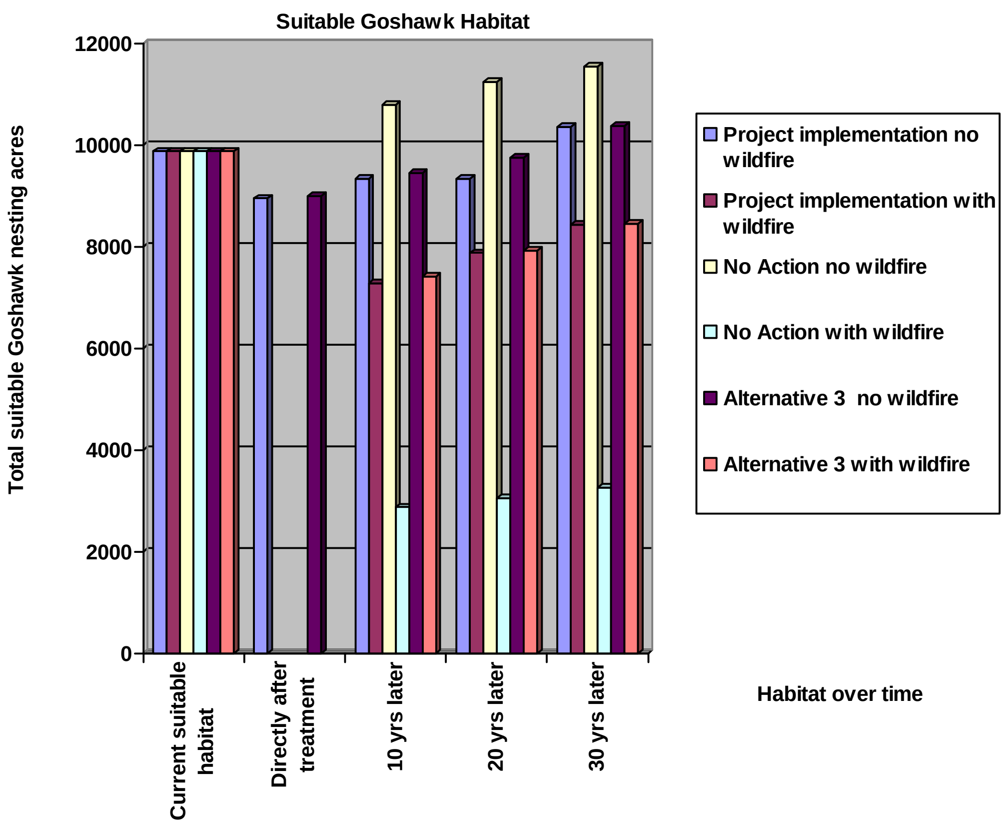


Figure 3-51 - Goshawk habitat effects of implementing the alternatives

Currently, 50,300 acres of suitable habitat for goshawk exist in the KRP planning area. Implementing Alternative 1 or Alternative 3 would result in a loss of about 900 and 880 acres of suitable habitat, respectively. This short-term loss of habitat is offset by the benefit of a greater reduction in wildfire effects over the long-term, compared to the Alternative 2 (see Figure 3-51).

As seen in the Figure 3-51, when no wildfire occurs the suitable habitat increases over time. Alternative 2 without wildfire is unlikely because, as stated before, it is only a matter of time before a wildfire occurs. The area shows a high fire hazard due to fuels on the ground and the high tree density. As a result of the No Action Alternative, stands would have higher tree density, and less growing space; therefore, leading to smaller diameter clumped trees, less foraging and nesting habitat, and restricted flight space.

Cumulative Effects for Northern Goshawk

The Northern Goshawk has a continuous distribution throughout the Sierra Nevada with a network of 50 managed territories on the Sierra National Forest. Given the scope and scale of the Kings River Project relative to the size of the Sierra Nevada and the goshawk's overall North American distribution, the area considered in determining the cumulative effects of past, present, and reasonably foreseeable activities on the Northern Goshawk will focus on the Sierra NF. Based on the following analysis, a determination of viability for the Northern Goshawk will be made.

Two Northern Goshawk territories are located within the KRP area, and they are in the following locations: (1) SIEGH10 in the Bear Fen 6 unit, and (2) a PAC (SIEGH6) in the El O Win unit.

Current and post-treatment suitable habitat acres for two Northern Goshawk territories

	Territory SIEGH10	Territory/PAC SIEGH6
Current suitable habitat acres	178	164
Post-treatment suitable habitat acres	149	142

Biological Evaluations for many of the past projects in the Sierra NF were reviewed to help inform the present analysis. Our review of these documents revealed the following basic information about effects to Northern Goshawks from these activities:

- Twenty-six (26) total project Biological Evaluations (BEs) were reviewed, dating back to 1993 on the Sierra NF.
- Determinations reached were:
  - No effect – 4 BEs
  - May affect individual goshawks, but not likely to lead to a trend toward federal listing or loss of viability – 20 BEs
  - May affect individual goshawks, and likely to lead to a trend toward federal listing or loss of viability – 0 BEs
  - Northern Goshawk was not addressed in the document we reviewed due to lack of habitat or other reasons – 2 BEs
- Types of Projects: Fuels reduction, harvest, hazard tree removal, thinning, and underburning were the proposed activities that were most often represented in the sample of BEs in which the Northern Goshawk was analyzed.
- Relative to "May Affect" projects, the described impacts to Northern Goshawks most often fell in the following categories:
  - Noise disturbances
  - Loss of foraging area if underburn gets out of control
  - Loss of plucking trees
  - Habitat quality reduction
  - A 210-acre reduction in canopy cover in the KRP area
  - A 1230-acre reduction in canopy cover on the Sierra NF

Additional past, present, and reasonably foreseeable future activities are outlined at the beginning of Chapter 3 of the Kings River FEIS. Two of these projects would result in a 210-acre reduction in canopy cover at the KRP level: (1) Jose 1 project (60 acres converted from 4M to 4P and 8 acres converted from 3M to 3P), and (2) South of Shaver Project (122 acres converted from 4M to 4P and 20 acres converted from 4D to 4M).

Currently, there are 405,000 acres of suitable goshawk habitat in the 4000 to 8,000 foot elevation range on the Sierra NF; 50,000 acres of that total are within the KRP area.

The cumulative effects described for the fisher under the headings, "**A review of the fire history dating back to 1916**" and "**A review of how past activities since about the mid-1960s have affected the landscape**" apply to the goshawk as well. Although these disturbances have caused notable changes in wildlife habitat, the amount of these changes over the last 30 years is not extraordinary compared to the total amount of suitable goshawk habitat that is available: i.e., over 400,000 acres across the Forest, and close to 50,000 acres within the KRP planning area.

As with other species, the SNFPA (USDA 2001c) provided our analysis of Northern Goshawks with useful historical and habitat information. Evidence suggests the low number of goshawk breeding territories (ranging from 12 reported in the SNFPA (USDA 2001c) to the 20 such territories known to exist today) has remained relatively stable since some of the earliest data were reported by Grinnell and Miller (1944 – as cited in USDA (2001c)), because there has been no apparent change in the geographic distribution of Northern Goshawks in the Sierra Nevada since then. Thus, goshawk numbers in the Sierra NF remain fairly low. Reasons for this, as put forth by the SNFPA (USDA 2001c), include (1) vegetation management practices, (2) the fact that the Sierra NF is near the southernmost edge of the goshawk's range, and (3) survey efforts for goshawks may be lower on the Sierra NF.

The major risk factors identified by the SNFPA (USDA 2001c) for goshawks are the effects of vegetation management and wildfires on the amount and distribution of quality habitat. Unfortunately, goshawk biologists are unsure of what constitutes "high quality" Northern Goshawk habitat in the Sierra Nevada, and as a result, historical patterns of land-use and its effects on goshawks are difficult to interpret. Brian Woodbridge (pers. comm., 8 Sept 2006), however, stated that the 4D CWHR size/density class, and perhaps also 5D, is used most frequently by nesting goshawks. Immediately after the implementation of the Proposed Action or the Reduce Harvest Tree Size alternative, the amount of suitable habitat would decrease by 924 acres or 875 acres, which is approximately two percent of the total suitable habitat (*ca*. 50,000 ac) within the KRP planning area and less than one percent of the suitable habitat on the Forest. In the long-term, this habitat is expected to recover within 10-20 years. This is important because the SNFPA (USDA 2001c) also reveals recent evidence suggesting there has been a reduction in good nesting and foraging habitat for goshawks within the Sierra Nevada. How these changes have affected the population, however, cannot be determined, due to a lack of reliable data on historic and current population sizes and distributions.

Because the alternatives put forth in this project will result in long-term increases in Northern Goshawk suitable habitat over time, along with the relatively stable geographic distribution and population levels of goshawks in the area, and the project's goal of increasing large diameter trees, the cumulative effects of vegetation management activities in the KRP initial eight management units taken together with past, present, and reasonably foreseeable activities on the Forest will not result in a loss of viability for the Northern Goshawk.

Cumulative Effects for Great Gray Owl

The area considered in determining the cumulative effects of past, present, and reasonably foreseeable activities on the Great Gray Owl encompasses the Sierra NF. This is an appropriate scale for cumulative effects for a species such as the Great Gray Owl, which is non-migratory and does not have a well-defined metapopulation structure (Duncan and Hayward 1994). Based on the following analysis, a determination of viability for the Great Gray Owl will be made.

Biological Evaluations for many of the past projects in the Sierra NF were reviewed to help inform the present analysis. Our review of these documents revealed the following basic information about effects to Great Gray Owls from these activities:

- Twenty-six (26) total project Biological Evaluations (BEs) were reviewed, dating back to 1993 on the Sierra NF.
- Determinations reached were:
  - No effect – 12 BEs
  - May affect individual owls, but not likely to lead to a trend toward federal listing or loss of viability – 10 BEs
  - May affect individual owls, and likely to lead to a trend toward federal listing or loss of viability – 0 BEs
  - Great Gray Owl was not addressed in the document we reviewed due to lack of habitat or other reasons – 4 BEs
- Types of Projects: Fuels reduction, harvest, hazard tree removal, and underburning were the proposed activities that were most often represented in the sample of BEs in which the Great Gray Owl was analyzed.
- Relative to "May Affect" projects, the described impacts to Great Gray Owls most often fell in the following categories:
  - Loss of foraging area if underburn gets out of control
  - Reduction of habitat quality
  - Temporary displacement because of smoke from underburning
  - Noise disturbance

Additional past, present, and reasonably foreseeable future activities are outlined at the beginning of Chapter 3 of the Kings River FEIS. Most of these activities were judged to have no effect on the Great Gray Owl due to the absence of suitable meadow habitat. Some of the cattle allotment and recreational activities, however, may affect the species. The two factors considered most important in determining habitat use by breeding Great Gray Owls are availability of nest sites and availability of suitable foraging habitat such as meadows (Duncan and Hayward 1994). Cattle allotments that alter the prey base in meadows may have an impact on this species.

Great Gray Owls in California prefer pine and fir forests adjacent to montane meadows (Winter 1986). It is likely that population densities and range expansion in California is limited by access to suitable hunting meadows, as Great Gray Owls seldom forage in forest habitat (Duncan and Hayward 1994). Currently, there are 9,015 acres of suitable Great Gray Owl habitat in the 4000 to 8,000 foot elevation range on the Sierra NF; 585 acres of that total are within the KRP planning area. The cumulative effects to the Great Gray Owl will be more limited in scope compared to some of the other species because the areas that are suspected to have owls (i.e., areas near or within meadows) have traditionally not been targeted for silvicultural treatments. These same conditions would apply under both action alternatives. Across the forest, meadows and usually 50 to 100 feet around them have not had treatments of any kind, not even burning over the last 30 years. The action alternatives do not propose any treatments within the 100 feet buffer zone around a meadow.

The total California population of Great Gray Owls was estimated to be 60 individuals by Winter (1985). At the time of his survey in 1984, Winter reported no new evidence of Great Gray Owls on the Sierra NF. In fact, only Black Point in Fresno County and Jackass Meadow in Madera County had recent owl evidence (two heard in 1979, and one possible sighting in 1980, respectively). Winter concluded that the Yosemite area was the owl's last stronghold in California. Rodney Siegel (2001, 2002) reported evidence (i.e., pellets or visual sightings of individuals) of Great Gray Owls at seven Sierra NF sites, ranging in elevation from 4000 – 7000 feet, in 2001 and 2002. An additional seven Sierra NF sites bore no evidence of Great Gray Owls during that time. Additionally, no nests were found during the 2001 and 2002 survey seasons. Most recently, just one management site within the project area (KRW PRV 1) had evidence of Great Gray Owls in 2004.

Given the amount suitable habitat within the project area and across the Forest, along with the fact that Siegel (2001, 2002) found evidence of Great Gray Owls at one-half of Sierra NF sites that were surveyed, and the project's goal of increasing large diameter trees while protecting meadow and riparian habitats, the cumulative effects of vegetation management activities in the KRP initial eight management units taken together with past, present, and reasonably foreseeable activities on the Forest will not result in a loss of viability for the Great Gray Owl.

Fisher, FSS and MIS

General Information

Fishers have been studied and monitored within the KRP since the mid-1990's (Boroski and others 2002; Mazzoni 2002; Zielinski and others 1997, 2005; Rick Truex, USFS, pers. comm. 2006; Mark Jordan, University of California, pers. comm. 2006). In addition to Forest Service inventory and monitoring work and Mark Jordan's studies of fisher population density, Amie Mazzoni conducted her master's thesis research in this area, radio-tracking fishers and determining the habitat characteristics of their resting sites (Mazzoni 2002). Although Mazzoni (2002) documented many rest sites throughout the KRP area, to date no den sites have been identified in the KRP.

Based on extensive track plate and camera surveys (1997-present) in the Region 5 Status and Trend Monitoring Program and the systematic surveys coordinated by Bill Zielinski from 1996-2002, the following observations can be made about the population (Rick Truex, USFS, pers. comm. 2006):

- Fisher currently appears to be limited in distribution from approximately the southern extent of the Sierra Nevada in Kern County (Greenhorn Mountains and Kern Plateau) to Yosemite National Park.

- Fishers appear to be absent from the Stanislaus NF, and the northern extent of the population in Yosemite National Park is not well defined. It appears fishers do not occur north of State Highway 120 in Yosemite NP.
- Within the southern Sierra population, fishers occur on the west slope of Sierra and Sequoia NF as well as on the Kern Plateau portion of Sequoia NF (and southernmost Inyo NF).
- Patterns of detection within the southern Sierra Nevada fisher population suggest the following:
    - Fisher are well distributed on the west-slope Sequoia NF, from the Kings River south through the Greenhorn Mountains. Annual rates of occupancy (i.e., proportion of sites sampled that detected fisher) are generally consistent, and the spatial distribution of detections is more consistent from year to year than elsewhere in the southern Sierra. This area has been consistently occupied since surveys began in earnest during the early 1990s.
    - Recently the detection rate of fisher on the Sierra NF is roughly half what it is on the Sequoia NF. Fisher may have increased their spatial distribution on Sierra NF since the mid-1990s. The annual occupancy rate within Sierra NF seems to be consistent, though the spatial pattern of detections appears more variable among years than on the Sequoia NF. Mark-recapture data collected over the last several years estimate the density of fisher in the KRP area at approximately 1 per 2,500 acres (Mark Jordan, University of California, pers. comm. 2006).
    - Fisher still occur on the Kern Plateau following the McNally fire of 2002. The long-term effects of the McNally fire on the fisher population are unknown. Surveys conducted by Region 5 and Sequoia NF suggest fishers are absent or reduced in distribution in the southern portion of the Kern Plateau, but have been detected on northern portion of the plateau at several locations. Occasional detections in the southern half of the plateau have been observed.

A picture of how the habitat requirements are provided for in the design of the initial eight management units can be drawn from the following table:

Habitat requirements provided for in the design of the initial eight management units.

Habitat/Life History Element	Applicable KRP Expectation
Multi-storied and multi-species coniferous forest are preferred by fisher	Uneven-aged silvicultural system provides multi-storied stands and seeks to restore historic multi-species tree composition.
Natal dens of fisher are in live and dead white fir and live black oak with average dbh of 22”. Resting habitat can be favored by retention of large trees and recruitment of these trees	Uneven-aged silvicultural system retains trees > 30” or 35” dbh, depending on the alternative. The purpose and need recognizes the need to increase the number of large trees.
The average female fisher home range is 2944 acres.	Management units are designed to be one-third the size of a female fisher home range. Treatments of the units are dispersed in time and space to limit effects to any given home range.
Fisher prefer to spend most of their time within 100 feet of water courses.	OFLs are focused on perennial stream courses.
Fisher prefer conifer cover > 20 %	All forested areas, except reforestation groups, will have conifer cover > 20 %

Evaluative Criteria

Informed by the discussion in this section, key criteria have been identified that will be used to clearly display and quantify the effects to the fisher and its habitat. Following is a summary of effects for these analysis criteria:

- **Canopy cover across the landscape**
  - Under Alternative 1, the long term goal is to develop or maintain 50% of the landscape (excluding rock and thin soils) in CWHR class 4 or higher with 50% canopy cover or greater. Even though there is a decrease in canopy cover from implementation of Alternative 1, the fisher goal is achieved in 10 years after treatment.
  - Under Alternative 3, the long term goal is to develop or maintain 50% of the landscape outside of WUI with canopy density >60% within female fisher home ranges, or where these ranges are unknown, within HUC 6 watersheds. Of the three HUC 6 watersheds used in the analysis, two remain unchanged and within one, (the Lower Dinkey Creek Watershed) the number of acres meeting the goal are reduced by 1%.

- **Protection of potential den sites and denning fishers**
  - An LOP will be implemented if den sites or denning fisher are found under either action alternative. Under Alternative 3, prescribed burning will be implemented outside the denning season, where practicable.
  - Natal dens of fisher are in live and dead white fir and live black oak with average dbh of 22”. Resting habitat can be favored by retention of large trees and recruitment of these trees. The uneven-aged silvicultural

strategy retains trees > 30" or 35" dbh, depending on the alternative. The purpose and need recognizes the need to increase the number of large trees.

- **Protection of stand-level habitat components and individual rest structures important to fisher (e.g., large diameter snags and oaks, patches of dense large trees, and coarse woody debris)**
  - Protect important habitat structures such as large diameter snags and oaks, patches of dense large trees (typically ¼ to 2 acres), large trees with cavities for nesting, and coarse woody material; use firing patterns and place fire lines around snags and large logs to minimize effects of underburning. The "Fisher and Priority Sites Marking Guide – Kings River Project" will be used to identify the most suitable individual trees and groups of trees for retention under Alternative 3.
  - Multi-storied and multi-species coniferous forest are preferred by fisher. The uneven-aged silvicultural strategy provides multi-storied stands and seeks to restore historic multi-species tree composition.

- **Establishment of a system of travel corridors or "old forest linkages" (OFLs)**
  - A system of old forest linkages have been created along perennial steams and include 300' of adjacent habitat with 60% canopy cover on each side of the streams.
  - Fisher prefer to spend most of their time within 100 feet of water courses. OFLs are focused on perennial stream courses.

- **Adaptive management and response mechanisms**
  - The response of fishers to changes resulting from treatments would be studied through densification and modification of the existing Region's Status and Change monitoring program to provide information on habitat use before and after treatment and in control areas

- **Resting site probability model (the probability of an area to be used by fisher over time)**
  - An analysis has been conducted to determine the probability of fisher using the area overtime and it shows they do return to the area when activities have occurred.

- **Effects of stand-replacement fire**
  - By implementing Alt 1 it will reduce the effects of stand-replacement fire with some large trees. If Alt 3 is implemented it will be the same outcome with a few larger trees not removed in treatment.
  - Stand replacing fire is a constant threat to fishers and their habitat. Model results indicate that following a fire that encompasses all eight management units, the number of suitable acres present will be 2862 for the No Action Alternative, 7160 for Alternative 1, and 7291 for Alternative 3. Suitable habitat is also predicted to develop more quickly post-fire under Alternatives 1 and 3.

Direct and Indirect Effects for Fisher – All Alternatives

The availability of suitable resting/denning habitat is considered to be more limiting to fisher populations than the availability of foraging habitats (USDA Forest Service 2006). We used data presented by Freel (1992) to help inform the definitions of resting/denning versus foraging habitat (Table 3-31). Also, we validated these habitat definitions by comparing them to CWHR Version 8.1 (California Department of Fish and Game 2005) and discussing them with fisher research scientists (Dr. W. J. Zielinski, Dr. K. Purcell, and R. Truex, pers. comm., 21 Sept 2006). This discussion resulted in the identification of an alternative method for describing fisher reproductive habitat.

In general, we found Freel's (1992) definition for resting and denning habitat matched the CWHR's definition of reproductive habitat. However, we noted that CWHR's definition of foraging habitat included several "S" and "P" densities that were not used by Freel. Interestingly, the discussions with research scientists, particularly Dr. Zielinski, indicated recent field work shows fisher are using most CWHR types for foraging. Nonetheless, we retained the somewhat more restrictive Freel model for the sake of consistency of approach and did not include the S and P densities as foraging habitat. We do not believe this appreciably changes the habitat picture, since foraging habitat is clearly not limiting to fisher. The fisher scientists believe that reproductive habitat is limiting to fisher.

CWHR version 8.1 was used as a basis to define what we consider to be a minimum habitat map, based solely upon forest types, ages, and canopy densities listed therein as HIGH quality reproductive habitat. We further restricted the forest types considered to provide reproductive habitat from those listed in CWHR, based upon personal communication with Dr. Bill Zielinski (21 Sept 2006). This resulted in the elimination of the following types: aspen, eastside pine, lodgepole pine, red fir, and subalpine conifer. This generated a more restrictive map of high quality reproductive habitat.

For purposes of this analysis and to ensure the full scope of effects is adequately portrayed, we present hereinafter fisher suitable habitat totals based on definitions (Table 3-31) provided by:

- Freel (1992); and
- CWHR Version 8.1 (California Department of Fish and Game 2005), as informed by the latest findings by fisher research scientists (hereafter **CWHR 8.1 Modified**)

Fisher Habitat Use Category	*Habitat Definitions for the Habitat Classification Systems Used in the Analysis*	
	Freel (1992)	**CHWR Version 8.1 + Current Research (CWHR 8.1 Modified)**
Denning/Resting	Jeffrey Pine, Lodgepole Pine, Montane Hardwood Conifer, Montane Hardwood, Montane Riparian, Ponderosa Pine, Sierran Mixed Conifer, Red Fir and White Fir 4M, 4D, 5D, 5M	Jeffrey Pine 4D, 5D Montane Hardwood Conifer 4D, 5D, 6 Montane Riparian 4D, 5D, 6 Ponderosa Pine 4D, 5D Sierran Mixed Conifer 4D, 5D, 6 White Fir 4D, 5D, 6
Foraging	3M, 3D, 4M, 4D, 5M, 5D	N/A – definitions not included due to the generalist use of habitats by foraging fishers

Table 3-31. Fisher habitat use category definitions for denning/resting and foraging habitats.

Using Freel, the eight units currently have 9050 acres of suitable habitat. Extrapolating from Jordan (2006), this area of suitable habitat could support approximately four fishers. However, because the management units are dispersed across the 131,500-acre KRP planning area, it is likely that these eight management units include portions of the home ranges of a larger number of fishers.

Of the three habitat elements (individual rest structures, stand-level habitat characteristics and landscape-level habitat composition) highlighted by Mazzoni (2002), the proposed action focuses on two, the need to increase the number of large trees and the adaptation in the KRP of the uneven-age silvicultural system to create and/or maintain multi-storied and multi-species stands. In addition, a major focus is to reduce the threat of severe wildfire. These improvements or benefits to fisher habitat come at the expense of a reduction in canopy cover in the initial eight management units but it is almost entirely in 11 to 24 inch trees (CWHR Class 4). This reduction is ameliorated by the creation of old forest linkages, as described in the proposed action, that are focused on perennial streams where fisher prefer to spend most of their time and by the canopy cover available at the landscape level.

The protection measures (see summary in F&WS technical advice - Appendix D, page 4) proposed for the fisher will provide some protection from harm and promote the recovery and development of suitable fisher habitat. Measure #1 states that the long-term project goal is to maintain >50% of the landscape in CWHR type 4 or greater with at least 50% canopy cover, or to maintain 50% of lands outside of WUI with canopy density >60%. This goal should ensure the maintenance and recovery of fisher foraging and dispersal habitat, however, because rest and den sites in the Sierra Nevada average >70% to > 90% canopy cover its effect on these uses cannot be evaluated. Measure #2 will reduce the likelihood that denning fishers will be harassed or harmed by prescribed burning. Measure #3 establishes a commitment to protect resting and denning-type structures and associated density in areas outside of WUI. Measure #4 protects large trees of the size typically used for resting and denning throughout the project area, but does not address the requirement for canopy density. Measure #5 refers to the system of OFL that will be maintained along streams to enhance habitat connectivity. Finally, measure #6 requires monitoring fishers in treatment and control units.

Fishers may be directly harmed by the removal of potential rest or den trees. The risk to fisher depends on the proportion of resting-size trees that will be harvested within any individual fisher's home range. The risk to fishers is mainly from harvesting conifers 12-34 in dbh. The probability of directly harming or killing a fisher during harvest is low. This is due to the number of resting size class trees remaining, low fisher densities in the area, and because fisher home ranges are generally larger than management units.

Alternative 1 and Alternative 3 limit removals to 35 inches and 30 inches respectively, with the exception of hazard trees. Over the last five years approximately 4400 hazard trees were removed across the 130,000 acres of the KRP area. This would indicate that one hazard tree for every 29 acres of the project area may exist. This would equal approximately 500 trees across the initial eight management units. Hazard tree removal may eliminate some potential fisher rest sites. Uneven-aged tree removals and thinning from below in Alternative 1 would remove approximately 12% of trees 30" to 35" dbh. Both action alternatives would remove an additional 12% of trees 20" to 30" and approximately 20% of trees 10" to 20" dbh. While these removals reduce the number of potential rest trees, the majority of potential rest trees will remain. This in combination with other protection measures will limit the effects on fisher.

Smoke and fire from prescribed burns on 4685 acres could also harm, harass, or kill fishers in the area. Because prescribed fire should not consume resting-size class trees, and snags and large logs will be protected during prescribed burning through the use of firing patterns and placement of fire lines to minimize effects on these resources, the direct effects of prescribed burning on fishers is generally expected to be small. Also, by conducting burning outside the fisher denning period of mid-March to mid-May, to the extent practicable, the potential effects will be minimized.

The eight management units currently contain 2779 acres of CWHR 8.1 Modified types 4D and 5D, which will be reduced to 1834 acres (Alternative 1) or 1917 acres (Alternative 3) after treatment. Because the available research indicates that fishers preferentially select forested habitats with >70% canopy density and multi-storied canopies, the effect of reducing the area of CWHR type 4D and 5D forest by 34% or 31 %, depending on the alternative, while maintaining ¼ to 2 acre pockets of suitable high density habitat, cannot be predicted with certainty. In these eight management units 6830 acres are in WUI and DFPZ, and 557 of these acres (5%) will be changed to habitat types unsuitable for use by fishers (i.e., not 5D, 4D, 5M, 4M, or 3D).

Over the 30 years following the initial treatments, habitat will recover and the acres of CWHR 8.1 Modified type 4D and 5D habitats are predicted to increase. Whereas there are currently only 69 acres of CWHR type 5D habitat, 30 years after treatment 363 (Alternative 1) or 383 (Alternative 3) acres of 5D are predicted. Similarly, CWHR type 4D currently totals 2710 acres, but 30 years after treatment 3686 (Alternative 1) or 3684 (Alternative 3) acres of 4D are projected. However, the models predict that CWHR type 4D acreage will be at or below current levels for more than 20 years after treatment.

Many of the activities proposed for the KRP have the potential to harass or harm fishers, causing animals occupying treated areas to move away from the project areas and avoid them for an undeterminable period of time, or at a minimum altering their normal patterns of movement and foraging. Mechanical treatment of 9751 acres within the eight units will substantially modify the vegetation and disturb the majority of habitat suitable for and likely occupied by fishers. Vegetation removal, noise and the physical presence of machinery and personnel for harvesting and fuels treatment operations are likely to harass fishers. Fishers may also leave areas of prescribed burning in response to smoke and fire. The ultimate effect on fishers of disturbance and potentially forced migration is unknown, but is unlikely to be wholly beneficial. Because management units are designed to be smaller than most fisher home ranges, it is conceivable that displaced individuals will shift their activities to portions of their home range outside of the disturbed areas; however, some may be displaced into unfamiliar territory. Fishers stimulated to migrate by project activities may have to move through or arrive in less suitable habitat where risk of mortality due to predation or physiological stress will likely be higher. Some fishers may remain in treated management units or return soon after treatment. These individuals are likely to be harmed by reduced habitat suitability and reduced availability of their small vertebrate prey base.

Disturbance may also increase the density of fishers in untreated areas. The temporal extent of these effects cannot be predicted with confidence, but model projections of habitat development suggest that effects will persist for between 10 and 20 years. Because the KRP area is bounded by the San Joaquin and Kings Rivers, which are thought to restrict dispersal, increased density in undisturbed habitat is expected. Assuming that during treatments fishers move from the eight units (9760 acres) to untreated suitable habitat in the KRP (38,400 acres), the density of fishers in these areas will be increased by approximately 41% overall. To acquire adequate resources, fishers may have to shift or expand their home ranges, encompassing larger areas of marginal quality habitat. Resource availability (e.g., prey) in adjacent untreated areas will likely decline due to the increased density of animals. Fishers expanding their home ranges into unfamiliar areas are likely to be more vulnerable to mortality from predators, physiological stress, or starvation. Because researchers have found dead fishers apparently killed by other fishers (Truex *and others* 1998), fishers displaced from treated areas into other fishers' home ranges also may be vulnerable to intraspecific predation. Although this temporary disturbance will affect most of the suitable fisher habitat to some degree, the area that will be converted to habitat unsuitable for fishers is estimated to be approximately 10% of what currently exists.

The table below shows the suitable acres immediately after thinning that are in the Old Forest Linkage (OFL) in and outside of the Protected Activity Center (PAC) and Defense and Threat Zones. It also shows the non OFL suitable acres that are in and outside of the PAC and Defense and Threat Zones. The final columns show how the habitat changes inside and outside the PACs but nothing changes in the OFL.

Table 3-32 - Summary of Plant Aggregation Level Analysis of Suitable Fisher Habitat Acres in the Initial Eight Mgt. Units immediately after Thinning using Freel (1992).

	OFL Suitable			NON OFL Suitable			Changed to NON-suitable habitat (4P or 5P)			
	PAC	NON PAC	OFL subtotal	PAC	NON PAC	Total Before Thinning	OFL	NON OFL inside and outside PACS	PAC	Total
WUI-Defense	32	189	221	617	1915	2753	0	296	5	296
WUI-Threat	54	366	420	791	2930	4141	0	243	-4	243
NON WUI	57	137	194	805	1980	2979	0	384	41	384
Sub Total	143	692	835	2213	6825	9873	0	924	46	924

Effects of Stand Replacing Fire: Each alternative incorporates the concept of wildfire entering one or a couple of the initial eight management units ten years after the record of decision. Fire records for the KRP indicate it is likely one or a couple of the management units could be significantly affected by a stand replacing fire on a hot windy summer day but it is unlikely numerous management units or an entire watershed would be affected at one time. The charts below assume that the wildfire would likely burn one or a couple of management units on a hot windy summer day. There would be a greater loss of habitat if no treatments occur because the trees are denser and there is a higher likelihood of habitat being burned severely. Stand replacing fire is a constant threat to fishers and their habitat. Model results indicate that following a fire that encompasses all eight management units, the number of suitable acres present will be 2862 for the No Action Alternative, 7160 for Alternative 1, and 7291 for Alternative 3. The best scenario among the alternatives is to implement the reduction of harvest tree size alternative because it reduces the effects of fire and after 30 years there would be approximately 9900 acres, if no wildfire occurs. Under this same alternative, approximately 8200 acres of suitable habitat would be available after 30 years, if wildfire occurs.

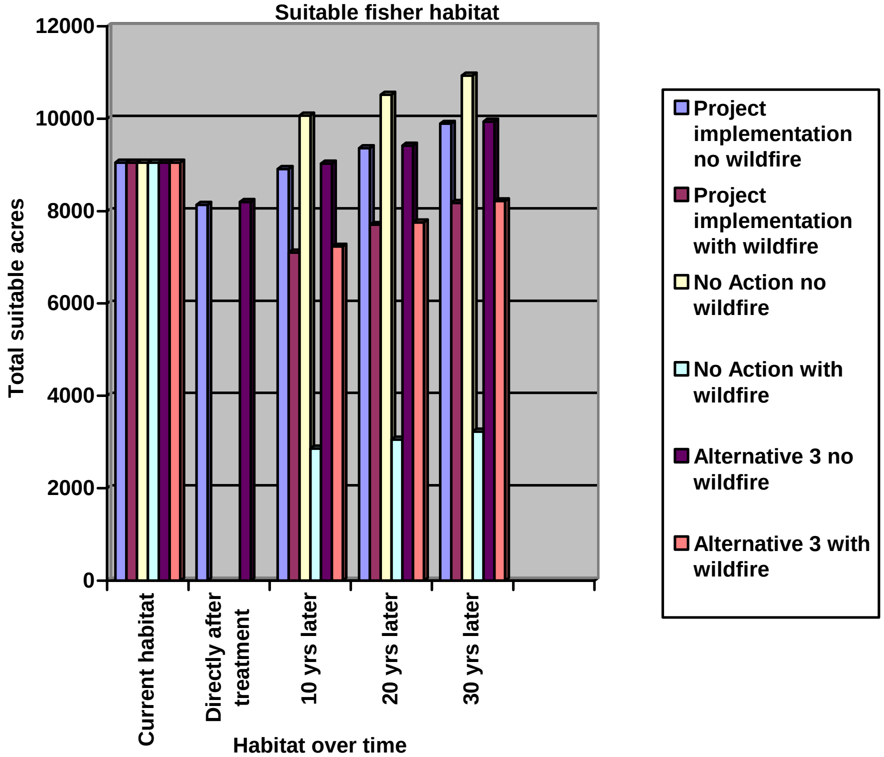


Figure 3-52 - Habitat effects of implementing the alternatives, with and without wildfire, using Freel.

The Forest Vegetation Simulator- Fire Fuels Extension was used to simulate potential fire intensity, tree mortality and fuel consumption. Figure 3-52 gives information detailing the potential impact of a simulated fire on forest structure and identifies which alternative responds best to fire.

If alternative 1 or 3 is implemented, it will move the fisher habitat closer to high suitable habitat and reduce habitat fragmentation due to wildfire. It is important to note under alternative 1 and 3 the mechanical treatment is important for the plantations because it helps move them toward foraging and eventually denning habitat over time. There may be a short term negative effect to the species; however, there will be a long term beneficial effect because the habitat elements are provided, as outlined in the preceding chart, and canopy cover will increase over time. If Alternative 1 or 3 is implemented and a wildfire occurs, then there will be a loss of habitat but it will not be as great as would occur with the No Action Alternative. Lower tree density and subsequent fuel treatments reduces the effects of wildfire. Both Alternatives 1 and 3 emphasize the retention of large trees which are more fire resistant.

The effects of fire (underburning) on fisher resting sites have shown a short term reduction on estimated fisher resting habitat suitability as described by Truex and Zielinski (2005). It appears that if care is taken to apply treatments with the goal of protecting large hardwoods and conifers the potential reduction in habitat quality may be mitigated. Therefore, under alternative 1 and 3 there may be a direct effect to fisher which utilizes the area. The smoke from burning may deter them for a short time but they most likely would return to the area. When trees are being removed with mechanical equipment (e.g. tractor, masticator) there may be a direct effect due to the noise disturbance involved with project activities. Underburning and vegetation manipulation have occurred in previous years where we have fisher detections. Moreover, district records show fisher being detected in areas that have previously received underburning or vegetation treatments. These detections support the idea that fisher would return to the project area once the proposed activities are completed.

Modeling Fire Effects on Fisher Habitat

As described in Appendix H, computer models were used to display the current condition, direct effects (post treatment), indirect (future) effects and cumulative effects (landscape and future) from the proposed action. A detailed description of modeling methods is contained Appendix H.

<u>Resting Site Probability Model:</u> Dr. Zielinski (PSW scientist) and Dr. Krucera (UC Berkeley scientist) were consulted by the KRP ID team to assist with the modeling of fisher rest site probability. Dr. Zielinski developed three equations (models) that predict probability of fisher rest site use (Zielinski and others 2004) for California. Two of these were used to model the change in fisher rest site probability (Sierra and Female models). Further consultation determined that the Fisher model (Zielinski and others 2004) was not appropriate for the KRP because it was intended for use at a larger bioregional scale (pers comm Zielinski and Krucera 2005).

Zielinski's Female and Sierra models were used to simulate changes to fisher rest habitat selection by various treatments contained in the alternatives (Appendix H). Parameters used in the two models follow:

1. Sierra model – largest dbh tree; standard deviation of the mean dbh; percent slope; presence of water within 100 meters
2. Female model – canopy density; dbh of largest tree; percent slope; presence of large conifer snag

Six scenarios were used to simulate the effects of alternatives using the two models above: 1) Proposed action/no wildfire; 2) No action/no wildfire; 3) Proposed action/wildfire; 4) No action/wildfire; 5) Reduction of harvest tree size/no wildfire and 6) Reduction of harvest tree size/wildfire.

More recent research on the use of forest inventory data to simulate the effects of forest management treatments on fisher resting habitat suitability in California has been published (Zielinski and others 2006). This newer research developed similar but more generic modeling algorithms to predict fisher rest site habitat use. The new models were developed to ease the use of Forest Inventory Analysis (FIA) data to predict and monitor rest site use. Additional consultation with Dr. Zielinski determined that to reanalyze fisher rest site use with the FIA model would not produce significantly different results (pers.comm email 2006).

<u>Model Output versus Actual Rest Site Data:</u> Known fisher rest site locations (Jordan and others (2005) and Mazzoni (2002)) were compared to predicted rest site locations. Jordan and others (2005) and Mazzoni (2002) trapped and or photographed fishers across the KRP area and the Sierra National Forest. This detection data was overlaid with the modeling results from Zielinski's rest site probability equations. The comparison

examined the plot locations with greater than ten percent probability to known rest sites. Where known rest site locations came with in 300 feet of plot data, the highest probability plots coincided with known sites.

The majority of the areas described by the model as non-suitable resting habitat did not have fishers located in the area. A correlation exists between the predicted model and where fisher data was collected with a confirmed animal, either by camera stations or photographs.

Research on fisher habitat rest site use emphasized the maintenance of canopy density, large trees, and habitat features near water. These forest attributes were used to create OFL (Appendix C). As discussed above, work by Jordan and others (2005) and Mazzoni (2002) was overlaid with the modeling rest site characteristics information; it was shown that the fishers were located in resting areas that the model predicted were resting sites. OFLs coincide with rest site use data collect by Jordan and others (2005) and Mazzoni (2002). In addition, it showed that 30% percent (245/796) of the resting areas in Jordan's work are in OFL while 51% (26/51) of the resting areas in Mazzoni's work are in OFL. This would infer that OFL design measure encompasses a large proportion of resting potential.

Results of the Resting Site Probability Modeling: The Sierra model shows a higher fisher rest site probability for Alternative 1 and Alternative 3 than Alternative 2 (No Action) after treatments. After wildfire, rest site use probability remains higher under Alternative 1 and Alternative 3. This would indicate that more fisher rest sites are protected in the treated landscape. The increase in probability for the action alternatives results from the increased diameter growth and maintaining variable stand structures. The structures under the no action alternative tend to become less variable over time as the density will kill suppressed and intermediates and diameter growth will be slower than in the action alternatives. The bottom line is there is minimal effect to the rest sites overall from Alternative 1 or Alternative 3 than Alternative 2 (No Action). See the terrestrial BE for the associated figures that show the summary above.

The Female model shows a loss of rest site probability after treatments. After severe fire, Alternative 1 and Alternative 3 maintain more fisher rest sites and have a higher probability for use than Alternative 2 (No Action). Within OFL, simulation results of the Female model indicate that all alternatives experience a similar high loss of fisher rest site habitat. Alternative 1 or Alternative 3 within the OFL maintains multi-storied canopies and high tree canopy density because minimal manipulation occurs in the drainages. Multi-storied stand conditions result in ladder fuels that often predispose fisher rest sites to torching and crown fire.

Provisions Made in the Design and Scheduling of Management Units for Fisher

As stated on page 41 of the Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement ROD, the Forest has been designated as part of the Southern Sierra fisher conservation area (SSFCA) because of the known occupied range of the Pacific fisher in the Sierra Nevada. The SSFCA is approximately 720,606 acres on the Forest. There are fisher sightings within some of the management units. Den sites exist but their locations are unknown. The following measures are designed to protect and maintain fisher habitat.

Old Forest Linkage (OFL): Within the KRP boundaries is an area where there is the largest concentration of private land within the boundaries of the Sierra National Forest. The Forest Service cannot rely on private land to be managed in a way that is favorable for the fisher and other species associated with old forests. Thus, the National Forest land base could prove important for the maintenance of habitat linkages for old forest species. The designation of the old forest linkage (OFL) within the KRP area was undertaken as described below.

Vegetation data, owl locations and stand boundaries were examined as the first step to identify the OFL areas within KRP. The objective was to identify areas that should be managed to maintain connectivity of old forest habitat areas within the KRP area as well as the rest of the Sierra NF to the north, east, and south. There are 4609 acres of OFL in the entire Kings River Project area. Of that there are 1085 acres of OFL within the initial eight management units. Some of the OFL follow roughly the same path as those identified in the LRMP. The majority of these OFL are within the Southern Sierra Conservation Area (SSFCA). The OFL outside the SSFCA are intended to maintain habitat connectivity for marten and spotted owls.

Several habitat linkages are needed to ensure habitat connectivity in the event that a linkage is lost to a stand replacing event, such as wildfire. Habitat on private land was not considered as a contribution to the OFL, for the reasons stated above. Therefore, OFL were only designated on Forest Service land around blocks of private land. Key habitats for fisher are structurally complex late successional coniferous forests. Habitat connections would be maintained by areas greater than forty percent crown canopy cover, interconnected via riparian areas (OFL). There are two major OFL extending north to south along Big Creek and Dinkey Creek. They are linked together from east to west at the northern and southern portions of the KRP area. There are a number of creeks that were designated OFL. The supporting rationale for designation of OFL is described in Appendix C. The creeks described are Big Creek and Dinkey Creek; Nutmeg Creek; Bear Meadow Creek, and Oak Flat Creek; Summit Creek and Grand Bluff Bald Mountain and Rock Creek; Cow Creek; Bear Creek and Deer Creek; East Deer Creek and House Meadow Creek; Bull Creek; Turtle Creek and Ross Creek (Appendix C).

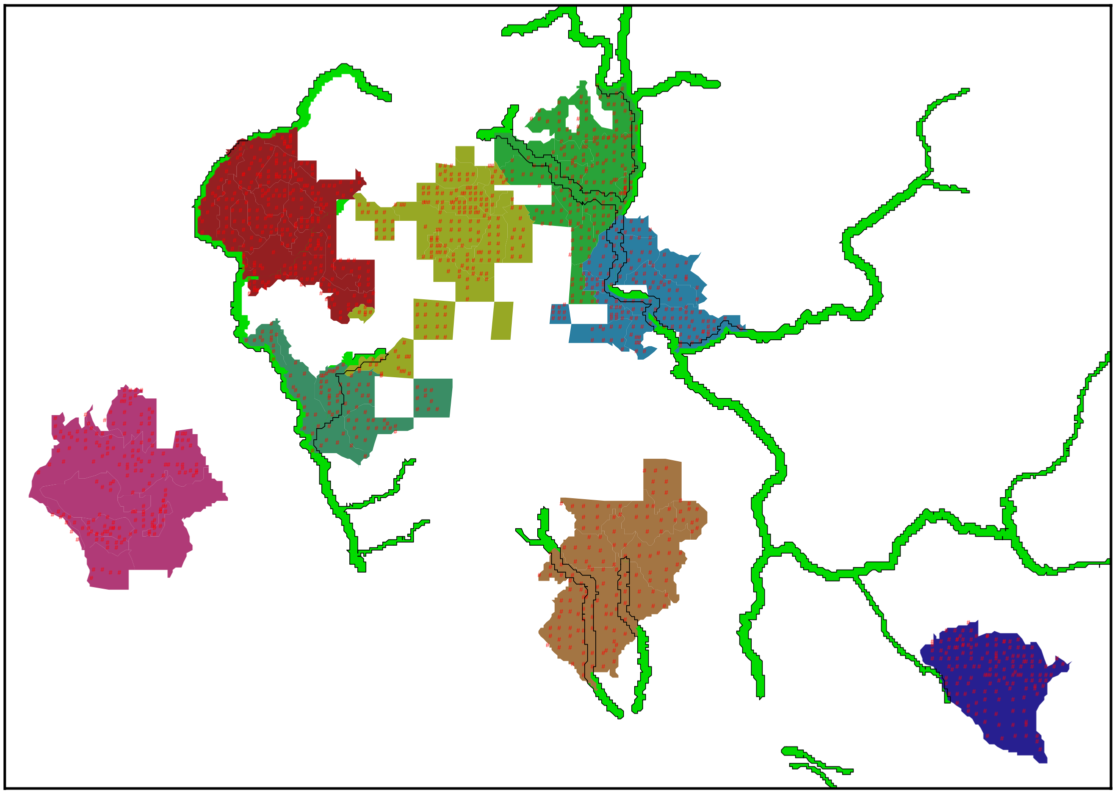


Figure 3-53 - The initial eight management units outlined with the fisher corridor buffers. Dots represent plot locations used in the fisher resting habitat suitability model.

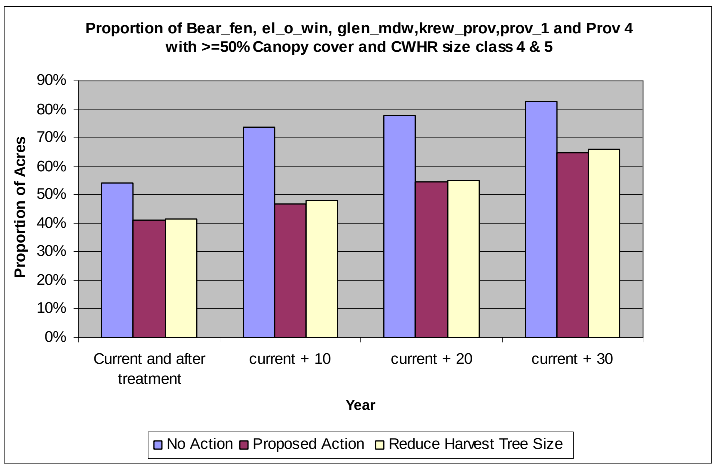
<u>Recruitment of Large Trees:</u> The purpose and need recognizes the need to increase the number of large trees. Alternative 1 limits tree removals to trees less than 35 inches. Alternative 3 limits tree removals to tree less than 30 inches. These design measures protect large, older trees that are found less frequently on the landscape. Treatments that remove fuel ladders (small trees) under the uneven-aged silvicultural strategy and the thinning from below are designed to protect large trees (> 35 inches) and the recruitment of medium sized trees (20-35 inches). Tree removals of medium sized trees provide additional growing space that allows these trees to grow larger faster. It is these medium sized trees that provide the necessary recruitment of future large trees (see Vegetation Section).

<u>Fisher Rest Site Retention Guide:</u> A fisher rest site retention guide protects key fisher habitat attributes (large trees, dense canopy, proximity to water, and percent slope). As the marking crew delineates the trees to be removed they will also assess the trees to see if they meet the criteria for fisher rest sites. If they do meet the criteria the associated area and tree will not be marked for removal. Each stand will have rest sites identified on the stand record card and GPS location recorded for future reference. This guide can be found in Appendix D. The guide was designed with the fuels officer, silviculturalist and wildlife biologist.

Indirect Effects from Change in Canopy Cover on Fisher Habitat

Both thinning from below up to a maximum diameter of 20 inches in the California Spotted Owl Study (CSOS) and up to a maximum diameter of 30 or 35 inches, depending on the alternative, in the KRP uneven-aged management strategy are proposed to increase growing space and reduce fuel ladders. Reductions in canopy cover result from this process of removing trees. Following thinning, canopy cover declines then recovers over the next thirty years due to growth.

The most appropriated representation of the effect on the fisher goals of the action alternatives is to ignore krew_bull_1, a high elevation habitat, and n_soapro_2, low elevation habitat. Although higher elevation habitats (i.e., red fir forests) may provide ample structures for denning and resting, deep snow during the winter months likely impedes fisher mobility (Krohn and others 1995); as a result, these forests are of less value to fisher than mid-elevation habitats where snow cover is sporadic and rarely deep for extended periods. Lower elevation habitats in the southern Sierra Nevada (chaparral and woodlands) lack resting and denning structures, and may not provide thermal regulation during hot summer months (Lamberson 2000).



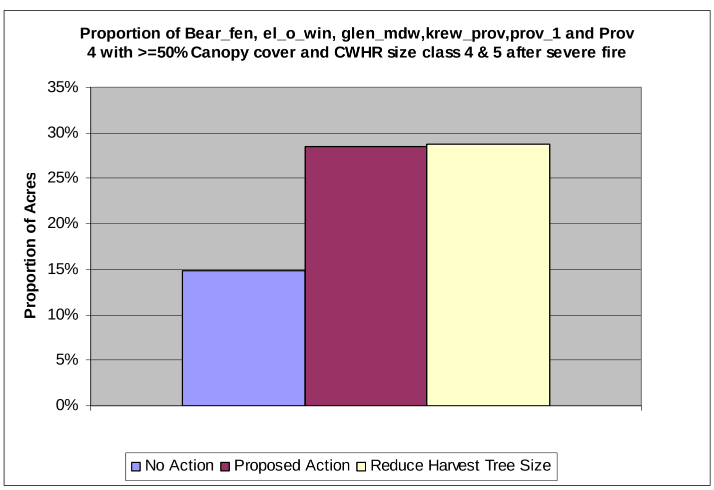


Figure 3-54a - Displays the proportion of the six initial management units that most appropriately represent the effect on the fisher goals of the action alternatives, throughout the analysis period. Figure 3-54b - Displays the effect of severe fire on canopy cover.

Figure 3-54a displays that across the six initial management units that most appropriately represent the effect on the fisher goal of the action alternatives, the proportion of 50 percent or more canopy cover and CWHR size class 4 and 5 drops due to treatments to just over 40 percent then increases to approximately 52 percent. This increase in acres of canopy cover is the result of tree crowns expanding to occupy growing space. The canopy cover must drop somewhat to accomplish the needs of increasing the number of large trees and reducing effects from wildfire and insect attack.

Even with the initial decrease in acreage from 43% to 40% that meets the fisher goal in canopy cover from the action alternatives, the fisher goal for the proposed action is achieved across the 72,000 acres of forested KRP landscape within 10 years. Since the initial eight management units are dispersed across the KRP area, the indirect effects of the initial eight management units are dispersed across the landscape.

The desired condition outlined by the 2004 SNFPA is to maintain high quality fisher habitat in known female fisher home ranges outside the WUI with tree canopy cover greater than 60% over 50% of a female home range. If female fisher home ranges are not known, HUC 6 watersheds are to be used in the analysis. Because female fisher home ranges are largely unknown for the analysis area, HUC 6 watersheds were analyzed. The management intent is to retain suitable habitat to the extent possible, recognizing that treated areas may be modified to meet fuels objectives (2004 SNFPA). The analysis displayed in Figure 3-22 (Vegetation Section of Chapter 3) indicates that for the HUC 6 watersheds, canopy cover greater than 60% is reduced in the lower Dinkey Creek watershed by approximately 1%. Within the Big Creek watershed reductions also occur but this watershed area is below the elevational range of the fisher (3500 feet) and contains the n_soapro_2 management unit. Reductions in canopy cover occur as a result of mechanical treatments in both action alternatives. These same treatments increase the resistance of home ranges to wildfire. Alternatives 1 and 3 maintain similar amounts of the dense tree canopy acres.

Summary of Direct and Indirect Effects:

Fishers have been studied and monitored within the KRP since the mid-1990's (Boroski and others 2002; Mazzoni 2002; Zielinski and others 1997, 2005; Rick Truex, USFS, pers. comm. 2006; Mark Jordan, University of California, pers. comm.2006). These studies were used to assess population stability, mortality, and effects of the uneven-aged management strategy.

<u>Population is stable:</u> Using camera traps, the density of fishers in the study area was estimated to be 13 fishers per 100 km^2 in 2002 (unpubl. data) and 10 fishers per 100 km^2 in 2003 and 2004 (Jordan *et al.* 2005). Jordan's study area was larger than the two watersheds described for the KRP. The abundance estimates for this time period were 47, 42, and 44 individuals from 2002 through 2004 respectively.

Based on this monitoring, it appears that fisher in the Sierra NF are well distributed but occur at lower densities than are observed farther south. (F&WS technical advice – Appendix D) Fisher detections were recorded at 20.3% and 17.3% of Sierra NF monitoring stations in 2002/2003 and 2004/2005, respectively (Rick Truex, USFS, pers. comm. 2006).

Recently the detection rate of fisher on the Sierra NF is roughly half what it is on the Sequoia NF. Fisher may have increased their spatial distribution on Sierra NF since the mid-1990s. The annual occupancy rate within Sierra NF seems to be consistent, though the spatial pattern of detections appears more variable among years than on the Sequoia NF. Rick Truex, USFS, pers. comm.. 2006).

An estimated 28-36 individual fisher inhabits the KRP. It is thought the numbers are stable (Purcell 2006).

<u>Mortality - Two individuals known to have died:</u> We do not have data saying we have sink or source habitat because it takes reproductive and survival data to make these statements and we do not have that type of data at this time. We do not have estimates of survival until Mark Jordan completes the work. However, presently there is no indication mortality rates are abnormal because in the last decade only two fishers are known to have been killed. One was killed due to another fisher and the other one was recently hit by a Forest visitor's car.

<u>Fecundity – Reproduction is occurring:</u> From August 1999 through July 2000, a total of 17 different fishers (9 males, 8 females) were captured at 20 different sites. All of the captured fishers *"appeared to be healthy, to represent a variety of age classes, and to be reproductively active once mature"* and *"seven of the eight known females within the Project area produced kits in the spring of 2000"* (Boroski and Mazzoni 2000).

<u>Uneven-age mgt. Strategy - Maintains and accentuates important fisher attributes:</u> Truex and Zielinski (2005) anticipate the reduction of canopy closure associated with most vegetation management projects. They suggest that managers can plan actions that will maintain other habitat elements important to fisher (e.g. presence of large diameter hardwoods). Zielinski and others (2004) determined that trees larger than 40 inches are important for fisher rest sites. Mazonni (2002) indicates that mean female fisher rest site trees for are 39 inches dbh in the KRP. However, smaller rest site trees were found to be used in these studies. Alternative 1 and Alternative 3 protect trees larger than 30 and 35 inches, respectively. No hardwoods are planned for removal. Additionally, the Fisher Rest Site Retention Guide (Appendix D) will be used to identify the most suitable trees and groups of trees for retention.

Truex and Zielinski (2005) recommend, if conditions permit, early season burns appear to be preferable to late season burns in terms of the short-term impacts on fisher habitat. Whenever possible, early burns should be timed to proceed or follow the fisher denning period (mid-March through mid-May) to minimize the likelihood of disturbing denning female fishers. If conditions necessitate burning earlier than mid-May, efforts should be made to avoid treating areas that have high density of structures likely to be used by females for denning as stated in Zielinski *et al.* 2004. Alternative 3 incorporates both recommendations. This reduces the direct effect on denning habitat.

Truex and Zielinski (2005) recommend, whenever possible, managers should plan vegetation management activities in a manner that disperses treatments over space and time to minimize impact on individual fishers. Both action alternatives disperse treatments in space and time, but emphasize treatment in WUI.

Truex and Zielinski (2005) recommend, lastly managers must be willing to commit to long-term monitoring efforts to better understand the impacts of vegetation management activities on fisher and other wildlife. Monitoring should include both a habitat component such as the approach described in the paper as well as a population monitoring component. Monitoring research will be conducted by PSW.

Zielinski *et al.* (2004b) present a model which estimates the relative likelihood that a fisher will select a given site. They caution that "the objective of recruiting and retaining large trees should not overshadow, however, the goal of encouraging structural diversity; standard deviation of dbh was included in the Sierra model. This observation suggests that developing stands that include variation in the sizes of trees may be beneficial. We agree with Weir and Harestad (2003) that the maintenance of large structural elements at small scales may mitigate for the negative effects of large-scale alterations of habitat. However, we cannot at this time recommend standards for the optimal distribution of resting-structure types across a landscape." The uneven-aged silvicultural strategy creates more diverse structures through the maintenance of trees in many size classes and retention of large trees.

An objective was to identify areas that should be managed to maintain connectivity of old forest habitat areas within the KRP area as well as the rest of the Sierra NF to the north, east, and south. There are 4609 acres of OFL in the entire Kings River Project area. Of that there are 1085 acres of OFL within the initial eight management units.

<u>Fire - Treated stands maintain more habitat:</u> Stand replacing fire is a constant threat to fishers and their habitat. Model results indicate that following a fire, the number of suitable acres present within all eight management units will be 2862 for the No Action Alternative, 7160 for Alternative 1, and 7291 for Alternative 3. Suitable habitat is also predicted to develop more quickly post-fire under Alternatives 1 and 3.

Cumulative Effects for Fisher

The area considered in determining the cumulative effects of past, present, and reasonably foreseeable activities on fisher encompasses the Kings River Project Area, the Sierra NF, and the Southern Sierra Fisher Conservation Area (SSFCA), which is approximately 1,018,000 acres in size. This conservation area is defined by an elevational band from 3,500 to 8,000 feet on the Sierra and Sequoia National Forests and includes the known occupied range of the fisher in the Sierra Nevada (USDA 2001d:A-45). This is an appropriate scale for cumulative effects analysis because the SSFCA is an integral component of the conservation strategy described in the 2001 SNFPA ROD (USDA Forest Service 2001d:43). Maintaining the capability for movement and dispersal of fisher between southern Sierra Nevada populations and populations found in northern California is one of the key objectives of the SSFCA and is another reason why the SSFCA represents an appropriate scale for the analysis of cumulative effects.

Our discussion of cumulative effects will address the following seven topics:

1. Availability of suitable resting/denning habitat versus foraging habitat
2. A description of recent past, present, and reasonably foreseeable future activities
3. Disclosure of monitoring data for fisher at the scale of the Forest and the SSFCA
4. A review of the fire history dating back to 1916
5. A review of how past activities since about the mid-1960s have affected the landscape
6. An analysis of how timber harvest since 1978 has affected fisher habitat
7. A summary of detection and disturbance data for fisher

Availability of suitable resting/denning habitat versus foraging habitat: Within the SSFCA, we examined the availability of suitable resting/denning habitat versus foraging habitat. The availability of suitable resting/denning habitat is considered to be more limiting to fisher populations than the availability of foraging habitats (USDA Forest Service 2006). We used data presented by Freel (1992) to help inform the definitions of resting/denning versus foraging habitat (Table 3-31). Also, we validated these habitat definitions by comparing them to CWHR Version 8.1 (California Department of Fish and Game 2005) and discussing them with fisher research scientists (Dr. W. J. Zielinski, Dr. K. Purcell, and R. Truex, pers. comm., 21 Sept 2006). This discussion resulted in the identification of an alternative method for describing fisher reproductive habitat.

In general, we found Freel's (1992) definition for resting and denning habitat matched the CWHR's definition of reproductive habitat. However, we noted that CWHR's definition of foraging habitat included several "S" and "P" densities that were not used by Freel. Interestingly, the discussions with research scientists, particularly Dr. Zielinski, indicated recent field work shows fisher are using most CWHR types for foraging. Nonetheless, we retained the somewhat more restrictive Freel model for the sake of consistency of approach and did not include the S and P densities as foraging habitat. We do not believe this appreciably changes the habitat picture, since foraging habitat is clearly not limiting to fisher. The fisher scientists believe that reproductive habitat is limiting to fisher.

CWHR version 8.1 was used as a basis to define what we consider to be a minimum habitat map, based solely upon forest types, ages, and canopy densities listed therein as HIGH quality reproductive habitat. We further restricted the forest types considered to provide reproductive habitat from those listed in CWHR, based upon personal communication with Dr. Bill Zielinski (21 Sept 2006). This resulted in the elimination of the following types: aspen, eastside pine, lodgepole pine, red fir, and subalpine conifer. This generated a more restrictive map of high quality reproductive habitat.

Applying the Freel (1992) definition from Table 3-31 to the various scales of analyses, we find that the current amount of resting/denning habitat in the Kings River Project area for the initial eight management units is 2.0% and 1.1% of the total available throughout the Sierra National Forest and the SSFCA, respectively (Table CE2). Furthermore, under the Proposed Action and Reduce Harvest Tree Size Alternatives, the proportion of suitable habitat composed of resting/denning habitat changes from 92% currently to 96% in 10 years and 98% in 20 years, assuming no fire occurs (Tables CE2 and CE3). Although resting/denning habitat would decline by 9-10% following treatment, the habitat is expected to recover in 10 years under the Reduce Harvest Tree Size Alternative and in less than 20 years for the Proposed Action. In the event of a wildfire, the differences within the Kings River Project area between the No Action alternative and the treatments under the Proposed Action and the Reduce Harvest Tree Size Alternative are dramatic. Corresponding data are presented in Table CE2 for the two definitions of describing fisher habitat. Data are not currently available to project habitat acres over time for scales larger than the Kings River Project Area.

Table CE2. Acres of suitable fisher resting/denning habitat within the Kings River Project area, the Sierra and Sequoia National Forests, and the Southern Sierra Fisher Conservation Area (SSFCA). In all instances, a range of numbers is provided, with the lower value representing the number calculated using the CWHR 8.1 Modified habitat definition and the larger value representing the number calculated using Freel (1992).

Fisher		**Acres of Suitable Fisher Resting/Denning Habitat Definition: See Table 3-31**					
Scale	**Alternative**	**Pre-Project**	**Post-Project**	**Year 10**		**Year 20**	
				Without Fire	**With Fire**	**Without Fire**	**With Fire**
Kings River Project	Proposed Action	2779 to 9050	1834 to 8135	2178 to 9007	1341 to 7222	2783 to 9490	1684 to 7796
	No Action	2779 to 9050	2779 to 9050	3770 to 10,294	1078 to 2873	5165 to 10,726	1399 to 3056
	Reduce Harvest Tree Size	2779 to 9050	1917 to 8202	2216 to 9123	1358 to 7353	2796 to 9547	1711 to 7849
Sierra National Forest	**N/A**	321,000 to 449,000					
Sequoia National Forest	**N/A**	164,700 to 334,700					
SSFCA	**N/A**	485,700 to 783,700					

Table CE3. Acres of suitable fisher foraging habitat within the Kings River Project area, the Sierra and Sequoia National Forests, and the Southern Sierra Fisher Conservation Area (SSFCA). Only acres that do not qualify as resting/denning are shown.

Fisher		Acres of Suitable Fisher Foraging Habitat Definition: See Table 3-31					
				Year 10		Year 20	
Scale	**Alternative**	**Pre-Project**	**Post-Project**	**Without Fire**	**With Fire**	**Without Fire**	**With Fire**
Kings River Project	Proposed Action	823	814	331	57	204	79
	No Action	823	823	494	5	513	7
	Reduce Harvest Tree Size	823	796	328	57	204	79
Sierra National Forest	**N/A**	31,911					
Sequoia National Forest	**N/A**	29,194					
SSFCA	**N/A**	61,105					

Past, Present, and Reasonably Foreseeable Activities

Past, present, and reasonably foreseeable activities on the High Sierra District are described at the beginning of Chapter 3 of the FEIS. The scale for cumulative effects also includes the Sierra National Forest (which includes the Bass Lake District) and the entire SSFCA.

In addition to the site-specific analysis of the eight management units, this EIS also addresses the establishment of 10 KRP management units as no-treatment controls, and the treatment of one unit (South of Shaver) under an existing decision that would degrade 142 acres of suitable habitat (122 ac from 4M to 4P and 20 ac from 4D to 4M).

The ongoing federal management activities within the Kings River Project area (all of which have already had their NEPA completed) that extend in time through the treatment of the initial eight management units and overlap them involve:

- The High Sierra Ranger District prescribed burn program of work (Figure 2, Chapter 3 of the FEIS), which will have no effect on the fisher, as explained below;
- Other Sierra National Forest timber and culture projects (Figure 2, Chapter 3 of the FEIS). These activities include plantation maintenance projects that have been determined to have no effect on the fisher and roadside hazard tree removal that may remove some legacy structures (e.g., snags) preferred by fisher;
- Active cattle allotments (Figure 3, Chapter 3 of the FEIS) that will have no effect on the fisher; and

- Recreational activities and events (e.g. off-highway vehicle and off-snow vehicles) (Figure 4, Chapter 3, FEIS) that may cause some disturbance to any fisher that may be present at the time the activities take place.

The ongoing activities on private land (Figure 5, Chapter 3, FEIS) within the Kings River Project area involve:

- Two potential timber sales near the n_soapro_2 management unit that are in the early stages of planning, so effects are not yet known;
- A housing development north of the sos_1 management unit, involving about 80 acres of land development;
- The Southern California Edison (SCE) timber management area that will have no effect on the fisher; and
- The Pacific Gas & Electric (PG&E) transmission line corridor maintenance that will have no effect on the fisher.

On the Bass Lake District, there is one present project (Sunny Meadows South – 1,400 or more acres of commercial thinning that will not result in changes to suitable habitat) and two reasonably foreseeable projects (Sunny Meadows North with 955 acres of treatments and Cedar Valley with approximately 2,680 acres of commercial thinning) that could influence the cumulative effect on fisher habitat. While Sunny Meadows North will not result in any changes in suitable habitat, the Cedar Valley project may result in a reduction in quality of suitable habitat on about 816 acres, where suitable habitat may change from 4D to 4M. On the High Sierra District, there is one present project (Jose Basin 1 – 1,263 acres of commercial thinning) where habitat would be degraded on 60 acres and eight acres of foraging habitat would be lost.

Other projects on the Bass Lake District include:

- Cattle allotments, prescribed burn program on 1,800 acres since 1994, and plantation maintenance, all of which will have no effect on the fisher
- Various recreational activities and events and roadside hazard tree removal activities since 2003, both of which will cause some disturbance to fisher or remove legacy structures

Within the remaining portion of the SSFCA, additional past, present, or foreseeable projects also occurred on the Sequoia National Forest/Giant Sequoia National Monument. In total, the Biological Evaluations for 70 past projects on the Sierra and Sequoia National Forests dating back to 1992 were reviewed for information that could describe cumulative impacts to the fisher.

The Sequoia National Forest released a quarterly Schedule of Proposed Actions for the period from 1 July - 30 September 2006; this schedule includes recreation, vegetation, fuels, and special use management projects. Although some of the projects on this list are within or on the periphery of suitable fisher habitat, detailed effects analyses were not yet available at the time of this writing. Four additional timber sales on the Sequoia National Forest (Saddle Helicopter, Ice Helicopter, White River Helicopter, and Frog Thinning) have been proposed. During its review of the Saddle Fuels Reduction project, the Fish and Wildlife Service examined the cumulative effects encompassing a 434,000-acre analysis area and including the effects of the White River, Ice, and Saddle fuels reduction projects; approximately 3,150 acres were identified for treatments between these projects

(U.S. Dept of Interior 2005). In its review of the potential effects of the Saddle Fuels Reduction Project, the U.S. Dept of Interior (2005) noted that “[C]atastrophic wildfires in the southern Sierra Nevada have destroyed fisher habitat and may result in injury or death of fishers.” They also determined that the proposed project would not likely result in adverse effects to the fisher.

Subsequent to the USFWS’ review of the Saddle project, a lawsuit resulted in halting any future work on the Saddle, Ice, White River, and Frog Thinning projects. According to current direction (dated 6 Sept 2006) on the Sequoia Forest/Monument, all activities proposed under the Environmental Assessments for these four timber sales are permanently enjoined and other projects may proceed but only if consistent with the Land and Resource Management Plan as amended by the SNFPA 2001 ROD and the Mediated Settlement Agreement. Outside of the Monument, the LRMP guidelines as amended by the SNFPA 2004 ROD are to be followed.

Collectively, all of the above-mentioned projects have the potential to affect the fisher and its habitat. For example, three commercial thinning and/or fuels reduction projects took place in the KRP area (Reese, 10S18 and I-Rock) after the change in timber management emphasis to commercial thinning in 1992. Generally, they reduced basal area to about 60% of full stocking and canopy cover to about 40% in ponderosa pine stands and 50% in mixed conifer stands, so the pre-treatment condition of the stands most likely represented foraging habitat for fisher. Stream Management Zones along perennial streams (100 feet on both sides) were not thinned so the best and preferred resting and denning habitat was not changed.

Over the last ten years, a slight increase in the acreage of suitable fisher habitat (as defined by Freel 1992) has been noted on the Sierra National Forest, even after considering the effect of commercial thinning/fuel reduction projects (such as the three projects described above) and post-1978 plantation maintenance (as described later) on basal area, canopy cover, or other suitable habitat attributes. Because of the large fires on the Sequoia, the trend there is masked.

The High Sierra underburning program schedule of work, displayed in Table 3-13, has approximately 17,300 acres planned under current decisions. These underburns are proposed for maintenance of DFPZs, reducing surface fuel loads, and reintroducing fire into the landscape. Burns are typically low intensity burns conducted in the spring. Scorch heights are typically less than 15 feet. Surface flame lengths are typically less than two feet. Based on our experience with these parameters, these prescribed burns do not change the suitability of fisher habitat in the KRP area (e.g., because prescribed burns occur in the winter and/or spring, large down logs or snags that have moisture in them don’t burn under these conditions).

Biological Evaluations for many of the projects listed above were reviewed to help inform the present analysis. Our review of these documents revealed the following basic information about effects to fisher from these activities:

- Seventy (70) total project Biological Evaluations (BEs) were reviewed, dating back to 1992 on the Sierra and Sequoia National Forests

  - This total includes 47 BEs on the Sequoia National Forest and 23 BEs on the Sierra National Forest
- Determinations reached were:
  - No effect – 17 BEs, (14 on the Sequoia NF and three on the Sierra NF)
  - May affect individual fishers, but not likely to lead to a trend toward federal listing or loss of viability – 43 BEs (27 on the Sequoia and 16 on the Sierra)
  - May affect individual fishers, and likely to lead to a trend toward federal listing or loss of viability – 0 BEs
  - Fisher was not addressed due to lack of habitat and/or no determinations for fisher were made in the document we reviewed – ten BEs (six on the Sequoia NF and four on the Sierra NF)
- Types of Projects: Salvage, underburning or prescribed burn, hazard tree removal, fuels reduction projects, or thinning/sanitation treatments were the proposed activities that were most often represented in the sample
- Relative to "May Affect" projects, the described impacts to fisher most often fell into the following categories
  - Noise or other types of disturbance
  - Reduction of legacy structures (e.g., snags, canopy cover, or down woody debris) or "degradation" of denning habitat such that it is converted to foraging habitat
  - Quantified loss of suitable habitat, with amounts usually ranging from 0 to 60 acres per project. The White River Analysis Area BE described a greater quantity of habitat loss (i.e., 250 – 320 acres), but that project is now permanently enjoined, as explained above

The most informative part of this exercise is that although more than 60% of the activities proposed by the Forest Service within the SSFCA planning area since 1992 had been determined to have some effect on the fisher, nearly all of the described effects were small in scale compared to the 1,018,000 acres within the SSFCA (e.g., a typical planning area for one of these projects might approach 5,000 acres – which is less than 0.5% of the size of the SSFCA). While these project activities may have the potential to influence long-term trends in vegetation change across a landscape, an argument can be made that other factors play a much larger role in the causes of past and foreseeable landscape vegetation changes.

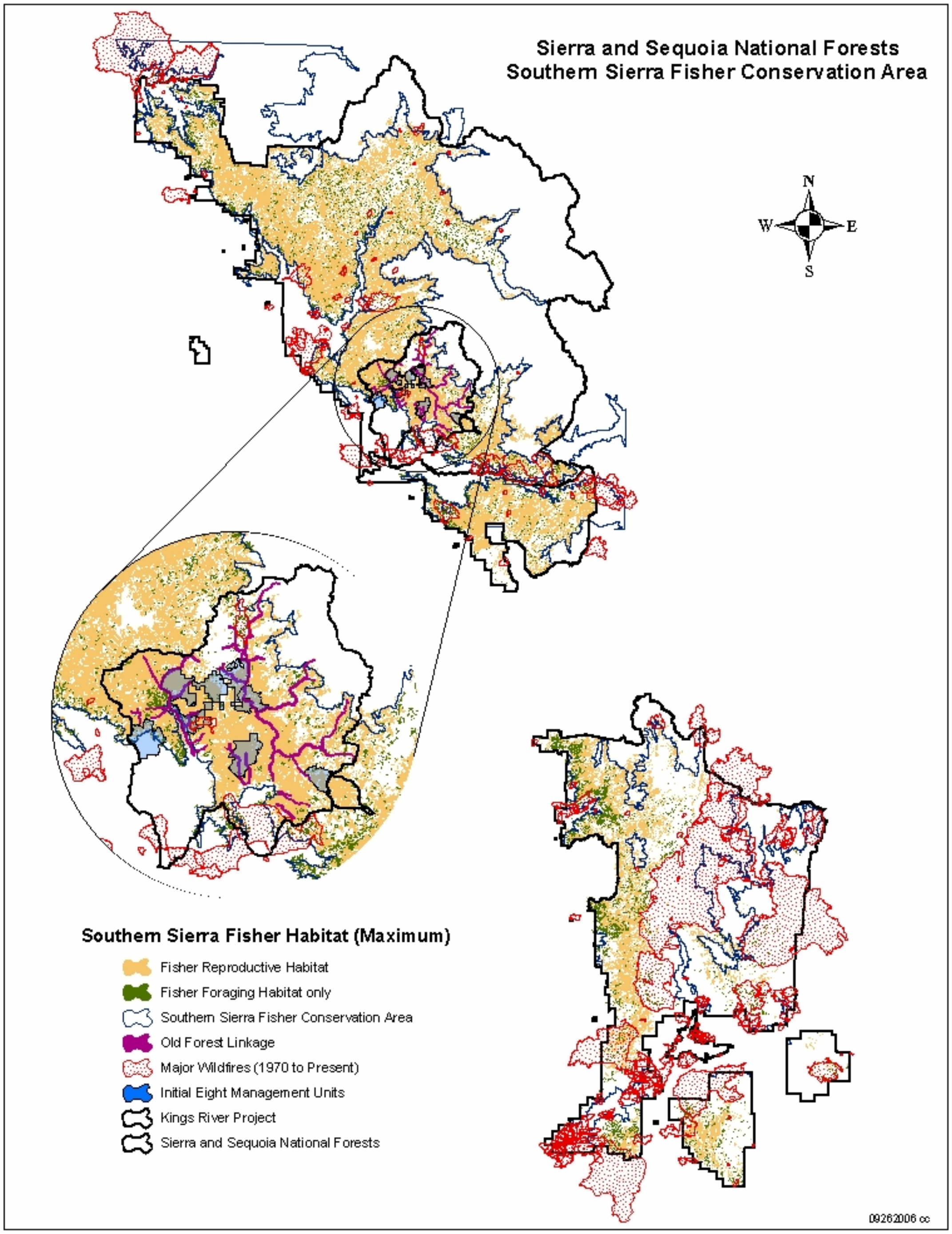
<u>California's Fire and Resource Assessment Program:</u> California state law (Public Resource Code 4789) requires the Fire and Resource Assessment Program (FRAP) of the California Department of Forestry and Fire Protection (CDF) to periodically assess California's forest and rangeland resources. This assessment is performed in cooperation with federal, state, and local agencies, public and private organizations, and California's academic research community (CDF 2006). In its latest assessment, the CDF (2006) estimates, on average, that a quarter-million acres of forest and rangeland are burned annually via wildfires.

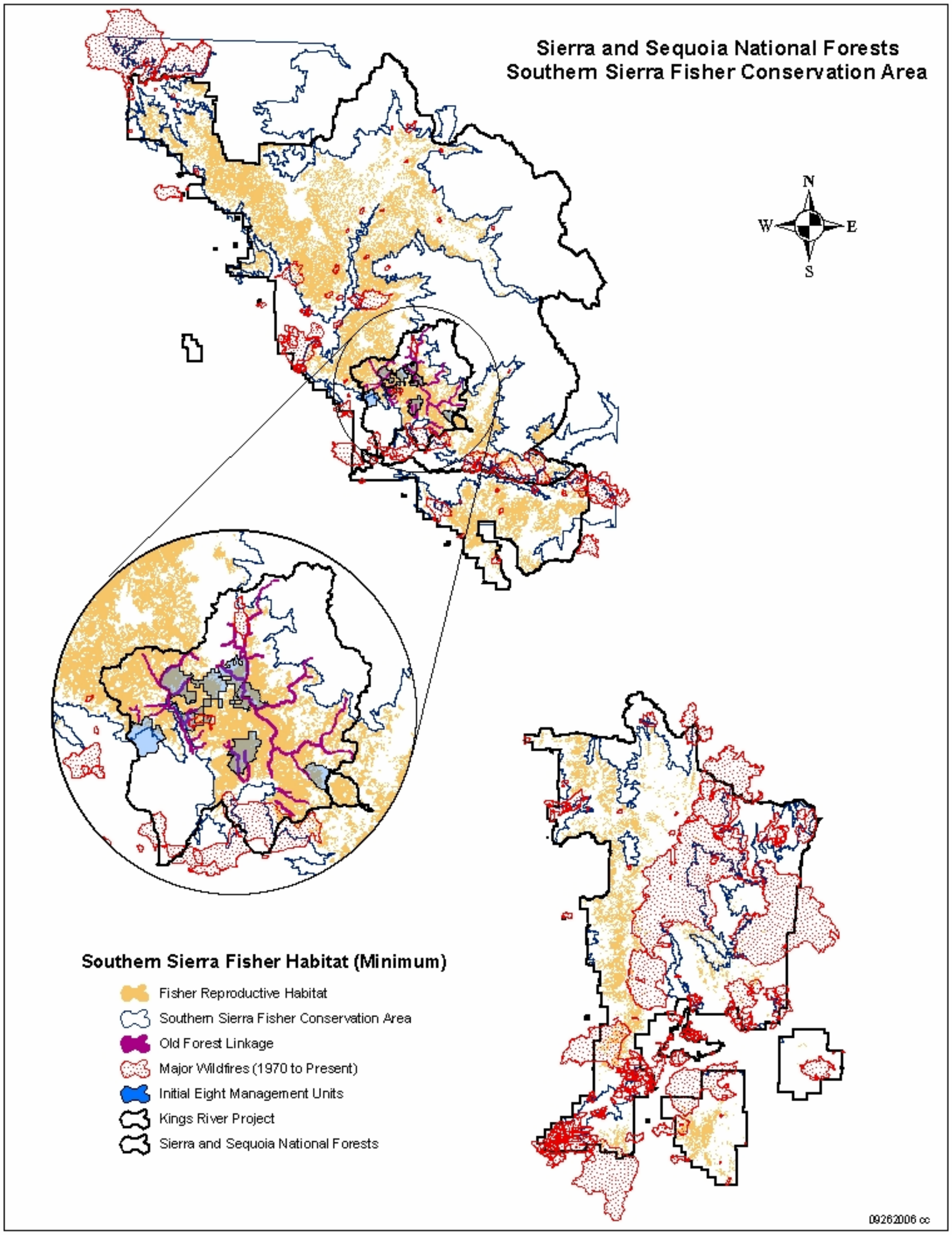
In cooperation with the Forest Service, the CDF developed the California Land Cover Mapping and Monitoring Program which measures and maps changes in vegetation cover. In its 2003 report, the CDF (2006) reported that between 1990 and 1995, the southern Sierra Nevada showed little to no change in forest canopy or vegetation cover across 90-99 percent of all forest and rangeland areas. Changes that were reported include, but are not limited to, the following:

- Large decrease in vegetation cover on 20,000 acres
- Small decrease in vegetation cover on 139,000 acres
- Little to no change in vegetation cover on 12,194,000 acres
- Small increase in vegetation cover on 833,000 acres
- Large increase in vegetation cover on 44,000 acres

In general, acres with increases in forest and rangeland cover exceeded decreases in the southern Sierra by a factor of 5:1. The southern Sierra area also had a 13% increase in vegetation cover within hardwoods, which was attributed to the re-growth of hardwoods, shrubs, and grasses following large fires (CDF 2006). Oaks are considered important in helping female fishers to meet their cover and food needs throughout their home range (Zielinski et al. 2004b).

The causes for change in vegetation cover are also tracked by the Land Cover Mapping and Monitoring Program. Fire was responsible for 47%, 36%, and 13% of the vegetation change in the Northeastern, North Coast, and Southern Sierra areas of the monitoring program (CDF 2006), respectively. Indeed, in all cases, fire was responsible for more changes in vegetation cover than was harvest; in the Southern Sierra, harvest accounted for only 6% of the changes noted in vegetation cover during the 1990-1995 period. Railroad logging in the late 19th century may have contributed to fragmentation and isolation of fisher populations; however the response of fisher populations to the resultant habitat changes is not quantified (Zielinski *et al.* 2005). Given these observations, we assumed that fire has historically been the dominant factor responsible for changes in vegetation throughout the analysis area. With this in mind, we created a map that displays current distribution of suitable habitat juxtaposed to the areas of large wildfires (i.e., wildfires 40 acres or larger in size) that have taken place over the last 36 years. Two versions of this map are provided on the following pages, corresponding to the two habitat definitions described in Table 3-31. The “Maximum” map employs the Freel (1992) habitat definition while the “Minimum” map employs the CWHR 8.1 Modified habitat definition.


Sierra and Sequoia National Forests
Southern Sierra Fisher Conservation Area
N
W
E
S
Southern Sierra Fisher Habitat (Maximum)
Fisher Reproductive Habitat
Fisher Foraging Habitat only
Southern Sierra Fisher Conservation Area
Old Forest Linkage
Major Wildfires (1970 to Present)
Initial Eight Management Units
Kings River Project
Sierra and Sequoia National Forests
09262006 cc



These maps clearly show the majority of large fires during this time period have occurred on the Sequoia NF, where the recent Manter and McNally fires have removed large blocks of suitable habitat (e.g., 6,000 ac of suitable fisher habitat was lost due to the Manter fire alone). Visually, the map shows a correlation between the location of large wildfires and the absence of suitable habitat (i.e., in many places where large wildfires have occurred in the recent past, suitable habitat is no longer present or occurs in small quantities). On the Sierra NF, fewer wildfires have occurred and, interestingly, a noticeable proportion of these wildfires have taken place outside of or below the elevational band that defines the Southern Sierra Fisher Conservation Area. Implementing the proposed action (the initial eight management units) at locations that are distant from the fragmented landscapes where the majority of the larger wildfires have occurred is likely to incur less risk to the fisher. As displayed on the map, the continuity of habitat surrounding the initial eight management units is more clearly defined on the Sierra NF compared to the habitat continuity in existence on the Sequoia NF. That being said, the locations of the initial eight management units occur within a relatively narrow band of fisher habitat that creates a bottleneck for north to south movement of populations (i.e., proposed activities in this location have the potential to reduce the permeability of the Kings River Project area with respect to fisher movements). To address this, the Old Forest Linkages are designed to maintain habitat corridors and provide refugia containing the highest quality of habitat, thereby allowing fisher to move through the Kings River Project area to other points in all directions, especially north or south (see maps on the foregoing two pages). The large wildfire polygon on the northwest corner of the map actually occurred on the Stanislaus NF and is likely to affect northward dispersal of fisher.

Given the past actions there is a risk with proceeding with the implementation of the Kings River project, especially since impacts will occur within CWHR 4D stands, which are considered by Zielinski et al. (2004b) to comprise the greatest proportion of fisher home ranges; however, given the objectives for reducing fire risk across the landscape and the specific conservation measures that are part of the Reduce Harvest Tree Size Alternative, the impact that wildfires may have in the future on fisher habitat and populations may be lessened by application of the proposed treatments. One of the challenges in assessing the effects of fire management on fisher habitat is the need to weigh the long-term benefits of the reduction of risk of catastrophic fires against any potential short-term effects on the quality or quantity of fisher habitat. Even greater emphasis must be placed on this because the fisher is only found in less than half the range it occupied in the early part of the 1900s (Zielinski et al. 2004b).

Parks and Rojas (2006) created spatially explicit animations of fisher habitat (as defined by Freel (1992)) before and after treatments in the initial eight management units. These animations are provided on the Sierra National Forest website (http://www.fs.fed.us/r5/sierra/projects/) and show how some of the management units (e.g., bear_fen_6 or el_o_win_1) have an abundance of high quality suitable habitat and low levels of fragmentation while other units (e.g., glen_mdw_1, krew_bul_1, or n_soapro_2) exhibit a scarcity of high quality suitable habitat or greater degrees of fragmentation. Proposed activities in management units fitting this latter category may pose a slightly higher risk to fisher.

At a programmatic level, the next areas in the KRP expected to be treated after the initial eight management units are not adjacent. There are fewer disturbances in an area when treatments are not adjacent to each other. Through the KRP adaptive management approach, as appropriate, the treatments will be refined to accommodate what is being found through monitoring and research. Future management units have been specifically designed to be no more than 1/3 the size of any fisher home range. Treatment of them is separated in space and time to further reduce impacts on an individual fisher. The expected treatment of future units is scheduled so that no adjacent management units will be treated within a 5-year period.

Disclosure of monitoring data for fisher at the scale of the Forest and the SSFCA: Using camera traps, the density of fishers in the study area (an area smaller than the District but larger than KRP) was estimated to be 13 fishers per 100 km^2 in 2002 (Jordon, M. unpubl. data) and 10 fishers per 100 km^2 in 2003 and 2004 (Jordan, M. et al. 2005). The abundance estimates for the time period were 47, 42, and 44 individuals from 2002 through 2004, respectively (Jordan, M. et al. 2005). As at the forest scale, fisher may have increased their spatial distribution on the District and in the KRP area. According to Purcell (pers. comm. 2006), an estimated 28-36 individual fisher inhabit the KRP area and it is thought the numbers are stable.

The Southern Sierras are the southernmost range of fishers known at this time. Although fishers appear well distributed in the Sierra NF (U.S. Dept. of Interior. 2006c), monitoring data suggest that fishers are approximately half as dense here as in the Sequoia NF. Moreover, population persistence of fisher in the Southern Sierras is threatened by a number of population, habitat, and environmental factors (Lamberson, et al. 2000). Available data suggest that high quality habitat for fishers, especially forest with canopy cover >60%, is present at lower densities in the KRP area than in Sequoia NF.

However, Landsat thematic mapping (2001) for the Sequoia National Forest (SQF) shows, between 3500 to 8000 feet in elevation, that 364,00 total acres are suitable fisher habitat. On the Sierra National Forest (SNF) for the same elevations, Landsat mapping shows that 481,000 total acres are suitable fisher habitat. Within the KRP 9,873 total acres are suitable fisher habitat. While population information described above indicates lower fisher densities in the KRP area than the SQF, habitat information shows a higher percentage of suitable fisher habitat on the HSRD and KRP than on the SQF.

Consistent with lower habitat quality in the KRP area, the average home range of radio-tracked female fishers was more than twice as large on the Sierra NF as compared with the Sequoia NF (Mazzoni 2002; Zielinski et al. 2004b). Comparisons of estimated densities of fishers in the KRP area with similar data collected elsewhere place KRP fisher densities at the low end of values observed in occupied habitat. The proportion of females showing evidence of breeding annually is also at the low end of the documented spectrum (Mark Jordan, University of California, pers. comm. 2006). These monitoring data emphasize the importance of the adaptive management component of the Kings River Project; that is, activities conducted in areas of lower habitat quality and lower population densities must be monitored closely to detect undesirable changes at the earliest possible opportunity.

A review of the fire history dating back to 1916: The Kings River Project has a recorded fire history dating back to 1916. Since then, thirty fires larger than 40 acres have occurred (either entirely or a portion of the fire) within the project area. The average size of wildland fires in KRP in the last 35 years is 1,866 acres. With the exception of the 1981 Rock Creek fire, which started in the upper reaches of the Dinkey Creek drainage, the majority of large fires (greater then 3,000 acres) started in chaparral or in the grassy lowlands of the Kings River drainage, and have run uphill into the forested areas. The largest fire – the 1961 Basin fire – started in the low elevation grasslands of the Dinkey Creek drainage and grew to 19,421 acres in four days before terrain moderated it. The 1961 Haslett Fire grew to over 3,000 acres in one burn period before hitting Fence Meadow ridge. Since 1916, ten fires were larger than 3,000 acres.

As discussed above, we believe that large wildfires have played a dominant role in shaping the current landscape for fisher in the southern Sierra Nevada. The fire history on the Sierra and Sequoia NFs, combined with recent large fires on the Stanislaus National Forest, raise concern for the ability of individual fisher to travel between the southern Sierra and other, more distant populations in northern California.

The statistical probability (rare event occurrence – Poisson probability distribution) of a large fire occurring within the KRP area within the next 30 years is 11% and any fire occurrence within the next 10 years is 36%. With current stand conditions, a wildfire of stand replacing intensity (97th percentile conditions) would become an active crown fire from the first spark. In such an event, the effectiveness of aerial suppression capabilities is limited due to existing stand densities and fuel loading.

<u>A review of how past activities since about the mid 1960s have affected the landscape:</u> Since about the mid-1960s, past activities within Sierra National Forest and the KRP planning area have included clearcutting and salvage logging (1960s - 1972), sanitation and salvage harvests (1972 - 1978), clearcutting, shelterwood cutting, and salvage harvests (1978 - 1992), and commercial thinning and salvage in recent times. The only fires to burn substantial amounts of timber were the Rock Fire in 1981 and the Big Creek Fire in 1995, with each fire burning about 3,000 acres of forest. Clearcuts or areas that burned prior to 1972 are most likely successful plantations today exhibiting size class 3 and density class M stands. Other, more recent disturbances, while they may be reforested, have probably not yet reached size class 3. This overview of plantations is a good measurement for the effects of regeneration cutting on fisher habitat. Overall, about 9,000 acres of disturbance resulting from timber sale activity or fires have taken place within the KRP planning area, and approximately 23,000 acres of disturbance have been documented for the larger area encompassing the Kings River and Pine Ridge Ranger Districts since about 1978 (Mark Smith, pers. comm.).

On the Sequoia National Forest, clearcutting, shelterwood cutting, and salvage harvests accounted for about two-thirds and overstory removal cutting accounted for about one-third of the timber management activity from the mid-1960s to about 1988. At the end of this period, the Forest switched to commercial thinning and salvage, driven to change by controversy over removing white woods from Giant Sequoia groves. (Glen Duysen, pers. com.) Similar to the Sierra, an overview of plantation establishment and growth is a good measurement for the effects of regeneration cutting on fisher habitat on the Sequoia.

<u>An analysis of how timber harvest since 1978 has affected fisher habitat:</u> At the Forest scale, timber harvest from the Sierra Forest has declined from an average of 126 MMBF in the 1980s to an average of 7 MMBF since 2000. At the same time, harvest on private

lands has remained relatively stable within the Forest boundary at about 5 MMBF annually. Declines in timber harvest affect the fisher in several ways. Declining harvest frequently means fewer disturbances in the woods and a greater opportunity that any given female fisher will breed and rear its young without substantial interference or disturbance. On the other hand, declining timber harvest also reduces the available funds for forest restoration and habitat management. The more recent disturbances (post-1978) described in the previous paragraph, which have almost all been reforested, have resulted in the following acres of plantations:

The acreage of plantations created since fiscal year 1978 (as recorded in the FACTs Database) on the Sierra and Sequoia National Forests[10]

Unit	Gross Acres	Acres Planted
Old Mariposa District	12,397	5,958
Old Minarets District	15,615	7,649
Old Kings River District	10,186	6,701
Old Pine Ridge District	13,169	9,613
Sierra NF Totals:	**51,367**	**29,921**
Sequoia NF Totals:	tbd	tbd

The LRMP specified stand types and a specific percentage of acres of each type that were to be targeted for regeneration. Generally, stands that were at lower stand density, i.e., canopy closure, were planned for about half the regeneration target to increase the productive capacity of the Forest as fast as possible. The other half of the regeneration target was planned in well stocked stands to sustain a high level of annual volume production from the Forest. So, about half (50%, or 26,000 acres) of the gross acreage of plantations was created from stands that were not suitable fisher habitat and about half was suitable habitat when the stand was regenerated. Although these disturbances have caused notable changes in wildlife habitat, the amount of these changes over the last 30 years is not extraordinary compared to the total amount of suitable fisher habitat that is available. (See following paragraph.)

As described in the draft Forest MIS Report for the Sierra Forest (USDA Forest Service 2006), fisher resting/denning habitat – as defined by Freel (1992) – has increased slightly on the Forest from 422,000 acres about ten years ago to 449,000 acres presently. The detection rate of fisher (based on systematic, large-scale surveys conducted between 2002 and 2006) on the Sierra Forest is roughly half what it is on the Sequoia Forest. Fisher may have increased their spatial distribution on Sierra Forest since the mid-1990s. The annual occupancy rate within the Sierra Forest seems to be consistent, though the spatial pattern of detections appears more variable among years than on the Sequoia Forest (Rick Truex, USFS, pers. comm. 2006).

[10] Note: Minarets and Mariposa Ranger Districts are now collectively known as the Bass Lake Ranger District; and the Kings River and Pine Ridge Ranger Districts are now collectively known as the High Sierra Ranger District.

The combination of a stable or slightly increasing amount of suitable fisher habitat on the Forest over the last ten years, and perhaps an increasing spatial distribution of fisher, make it reasonable to conclude the cumulative effects of vegetation management activities on the Forest have not affected viability of the fisher; however, given the uncertainty inherent in these data, other alternative (and perhaps conflicting) conclusions are also possible. For example, this information could suggest considerable movement of individuals either dispersing or seeking to meet habitat requirements, implying that habitat quality may be lower than the CWHR model predicts.

Timber harvest has declined at similar rates at both the Kings River Project and Forest scales. Harvest on private lands has remained relatively stable within the High Sierra District and the KRP area. So, the effects of timber harvest on fisher at the project scale are similar to those effects presented at the Forest scale. Suitable fisher habitat on the District has increased slightly from about ten years ago to 239,000 acres presently. The more recent disturbances (post-1978) described above, which have almost all been reforested, have resulted in the following acres of plantations on the District and the KRP area:

<u>The acreage of plantations created since fiscal year 1978 (as recorded in the FACTs Database) across the Kings River Project area and the High Sierra Ranger District (which was formed from the old Kings River and Pine Ridge Ranger Districts)</u>:

Unit	Gross Acres	Acres Planted
Kings River Project	9,129	5,688
Old Kings River District	10,186	6,701
Old Pine Ridge District	13,169	9,613

Overall, about 9,000 acres of disturbance resulting from timber sales or fires have taken place within the KRP planning area and approximately 23,000 acres of disturbance have been documented for the larger area encompassing the old Kings River and Pine Ridge Ranger Districts since about 1978.

Three commercial thinning and/or fuel reduction projects took place in the KRP area (Reese, 10S18 and I-Rock) after the change in timber management emphasis to commercial thinning in 1992. Their effects on fisher habitat have been described above in the section on **Past, Present, and Reasonably Foreseeable Activities**.

Figure 3-55 addresses the cumulative effects from change in canopy cover on fisher habitat in the initial eight management units. The current landscape condition is that forty six percent of all acres with medium and larger trees have greater than 50 percent canopy cover. After thinning, the acres meeting this canopy cover condition recovers in less than ten years across the landscape to about 50 percent for the action alternatives, assuming no fire occurs, which meets the fisher habitat goal for the proposed action[11]. In 20 years, the acres meeting this canopy cover condition reaches 60 percent for the action alternatives, again assuming no fire or other vegetation management activities occur, which meets the fisher habitat goal for the Reduce Harvest Tree Size alternative[12].

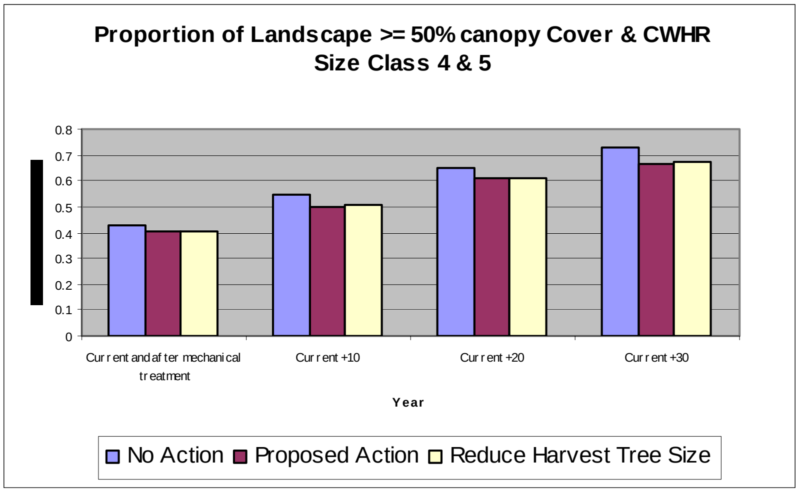


Figure 3-55 displays the proportion of acres across the Kings River Landscape that meets the fisher goal throughout the analysis period.

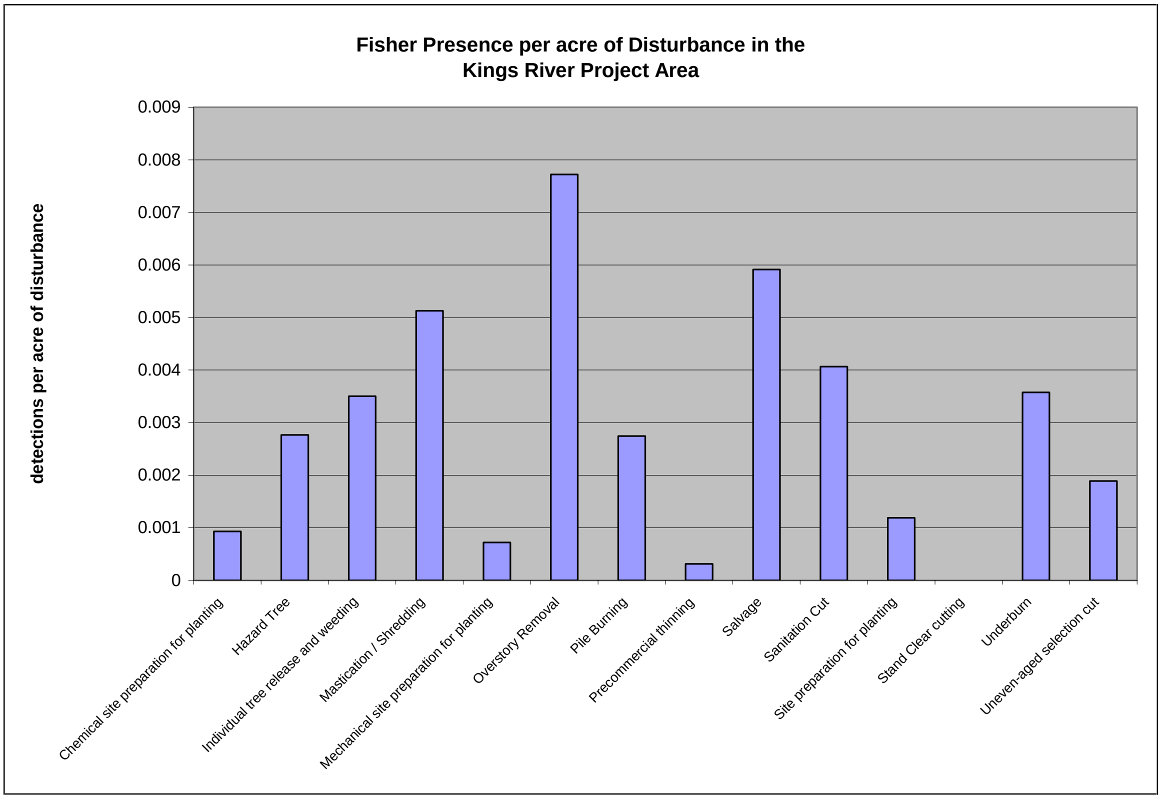
<u>A summary of detection and disturbance data for fisher:</u> The chart and table below present information about fisher detections in areas following various types of disturbance. The key variables include the period of analysis (1993 - 2005), acres of treatment, and the number of fisher detections following treatment. In effect, the chart displays the number of detections per acre for each disturbance type. For example, the uneven-aged selection cut had six fisher detections in 3,171 acres that were disturbed by this treatment. This resulted in 0.002 detections per acre of disturbance. Interestingly, if one takes all the detections in the KRP by Jordan et al. (2005) and Mazzoni (2002) (818) and divides by the total acres between 3,500 feet and 8,000 feet in elevation (86,083 acres) the result is 0.010 detections per acre. Precommercial thinning (< 0.001 detections per ac) and the site preparation (about 0.001 detections per ac) treatments are connected to previous clearcuts. The release treatments (about 0.0035 detections per ac) are also associated with previous regeneration harvest. While it is debatable whether this indicates a trend in avoidance or preference, it does allow for comparison of detections based on the amount of disturbance. Interesting are the release and weeding treatments that have a longer time frame for the detection of a fisher than uneven-aged selection, but the release and weeding have more detections (refer also to Table 6). That is, more detections occur following release and weeding treatments but it takes longer for the detections to occur after treatments than uneven-aged selection. Even though release and weeding treatments

[11] The long-term habitat goal is to develop or maintain 50% of the area of potential fisher habitat in CWHR Class 4 (11-24 in dbh) or higher with 50% canopy cover or greater

[12] The long-term habitat goal for Alternative 3 is to develop or maintain 50% of the landscape outside of WUI with canopy density >60%

occur in large openings, sufficient cover in young trees and brush may return after 6 - 10 years.

We acknowledge in advance that the source of the data for the following graph and table is a convenience sample with an unknown precision or confidence interval. Given that caveat, the data appear to indicate that fishers do not avoid underburned areas, for example, and are detected more often than in areas where pile burning occurs; and that the range in time since dispersal is similar for both underburning and pile burning (0 - 10 years for underburning, and 0 - 9 years for pile burning). If we discuss the qualitative aspects of each disturbance and relate it to known suitability for fishers, then we could also say that treatments that result from larger openings (precommercial thinning, site preparation) have fewer detections than those with scattered tree removal such as sanitation cut, mastication, and salvage. The scattered treatments are those that create small amounts of change in habitat suitability for cover, and those associated with larger openings represent large changes in habitat suitability for cover.



These fisher detections infer presence only and no conclusions may be drawn regarding absence. This is because the disturbance and the detection were done independently. As a result, presence following disturbance is the only inference that can be drawn. Because the data are reported on a detection-per-acre basis, the reader should exercise caution in interpreting the results. For example, the number of detections per acre is greater in salvage polygons, while fewer detections per acre occurred in precommercial thinning. While it may be tempting to infer a preference for salvaged areas, the large number only indicates the large size of salvage polygons and the relatively large area disturbed by salvage. The opposite is true for overstory removal cut. That is, these areas are small polygons and occupy a small portion of the KRP, thus few detections occurred in these polygons.

The table below displays the same detection and disturbance data, but with a time range that represents the maximum and minimum years between the disturbance and the detection. Thus, for uneven-aged selection cuts there were six detections following the treatment, and the maximum time between disturbance and detection was three years. The minimum time occurred within the same year of disturbance, or about 0.42 years. A display of average time is not appropriate since it does not account for the size of polygons or the area of the treatments across the KRP. The inference is that fisher return to disturbed areas (at least for the time periods examined) and they are detected at different times since disturbance. **Since we did not go out and sample each disturbed area each year after disturbance, all we can say is that fishers have either remained in or reoccupied these areas within the specified time period.** The time range does not represent a fisher return interval, but simply the time between detection and disturbance (treatment). Fishers may have been there sooner, but we did not go out and sample. **Since no detections occurred in stand clear cutting, we might be able to say that fishers are excluded from these large openings.**

Treatment Type	Number of Fisher Detections	time range since presence detected (years)	Acres
Chemical site preparation for planting	1	1 to 1	1075
Hazard Tree	14	5 to 0	5063
Individual tree release and weeding	16	10 to 6	4567
Mastication / Shredding	1	2 to 2	195
Mechanical site preparation for planting	2	2 to 1	2771
Overstory Removal	2	7 to 7	259
Pile Burning	7	10 to 0	2550
Precommercial thinning	1	2 to 2	3218
Salvage	131	10 to 1	22145
Sanitation Cut	1	2 to 2	246
Site preparation for planting	1	1 to 1	841
Stand Clear cutting	0	to	0
Underburn	66	9 to 0	18448
Uneven-aged selection cut	6	3 to 0.42	3171
Grand Total	249	10 to 0	64549

Conclusions

In summary, this analysis of cumulative effects to the fisher for the Kings River Project reveals the following key points:

- The amount of suitable fisher habitat on the High Sierra Ranger District and in the KRP area over the last ten years is stable or slightly increasing. Looking more closely at this, we see that a greater proportion of resting/denning habitat may benefit over the next 10-20 years from treatments proposed in the Proposed Action or Reduce Harvest Tree Size alternatives compared to foraging habitat (Tables CE2 and CE3). This is important because, when compared to foraging habitat, resting/denning habitat is generally considered the most limiting habitat component for fisher across the landscape. At the larger landscape scale of the SSFCA, the Sierra NF currently contains 57% of the 844,776 acres of suitable fisher habitat in the SSFCA (as defined by Freel (1992)); treatments under the Proposed Action or the Reduce Harvest Tree Size alternatives would result in a loss of suitable fisher habitat totaling approximately 0.10% of the total available within the entire SSFCA (Tables CE2 and CE3). Full recovery of reproductive habitat is expected within 10-20 years.

- There is preliminary evidence of a stable fisher population in the KRP. However, within the Southern Sierra Fisher Conservation Area, fisher in the KRP area may be more sensitive to treatments than on the Sequoia National Forest because fisher are present in lower population densities.
- The U.S. Dept. of Interior's Fish and Wildlife Service (2005 and 2006c) has reviewed the proposed Saddle Fuels Reduction Project on the Sequoia National Forest and the proposed action for the Kings River Project. In both instances, they provided conservation recommendations and reached the following conclusions with respect to fisher:

    - Saddle Fuels Reduction Project was not likely to result in adverse effects to the fisher (U.S. Dept of Interior 2005)
    - Kings River Project is likely to affect fishers but the identified protection measures (listed at the beginning of the Direct and Indirect Effects section of the BE for fisher) would reduce those effects (U.S. Dept of Interior 2006c).

  The U.S. Dept of Interior (2006c) further notes that the federal status of and threats to the fisher will be re-examined annually (in the most recent 2005 status review, the threats to the fisher were "evaluated as of high magnitude but as non-imminent … based on the observation that numbers of fishers in occupied habitat appear to be stable or not rapidly declining"). As has been noted by other researchers, the U.S. Dept of Interior (2006c) states that the threats of most importance to fisher involve conservation issues relating to small isolated populations and the potential that further loss and fragmentation of habitat may occur. These concerns are most applicable to management units glen_mdw_1, krew_bul_1, or n_soapro_2, which exhibit a scarcity of high quality suitable habitat or a greater degree of suitable habitat fragmentation than the other management units within the Kings River Project analysis area. To address this, the Old Forest Linkages are designed to maintain habitat corridors and provide refugia containing the highest quality of habitat, thereby allowing fisher to move through the Kings River Project area to other points north or south. The entire foregoing spatial and temporal analysis has taken habitat connectivity into account and disclosed the potential risks of the short-term impacts to fisher and its habitat, as well as the long-term benefits to fisher resulting from a greater number of large trees and denser canopy across the landscape concomitant with a reduction of the risk of stand-replacement wildfire.
- A number of project activities have been implemented within the boundary of the SSFCA in the recent past that have the potential to disturb fisher or remove/modify its habitat. Fisher appear capable of returning to disturbed areas, and are detected at different times following disturbance. However, historically, wildfire plays a more dominant role in affecting the quantity, quality, and distribution of fisher habitat; for the indefinite future, that trend is expected to continue. Given the impacts to habitat over the past 100 years, the gap in the

fisher population between the southern Sierra and northern California, and the lower estimates for quality of habitat and fisher population density on the Sierra Forest compared to the Sequoia Forest, implementation of the Kings River Project undoubtedly poses an unknown risk to fisher that inhabit the area. However, one of the challenges in assessing the effects of fire management of fisher habitat is the need to weigh the long-term benefits of the reduction of risk of catastrophic fires against any potential short-term effects on the quality or quantity of fisher habitat (see, for example, the U.S. Fish and Wildlife Service letter that evaluates the net benefits of hazardous fuels treatment projects (U.S. Dept of Interior 2002)). Both action alternatives, especially the Reduce Harvest Tree Size alternative, have the potential to improve fisher habitat in the long term. Based on the body of evidence before us, and until further information is presented, proceeding with either the Proposed Action or the Reduce Harvest Tree Size alternative ***under an adaptive management approach*** is currently the best option we can take. Within the scale of recent past land management activities, implementation of the initial eight management units would not preclude future management options for the fisher or result in a loss of viability of fisher populations on the Sierra NF. Moreover, under the adaptive management approach described in the proposed action, future management activities within the KRP would be informed by the results of monitoring and research tied to the initial eight management units.

As a result, the cumulative effects of vegetation management activities in the KRP initial eight management units taken together with past, present, and reasonably foreseeable activities on the Forest and across the SSFCA will not result in a loss of viability for the fisher.

Marten, FSS and MIS; Wolverine, FSS; and Sierra Nevada Red Fox, FSS

In the initial eight management units, only one of these species (marten) has been sighted in one unit (KREW_prv_1). It is unlikely these mesocarnivores den in these units due to the elevation range of the species. If they are foraging or resting in one of these units, when trees are being removed with mechanical equipment (tractor, masticator, etc.) there may be a direct effect due to the noise disturbance involved with project activities. Short term disturbance may occur to their behavior patterns from prescribed fire because these animals may leave the area due to smoke or noise disturbance associated with the activities.

Evaluative Criteria for Martin and Summary of Direct Effects

The following criteria are similar to fisher, however, they have been modified where it is applicable for the marten. (They are not applicable to the wolverine and Sierra Nevada red fox because there is minimal suitable habitat identified in the initial eight management units.)

- Canopy cover across the landscape
    - Under alt 3, the long term goal is to develop or maintain 50% of the landscape outside of WUI with canopy density >60%

  - Under alt 1, the long term goal it to develop or maintain 50% of the are of potential fisher habitat in CWHR class 4 or higher with 50% canopy cover or greater
- Protection of stand-level habitat components and individual rest structures important to fisher (e.g., large diameter snags and oaks, patches of dense large trees, and coarse woody debris)

  - Protect important habitat structures such as large diameter snags and oaks, patches of dense large trees (typically ¼ to 2 acres), large trees with cavities for nesting, and coarse woody material; use firing patterns and place fire lines around snags and large logs to minimize effects of underburning. The “Fisher and Priority Sites Marking Guide – Kings River Project” will be used to identify the most suitable individual trees and groups of trees for retention. (Alt 3).

- **Establishment of a system of travel corridors or “old forest linkages” (OFL)**
  - A system of old forest linkages have been created along perennial steams and including 300’ of adjacent habitat with 50-60% canopy cover on each side of the streams.
- **Effects of stand-replacement fire**
  - By implementing Alt 1 it will reduce the effects of stand-replacement fire with some large trees. If Alt 3 is implemented it will be the same outcome with a few larger trees not removed in treatment.

Indirect Effects to Marten

While the effects to the marten will be similar to those described for the fisher, they will also be smaller in scale since some elevations within the project area are below the elevations where marten are usually found. Elevations above the KRP area could also serve as potential refugia for marten. Prey species may leave the areas of disturbance or use underground tunnels, depending on the small mammal. It is assumed the prey species would move back into the area after underburning has been completed.

Cumulative Effects to Marten

The area considered in determining the cumulative effects of past, present, and reasonably foreseeable activities on marten encompasses the Sierra NF. This is an appropriate scale for cumulative effects for a wide-ranging species (such as the marten) that has also been selected as a Management Indicator Species for the Sierra NF. Based on the following analysis, a determination of viability for the marten will be made.

The pre-project quantity of suitable marten resting/denning habitat in the Sierra NF is 319,000 acres, and 2,556 of those are located within the KRP area. There are an additional 41,500 acres of suitable marten foraging habitat in the Sierra NF, 57 of which are in the KRP area. Additional pre- and post-project marten habitat data can be found in following tables.

Suitable marten resting/denning habitat in the KRP area before, immediately after, 10 years after, and 20 years after implementation of alternatives.

Marten		Acres of Suitable Resting/Denning Habitat Definition: CWHR 4D, 4M, 5D, 5M, elevation 6000 – 10,000 ft					
Scale	Alternative	Pre-project	Post-project	Year 10 Without Fire	Year 10 With Fire	Year 20 Without Fire	Year 20 With Fire
Kings River Project	Proposed Action	2556	2222	2329	1680	2423	1909
	No Action		2556	2710	552	2802	567
	Reduced Harvest Tree Size		2236	2644	1700	2670	1924

Suitable marten foraging habitat (in addition to resting/denning habitat) in the KRP area before, immediately after, 10 years after, and 20 years after implementation of alternatives.

Marten		Acres of Suitable Foraging Habitat Definition: CWHR 3D, 3M, elevation 6000 – 10,000 ft					
Scale	Alternative	Pre-project	Post-project	Year 10 Without Fire	Year 10 With Fire	Year 20 Without Fire	Year 20 With Fire
Kings River Project	Proposed Action	57	50	25	4	73	1
	No Action		57	68	0	119	0
	Reduced Harvest Tree Size		50	25	4	73	1

Data from the SNFPA (USDA 2001c) indicate that CWHR habitat stages 4M, 4D, 5M, 5D, and 6 are moderately to highly important for the marten. The identified habitat risk factors for this species include: (1) removal of overhead cover, large diameter trees, and coarse woody debris, (2) conversion of xeric to mesic sites, (3) grazing, and (4) fire suppression.

Martens typically have a large home range size for such a small carnivore, averaging about 1 mi^2 (males average 807 acres, or 1.26 mi^2, and females average 254 acres, or 0.40 mi^2; USDA 2001c, Dr. W. J. Zielinski, pers. comm., 8 Sept 2006). Additionally, Dr. W. J. Zielinski (pers. comm., 8 Sept 2006) stated that the average elevation at which martens are found in the southern Sierra Nevada is 6900 feet. As a result, if martens reside in the KRP area, they are likely meeting their denning, resting, and foraging needs there. Elevations above the KRP area could also serve as potential refugia for the species, because their preferred elevational range extends to 10,000 feet or higher. Despite requiring such large home ranges, the marten remains well-distributed throughout its current range in the southern Sierra Nevada (Zielinski *et al.* 2005), which continues to resemble its historical range.

In addition to the previously mentioned habitat risk factors, there are two important non-habitat risk factors for martens: (1) development and (2) climate change. Climate change is beyond the scope for this analysis and areas of large-scale development are not planned for the Kings River Project area. Changes in vegetation composition and structure at a scale larger than the Kings River Project area are summarized below.

Biological Evaluations for many of the past projects in the Sierra NF were reviewed to help inform the present analysis. Our review of these documents revealed the following basic information about effects to marten from these activities:

- Twenty-six (26) total project Biological Evaluations (BEs) were reviewed, dating back to 1993 on the Sierra NF.
- Determinations reached were:
    - No effect – 7 BEs
    - May affect individual marten, but not likely to lead to a trend toward federal listing or loss of viability – 15 BEs
    - May affect individual marten, and likely to lead to a trend toward federal listing or loss of viability – 0 BEs
    - Marten were not addressed in the document we reviewed due to lack of habitat or other reasons – 4 BEs
- Types of Projects: Fuels reduction, harvest, hazard tree removal, and thinning were the proposed activities that were most often represented in the sample of BEs in which the marten was analyzed.
- Relative to "May Affect" projects, the described impacts to marten most often fell in the following categories:
    - Temporary disturbances
    - Foraging area may be burned if underburning gets out of control
    - Removed hazard trees could serve as resting or denning sites
    - Habitat altered or removed
    - Reduction of habitat quality (e.g., reduction in canopy cover)
    - Habitat will be entered
    - Noise disturbance

Additional past, present, and reasonably foreseeable future activities are outlined at the beginning of Chapter 3 of the Kings River FEIS. Many of these activities were judged to have no effect on the marten because the project(s) were taking place below 6000 ft elevation. Some of the roadside hazard tree removal and recreation activities may cause disturbance to marten that may be in the area.

<u>A review of the fire history dating back to 1916:</u> Marten habitat has been exposed to and affected by fire to a similar extent as that of fisher habitat. For a detailed discussion, please refer to the section entitled "**A review of the fire history dating back to 1916**" within the fisher cumulative effects section.

<u>A review of how past activities since about the mid 1960s have affected the landscape:</u> As with fire, past activities since the mid-1960s have affected marten habitat in much the same way as fisher habitat. For a detailed discussion of these effects, please see the section entitled "**A review of how past activities since about the mid 1960s have affected the landscape**" within the fisher cumulative effects section.

<u>An analysis of how timber harvest since 1978 has affected fisher habitat</u>: Because marten and fisher use similar habitats, please refer to the section entitled "An analysis of how timber harvest since 1978 has affected fisher habitat" within the fisher cumulative effects section.

Given the marten's continued occupancy of a range similar to its historical distribution, the small percentage of suitable habitat being affected (compared to what is available on the Forest), the long-term objective for increasing the number of large trees across the landscape, the intention of reducing fuels, and the discussion of cumulative effects, the Kings River Project, although it is not without risk, is not likely to result in a loss of viability for the marten.

Direct, Indirect and Cumulative Effects to Wolverine

In the southern Sierra Nevada, wolverines are typically found at elevations above 8,000 feet[13] (Dr. W. J. Zielinski, pers. comm., 8 Sept 2006 and California Department of Fish and Game (2005:M159)), which exceeds elevations of all initial eight management units except a small part of KREW BUL. Additionally, Dr. W. J. Zielinski (pers. comm., 8 Sept 2006) stated that the chances of wolverine presence in the project area are low to non-existent, based on PSW surveys in the area from 1996 – 2002. Moreover, no corroborated wolverine sightings have occurred in California in over 50 years.

The area considered in determining the cumulative effects of past, present, and reasonably foreseeable activities on wolverines encompasses the Kings River Project (KRP) area and includes the entire Sierra National Forest (NF). Based on the following analysis, a determination of viability for the wolverine will be made.

Within the Sierra NF, there are 319,000 acres of habitat suitable to wolverines (i.e., CWHR 4D, 4M, 5D, 5M; elevation 6,000 – 10,800 feet), and the KRP area contains 2,556 such acres. Following implementation of each of the alternatives, acreage of suitable wolverine habitat in the KRP area is illustrated in following table.

Suitable wolverine habitat in the KRP area before, immediately after, 10 years after, and 20 years after implementation of alternatives.

Wolverine		Acres of Suitable Habitat (4D, 4M, 5D, 5M; elevation 6,000 – 10,800 feet)					
Scale	Alternative	Pre-project	Post-project	Year 10 Without Fire	Year 10 With Fire	Year 20 Without Fire	Year 20 With Fire
Kings River Project	Proposed Action	2,556	2,222	2,329	1,680	2,423	1,909
	No Action		2,556	2,710	552	2,802	567
	Reduce Harvest Tree Size		2,236	2,644	1,700	2,670	1,924

Biological Evaluations for many of the past projects in the Sierra NF were reviewed to help inform the present analysis. Our review of these documents revealed the following basic information about effects to wolverines from these activities:

- Twenty-six (26) total project Biological Evaluations (BEs) were reviewed, dating back to 1993 on the Sierra NF.
- Determinations reached were:
  - No effect – 5 BEs
  - May affect individual wolverines, but not likely to lead to a trend toward federal listing or loss of viability – 3 BEs

[13] Range = 5,000 - 6,400 ft to 10,800 - 13,000 ft

  - May affect individual wolverines, and likely to lead to a trend toward federal listing or loss of viability – 0 BEs
  - Wolverine was not addressed in the document we reviewed due to lack of habitat or other reasons – 18 BEs
- Types of Projects: Hazard tree removal and underburning were the proposed activities that were most often represented in the sample of BEs in which the wolverine was analyzed.
- Relative to "May Affect" projects, the described impacts to wolverines most often fell in the following categories:
  - Noise disturbance
  - Habitat alteration

Additional past, present, and reasonably foreseeable future activities are outlined at the beginning of Chapter 3 of the Kings River FEIS. Of those activities outlined in Chapter 3, most made a "No Effect" determination for the wolverine because the project occurred below 6,000 feet in elevation. None of the "May Affect" activities quantified the impacts on wolverines. Due to the nature of the proposed activities, the Kings River Project would not contribute to an increase in snowmobile or hiker use of the backcountry, which are recreational activities that could pose risks to wolverine populations in the Sierra Nevada (USDA 2001c).

As a result, the cumulative effects of vegetation management activities in the KRP initial eight management units taken together with past, present, and reasonably foreseeable activities on the Forest will not result in a loss of viability for the wolverine.

Direct, Indirect and Cumulative Effects to Sierra Nevada Red Fox

In the Sierra Nevada, this species is typically found at elevations above 7,000 feet[14] (Dr. W.J. Zielinski, pers. comm., 8 Sept 2006 and California Department of Fish and Game (2005:M147)), which exceeds elevations of all initial eight management units except KREW BUL. Additionally, Dr. W. J. Zielinski (pers. comm., 8 Sept 2006) stated that PSW survey data from 1996 – 2002 appear to support the conclusion that the Lassen National Park is the last holdout for the Sierra Nevada red fox. Furthermore, Zielinski stated there is no recent evidence of Sierra Nevada red foxes within several hundred miles of the KRP area.

The area considered in determining the cumulative effects of past, present, and reasonably foreseeable activities on Sierra Nevada red foxes encompasses the KRP area and includes the entire Sierra NF. Based on the following analysis, a determination of viability for the Sierra Nevada red fox will be made.

Within the Sierra NF, there are 41,000 acres of suitable habitat for Sierra Nevada red foxes (i.e., CWHR 4M lodgepole pine/red fir; elevation 5,000 – 9,700 feet), and the initial eight management units contain 54 such acres. Following implementation of the alternatives, the acreage of suitable Sierra Nevada red fox habitat in the KRP area will remain unchanged for at least 20 years.

[14] Range = 3,900 - 4,500 ft to 11,500 - 11,900 ft

Biological Evaluations for many of the past projects in the Sierra NF were reviewed to help inform the present analysis. Our review of these documents revealed the following basic information about effects to foxes from these activities:

- Twenty-six (26) total project Biological Evaluations (BEs) were reviewed, dating back to 1993 on the Sierra NF.
- Determinations reached were:
  - No effect – 11 BEs
  - May affect individual foxes, but not likely to lead to a trend toward federal listing or loss of viability – 6 BEs
  - May affect individual foxes, and likely to lead to a trend toward federal listing or loss of viability – 0 BEs
  - Sierra Nevada red fox was not addressed in the document we reviewed due to lack of habitat or other reasons – 9 BEs
- Types of Projects: Hazard tree removal, thinning, and underburning were the proposed activities that were most often represented in the sample of BEs in which the red fox was analyzed.
- Relative to "May Affect" projects, the described impacts to red foxes most often fell in the following category:
  - Reduction of habitat quality

Additional past, present, and reasonably foreseeable future activities are outlined at the beginning of Chapter 3 of the Kings River FEIS. As with the wolverine, many of the activities outlined in Chapter 3 were determined to have no effect on foxes because the proposed activities occurred below 6,000 feet in elevation. Additionally, none of the "May Affect" activities, with respect to foxes, quantified the potential impact on Sierra Nevada red foxes. Due to the nature of the proposed activities, the Kings River Project would not contribute to an increase in snowmobile or hiker use of the backcountry, which are recreational activities that could pose risks to Sierra Nevada red fox populations in the Sierra Nevada (USDA 2001c).

As a result, the cumulative effects of vegetation management activities in the KRP initial eight management units taken together with past, present, and reasonably foreseeable activities on the Forest will not result in a loss of viability for the Sierra Nevada red fox.

Pallid Bat, FSS

Direct and Indirect Effects

The Pallid bat tends to be a roosting habitat generalist that utilized many different natural and manmade structures. Foraging requirements appear to be more restrictive. Pallid bats appear to be more prevalent within edges, open stands, particularly hardwoods, and open areas without trees. The reduction of hardwoods, both from manual removal and competition from conifers, reduces foraging habitat for pallid bats. The hardwoods will be protected within the initial eight management units; therefore, there should be a beneficial effect to the species (SNFPA, Part 4.4).

Pallid bats may roost in tree hollows, which may be burned when the underburning occurs. Bats could leave the area due to smoke from underburning. As stated above, literature shows that they utilize snags. They may leave the area when logging occurs due to noise disturbance.

Cumulative Effects to Pallid Bat

The area considered in determining the cumulative effects of past, present, and reasonably foreseeable activities on pallid bats encompasses the Sierra NF. Based on the following analysis, a determination of viability for the bat will be made.

Biological Evaluations for many of the past projects in the Sierra NF were reviewed to help inform the present analysis. Our review of these documents revealed the following basic information about effects to pallid bats from these activities:

- Twenty-six (26) total project Biological Evaluations (BEs) were reviewed, dating back to 1993 on the Sierra NF.
- Determinations reached were:
    - No effect – 4 BEs
    - May affect individual bats, but not likely to lead to a trend toward federal listing or loss of viability – 10 BEs
    - May affect individual bats, and likely to lead to a trend toward federal listing or loss of viability – 0 BEs
    - Pallid bat was not addressed in the document we reviewed due to lack of habitat or other reasons – 12 BEs
- Types of Projects: Fuels reduction, hazard tree removal, thinning, and underburning were the proposed activities that were most often represented in the sample of BEs in which the pallid bat was analyzed.
- Relative to “May Affect” projects, the described impacts to pallid bats most often fell in the following categories:
    - Loss of roosting trees/snags
    - Displacement because of smoke from underburning
    - Noise disturbance
    - Two KRP-scale projects reduced canopy cover on a total of 210 acres

Additional past, present, and reasonably foreseeable future activities are outlined at the beginning of Chapter 3 of the Kings River FEIS. Two projects mentioned in Chapter 3 would result in a 210-acre reduction in canopy cover at the KRP level: (1) Jose 1 project (60 acres converted from 4M to 4P and 8 acres converted from 3M to 3P), and (2) South of Shaver Project (122 acres converted from 4M to 4P and 20 acres converted from 4D to 4M).

Several risk factors were identified for pallid bats in the SNFPA (USDA 2001c): (1) removal of hardwoods and subsequent reduction in foraging habitat, (2) thick understory vegetation between the ground and eight feet in height, (3) prey reduction resulting from heavy grazing, (4) renewed exploration or closure of mines, (5) recreational caving, and (6) loss of tree roosts. Relative to risk factor #2 (thick understory vegetation), the cool burns and mechanical removal of small trees and brush that would result from implementation of the Proposed Action or Reduce Harvest Tree Size alternatives would benefit the pallid bat by thinning the understory that occurs within eight feet of the ground (Mark Smith, pers. comm., 22 Sept 2006).

Pallid bats occur most frequently below 6,000 feet and are especially sensitive to the removal of hardwoods (USDA 2001c). Except for 4D and 5D, CWHR rates all size classes and densities in blue oak woodlands as High for pallid bat, in terms of meeting its foraging needs. Montane hardwood conifer and montane hardwood habitats are rated

Low for pallid bat by CWHR (California Department of Fish and Game 2005). Currently, there are 32,600 acres of blue oak woodlands and 251,000 acres of montane hardwoods and montane hardwood conifers below 8,000 ft on the Sierra NF in CWHR size classes 2 and higher; 2,732 acres of that total are within the initial eight management units of the KRP area. The protection, maintenance, and enhancement of such westside foothill oaks and montane oaks are expected to benefit pallid bats by ensuring the continued availability of roosting sites. Indeed, all alternatives proposed in the SNFPA would lead to an increase in oak species (USDA 2001c).
Three known night roosts for pallid bats exist on the Sierra NF, and they are at the following locations: (1) Million Dollar Mile Road, (2) under the bridge that crosses Highway 168, before the Rancheria Bridge, and (3) on the Kings River Ranger District. To date, the Million Dollar Mile roost can only be entered via a locked gate, to which Southern California Edison (SCE) employees have sole access. There are no protection measures on the two additional roost sites because they are located along public access routes through the Forest. With respect to human recreation pressure on these sites, the only pressure has come, and in the foreseeable future will continue to come, from forest visitors in their personal vehicles.

Cumulative effects discussed in the SNFPA stated that there have been no recent changes in the range or distribution of the pallid bat (USDA 2001c). For these reasons, and given the long-term objective for increasing the number of large trees across the landscape, the intention of reducing fuels, and the foregoing discussion of effects, the cumulative effects of vegetation management activities in the KRP initial eight management units taken together with past, present, and reasonably foreseeable activities on the Forest will not result in a loss of viability for the pallid bat.

Townsend’s Big-eared Bat

Direct and Indirect Effects

The distribution of the species is patchy and associated with limestone caves, lava tubes, and man-made structures, such as mines and abandoned buildings. Given the requirement of a specific environment and this bat’s sedentary behavior, it is likely that Townsend’s big-eared bat is limited by roost site availability. Although natural deterioration of caves and mines is expected, the majority of roost loss is related to human activity in the form of disturbance, demolition, renewed mining, hazard abatement, or vandalism (SNFPA Part 4.4). There will be no direct or indirect effects to the species because treatments will not occur in their habitat of caves, mines or other areas mentioned above.

Cumulative Effects to Townsend’s Big-eared Bat

Although not much is known about the Townsend's big-eared bat, projects are rarely implemented in its habitat. Gates have been installed to protect the caves and to provide suitable structures for bats to enter and exit known areas. The Townsend's big-eared bat is a relatively sedentary species. As a result, if appropriate foraging habitat is unavailable or inaccessible then providing roosting habitat may not be adequate for complete conservation of this species. However, lack of spatial data prevents a thorough analysis of foraging habitat (USDA 2001c). At a larger scale, there is no indication that there have been reductions in the Townsend's big-eared bat's historic range or in the habitat upon which this species depends. Hardwood habitat throughout this species' range is declining but to what extent this is affecting the species is uncertain. Fluctuations in the development and use of mines and caves have been reported (USDA 2001c). Because there will be no direct or indirect effects resulting from implementation of the proposed action, there will be no cumulative effects to Townsend's big-eared bat and therefore viability for this species will not be affected by the Kings River Project.

Management Indicator Species Habitat and/or Population Information and Effects of the Alternatives on those Species that are Not Sensitive

Mule Deer, MIS

Habitat-Species Relationships and Forest Habitat and Population Data

Mule deer are thought to occupy about 64 million acres of habitat in California. Of that total, estimates of the amount of suitable habitat in the Sierra Nevada range from 2,262,890 acres (SNFPA 2001) to over 11 million acres as calculated by summing High and Moderate CWHR habitat capability types for this species. The CWHR High and Moderate habitat estimate for the Sierra National Forest is currently 493,000 acres.

Quantity of habitat on the Sierra National Forest has decreased by about 70,000 acres between 1996 and 2006 (USDA Forest Service 2006). The population of mule deer in California and in the Sierra Nevada has been described as “demonstrably widespread, abundant, and secure” (NatureServe 2005). Within Hunt Zone D-6, 39.4% of which is comprised of Forest Service lands from the Stanislaus and Sierra National Forests, the California Department of Fish and Game estimated the population of mule deer to be 24,600 individuals in 2002 (CDFG 2003). Similarly, the population trend for Deer Assessment Units 5 and 6, which include lands on the Sierra National Forest, has been described as Increasing and Stable, respectively. The Sierra National Forest reports that monitoring of the Yosemite Deer Herd during the 2001 – 2004 period shows a slight downward population trend (USDA Forest Service 2006). These population data gathered from the Sierra NF and other areas in the Sierra Nevada for the Deer Assessment Units and Deer Herds present on the Sierra NF indicate a stable or secure Forest-wide population trend.

For more detailed information on habitat-species relationships and forest habitat and population data, see the Management Indicator Species Specialist Report – Kings River Project (Robinson 2006).

Direct, Indirect, and Cumulative Effects of the Proposed Action

The North Kings Deer Herd Segment is located on the western slopes of the Sierra Nevada Mountains in Fresno County. In the LRMP, important habitat types for deer were described and specific areas were identified where management for these habitat types is emphasized. Each type has standards and guidelines in the LRMP for management and they are incorporated into stand prescriptions where they occur in the initial eight management units. The specific areas that occur in the initial eight management units are listed in the following table.

Deer habitat types found in the project area, displayed by management unit.

Management Unit	Holding Area	Migration Corridors	Population Center	Winter Range
Bear_fen_6	Oak Flat (#12)	Yes	No	No
El_O_Win	Big Fir-Dinkey-Lower Dinkey (#11)	Yes	Dinkey (#13)	No
Glen_Meadow_1	No	Yes	No	No
KREW_Bul_1	No	Yes	No	No
KREW_Prv_1	Summit (#9); Blue Canyon – Providence (#10)	Yes	No	No
N_Soapro_2	No	No	No	Secata-Cottonwood (#6)
Providen_1	Summit (#9)	Yes	No	No
Providen_4	No	No	No	Secata-Cottonwood (#6)

With the application of the LRMP standards and guidelines, direct and indirect effects to deer will be minimal because the most important habitat types to deer will receive the management emphasis called for in the LRMP and the KRP uneven-aged silvicultural treatments and prescribed burning will tend to improve deer foraging habitat.

The cumulative effects are considered at the scale of the KRP project area and extended to the entire Sierra National Forest. Outside of the initial eight management units but within the rest of the KRP, there is substantial summer range at higher elevations and winter range at lower elevations. The KRP encompasses most of the range of the North Kings Deer Herd Segment and the deer move with the seasons over this large area of the forest. To determine cumulative effects to deer, the activities described at the beginning of Chapter 3 of the FEIS (e.g., plantation maintenance and thinning, fuels reduction and underburn projects, hazard tree removal, and uneven-aged management on private land) were considered. These management activities will affect no less than 24,000 acres and some loss of suitable habitat in selected areas is to be expected. However, considered together with those activities proposed in the initial eight management units and possible future treatments in the KRP, these predominantly uneven-aged management activities are expected to have a beneficial cumulative impact to deer by providing the openings and vegetation/structural diversity needed for deer foraging habitat.

Project Impacts to MIS Population Attributes or Trends at the Forest Scale

The Kings River Project will affect 10,250 acres of deer habitat, which is 2% of the 493,000 acres of deer habitat on the Sierra NF and equivalent to about 21 deer home ranges (assumes an average home range size is 480 acres or 0.75 mi^2, as reported by the

California Department of Fish and Game (2005:M181)). Given the proportionately small quantity of habitat affected and the expectation that many impacts will be beneficial to deer, the direct, indirect, and cumulative effects of the alternatives are not expected to change the current Forest scale habitat or population trends of mule deer on the Sierra National Forest.

Riparian Avian Species, MIS

Habitat-Species Relationships and Forest Habitat and Population Data

The Warbling Vireo (WAVI), White-crowned Sparrow (WCSP), Wilson's Warbler (WIWA), and Yellow Warbler (YWAR) were selected to represent a range of meadow edge / riparian habitat types. WAVI is a fairly common to common, summer resident throughout much of California, but occurs only as a spring and fall migrant in the southern interior and Central Valley (CWHR 2005). WCSP is common-to-abundant year-round in California, breeding in higher mountains, and in the humid coastal strip south to Santa Barbara County; it is widespread from October to April throughout most of state, below heavy snows (CHWR 2005). WIWA is a common migrant and summer visitor the length of California (CWHR 2005). The Yellow Warbler (YWAR) breeds from northern Alaska across northern Canada to Labrador, south to Panama and through West Indies to northern coast of South America, and winters in southern California, southern Arizona, northern Mexico, and southern Florida south to central Peru, northern Bolivia, and Amazonian Brazil (NatureServe 2005). In California, the YWAR breeds from the coast range in Del Norte county, east to Modoc plateau, south along the coast range to Santa Barbara and Ventura counties and along the western slope of the Sierra Nevada south to Kern county; it also breeds along the eastern side of California, from the Lake Tahoe area south through Inyo County and in several southern California mountain ranges and throughout most of San Diego County (CWHR 2005).

Management concerns applicable to these species include cowbird parasitism and habitat degradation resulting from grazing.

Population trend information reported below for these species is derived from the BBS data analyzed at a variety of scales. For more information about the BBS data and how they have been applied to this report, please see USDA Forest Service (2006).

The current estimate of suitable habitat for the WIWA and WAVI is 181,000 acres (USDA Forest Service 2006). These acres were computed by summing the acres of CWHR habitat types extending out 200 meters from perennial streams, lakes, and meadows into the surrounding forest across the Sierra NF. YWAR and WCSP utilize habitat within about 35 meters of streams or small meadows and openings (3acres or greater). Resolution of small meadows and openings is poor on the Sierra NF Vegetation GIS Coverages so it was not possible to calculate the current acreage of habitat for these species.

Population trend data for each of these species is shown in the following table and is adapted from information in the Sierra National Forest MIS Report (USDA Forest Service 2006). At a statewide scale, each of these four species has a negative population trend. Within the Sierra Nevada, population trend data are less certain, though with the exception of WAVI, all still appear to be declining. Population trends for these species at the North American scale of the entire BBS range from Definitely Decreasing (Wilson's Warbler) to Definitely Increasing (Warbling Vireo). With population trend data suggesting these species to be declining in California, and the Sierra Nevada representing a significant portion of their range in the state, the habitat needs of these species should be a priority of land managers here.

Population trends for riparian avian species, as computed from BBS data for the 1966-2004 survey.

	Population Trend Summary For Riparian Avian Species		
Species Name	Sierra Nevada	California	Survey-Wide
Warbling Vireo	Definitely Stable	Definitely Decreasing	Definitely Increasing
White-crowned Sparrow	Possibly Decreasing	Definitely Decreasing	Likely Decreasing
Wilson's Warbler	Likely Decreasing	Definitely Decreasing	Definitely Decreasing
Yellow Warbler	Possibly Decreasing	Possibly Decreasing	Definitely Stable

At the Forest scale, the Warbling Vireo is monitored on eight of nine BBS routes with an average population trend estimate of 7.25% per year; the White-crowned Sparrow is monitored on three of nine BBS routes; the Wilson's Warbler and Yellow Warbler are monitored on seven of nine BBS routes (Appendix 1mis). Average population trend estimates for the latter three species are stable. All Forest-level average population trend estimates provided here only utilized the LOESS trend estimator (Appendix 1mis). Purcell (2006) found that WAVIs were most abundant at mid-elevation mixed conifer forests on the Sierra NF. Mixed conifer habitat also had the highest rates of nest success, followed by ponderosa pine and true fir.

For more detailed information on habitat-species relationships and forest habitat and population data, see the Management Indicator Species Specialist Report – Kings River Project (Robinson 2006).

Direct, Indirect, and Cumulative Effects of the Proposed Action

The proposed activities (Alternatives 1 and 3) will begin implementation of a landscape level program of uneven-aged silviculture and prescribed fire on over 9,000 acres within the approximate 13,700-acre project area. Specifically, 9,751 acres are planned for mechanical treatments using a combination of methods (e.g., helicopter, tractor bunch, etc.). Herbicides (glyphosate) will be applied to 1,183 acres, and prescribed burning would occur on over 9,000 acres. During implementation of these treatments, project design measures and best management practices that were incorporated into the proposed action include (but are not limited to) the following:

- Follow all applicable aquatic wildlife species and riparian habitat standards and guidelines from the 2004 Sierra Nevada Forest Plan Amendment (USDA 2004a), the existing Sierra National Forest LRMP direction (USDA 1992), FSH 2509.22 Sierra Supplement #1 for treatments within stream management zones (USDA 1990), Best Management Practices and other applicable laws and regulations.
- Riparian Conservation Areas include a protected area of 300 feet on either side of perennial streams, measured from the bank full edge of the stream.
- Within Riparian Conservation Areas, no mechanical equipment is allowed within 100 feet of meadows or other special aquatic features and a no streambank trees are cut.
- Within Riparian Conservation Areas, reduce as much as possible ground disturbing impacts
- Special protection measures for California red-legged frogs, Western pond turtle, and relictual slender salamander
- A number of Best Management Practices, including Streamside Management Zone designation, meadow protection, streamcourse and aquatic protection, consideration of water quality in formulating fire prescriptions, protection of water quality from prescribed fire effects, protection of wetlands (ground-disturbing activities are not allowed in wetlands or meadows)
- Do not remove or otherwise alter existing riparian vegetation

These project design measures will substantially minimize (although by no means completely eliminate) impacts to fish and wildlife species dependent on riparian and meadow habitats. This is especially true for individuals of riparian- or meadow-dependent species whose breeding and/or foraging areas extend beyond the protection zones described above. In large part, however, treatments will be kept out of meadows and the immediate riparian habitats. Exceptions to the above project design measures occur and were made to accommodate the Kings River Experimental Watershed Study in the krew_bul_1 and krew_prv_1 management units, as described in the Project Design Measures listed in Chapter 2. Noise from the operation of equipment adjacent to riparian areas may cause intermittent or periodic disturbance to species in these habitats. Birds tend to temporarily move away from noise-generating activities; however, the full effects of noise disturbance are not known and are certainly expected to vary between species. Depending on the timing and location of the proposed activities, nests of some individuals may be disturbed or destroyed. The proposed actions do not increase the amount of grazing activity in the planning area and are therefore not expected to have any measurable impact on cowbird parasitism rates or grazing pressures that may be affecting the target species (WIWA, WCSP, WAVI, and YWAR).

The Best Management Practices and some of the specific KRP project design measures listed above may also apply to the activities described at the beginning of Chapter 3 (e.g., plantation maintenance and thinning, fuels reduction and underburn projects, and hazard tree removal). Considering these other ongoing or reasonably foreseeable actions planned for the KRP project area, the cumulative effects of implementing the proposed activities (Alternatives 1 or 3) is the temporary displacement of wildlife species from meadows or riparian areas due to noise disturbance and the impacts to riparian- or meadow-dependent species whose breeding or foraging areas extend beyond the protection zones created by the project design measures. Such effects are, however, ameliorated by the broad protection extended to riparian and meadow habitats via the project design measures and Best Management Practices described above.

Alternative 2 (the No Action alternative) would have no impact on the riparian species or their habitat.

Project Impacts to MIS Population Attributes or Trends at the Forest Scale

Implementation of the proposed activities (Alternatives 1 or 3) may affect individual riparian- or meadow-dependent avian species but is not expected to have any measurable impact on the ability of these species to breed and reproduce in riparian and meadow habitats on the Sierra National Forest. Based on existing home range data for these species, ground-disturbing activities in riparian areas that are one to three acres in size may adversely affect one breeding pair; however, given the project design standards and Best Management Practices that are in place, such disturbances will not be common or widespread. Therefore, the direct, indirect, and cumulative effects of the alternatives are not expected to change the current Forest scale habitat or population trends for riparian avian species on the Sierra National Forest.

Oak Woodland Avian Species, MIS

Habitat-Species Relationships and Forest Habitat and Population Data

The Acorn Woodpecker (ACWO), Blue-gray Gnatcatcher (BGGN), and Oak Titmouse (OATI) were selected to represent a range of hardwood/oak woodland habitat types. The BGGN is an uncommon to common California summer resident in xeric, upland woodland and scrub habitats, especially with oaks (CWHR 2005). The OATI is a common resident in cismontane California, from the Mexican border to Humboldt County (CWHR 2005). ACWO is a common yearlong California resident, occurring in western Sierra Nevada foothills, Coast Ranges, Klamath Range, and locally on the eastern Sierra Nevada slope from Modoc to Nevada Counties (CWHR 2005).

The greatest threat facing these species in the Sierra Nevada is the widespread development of oak woodland habitats. Both OATI and ACWO are totally dependent on oaks, thus they are susceptible to any management practices that result in the loss or degradation of oaks and oak woodland habitat. Both of these species are cavity nesters thus they require snags and natural cavities in senescing oaks. Conversely, any project that results in the increase in oak habitat and oak vigor including increased mast production and oak regeneration should benefit these species. While BGGN are strongly correlated with oak woodland in the Sierra Nevada, they are not directly dependent on oaks (PRBO unpublished data). The key habitat attribute for this species in oak woodlands appears to be shrub understory (CalPIF 2002a, PRBO unpublished data). Fuel reductions that remove or inhibit shrub understory within oak woodlands may have a negative impact on this species. It should be noted that all three of these species are far more abundant in blue oak (*Quercus douglasii*) woodlands in the Sierra Nevada than higher elevation black oak dominated woodlands (pers. comm., Ryan Burnett). On the Sierra NF, the blue oak woodland habitat usually does not extend much higher on the slope than about the 3000 ft elevation mark, where it is replaced by California black oak (*Quercus kelloggii*).

Over the past decade, acres of suitable habitat (i.e., oak woodlands, ponderosa pine) for the Acorn Woodpecker have increased across the forest from 300,000 to 326,000 acres (USDA Forest Service 2006). The prime habitat for the other species considered in this group of species typically occurs at elevations lower than those extant in the KRP area.

Population trend data for each of these species is shown in the following table and is adapted from information in the Sierra National Forest MIS Report (USDA Forest Service 2006). At a statewide scale, populations appear to be stable except for the Oak Titmouse, which is likely in decline. Within the Sierra Nevada, a decreasing tendency is evident for two of the three species, while the BGGN shows an increasing tendency. Population trends for these species at the North American scale of the entire BBS range from Likely Stable (Blue-gray Gnatcatcher and Acorn Woodpecker) to Likely Decreasing (Oak Titmouse).

Population trends for oak woodland avian species, as computed from BBS data for the 1966-2004 survey period.

	Population Trend Summary For Oak Woodland Avian Species		
Species Name	Sierra Nevada	California	Survey-Wide
Blue-gray Gnatcatcher	Increasing Tendency	Definitely Stable	Likely Stable
Oak Titmouse	Decreasing Tendency	Likely Decreasing	Likely Decreasing
Acorn Woodpecker	Decreasing Tendency	Likely Stable	Likely Stable

At the Forest scale, the Blue-gray Gnatcatcher is monitored on seven of nine BBS routes with an average population trend estimate of 3.2% per year; and the Oak Titmouse and Acorn Woodpecker are monitored on nine BBS route with average population trend estimates of –8.06% and –4.86% per year, respectively (Appendix 1mis). All Forest-level average population trend estimates provided here only utilized the LOESS trend estimator (Appendix 1mis). Between 1985 and 2006, additional monitoring data for these species have been collected at the San Joaquin Experimental Range on the Sierra National Forest in Madera County by Dr. Kathryn Purcell (K. Purcell, pers. comm., 22 Sept 2006).

For more detailed information on habitat-species relationships and forest habitat and population data, see the Management Indicator Species Specialist Report – Kings River Project (Robinson 2006).

Direct, Indirect, and Cumulative Effects of the Proposed Action

The proposed activities (Alternatives 1 and 3) will begin implementation of a landscape level program of uneven-aged silviculture and prescribed fire on over 9,000 acres within the approximate 13,700-acre project area. Specifically, 9,751 acres are planned for mechanical treatments using a combination of methods (e.g., helicopter, tractor bunch, etc.). Herbicides (glyphosate) will be applied to 1,183 acres, and prescribed burning would occur on over 9,000 acres. Of the eight management units included in the proposed action, only three of them contain appreciable quantities (e.g., between 100 and 700 acres each) of hardwood/oak woodland habitats: N_soapro_2, Providen_1, and Providen_4.

Currently, the dominant CWHR forest types across the initial eight management units are Ponderosa pine (28%) and Sierra mixed conifer (43%); montane hardwood (1,044 acres) and montane hardwood conifer (394 acres) make up only 8% and 3%, respectively, of the vegetation within the initial eight project area. Mixed chaparral and montane chaparral forest types currently total 890 acres, which is approximately 6% of the total habitat within the initial eight management units.

Implementation of the proposed activities (alternatives 1 or 3) would result in a slight decrease (about 55 acres) in trees in size classes 2 and 3 and about 108 more acres in size classes 4 and 5 (Tables 6mis, 7mis, and 8mis). These changes are small compared to the existing condition within the project area and the total of 4235 acres of oak woodland habitat within the approximate 72,000 acres of forested land comprising all 80 management units of the KRP (Tables 9mis and 10mis). Over the following ten years, considering all of the reasonably foreseeable and ongoing activities identified at the beginning of Chapter 3 of the FEIS, additional changes are expected; however, as shown above, the magnitude of these shifts is likely to be small compared to the total acres available. The loss of oak woodlands has been identified as a management concern for species dependent on this habitat. However, for the reasons stated here, the KRP is not expected to contribute to additional appreciable losses of oak woodland habitat.

Noise from the operation of equipment in or adjacent to oak woodlands may cause intermittent or periodic disturbance to species in these habitats. Birds tend to temporarily move away from noise-generating activities; however, the full effects of noise disturbance are not known and are certainly expected to vary between species. Depending on the timing and location of the proposed activities, nests of some individuals may be disturbed or destroyed. The proposed actions do not increase the amount of grazing activity in the planning area and are therefore not expected to have any measurable impact on cowbird parasitism rates or grazing pressures that may be affecting the BGGN.

The following design measure will apply throughout the KRP project area:

“Provide for oaks for wildlife needs, maintain the 5 to 35 percent of growing space devoted to oaks. Also, maintain all decadent oaks throughout the stand(s) within the limits appropriate for each forest type. Do not remove decadent oaks. Do not prevent over topping of decadent oaks.”

At the same time, the proposed activities meet the stated purpose and need of the KRP, which is to increase the number of large trees across the landscape and reduce tree density while increasing the proportion of shade intolerant species such as pine and black oak.

The No Action alternative would have no direct impact on the oak woodland species or their habitat, though with current fire suppression the continued encroachment of shade tolerant conifers would continue unabated resulting in further declines in the quantity and quality of black oak habitat with which these species may occur.

As noted above, the prime habitat for species such as the Acorn Woodpecker and Oak Titmouse is found in the blue oak woodlands, which typically occur at elevations lower than those in the KRP area. Indeed, no blue oak woodlands occur in the project area (initial eight management units), and only 66 acres of blue oak woodland are found across the entire set of the 80 KRP management units (Tables 9mis and 10mis). Because oaks in general are largely unaffected by the proposed activities (Alternative 1 or 3) and because oak woodland habitat in particular is generally absent from the planning area, the cumulative effects of implementing the proposed action are negligible.

Project Impacts to MIS Population Attributes or Trends at the Forest Scale

Implementation of the proposed action may affect individual oak woodland-dependent avian species but is not expected to have any measurable impact on the ability of these species to breed and reproduce in oak woodland habitats on the Sierra National Forest. Based on existing home range data for these species, ground-disturbing activities in oak woodland habitat that are as large as five acres in size may adversely affect one breeding pair; however, given the project design standards and Best Management Practices that are in place, such disturbances will not be common or widespread. Therefore, with the project resulting in an increase in the quality and quantity of oak components of mixed conifer forest, the project may increase the suitable habitat for these species. Thus, the direct, indirect, and cumulative effects of the alternatives are not expected to change the current Forest scale habitat or population trends for oak woodland avian species on the Sierra National Forest.

Meadow Edge Avian Species, MIS

See the discussion under Riparian Avian Species above for full discussion of this species guild.

Mature Mixed-Conifer Avian Species, MIS

Habitat-Species Relationships and Forest Habitat and Population Data

The California Spotted Owl, Northern, Olive-sided Flycatcher, and Western Tanager were selected to represent a range of mixed conifer forest habitats, from open forests to dense mature forests. The California Spotted Owl and Northern Goshawk are addressed separately in this MIS report and are analyzed in depth in the biological evaluation for the KRP.

The Olive-sided Flycatcher (OSFL) is an uncommon to common breeding resident from May – August in a wide variety of forest and woodland habitats below 2800 m (9000 ft) throughout California exclusive of the deserts, the Central Valley, and other lowland valleys and basins (CWHR 2005). The Western Tanager (WETA) is a common breeding resident of montane forests from May through August throughout most of California, including coastal ranges; it is common and widespread in migration in foothills and lowlands, and winters rarely along the coast, mostly south of Monterey Bay (CWHR 2005).

Management concerns for these species are summarized as follows, using information contained in the Sierra National Forest's MIS Report (USDA Forest Service 2006). "The Olive-sided Flycatcher's association with decreased canopy cover allows it to respond positively to timber management. Using fire as a management tool also benefits the Olive-sided Flycatcher. Many studies indicate an increase in Olive-sided Flycatchers as canopy cover decreases (CALPIF 2002).

"Most sources suggest that Western Tanagers are not harmed by disturbances and favor stands with openings and edge or ecotone situations including those associated with second growth after logging, lake margins, and rock bluffs. However, in mixed-conifer forests of the Sierra Nevada, densities were significantly reduced after natural fires (CALPIF 2002 referencing Bock and Lynch 1970). Brood parasitism should always be a concern in locations that could potentially harbor large cowbird populations, especially areas with large amounts of grazing (CALPIF 2002)."

Throughout migration and during breeding, these two species may be found in habitats other than mixed conifer forests; however, for the purposes of this analysis for Management Indicator Species, the only habitat that will be addressed below is mixed coniferous forests, the primary breeding habitat for these two species in the Sierra Nevada.

During the period ranging from 1996 to 2006, mixed conifer habitat in general increased from 232,000 to 240,000 acres (USDA Forest Service 2006). Using the description of suitable habitat provided above for the Western Tanager and Olive-sided flycatcher, suitable habitat currently on the Sierra National Forest for these two species is approximately 79,000 acres for the WETA and 67,000 acres for the OSFL.

Population trend data for each of these species is shown in following table and is adapted from information in the Sierra National Forest MIS Report (USDA Forest Service 2006). Within the Sierras and at a statewide scale, populations of the Western Tanager are likely stable while populations of the Olive-sided Flycatcher are definitely decreasing. Population trends for these species at the North American scale of the entire BBS are similar, except that the data reflects an even more stable population for Western Tanagers.

Population trends for mixed conifer avian species, as computed from BBS data for the 1966-2004 survey period.

	Population Trend Summary For Mixed-Conifer Avian Species		
Species Name	Sierra Nevada	California	Survey-Wide
Western Tanager	Likely Stable	Likely Stable	Definitely Stable
Olive-sided Flycatcher	Definitely Decreasing	Definitely Decreasing	Definitely Decreasing

At the Forest scale, the Western Tanager is monitored on eight of nine BBS routes with an average population trend estimate of 3.89% per year; and the Olive-sided Flycatcher is monitored on six of nine BBS routes with a an average population trend estimate of – 1.67% per year (Appendix 1mis). All Forest-level average population trend estimates provided here only utilized the LOESS trend estimator (Appendix 1mis).

For more detailed information on habitat-species relationships and forest habitat and population data, see the Management Indicator Species Specialist Report – Kings River Project (Robinson 2006).

Direct, Indirect, and Cumulative Effects of the Proposed Action

The proposed activities (Alternatives 1 and 3) will begin implementation of a landscape level program of uneven-aged silviculture and prescribed fire on over 9,000 acres within the approximate 13,700-acre project area. Specifically, 9,751 acres are planned for mechanical treatments using a combination of methods (e.g., helicopter, tractor bunch, etc.). Herbicides (glyphosate) will be applied to 1,183 acres, and prescribed burning would occur on over 9,000 acres.

Currently, the dominant CWHR forest types across the initial eight management units are Ponderosa pine (28%) and Sierra mixed conifer (43%). Sierra mixed conifer habitat currently comprises 5,926 acres across the initial eight management units.

Implementation of the proposed activities (alternatives 1 and 3) would result in acres of coniferous forest (e.g., Ponderosa pine, red fir, Sierra mixed conifer) dropping by about 111 acres in size classes 2 and 3 and by about 160 acres in size classes 4 and 5 (Tables 6mis, 7mis, and 8mis). These changes, however, are small compared to the existing condition within the project area and the more than 56,000 acres of coniferous forests within the approximate 72,000 acres comprising all 80 management units of the KRP (Tables 9mis and 10mis). Over the following ten years, considering all of the reasonably foreseeable and ongoing activities identified at the beginning of Chapter 3 of the FEIS, additional changes are expected; however, as shown above, the magnitude of these shifts is likely to be small compared to the total acres available.

Noise from the operation of equipment in or adjacent to mixed conifer stands may cause intermittent or periodic disturbance to species in these habitats. Birds tend to temporarily move away from noise-generating activities; however, the full effects of noise disturbance are not known and are certainly expected to vary between species. Depending on the timing and location of the proposed activities, nests of some individuals may be disturbed or destroyed. The proposed actions do not increase the amount of grazing activity in the planning area and are therefore not expected to have any measurable impact on cowbird parasitism rates or grazing pressures that may be affecting the WETA. Forest management and prescribed fire activities foster the development of open spaces or ecotone habitats favored by both of these species. Additionally, the project will increase the quality and quantity of hardwood components of mixed conifer forest that WETA are associated with and increase forest openings that OSFL favor.

The No Action alternative would have no direct impact on the mixed coniferous forest species or their habitat. The opportunity to increase the number of large trees, increase the representation of shade intolerant hardwoods, and create a more diverse open forest structure favored by these species would be lost under this alternative.

The combination of reintroducing fire to the landscape, creating small openings or edge habitat, enhancing black oak, and increasing the number of large trees over time will have a mostly beneficial cumulative effect on species such as the Olive-sided Flycatcher and Western Tanager, whose environmental preferences and life history needs are dependent on the presence of these habitat elements. The mixed conifer habitat type is the most abundant habitat type (43% of existing vegetation) in the project area (Table 6mis). Over time, as the KRP and other projects are implemented, the location of prime habitat for these species will gradually shift as some stands mature and others are thinned or harvested as they would have under the natural disturbance regime that these species evolved with in the Sierra Nevada. As the role of fire has been reduced in shaping Sierra Nevada forests mechanical treatments and prescribed fire as proposed in this project can mimic natural disturbance and increase habitat quality for these and other mixed conifer forest bird species. In the long-term, and at a much larger scale, overall cumulative impacts to species such as these which migrate to Central or South America, will involve an integrated combination of factors taking place on their breeding grounds and habitat loss occurring on the species' wintering grounds.

<u>Project Impacts to MIS Population Attributes or Trends at the Forest Scale</u>

Implementation of the proposed action may affect individual mixed conifer-dependent avian species but is not expected to have any measurable impact on the ability of these species to breed and reproduce in these habitats on the Sierra National Forest. Based on existing home range data for these species, ground-disturbing activities in Sierran mixed conifer habitat that are seven acres or larger may adversely affect one breeding pair of Western Tanager; disturbances across larger areas may impact a territory of Olive-sided Flycatcher. However, given that forest management and prescribed fire activities foster the development of open spaces or ecotone habitats that are favored by both of these species, some of these disturbances may benefit these species. Therefore, the direct, indirect, and cumulative effects of the alternatives are not expected to change the current Forest scale habitat or population trends for mature mixed conifer avian species on the Sierra National Forest.

All Terrestrial Species

Direct Effects from Spraying Glyphosate and a Surfactant (R-11) of Alternative 1 and 3

No direct effects are expected to occur because the herbicide (Accord plus R-11) would not be applied to fish and wildlife unless an accident occurs or project design features are not followed. The VMFEIS (on pages 4-43 to 4-45) describes an analysis of direct effects to wildlife such as rubbing against or eating treated vegetation and concludes none are likely to occur.

Indirect and Cumulative Effects to Terrestrial Species from Spraying Glyphosate and a Surfactant of Alternative 1 and 3

There is little effect on fish or wildlife if glyphosate is applied at the recommended rate. The toxicity is extremely low because it is highly water soluble, so does not bioaccumulate, and because the mode of action is by inhibiting the formation of the amino acid phenylalanine. This is one of the essential amino acids, which cannot be synthesized by animals, so it is affecting a process only carried on by plants (Newton and Knight 1981).

For additional information on the likelihood of glyphosate having an estrogen mimicking effect, see the Section on Aquatic Species.

Direct, Indirect and Cumulative Effects from Spraying Glyphosate and a Surfactant (R-11) of Alternative 2

There are no effects.

Determinations for All Alternatives

Alternative 3 is similar to Alternative 1, except that the uneven aged management strategy is modified to reduce vegetation treatments to trees 30" dbh and smaller (compared to 35" dbh and smaller in Alternative 1); protection measures for the Pacific fisher (*Martes pennanti pacifica*) are adopted; and all treatments outside of the research areas will be consistent with the standards and guidelines in the SNFPA ROD (USDA 2004).

Alternative 1, the Proposed Action and Alternative 3, the Reduction in Harvest Tree Size Alternative Determinations

Based on the above assessment of direct, indirect, and cumulative effects, the District Biologist determined that implementation of the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the California Spotted Owl under alternative 1 and 3. This determination is based on:

1. Although operations may affect individual owls or owl pairs through changes in forest structure and disturbance effects, the overall reduction in fire hazard and an emphasis on uneven-aged management will help maintain larger amounts and better California Spotted Owl habitat throughout the planning area.

2. Operations will affect between 1881 and 4729 acres yearly, which represents between 1.5% and 3.5% of the planning area, respectively.
3. Because of the dispersed nature of the project, we assume that foraging owls could select areas away from the operational disturbance and reduce the impact on any individual's reproductive potential.
4. Loss of habitat across all PACs would range from one acre up to 36 acres per individual PAC, with an average loss of 6.6 acres of suitable habitat. The amount of suitable habitat would not change under the proposed activities for five PACs.
5. Based on the amount of forested habitat with more than 40% canopy closure and the amount of suitable habitat within owl home ranges, the potential for reproduction in the project area appears very good and the capability for owls to replace themselves exists throughout the entire project area. These conditions would persist under both of these alternatives.
6. The activities proposed in the KRP are within the scope of effects considered and described by the USFWS in its 12-month finding to not list the California Spotted Owl. As a result, the KRP would not result in any cumulative effects that are greater than those already analyzed by the USFWS when it determined that listing of the California Spotted Owl as Threatened or Endangered is not warranted at this time.

The District Biologist determined the Kings River Project under alternative 1 or 3 may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the marten because martens may forage in the area. As vegetation treatments are implemented it may cause noise disturbance and the animals may leave the areas for a short time. Overall, resting habitat in the area will increase once vegetation treatments occur and in the long term it will allow more space for trees to grow larger and therefore provide habitat for two (foraging and resting) of the marten's three life history needs (denning, foraging, resting).

The District Biologist determined the Kings River Project under alternative 1 and 3 may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the fisher because:

1. An estimated 28-36 individual fishers inhabit the KRP. It is thought the numbers are stable (Purcell 2006).
2 The dispersed nature of the project allows foraging fisher the opportunity to move away from operation disturbance and there is anecdotal information they do so.
3 Several provisions have been made in the design of the management units (and the scheduling of treatments within them), as discussed above, to minimize effects and improve habitat. These include:
    a. Provisions for OFL
    b. Meeting the need to increase the number of large trees
    c. Designing management units in a manner that limits their size and disperses the treatments within them over time
    d. Minimum canopy cover retention levels based on historic and geographic information that provides evidence the levels are sustainable over time in a fire adapted ecosystem

4 Operations will affect between approximately 4,726 acres and 1,881 acres yearly. This represents between 1.5% and 3.5% of the planning area for however long the treatment of management units continues.
5 The UMS according to the fire modeling described above will reduce the loss of habitat when a severe fire strikes a management unit.
6 Part of the purpose and need is to provide the opportunity to study the effects of the UMS and prescribed fire on fisher and their habitat as envisioned by the proposed PSW monitoring study. That need will be met under these alternatives.
7 The Fish and Wildlife Service found the fisher is proposed for listing for the following reasons:
   a. low reproductive rate
   b. low dispersal abilities
   c. its dependence on closed canopy, late successional forests in West Coast range
   d. alteration of forest habitats as a result of logging and conversion to other land uses

8 The proposed project will improve the primary habitat issue – the impact of fires and the effects of future fires. If alternative 1 or 3 is implemented it will move the habitat closer to high suitable habitat and reduce the habitat fragmentation due to wildfire.

The District Biologist determined that under alternative 1 and 3 the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the Wolverine and the Sierra Nevada red fox because there is suitable habitat in the KRP planning area and although there are no animals present today, one or both of the species could reoccupy the area at sometime in the future.

Under alternative 1 or 3, the District Biologist determined the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the goshawk due to noise disturbance from mechanical and prescribed fire activities. It may be a short term negative effect to the species for the reasons listed above; however, it will be a long term beneficial effect because it will increase tree size and canopy over time.

Under alternative 1 and 3 the District Biologist determined the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the Great Gray Owl because the owls may use the trees for roosting, or the area for foraging, as well as they may leave the area because of smoke when underburning or when vegetation treatments occur. It will be a short tem effect to the species and a benefit in the long run due to the removal of suppressed trees, allowing the growth on dominant trees to grow larger. The owls will continue to use the areas for foraging.

Under alternative 1 and 3 the District Biologist determined the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the Pallid bat because the bats may use the trees for roosting, and they may leave the area because of smoke during underburning activities. There would also be noise disturbance to the bats while logging occurs.

Under alternative 1 and 3 the District Biologist determined the Kings River Project will not affect the Townsend's big-eared bat because treatments are not occurring within or adjacent to their habitat.

Alternative 2 – No Action Determinations

Based on the above assessment of direct, indirect, and cumulative effects, the District Biologist determined that alternative 2 of the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the California Spotted Owl. This determination is based on the assumption that taking no action maintains or exacerbates the current effects of stand-replacement fire over time – leading to a potentially greater loss of suitable habitat should one or more fires occur within the planning area.

Under alternative 2, the District Biologist determined the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the martin or fisher. This determination is based on the assumption that taking no action maintains or exacerbates the current effects of stand-replacement fire over time – leading to a potentially greater loss of suitable habitat should one or more fires occur within the planning area.

The District Biologist determined that under alternative 2 the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the wolverine and the Sierra Nevada red fox because there is suitable habitat in the KRP planning area and although there are no animals present today, one or both of the species could reoccupy the area at sometime in the future.

Under alternative 2, the District Biologist determined the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the great gray owl or goshawk. This determination is based on the assumption that taking no action maintains or exacerbates the current effects of stand-replacement fire over time – leading to a potentially greater loss of suitable habitat should one or more fires occur within the planning area.

Under alternative 2, the District Biologist determined the Kings River Project may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the Pallid bat. This determination is based on the assumption that taking no action maintains or exacerbates the current effects of stand-replacement fire over time – leading to a potentially greater loss of suitable habitat should one or more fires occur within the planning area.

Under alternative 2, the District Biologist determined the Kings River Project will not affect the Townsend's big-eared bat because treatments are not occurring within or adjacent to their habitat.

Table 3-41 - Summary of determinations for All Alternatives

Species	Status	Determination for the Initial Eight Management Units of the Kings River Project
California spotted owl	Forest Service Sensitive Management Indicator Species	***may affect, but is not likely to lead to federal listing or loss of viability***
Marten	Forest Service Sensitive Management Indicator Species	***may affect, but is not likely to lead to federal listing or loss of viability***
Fisher	Federal Candidate Forest Service Sensitive Management Indicator Species	***may affect, but is not likely to lead to federal listing or loss of viability***
Wolverine	Forest Service Sensitive	***may affect, but is not likely to lead to federal listing or loss of viability***
Sierra Nevada red fox	Forest Service Sensitive	***may affect, but is not likely to lead to federal listing or loss of viability***
Northern goshawk	Forest Service Sensitive	***may affect, but is not likely to lead to federal listing or loss of viability***
Great gray owl	Forest Service Sensitive	***may affect, but is not likely to lead to federal listing or loss of viability***
Pallid bat	Forest Service Sensitive	***may affect, but is not likely to lead to federal listing or loss of viability***
Townsend's big-eared bat	Forest Service Sensitive	***no effect***

SOILS

Affected Environment

The project area is underlain with 13 soil types that combine into 25 soil map units. The most dominant soils affected by the project include: Shaver family, Holland family, Chaix family, Gerle family, Cagwin family, Umpa family, Chawanakee family, Sirretta family, Auberry family, Tollhouse family, and Typic Xerumbrepts. The soils that have the greatest extent or acreage within the proposed treatment areas are Shaver family, Holland family, Cagwin family and Gerle family. The majority of soil in the project area is moderately deep (20-40 inches) to deep (60 inches). Shaver family and Holland family soils are deep (> 40 inches). Some areas of shallow soils (< 20 inches) and rock outcrop occur in the area and these soils consist of Chawanakee family, Dystric Lithic Xerocrepts, and Tollhouse family soils. The soils vary in characteristics from shallow to deep, thermic to frigid temperature regimes, xeric moisture conditions and have developed in metamorphic and granitic parent materials (Giger, 1993). See soils report in the project file for more information.

Soils in the proposed project area vary in their sensitivity to management. Soils with higher clay content and soil moisture have the highest potential to reduced soil porosity. Soil compaction can occur down to 12" deep. Soils that are shallow have the potential for a loss of soil productivity.

There is a concern that:

- Areas proposed for ground based harvest have soils that are highly susceptible to reduction of soil porosity caused from compaction by heavy equipment operating when soils are moist or wet.
- Prescribed fire and tractor piling will reduce soil cover and accelerated erosion could result in a loss of soil productivity.
- Ground based harvest systems on slopes that are too steep or have shallow soils will displace surface soil horizons that could result in accelerated erosion and reduced soil productivity.

Ground disturbance within RCA's was determined by analyzing areas that will have ground disturbing activities within the eight proposed management units. The definition of ground disturbing activities according to the Sierra Nevada Forest Plan Amendment is " activities that result in detrimental soil compaction or loss of organic matter beyond the thresholds identified by soil quality standards" (USDA, 2004). These activities include tractor logging or some form of tractor piling or some form of heavy equipment operation off of established roads. Helicopter logging and prescribed fire are not considered ground disturbing activities.

The total acres of RCA's in the 8 proposed management units are 11,556 acres or 83% of the total project area (13,847 acres). Approximately, 4,743 acres of RCA in the project area either is not included in the project proposal or the areas are proposed for "no treatment" or as a "control" in the case of the krew_prv_1 and krew_bul_1 management units. An additional 2,628 acres will not be disturbed because these areas are either streamside management zones and are equipment exclusion zones where ground disturbing activities will not permitted or they are proposed for helicopter logging with under burning or gross yarding for fuel treatments, which are also considered non-ground disturbing. Gross yarding will result in removing the whole tree with a helicopter to a landing where processing of the tree will occur on a landing. The resultant RCA that will be disturbed is 4,185 acres or 36.21%.

The 4,185 acres of disturbed ground will not be completely disturbed. Design measures for the Kings River Project include maintaining at least 90% of the soil porosity over 15% of an activity area found under natural conditions. This means that up to 15% of an activity area can have disturbed ground. Applying 15% disturbance factor to 4,185 acres of potentially disturbs ground in the RCA amounts to 5.43%. Therefore, a peer review will not be required for this project.

Holland soils have a moderate soil compaction hazard and high to very high maximum erosion hazard rating. These soils are most sensitive to management and they occur in soil map units 136, 137, 138, 139, and 140. These soil map units occur in the South of Shaver 1 (SOS-1) project area, providen_1, n_soapro_2, bear_fen_6, providen_4, and krew_prv_1 management units.

Soil map units with high amounts of impervious surfaces such as rock outcrop or shallow soils are most susceptible to runoff and subsequent surface erosion of soils adjacent to the rock outcrop. Soil map units with a rock outcrop component include soil map units 126, 150, 148, 123, 159, 166, 110, 113, 116, 147. Soil map units with inclusions of rock outcrop and or shallow soils include soil map units 139, 135, 138, 140, and 112. These soil map units are distributed throughout all proposed project areas and are a concern for increased runoff and potential accelerated erosion of soils below the rock outcrop and within the shallow soils.

Areas proposed for ground based harvest systems are generally less then 35%. However, some areas exist where slopes exceed 35% and tractor logging could result in soil disturbance that mixes or removes soils below the A horizon.

Some areas are proposed for treatment where rock outcrop and or shallow soils are extensive. These areas have low soil productivity and should not be treated in the proposed action. These areas have been identified from the Order 3 Soil Survey, which is not designed for project planning. Review of digital orthographic quadrangle photos identified that some of those areas of rock out crop are not mapped accurately and some are mapped accurately. The ID team determined that rock outcrops and associated shallow soils are not part of the proposal and during project layout those areas will be excluded.

Soil conditions have been reviewed in all proposed management units. Soil transect data was collected and evaluated in the providen-1, n_soapro_2, bear_fen_6, providen_4, glen_mdw_1, and el_o_win_1 management units. Soil data for the krew_prv_1 and krew_bul_1 management units consisted of data collected by the PSW Fresno lab as part of their base line data collection for their watershed study. This data includes soil cover, large woody debris, and soil bulk density (soil compaction).

Forty eight soil transects consisting of 20 points per transect were collected to characterize soil conditions using the 2005 Framework Soil Monitoring Methods Protocol. Data for soil cover, soil disturbance, soil compaction and large woody debris were collected along transects and summarized in the 2005 Kings River Project Soils Monitoring Report, (Alvarado, 2005) and the 2006 Soil Conditions Report for the n_soapro_2, glen_mdw_1, krew_prv_1, and krew_bul_1 management units. This data will serve as baseline conditions from which to compare soil conditions in the future. Soil transects data showed that soil cover ranges from 86% to 100%, which is well over the Forest Soil Standard and Guideline. Soil compaction ranges from less then 1% to 12.2%. Some areas in the bear_fen_6 management unit have excessive levels of soil compaction that do not meet Forest Standard and Guidelines. Large woody debris (LWD) ranged from 23 to 1.1 pieces/acre. The only areas that do not meet the Forest Standard and Guideline for large woody debris are the providen_4, n_soapro_2, and glen_mdw_1 management units. These areas average 1 piece/acre of large wood debris.

Soil Survey Data

The Glen_Mdw_1 and krew_bul_1 management units have coarse textured, moderately deep to deep soils with less then 25 acres that have been treated in the last 5 years. Soil cover data from the soil transects collected in the other management units shows that existing soil cover is meeting the Forest Soil Quality Standard and Guidelines. In addition, past monitoring has shown that ground cover after mechanical treatment recovers after several years and that existing soil cover meets forest soil quality standard and guidelines (Roath, 1996).

The krew_prov_1 Management Unit has soils that are mostly deep to moderately deep including Holland family soils. Soil textures for most of the soils are coarse loamy to coarse sandy loams and have a low soil compaction hazard. The Holland family soils are present in this management unit and they have a moderate soil compaction hazard and there is a concern for reductions in soil porosity due to soil compaction in these soils. Dystric Lithic Xerocrepts are present in this management unit. These soils are mesic, shallow, and somewhat excessively drained soils formed from metasedimentary parent material. These soils have a slow infiltration rate, a high runoff potential and are highly sensitive to intensive management activities. These soils are susceptible to a potential loss of productivity from logging related disturbances. Approximately 135 acres of this management area has been treated with mechanical equipment in the last 5 years (Gallegos, 2005b). The area with Holland family soils has some soil compaction limited to the existing skid trails. Data has not been collected to determine the degree of soil compaction in these areas. Soil disturbance in this area is also unknown.

The n_soapro_2 management unit has soils that are mostly moderately deep to deep. These soils include Auberry family and Holland family which have coarse sandy loam surface soils and sandy clay loam sub soils. The surface soils have a moderate soil compaction hazard and there is a concern for reductions in soil porosity due to soil compaction in these soils. Tollhouse family soils are also present in this management unit. These soils are mesic, shallow, and somewhat excessively drained soils formed from granitic parent material. These soils have a slow infiltration rate, a high runoff potential and are highly sensitive to intensive management activities. These soils are susceptible to a potential loss of productivity from logging related disturbances. Some areas of lost soil productivity have been identified in the Soaproot Watershed Restoration Plan. Seven deteriorated watershed sites identified in the Soaproot Watershed Restoration Plan are outside of the proposed project area. Approximately 13 acres of the area has been treated with mechanical equipment in the last 10 years (Gallegos, 2005b). The area with Auberry and Holland family soils has some soil compaction limited to the existing skid trails. Data has not been collected to determine the degree of soil compaction in these areas. Soil disturbance in this area is also unknown.

Soil Transect and Grid Data

Soil conditions have been reviewed for all eight management units. Soil transects consisting of 20 points per transect were collected to characterize soil conditions using the 2005 Framework Soil Monitoring Methods Protocol. Data for soil cover, soil disturbance, soil compaction and large woody debris were collected along transects and summarized in the 2005 Kings River Project Soils Monitoring Report and 2006 Soil Conditions Report for the n_soapro_2, glen_mdw_1, krew_prov_1 and krew_bul_1 management units. This report will serve as baseline conditions from which to compare soil conditions in the future.

Soil transects data showed that soil cover ranges from 86% to 100%, which is well over the Forest Soil Standard and Guideline. Soil compaction ranges from less then 1% to 12.2%. Some areas in the Bear_fen_6 management unit have excessive levels of soil compaction that do not meet Forest Standard and Guidelines. Large woody debris (LWD) ranged from 23 to 1.1 pieces/acre. Management units that do not meet the Forest Standard and Guideline for large woody debris is the providen_4, n_soapro_2, and glen_mdw_1 management units, which have the approximately 1 piece/acre of LWD.

The following is a summary of soil conditions for the proposed management units.

Nine soil transects were collected in the el_o_win management unit. Soils in this management unit are mostly Shaver family, Sirretta family, and Umpa family. The average soil cover for all 9 transects is 86%. Transect 3 had an average soil cover of 38%, which is below the Forest Standard and Guideline of 50%. Transect 3 is located in the north end of a plantation in Treatment Unit 480. Less then 1% of the area has compacted soils and that occurred on transect 3, where 5% of the transect is compacted. Large woody debris (LWD) averages 23 pieces per acre, which is 4 times the Forest Standard and Guideline.

Eleven soil transects were collected in the providen_1 management unit. Soils in this management unit are mostly Holland family, Chawanakee family, Dystric Lithic Xerocrepts and rock outcrop. The average soil cover for all 11 transects is 99%. Compacted soils occur on 3 out of 11 soil transects for an average soil compaction of 5.36%. The 3 soil transects where soil compaction was found occurs in treatment units 205, 262, and 350. Large woody debris (LWD) averages 6.3 pieces per acre, which meets the Forest Standard and Guideline of 5 pieces per acre.

Three soil transects were collected in the providen_4 management unit. Soils in this management unit are mostly Holland family, Chaix family, Chawanakee family, and Shaver family. The average soil cover for the 3 transects is 100%. Compacted soils occur on 1 out of the 3 soil transects for an average soil compaction of 3.51%. The 1 soil transect where compaction was found occurs in treatment unit 956. Large woody debris (LWD) averages 1.1 pieces per acre, which does not meet the Forest Standard and Guideline of 5 pieces per acre.

Ten soil transects were collected in the bear_fen_6 management unit. Soils in this management unit are mostly Holland family and Shaver family. The average soil cover for all 10 transects is 97%. One transect had 5% moderately disturbed soils, which includes skid trails with several passes of equipment. One transect did not have a single large woody debris (LWD) piece, however 9 transects had between 98 and 5 LWD pieces/acres. The soil standard and guideline for LWD is 5 pieces/acre. One soil transect had 5% compacted soils. Based on this data, the bear_fen_6 Management Unit meets the Forest Soil Standard and Guidelines.

In 1996, soil monitoring was conducted in the Bear Meadow Project Area (Roath, 1996). A total of 144 soil transects were collected that included data to evaluate soil compaction. The average level of area compacted in the Bear Meadow Area is 12.2%, which is below the Forest Soil Standard and Guideline of 15%. Some individual stands have excessive levels of soil compaction that does not meet Forest Standard and Guidelines. Stands in the Bear Meadow Project Area that do not meet compaction standards include 7, 8, 20, 21, 23, 24, 25, 26, and 27 (see Bear Meadow Project Area Stand Map). Five of the nine stands that do not meet soil compaction standards occur in the Holland family soil type.

Nine soil transects were collected in the n_soapro_2 management unit. Soils in this management unit are mostly Auberry family, Holland family, Tollhouse family and rock outcrop. The average soil cover for the 9 transects is 97%, which meets forest standard and guidelines. Compacted soils occur on 4 out of the 9 soil transects for an average soil compaction of the management unit of 8%. This area is currently meeting forest standard and guidelines for soil compaction. The 4 soil transects where compaction was found occurs in treatment units 691, 698, and 591. Large woody debris averages 1 piece/ac, which does not meet the forest standard and guideline of 5 pieces/ac.

Six soil transects were collected in the glen_mdw_1 management unit. Soils in management unit are mostly Gerle family, Cagwin family, Umpa family, and Sirretta family soils. The average soil cover for the 6 transects is 87%, which meets forest standard and guideline. Compacted soils occur on 3 out of the six soil transects for an average soil compaction of the management unit of 4%. The 3 soil transects where compaction was found occurs in treatment units 245, 296, and 1037. Large woody debris averages 1 piece/ac, which does not meet the forest standard and guideline of 5 pieces/ac.

The n_soapro_2 management unit has soils that are mostly moderately deep to deep. These soils include Auberry family and Holland family which have coarse sandy loam surface soils and sandy clay loam sub soils. The surface soils have a moderate soil compaction hazard and there is a concern for reductions in soil porosity due to soil compaction in these soils. Tollhouse family soils are also present in this management unit. These soils are mesic, shallow, and somewhat excessively drained, formed from granitic parent material. These soils have a slow infiltration rate, a high runoff potential and are highly sensitive to intensive management activities. These soils are susceptible to a potential loss of productivity from logging related disturbances. Some areas of lost soil productivity have been identified in the Soaproot Watershed Restoration Plan. Seven deteriorated watershed sites identified in the Soaproot Watershed Restoration Plan are outside of the proposed project area. Approximately 13 acres of the area has been treated with mechanical equipment in the last 10 years (Gallegos, 2005b). The area with Auberry and Holland family soils has some soil compaction limited to the existing skid trails. Nine soil transects were collected in the n_soapro_2 management unit. The average soil cover for the 9 transects is 97%, which meets forest standard and guidelines. Compacted soils occur on 4 out of the 9 soil transects for an average soil compaction of the management unit of 8%. This area is currently meeting forest standard and guidelines for soil compaction. The 4 soil transects where compaction was found occurs in treatment units 691, 698, and 591. Large woody debris averages 1 piece/ac, which does not meet the forest standard and guideline of 5 pieces/ac.

Soils in glen_mdw_1 management unit are mostly Gerle family, Cagwin family, Umpa family, and Sirretta family soils. Six soil transects were collected in the Glen Meadow Management Unit. The average soil cover for the 6 transects is 87%, which meets forest standard and guideline. Compacted soils occur on 3 out of the six soil transects for an average soil compaction of the management unit of 4%. The 3 soil transects where compaction was found occurs in treatment units 245, 296, and 1037. Large woody debris averages 1 piece/ac, which does not meet the forest standard and guideline of 5 pieces/ac.

Soils data for the krew_bul_1 and krew_prv_1 management units have been collected by the PSW Fresno Lab, as part of their baseline data collection, for their watershed and soils study. Carolyn Hunsaker, coordinator for the KREW studies, provided their raw data in the form of Microsoft excel spreadsheets and ACCESS Database information. This information was evaluated and analyzed and determined that it meets the standards for determining if soil conditions meet Forest Soil Standard and Guidelines. Large woody debris (LWD) was collected using a different protocol then what is used in the Region 5 Method for soil monitoring. The Region 5 method calls for counting large woody debris over 10' long and at least 12" in diameter, within 37' radius, at every 5th point, along a 20 point transect. Whereas the KREW protocol measures all cover by large woody debris along a transect, in 1 square meter quadrats, at 2, 7 and 12 m along a 22 meter transect (Hunsaker, personal communication). Determining whether measurements of LWD along the KREW transects meets soil standard and guidelines is difficult because of the different protocols. However, 5 logs that are 10' long x 12" in diameter would cover a 50 ft^2 area, which is .1% of an acre. This would suggest that .1% cover in a 1 m^2 quadrant is equivalent to 5 pieces/ac.

Soil bulk density samples were collected at each soil horizon in 44 soil pits that were dug in the krew_bul_1 and krew_prv_1 management units. Soil cover and large woody debris data were collected along 114 transects in the krew_bul_1 and krew_prv_1 management units. The soil pits and vegetation transects were distributed throughout the eight sub-watersheds in their study area. The following is a summary of the soil conditions for the krew_bul_1 and krew_prv_1 management units.

The krew_prov_1 management unit has soils that are mostly deep to moderately deep including Holland family soils. Soil textures for most of the soils are coarse loamy to coarse sandy loams and have a low soil compaction hazard. The Holland family soils are present in this management unit and they have a moderate soil compaction hazard and there is a concern for reductions in soil porosity due to soil compaction in these soils. Dystric Lithic Xerocrepts are present in this management unit. These soils are mesic, shallow, and somewhat excessively drained soils formed from metasedimentary parent material. These soils have a slow infiltration rate, a high runoff potential and are highly sensitive to intensive management activities. These soils are susceptible to a potential loss of productivity from logging related disturbances. Approximately 135 acres of this management area has been treated with mechanical equipment in the last 5 years (Gallegos, 2005b). The area with Holland family soils has some soil compaction limited to the existing skid trails. Soil bulk density samples were collected in 19 soil pits in the krew_prv_1 management unit. Six soil pits were excavated in sub-watershed D102, 5 soil pits were excavated in sub-watershed P301, 4 soil pits were excavated in sub-watershed P303 and 4 soil pits were excavated in sub-watershed P304. Two out of the 19 soil pits, with one in sub-watershed D102 and one in sub-watershed P304 have A soil horizons with soil bulk density samples of 1.37 and 2.17, respectively. The 1.37 soil bulk density sample is on the outer range for soil bulk density for the soil type in this management unit and could indicate compacted soils or soil porosity outside the range of Forest Standard and Guidelines. The 2.17 soil bulk density sample clearly is indicative of compacted soils and does not meet Forest Standard and Guidelines. When all the soil bulk density data is considered, 10.53% of the soils in the krew_prv_1 management unit is compacted and does meet Forest Standard and Guidelines. Fourteen vegetation transects were collected in sub-watershed D102, 13 in sub-watershed P301, 15 in sub-watershed P303, and 10 in sub-watershed P304 for a total of 52 vegetation transects in the krew_prv_1 management unit. Soil cover ranged from 77% to 95% and large woody debris ranged from 16 to 20% for the four sub-watersheds in krew_prv_1. When all the soil cover and large woody debris data is averaged over the management unit, there is 89% soil cover and 18% large woody debris throughout the management unit. Therefore, soil standard and guidelines are being met in the krew_prv_1 management unit.

KREW_bul_1 Management Units have coarse textured, moderately deep to deep soils with less then 25 acres that have been treated in the last 5 years. Soil bulk density samples were collected in 25 soil pits in the krew_bul_1 management unit. Six soil pits were excavated in sub-watershed B201, 6 soil pits were excavated in sub-watershed B203, 6 soil pits were excavated in sub-watershed B204 and 7 soil pits were excavated in sub-watershed T003. Three out of the 25 soil pits, with 3 in sub-watershed B201 and one in sub-watershed B203 have A soil horizons with soil bulk density samples of 1.40, 1.42 and 1.39, respectively. These soil bulk density measurements are on the outer range for soil bulk density for the soil types in this management unit and could indicate compacted soils or soil porosity outside the range of Forest Standard and Guidelines. When all the soil bulk density data is considered, 12% of the soils in the krew_bul_1 management unit is compacted and does meet Forest Standard and Guidelines. Ten vegetation transects were collected in sub-watershed B201, 15 in sub-watershed B203, 15 in sub-watershed B204, and 20 in sub-watershed T003 for a total of 62 vegetation transects in the krew_bul_1 management unit. Soil cover ranged from 85% to 94% and large woody debris ranged from 23 to 32% for the four sub-watersheds in this management unit. When all the soil cover and large woody debris data is considered, there is an average of 91% soil cover and 27% large woody debris throughout this management unit. Therefore, soil standard and guidelines are being met in the krew_bul_1 management unit.

Environmental Consequences

Alternative 1 – Proposed Action

Soil resource management is achieved by maintaining soil productivity using Regional Soil Standard and Guidelines and management direction provided in the Forest Land Management Plan – Sierra National Forest, 1991. The project proposal could affect soil productivity by reducing soil porosity, soil cover and large woody debris.

<u>Direct Effects to Soils in General:</u> Mechanical harvest will cause soil disturbance and poses increased risk of soil compaction and erosion. Standard operating procedures such as cross ditching skid trails for erosion control will reduce the risk of erosion and promote surface soil stabilization and re-vegetation. The soils in this project area are highly productive so rapid natural re-vegetation is expected. Some of these soils are highly susceptible to soil porosity loss, due to compaction from heavy equipment operation when soils are moist or wet. To prevent soil compaction soil moisture needs to be dry enough to reduce the susceptibility to compaction. The ideal moisture content

varies between soils and should not be above 12% to prevent soil compaction. A soil scientist or other earth scientist should be consulted prior to mechanical equipment operating on soils that have a moderate soil compaction hazard, especially outside of the standard operating season (June 1 to October 15). Soil compaction will be reduced by subsoiling skid trails and landings to ensure that soil standard and guidelines are being met in the management units. See soil report in the project record for more details on soils that have a moderate soil compaction hazard.

Tractor logging is planned for areas with slopes under 35%, which will reduce excessive soil displacement. Areas of slopes in excess of 35% will be logged with a helicopter yarding system to prevent undue soil disturbance.

In areas where tractor piling of slash is planned, it is a normal Forest practice to leave at least 50 percent, well distributed soil cover for erosion protection on slopes under 35%. If slopes are greater then 35%, soil cover should be at least 70%. Past observations on the Sierra NF have found that this amount of soil cover generally prevents accelerated erosion. For tractor logging and piling, a design feature is to conduct tractor logging and piling when the soil is dry to avoid soil porosity loss (compaction). A buffer of 100' will be provided around rock outcrop to prevent accelerated erosion of the adjacent soils from rapid runoff from rock outcrops.

No significant impacts to soil productivity are expected given the design measures incorporated in the Proposed Action.

<u>Direct Effects from Mastication Treatment Areas:</u> Areas planned for mastication pose little risk of causing negative effects to soil because this treatment increases soil cover reducing the erosion hazard and generally causes little soil disturbance and compaction.

<u>Direct Effects from Treatment of Fuels with Prescribed Fire:</u> Areas planned for prescribed fire pose little risk of causing significant effects to soil productivity based on the past performance of the High Sierra District prescribed fire program. Past prescribed fires on the district has resulted in low burn severity where the fire has burned in a mosaic leaving patches of unburned vegetation and patches of burned area where duff and litter has burned. Most trees are left undamaged except for a few small patches that have burned at a moderate burn severity. Soil quality standards have been met from past prescribed fires and are expected to be met from the proposed action. Soil cover of 50% is expected to be met on slopes less the 35% and 70% on slopes greater the 35%. Monitoring of prescribed fire areas has shown that soil quality standard are being met in the last 5 years of prescribed fire on the High Sierra District (district files).

<u>Direct Effects from Treatment of Brush and Noxious Weeds by use of Glyphosate:</u> According to a review of studies by Ghassemi and others (1981) glyphosate rapidly attaches to organic matter on top of or in the soil and its mobility is very limited. The soils in the project area include: Holland family, Chaix family, Cannell family, Cagwin family. Glyphosate becomes strongly attached to soil particles or organic matter on the soil surface or the plant surface. It does not become mobile again with additional precipitation and does not leach through the soil. Because of its very low mobility in soil the only mechanism for off site movement of glyphosate would be if it were attached to soil particles that were eroded and transported to another location. Normal hydrolysis in a stream will not break the attachment of glyphosate to soil particles. So, even if the

combination reached the water, it would not be in a form that can be taken up by plants or released through digestion by animals. It would not affect either surface or ground water quality. The only potential impact to the soil resources is from direct disturbance and displacement of the soil by applicators walking on the ground.

Glyphosate provides a means of vegetation control that causes little, if any, direct soil disturbance. The dead foliage and leaf drop onto the soil surface continues to provide protection from erosion until seeds present sprout. It biodegrades within weeks of application into natural products including: carbon dioxide, nitrogen, phosphate and water. The primary metabolite of glyphosate is aminomethylphosphonate (AMPA). The position taken by U.S. EPA/OPP (2002) that AMPA is not of toxicological concern regardless of its levels in food appears to be reasonable and is well-supported (SERA 2003; p. 3-25). The half-life of glyphosate can range from 20 to 60 days (SERA 2003). Effects on soil microflora are minimal and not pronounced (Ghassemi, 1981). There is very little information suggesting that glyphosate will be harmful to soil microorganisms under field conditions and a substantial body of information indicating that glyphosate is likely to enhance or have no effect on soil microorganisms (SERA 2003; p. 4-7). R-11 is also broken down by soil microorganisms.

Indirect Effects

There are no potential indirect effects of the proposed action, to soil productivity, if soil compaction is kept to less then 15% of an activity area and erosion control measures are implemented in a timely manner. There could be an occasional summer storm event that could cause accelerated erosion of bare exposed soils. In the event that this should occur soil erosion sites may be restored to pre-storm conditions either through contracts or appropriated funds.

Cumulative Effects

Cumulative effects to soils are a component of analyzing cumulative watershed effects, so refer to the watershed effects section for the discussion.

Alternative 2 – No Action

If vegetation is left in its current state of high fuels and high wildfire risk, it is inevitable that a wildfire will occur. The area of potential high burn severity would not meet soil quality standards in terms of soil cover. Soil cover would be less the 10% and some soils would develop hydrophobic conditions which would result in accelerated erosion. Soil loss could range from 10–60 tons per acre in these areas. Past monitoring of wildfire areas on the nearby Stanislaus National Forest has found that bare ground averaged about 70% by spring of the first year and by spring of the second year bare ground averaged 27 percent (Janicki, 2003). Large woody debris would probably be consumed in a fire and long term soil productivity could be decreased without large woody debris. There would be no effect to soil porosity.

Modeling of the No Action alternative with a fire in the year 2015 predicted 52 tn/ha/yr (see Watershed Section). Modeling of the proposed action with a fire in the year 2015 predicted 13 tn/ha/yr. This analysis shows that the no action alternative with a fire in the year 2015 will result in 400% more erosion then the proposed action with a fire in the year 2015. This modeling exercise demonstrates that the no action alternative will have a significant effect on erosion and soil productivity if a wildfire occurs.

Alternative 3 – Reduction in Harvest Tree Size

The only difference between this alternative and Alternative 1, on the effects to the soils resource, is the design measures required in those sub-watersheds where cumulative watershed effects are a concern. These sub-watersheds include 519.0057, 519.3053, 519.4051, 520.1002, 520.1051, 520.1101, and 520.1151. These measures are designed to minimize ground disturbance and include light-on-the land mechanical logging and grapple piling of areas proposed for tractor piling. The effects of these treatments will result in no decrease of ground cover from pre-treatment conditions and soil compaction should be mitigated by the sub-soiling of the main skid roads and landings to at least pre-treatment conditions or less. Implementation of the watershed restoration component of the proposed project will result in increased soil productivity at those sites. Existing large woody debris is not expected to decrease because the prescribed burning is designed to be a low burn severity and the fire behavior rarely consumes large woody debris. In addition, trees larger then 30", are being retained and overtime will fall and become large woody debris. No impacts to soil productivity are expected given these management requirements and soil productivity should increase.

Watershed

Affected Environment

This section describes the existing condition and identifies the indicators and analysis methods used in the analysis of environmental consequences on watershed resources.

The Kings River Project lies in the Dinkey Creek and Big Creek watersheds (see Watershed Map 1, in Appendix F), comprised of three 6^{th} code Hydrologic Units (HUC6s); two within Dinkey Creek and one within Big Creek. Dinkey Creek is tributary to the North Fork Kings River and Big Creek flows directly into Pine Flat Reservoir.

Each of these basins is further divided into HUC7s and HUC8s (smaller areas nested within the HUC6s). The R5 Cumulative Watershed Effects (CWE) Analysis is conducted at the HUC8 scale, which ranges from approximately 400 to 2,200 acres in the Kings River Project area. In this analysis, the term 'sub-watershed' is used to refer to HUC8s.

The watershed analysis is based on the following factors: stream flow, water quality (including sediment), and CWE.

Table 3-45 summarizes the hydrography of the management units, based on District GIS data. This table provides a crosswalk between management units, streams, and sub-watersheds for future discussions. These sub-watersheds are shown on Watershed Maps 2a, 2b, and 2c, in Appendix F.

Table 3-45 - Stream systems, sub-watersheds, and miles of stream in each Management Unit.

Management Unit	Main Stream System(s)	Sub-watersheds	Stream miles			
			Perennial (order 3+)	Intermittent (order 2)	Ephemeral (order 1)	Total
Bear_fen_6	Bear Meadow Cr Oak Flat Cr	520.0053 520.0054 520.1001 520.1002 520.1051 520.1101 520.1151	6	6	22	34
El_o_win_1	Dinkey Cr Dinkey Meadow Cr	520.0014 520.0015 520.0016 520.0056 520.0057 520.4001 520.4051 520.4052	7	5	15	27
Glen_mdw_1	Glen Meadow Cr Rock Cr Dinkey Cr	520.0014 520.0016 520.0017 520.0056 520.0057 520.5051	8	6	18	32
Krew_bul_1	Bull Cr	520.3002 520.3051	2	4	8	14
Krew_prv_1	Duff Cr Providence Cr	519.0005 519.0007 519.0008 519.0011 520.0014 520.0016 520.0017	7	8	24	39
N_soapro_1	Rush Cr	519.0009 519.3001 519.3002 519.3003 519.3004 519.3052 519.3053	7	8	22	37
Providen_1	Providence Cr Summit Cr Big Cr	519.0007 519.0008 519.0011 519.0057 519.4001 519.4051	8	12	26	46
Providen_4	Duff Cr Big Cr	519.0007 519.0008 519.0055 519.0056	7	6	11	24

Stream Flow

Average annual precipitation ranges from 30 inches in the n-soapro_2 management unit to almost 60 inches in glen_mdw_1 and el_o_win_1. The stream flow parameters including peak flow, base flow, and annual yield will be used as indicators in the analysis of environmental consequences.

Peak flow is the highest flow for a given time period. There is a peak flow for each precipitation event, for each spring runoff season, and for each water year. Peak flow can be discussed in terms of an instantaneous peak (the highest flow reached, regardless of its duration) or an annual peak based on daily mean flows. There is less variability in daily mean flows, but often the instantaneous peak is important because of its effects on the stream channel and on infrastructure, particularly culverts and bridges.

Base flow is the portion of stream flow that comes from sub-surface rather than surface water sources. The level of base flow varies throughout the year – during wet periods with saturated soils, more sub-surface flow is delivered to streams than during dry periods when soil moisture is low. Base flow will be discussed as a contributor to high flows, but changes will only be estimated for the low flow period.

Annual yield is the average amount of water that flows out of an area over a one year period. It is often reported in acre-feet / year, which is the depth that the total volume of flow would cover a one acre flat surface.

Baseline stream flow data for the KREW Watershed Study has been collected in Providence, Duff, and Bull Creek watersheds since October 2003. The data collected at these stations is intended to answer specific questions about the response of flows in these small headwater drainages to the vegetation treatments, including before and after comparisons as well as comparisons between treated areas and ‘control’ areas that receive no treatment. It is also helpful in describing the current hydrology of the project area.

Automatic data loggers record the stream flow at least once every hour at each of 7 flumes in the project area, shown on Watershed Map 1 (Appendix F). Figure 3-58 shows an example hydrograph for selected stations in Water Year 2005 (WY 2005 = October 1, 2004 – September 30, 2005). Daily mean flows (the average of all flows recorded each day) are shown for two stations, Duff Creek (D102) and Bull Creek (B203). The project file contains this data and a complete set of hydrographs.

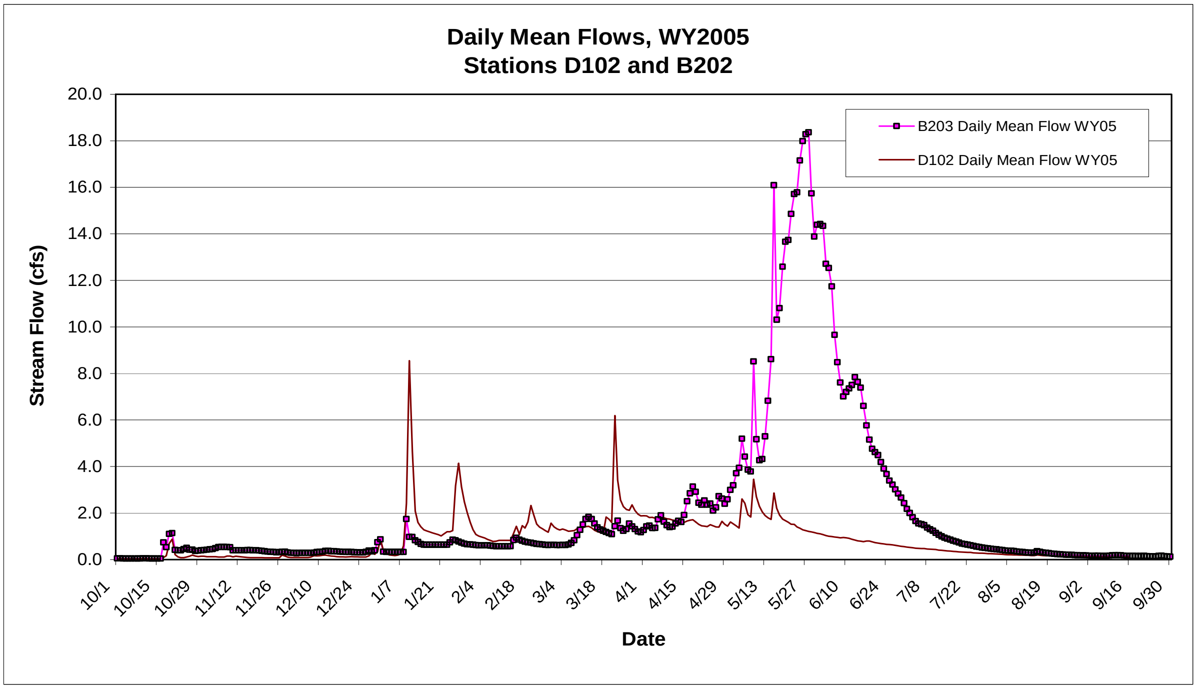


Figure 3-58 - Hydrograph of daily mean flows at stations D102 and B203, KREW Study.

In Figure 3-58, a clear difference can be seen between Duff 102 and Bull 203. Duff Creek (elev. 4920 ft) responds to winter season precipitation by producing immediate spikes, while in Bull Creek (elev. 7235) these spikes are much less dramatic. There is a sustained peak at B203 in May and June that is absent at the Duff Creek site. For example, the maximum daily mean flow in D102 was 8.6 cfs (cubic feet per second), which occurred on January 10. The matching peak at B203 was 1.7 cfs. Bull Creek's maximum daily mean flow occurred on May 28 and was 18.4 cfs. The largest spring flow at D102 was only 3.4 cfs on May 9. This illustrates that Duff Creek is rain-dominated and Bull Creek is snowmelt-dominated. The peaks in early May that occur at both stations are rain events that in Bull Creek were likely rain-on-snow. The data collected at the stations in Providence Creek resembles the Duff Creek data.

The daily maximum flows at these stations are an average of 10 – 15% higher than the daily mean flows. The instantaneous peaks from large storms are as much as 3.5 times higher than the daily mean at a given station.

The flow record is too short to support the calculation of flood frequencies, including bankfull flow. Cross section data has been collected at the stations, but bankfull flows have not yet been estimated (pers. comm., C. Hunsaker, July 25, 2006). Instead, the USGS Regressions for the Sierra Region (Waananen and Crippen 1977) and regional regressions for the Kern River (Kaplan-Henry and Schoener 2002) were used to estimate various return-interval flows[15].

The Kern River relationships were used because they include small watersheds and account for the effects of wildfire on small watersheds. The benefit of both of these methods is that they can be applied to any size watershed, including the sub-watersheds (HUC8s) used for the CWE analysis. However, Kaplan-Henry and Schoener (2002) found that the Sierra Region relationships under-estimated flows at sites with drainage areas less than 10 mi^2 in the Kern River Basin. Although the project area differs from the Kern River in several ways, and flows in the project

[15] Flows of various return intervals are denoted by Qx where Q = flow in cubic feet per second (cfs) and x = the return interval in years.

area may be more closely approximated by the Sierra Regional relationships than the Kern River stations are, both estimates are presented to represent the possible range of flows. The Kern River relationships are of particular interest for evaluating the possible effects of a wildfire such as the McNalley Fire.

The complete set of calculated flow estimates is available in the project file. In general, the flows calculated with the Kern River relationships are slightly lower than the USGS estimates for return intervals up to 5 years. At Q10, the results are fairly close, but the Kern River estimates are slightly higher in smaller watersheds. At Q50, the Kern River relationships produce flow estimates that are two orders of magnitude higher than the USGS regional relationships. Table 3-46 shows a few examples.

Table 3-46 - Subset of flow estimates at various return intervals, calculated with USGS Regional Regressions (Waananen and Crippen 1977) and with Kern River relationships (Kaplan-Henry and Schoener 2002). All flows in cfs (cubic feet per second).

Station or sub-watershed #	Q2		Q5		Q10		Q25		Q50	
	USGS	Kern	USGS	Kern	USGS	Kern	USGS	Kern	USGS	Kern
D102	10.3	6.8	33.0	13.6	52.3	59.9	90.2	414	178	5580
B203	10.0	7.4	32.8	15.1	52.5	65.0	91.4	442	183	5782
519.0005	37.3	16.5	107	37.5	165	133	278	783	527	7870
520.1001	19.4	10.4	58.4	22.1	91.1	87.9	155	563	299	6580

The USGS maintained a stream flow measurement station on Big Creek downstream of the project area from 1953 to 1973. There have been two stations on Dinkey Creek, one upstream of the project area and another at the mouth. Another station was operated on Rock Creek, a tributary to Dinkey Creek. The locations of these stations are shown on Watershed Map 1, in Appendix F. The data collected at these stations was used in developing the Regional Regressions for the Sierra. A summary of the data at these stations from Waananen and Crippen (1977) is shown in Table 3-47 and Table 3-48 shows a summarization of the data by unit area (flow per square mile of drainage area) for comparison between stations.

Table 3-47 – Stream flow at USGS gauging stations at various intervals (from Waananen and Crippen 1977). Flows in cfs.

Station	Drainage Area (mi^2)	Elevation (ft)	Average Annual Precip (in)	Q2	Q5	Q10	Q25	Q50
Big Cr	70	961	35	1810	4670	7700	13200	18800
Dinkey Cr	51	5440	38	1050	1780	2350	3170	3850
Dinkey @ mouth	136	1283	35	1940	3190	4140	5500	6620
Rock Cr	7.6	6148	36	404	928	1440	2320	3160

Table 3-48 - Selected stream flow information from USGS gaging stations operated in the project area watersheds, presented as absolute value and as normalized value (from Gallegos 2004).

Station	Mean Annual Flood cfs/mi²	Largest Rain-on-Snow Flood (cfs/mi²)	Largest Snowmelt Flood (cfs/mi²)	Period of Record
Big Cr	45	234	N/A	1953-73
Dinkey Cr*	48	219	50	1921-35; 1977-87
Dinkey @ mouth	2236		2900	1920-37
Rock Cr	110	375	62	1960-70

*The 1977-87 data from Dinkey Creek is not reflected in Table, which is based on data published in 1977

The monthly average flows for Big Creek are also displayed in the Big Creek Watershed Analysis, and presented in Figure 3-59. The shape of the hydrograph of the tributary Duff Creek at D102 (shown in Figure 3-58- 1st hydrograph) generally fits these monthly average flows in Big Creek.

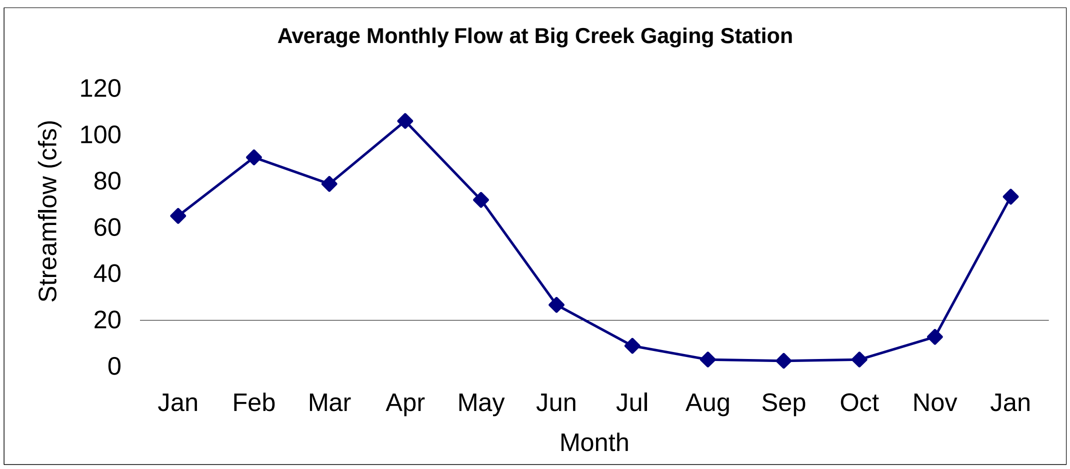


Figure 3-59 – Monthly average flows at the Big Creek gauging station, from Gallegos 2004.

Analysis Methods for Evaluating Changes in Stream Flow: Literature reviewed (and summarized in the General Discussion of Environmental Consequences) reports the effects of forest management actions on stream flow in terms of the amount of forest cover removed. For this analysis, the percent change in basal area and the percent change in forest canopy were calculated for each vegetation patch modeled in the vegetation and fuels analyses. These were then aggregated at the sub-watershed scale as a weighted average. These values are compared to reported studies in order to qualitatively predict the effects of the alternatives on stream flow.

Water Quality

Water quality in the project area is managed under the Water Quality Control Plan for the Tulare Lake Basin (Central Valley Regional Water Quality Control Board (CVRWQCB) 2004). This plan designates the beneficial uses to be protected, water quality objectives, and an implementation program for achieving objectives. The designated beneficial uses in the project area are shown in Table 3-49.

Table 3-49. California designated Beneficial Uses for Dinkey Creek and Big Creek, based on the Water Quality Control Plan for the Tulare Lake Basin.

Beneficial Use	Dinkey Creek	Big Creek
POW – Hydropower Generation	X	X
REC1 – Water Contact Recreation	X	X
REC2 – Non-Contact Water Recreation	X	X
WARM – Warm Freshwater Habitat (including reproduction and early development)	X	X
COLD – Cold Freshwater Habitat	X	X
WILD – Wildlife Habitat	X	X
RARE – Rare, Threatened, or Endangered Species	X	
SPWN – Spawning, Reproduction, and/or Early Development (cold water)	X	
FRSH – Freshwater Replenishment	X	X

Hydropower generation occurs at Pine Flat Dam, downstream of the project area. Water contact and non-contact recreation occurs in the streams in and downstream from the project and at Pine Flat Reservoir. Aquatic habitat is discussed more comprehensively in the Aquatics section, but some elements of habitat, such as sedimentation, are analyzed in this section.

Section 303(d) of the Clean Water Act requires states to identify waters that are not meeting water quality objectives and are at risk of not fully supporting their designated beneficial uses. These water bodies are called Water Quality Limited Segments (WQLS). The 2002 list is the most recent California list that has been approved by the EPA. No water bodies in the Kings River Project area are listed as water quality impaired. The nearest listed segment is the Lower Kings River approximately 50 miles downstream of Pine Flat Dam, which is identified for Electrical Conductivity, Molybdenum, and Toxaphene, all due to agricultural uses.

Water Quality Objectives are narrative or numeric limits designed to protect beneficial uses of water. The parameters with specified objectives in the Tulare Lakes Basin Control Plan include ammonia, bacteria, biostimulatory substances, chemical constituents, color, dissolved oxygen, floating material, oil and grease, pH, pesticides, radioactivity, salinity, sediment, settleable material, tastes and odors, temperature, toxicity, and turbidity. The parameters that this project has the potential to affect are chemical constituents (glyphosate), dissolved oxygen (DO), sediment, temperature, and turbidity.

Limited water quality sampling has been conducted in the analysis area. Between 1979 and 1983, the Forest collected water chemistry data at established stations on an irregular schedule. Data that was collected on dissolved oxygen, temperature, and turbidity at the mouth of Big Creek and the mouth of Dinkey Creek are presented in Table 3-48. Sampling locations are shown in Watershed Map 1 (Appendix F). These locations are well downstream of the project area, but serve as general indicators of the water quality in these watersheds. Since 1999, water quality data has been collected as part of Stream Condition Inventory (SCI) assessments, and aquatic species-specific surveys. This information includes macroinvertebrate samples (an indicator of water quality). This data is presented in the Aquatic Species Report (Sanders 2006b). More recent data has also been collected on sediment, which is considered to be the primary threat to water quality in these watersheds. Sediment data is discussed in a separate section below.

Table 3-50 - Water quality in Big Creek and Dinkey Creek, 1979-1983, including temperature, dissolved oxygen (DO), and turbidity.

Sample location	Date	Temp (air/water)	DO (mg/l)	Turbidity (NTU)
Big Creek	6/14/79	27 / 22° C	8.3	0.36
	12/22/81	13 / 5°C	9.0	0.34
	7/7/83	21 / 18°C	8.1	2.2
	10/21/82	21 / 11° C	8.4	10
	12/3/83	22 / 12° C	10.6	3.0
	11/1/84	Not recorded	9.1	10
Dinkey Creek	6/14/79	27 / 16° C	9.2	0.6
	12/16/81	22 / 10° C	9.0	3.0
	10/21/82	21 / 11° C	9.0	100
	7/7/83	15 / 4.5°C (water temp suspect)	10.5	0.75
	12/3/83	20 / 10° C	12.5	30
	11/1/84	Not recorded	9.2	20

The applicable CVRWQCB objective for temperature states:

> "Natural temperatures of waters shall not be altered unless it can be demonstrated to the Regional Water Board that such alteration in temperature does not affect beneficial uses".

Temperatures are not thought to be a limiting factor for beneficial uses in these watersheds. The temperature recorded in Big Creek in June 1979 (22° C or 72° F) is the highest in this data set, and is similar to the maximum temperatures recorded with continuous data loggers in Big, Providence, and Summit Creeks in the summer of 2005 (Sanders 2006b; Strand 2006). The effects of this project on temperature are analyzed in the Aquatics section.

Dissolved oxygen (DO) is an important water quality parameter because aquatic organisms need oxygen. DO levels can range from 0 – 18 mg/l; levels of 5-6 mg/l are stressful for organisms, and lower can be fatal (Renn 1970). DO is related to water temperature; generally, cooler water has higher DO. Turbulence increases DO as oxygen from the air gets mixed into the water. Other factors that exert a control on DO include photosynthesis, respiration, and decomposition of plant material. Photosynthesis only occurs during the day, and it increases DO. Respiration and plant decomposition occur around the clock, and deplete DO.

The applicable CVRWQCB water quality objective for dissolved oxygen (DO) state:

> "The DO in surface waters shall always meet or exceed 7.0 mg/l in waters designated COLD or SPWN".

Although the data record is short and sporadic, DO levels in these watersheds do not appear to be at risk of not meeting the objective. Dissolved Oxygen will not be used as an indicator of Environmental Consequences in this analysis.

Turbidity is a measure of the amount of fine material suspended in the water. Water with higher turbidity is cloudier than water with low turbidity. Turbidity varies naturally and is often higher during rainfall runoff, especially during large storms. It is often higher when stream flow is rising ('on the rising limb of the hydrograph') than when stream flow is falling. Chronically increased turbidity can result in increased temperature because solar warming has a greater effect on water carrying fine sediment particles. Fine sediment particles can also be associated with nutrients, and more nutrients can increase aquatic production, which in turn depletes DO. In the analysis area, erosion could carry fine sediment to streams and cause an increase in turbidity.

The applicable CVRWQCB water quality objective for turbidity states:

> "Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:
>
> - Where natural turbidity is between 0 and 5 NTU, increases shall not exceed 1 NTU.
> - Where natural turbidity is between 5 and 50 NTU, increases shall not exceed 20 percent.
> - Where natural turbidity is equal to or between 50 and 100 NTU, increases shall not exceed 10 NTU.
> - Where natural turbidity is greater than 100 NTU, increases shall not exceed 10 percent.
>
> In determining compliance with the above limits, the Regional Water Board may prescribe appropriate averaging periods provided that beneficial uses will be fully protected."

The highest measured turbidity in this data set occurred on 10/21/82 in both streams, and likely represents storm runoff although weather conditions were not noted at the time of data collection.

The data presented in Table 3-51 does not allow comparison with the water quality objectives. Because turbidity is highly variable seasonally and in response to runoff events, determining natural background levels is very difficult and requires continuous monitoring (National Council for Air and Stream Improvement (NCASI) 1999). Turbidity varies with flow levels – it tends to be lower in the drier, base flow period (June and July) and higher during winter, higher precipitation period (see Table 3-51). Literature shows that it also varies in different locations in the same stream, and in different positions both across a single channel cross section and at different positions in the flow profile (i.e., at different depths) (NCASI 1999). Conroy (2003) found that two identical turbidity meters gave different readings for the same sample, and Davies-Colley and Smith (2001) found even greater differences when different types of meters were used, making it difficult to compare data collected by more than a single meter.

Turbidity has not been thoroughly investigated in these watersheds because it is not thought to impair beneficial uses. It will not be used as an indicator of environmental consequences in this analysis.

Glyphosate is an herbicide that would be used in each of the action alternatives. The Tulare Lake Basin Control Plan does not specify objectives for glyphosate, but does note that waters designated MUN (municipal supply) shall comply with water quality objectives in Title 22 of the California Code of Regulations. The referenced table for Organic Chemicals displays numeric objectives for glyphosate in drinking water ranging from 700 – 1000 ppb (parts per billion). The project area waters are not designated for municipal use. However, glyphosate will be tracked through the analysis of effects due to public interest in the environmental effects of herbicides.

Routine water quality sampling does not include a test for glyphosate. However, in Bakke's (2001) review of studies of glyphosate use on several forests including the Sierra, surface water samples resulted in no detections (detection limits ranged from 6 to 25 ppb). Glyphosate is probably not currently present in surface water in the analysis area.

Sediment is the primary threat to water quality in the project area. The indicator used to measure sediment on the Sierra NF is V* ("V-star"), which is the fraction of scoured pool volume that is occupied by fine sediment (Lisle and Hilton 1992, Hilton and Lisle 1993). This is thought to be a good index of variations in fine sediment supply. Lisle and Hilton (1999) show that V* correlates with annual sediment yield in systems with abundant sandy sediment, and that changes in V* correspond to changes in the balance between sediment supply and sediment transport.

V* was collected in 1995, 1996, 1997, 2003, and 2004 in the Big Creek and Dinkey Creek watersheds to quantify existing fine sediment storage. Watershed Maps 2a, 2b, and 2c (Appendix F) show the locations of these V* reaches.

Data collected in the 1990s used a variation of the V* technique, and is not directly comparable to more recent data. The measurement areas were not explicitly identified and therefore cannot be revisited with confidence. The reaches were not selected using the criteria recommended by Hilton and Lisle (1993), and far fewer than the recommended 10 pools were sampled in almost every case. The data collected beginning in 2003 follows the established guidelines for V* measurement closely, and will be used as the baseline for project monitoring. However, the older data can be generalized for comparison with desired conditions.

The desired condition (DC) for sediment in pools in the Big Creek watershed, based on watershed potential considering the geology, soils, and channel types, is a maximum of 30%. V* was measured in twenty stream reaches in the Big Creek watershed in the 1990s. These reaches span from the headwaters of Summit Creek to the lower reaches of Big Creek (see Watershed Map 2a in Appendix F for approximate locations) and include some tributaries. Forty percent of the sampled areas had V* values that exceeded the DC. The 2003-2004 data in Big Creek (see Table 3-51) shows that both sampled reaches in Big Creek are above the DC. The reach in Summit Creek just above the confluence with Big Creek meets the DC.

The desired condition for sediment in pools in the Dinkey Creek watershed, based on the watershed potential considering the geology, soils, and channel types, is a maximum of 20%. This is lower than the DC in Big Creek due to differences in soils and channel types. Twenty-four stream reaches were measured in Dinkey Creek in the 1990s, from the headwaters of Dinkey Creek and including several tributaries (see Watershed Maps 2b and 2c for approximate locations). Eighty-three percent of these sampled areas met the DC. The reaches in upper (520.1002-1) and lower Bear Meadow Creek (520.1051-1 and 520.1051-2) are noteworthy because the measured V* values were approximately 80%, far higher than the DC. The reach in Oak Flat Creek (520.1151-1), tributary to Bear Meadow Creek, slightly exceeded the DC.

Table 3-51 - V* reach data 2003-2004 (after Morales 2004). (Reaches beginning with 519 are located in the Big Creek watershed. Reaches numbered 520 are in Dinkey Creek.)

Management Units	Creek	Reach #	# Pools	Mean V*
Not in initial eight management units	Big	519.0012-1	10	0.68
providen_1	Big	519.0057-1	10	0.40
providen_1	Summit	519.4051-1	10	0.18
Not in initial eight management units	Dinkey	520.0056-1	3	0.04
glen_mdw_1	Glen Meadow	520.0017-1	10	0.16
bear_fen_6	Oak Flat	520.1151-1	8	0.45
bear_fen_6	Oak Flat	520.1151-2	10	0.61

The 2003-2004 data in Dinkey Creek shows that surveyed reaches in Dinkey and Glen Meadow Creeks meet the DC. Both surveyed reaches in Oak Flat Creek clearly exceed the DC. Because of the limitations of the earlier data, the difference in V* values in Oak Flat Creek between the earlier measurement and the recent data cannot be interpreted as a trend.

The analysis method for evaluating changes in sediment relies on literature, WEPP modeling (described in the CWE analysis), current V* values, channel types (described below), the expected changes in flows, and the professional judgment of the hydrologist and geologist. Three sources are considered in the analysis of sediment; roads, treatment units, and in-channel erosion. The analysis of effects on sediment levels utilizes five types of information; the predicted effects on erosion and sedimentation from the soils analysis, the predicted increases in flows from this analysis, the effects of design measures whose purpose is to minimize or mitigate effects, channel type (sensitivity to disturbance) and channel condition (existing bank stability).

In addition to V*, stream condition data has been collected at various locations throughout the project area (see Watershed Maps 2a, 2b, and 2c) using the R5 Stream Condition Inventory (SCI) protocols (Frazier and others 2005). SCI was developed to inventory and monitor stream condition, and to enable comparison of conditions within or between reaches with statistical confidence. A suite of attributes are collected in order to characterize the channel. Baseline SCI reaches will be established and monitored as described in the Adaptive Management Plan, to detect possible changes in these streams. The baseline data has already been collected for some of the reaches.

For this analysis, bank stability measurements from SCI are used as an indicator of possible channel response to increases in flow that may result from project implementation. Rosgen channel type (Rosgen 1996) is also used as an indicator of sensitivity to disturbance. “Disturbance” includes changes in flow and sediment supply coming from upstream. It is important to note that this data represents the reach where it was collected, not the entire stream channel. Table 3-52 presents these attributes from the SCI data collected in the project area in 2005.

Table 3-52 - Selected SCI attributes for sample reaches in the project area. Bank stability ratings are based on 100 data points collected on each bank at 50 locations within the reach. Channel type is an average of 3 surveyed cross sections within each reach. The interpretation of sensitivity to disturbance comes from Table 8-1 in Rosgen (1996).

Reach	Sub-watershed	Bank Stability			Channel Type	Sensitivity to disturbance
		Stable	Vulnerable	Unstable		
Big Cr 7	519.0056	90%	9%	1%	B4c	moderate
Big Cr 4b	519.0012	37%	38%	25%	B4c	moderate
Big Cr 4a	519.0057	33%	40%	27%	F4	extreme
Big Cr trib	519.0011	71%	20%	9%	B3a*	low
Summit Cr	519.4051	75%	23%	2%	B3c	low
Oak Flat Cr	520.1002 520.1051	32%	39%	29%	B4c	moderate
Laurel Cr	520.4001	66%	23%	11%	B4c	moderate
Bull Cr	520.3002	65%	30%	5%	C3b	moderate

* indicates a transport reach, based on the reach gradient; all others are response reaches.

The SCI Technical Guide (Frazier and others 2005) presents a data summary from forests in the northern Sierras collected during pilot development of the program. This data is sorted into 'reference' and 'non-reference' sites, and 'transport' and 'response' stream reaches. In that data set, reference response reaches had a mean stability of 75%, and non-reference response reaches averaged 53% stable. The stability in transport reaches was slightly higher: 81% at reference sites and 56% at non-reference sites. Using these values as general indicators, the reaches Big Cr 4a, Big Cr 4b, and Oak Flat Cr have lower channel stability than would be expected, all in the 30-40% range. This is especially a concern for reach Big Cr 4a, where the channel type is extremely sensitive to disturbance.

Channel typing has also been done to various levels as part of other data collection efforts since 1989. High sensitivity reaches are listed in Table 3-53. The analysis method for evaluating effects on sensitive channel types is based on consideration of the estimated effects on stream flows and sediment, how those changes would be transmitted downstream and their potential to trigger effects in these locations. The indicator is change in stream bank stability.

Table 3-53 - Reaches with channel types characterized as having 'very high' or 'extreme' sensitivity to disturbance (per Rosgen 1996).

Management Unit	Sensitive Channel Reach Locations	Sub-watershed
bear_fen_6	B5 reach in headwaters of tributary to Bear Meadow Cr, outside of MU B4 reach on Bear Meadow Cr, near downstream end of MU F4/G4 reaches on Oak Flat Creek, at downstream end of MU	520.1051 520.1051 520.1151
el_o_win_1	B4 reach on tributary to Dinkey Creek	520.0017
glen_mdw_1	B4 reach on tributary to Glen Meadow Creek	520.0057
krew_bul_1	A4 and B6 reaches in headwater tributaries of Bull Creek	520.3002
krew_prv_1	None known	-
n_soapro_2	C4 reaches in Rush Creek and a tributary, upstream of the MU	519.3053
providen_1	None known	-
providen_4	B4 reach in Providence Creek, near mouth F5 reach downstream of Providence Creek B4/G4 reach in Big Creek, along edge of MU	519.0008 519.0056 519.0056 and 519.0057

The sub-watersheds containing the Management Units also contain a network of system roads that have the potential to contribute water and sediment to streams. The action alternatives include road maintenance, reconstruction, and construction, which may have the potential to change the effects of roads. Some of the characteristics of the road system are presented in Table 3-54.

Table 3-54 - Miles of road in Riparian Conservation Areas (RCAs) and the number of stream crossings.*

Management Unit	Road density (mi/mi^2)	Miles of road in RCAs	Total Number of Stream Crossings	Number of Perennial Stream Crossings
bear_fen_6	5.8	10.5	107	7
el_o_win_1	7.9	10.9	110	19
glen_mdw_1	9.8	16.0	148	28

Management Unit	Road density (mi/mi²)	Miles of road in RCAs	Total Number of Stream Crossings	Number of Perennial Stream Crossings
krew_bul_1	5.4	4.9	48	2
krew_prv_1	4.0	8.8	84	11
n_soapro_2	1.8	3.4	13	4
providen_1	3.9	8.4	90	11
providen_4	5.4	7.1	81	18

*Based on GIS information. The Dinkey Creek map quadrangle has a noticeably denser channel network than surrounding maps. This is thought to be a mapping consistency problem rather than a reflection of actual conditions. It results in elevated values for that area compared to areas outside of that quad. This affects the miles of road in RCAs and the number of stream crossings in all of the management units except n_soapro_2 and krew_bul_1, although the degree of this effect has not been determined. Perennial stream crossings include crossings of roads and trails on order 3 and greater channels.

It is important to consider that not all roads are the same. Some generate very little erosion, while others have widespread problems. More commonly, roads have a few discrete trouble spots where drainage problems or erosion occur. We also do not assume that all roads within an RCA contribute water or sediment to streams. The miles of road within RCAs and the number of stream crossings are presented as indicators of the potential for roads to affect streams.

A measure such as the length of hydrologically connected roads (roads directly connected to streams via a surface flow path) would provide a better indication of the potential for roads to increase peak flows or sediment effects (Gucinski and others 2001). Other factors such as soil types, road grade, effectiveness of road drainage design, road condition, channel condition and channel sensitivity are also important factors to consider when determining this potential. Korte and MacDonald (2005) found that 13% of the road length in their study areas in krew_prv_1 and krew_bul_1 are hydrologically connected. The average length of connected segments is 553 ft on native surface and 385 ft on gravel surfaced roads (Gallegos 2006a).

The current sediment contribution from roads to streams was assessed using Korte and MacDonald's site-specific study (2005) and the WEPP:Road model (described in the CWE analysis later in this section). Stream crossings are by and large the most significant areas along roads that contribute sediment to the stream system. The effect of hydrologically connected portions of roads is that they concentrate surface flow from the road bed where sediment is produced and deposit it directly into channels, or near channels where it can eventually make its way to the channel.

Roads/channel crossings were evaluated to determine the average length of road that is hydrologically connected to a channel on native and gravel surfaced roads (Gallegos 2006a). The data set included 38 road/channel crossings, on nine Forest System Roads. Korte and MacDonald (2005) found that the annual sediment production rate was .44 kg/m^2 (1.98 tons/ac) for native surface roads and .06 kg/m^2 (0.27 tons/ac) for gravel surface roads in krew_prv_1 and krew_bul_1 management units. This sediment production rate is based on the sediment volume collected in silt fences in 2004 (a dry year) and 2005 (a wet year). A similar study conducted between 1999 and 2002 on the El Dorado National Forest determined that annual sediment production rates for native surface roads was .64 kg/m^2 and from gravel surfaced roads was .01 - .03 kg/m^2 (Coe and McDonald 2006). Coe and MacDonald's sediment production rates on the El Dorado National Forest corroborate Korte and MacDonald's findings in krew_prv_1 and krew_bul_1.

Korte and MacDonald's sediment production rates, the average length of hydrologically connected road, and the average road width of 14 feet, were used to calculate the average volume of sediment produced from each crossing as .35 tons/yr for a native surfaced road and .03 tons/yr for a gravel surfaced road. A parallel analysis of the same road/channel crossings over a 30 year simulation, using the WEPP:Road model, estimated that the average sediment delivery rate is 3.44 tons/yr for native surfaced roads and .67 tons/yr for gravel surfaced roads (USDA 2006). These estimates are compared in Table 3-55.

Table 3-55 - Comparison of estimated average annual sediment production at road/stream crossings

Road surface type	After Korte and MacDonald (2005)	WEPP:Road Model
Native surface	0.35 tons/yr	3.44 tons/yr
gravel	0.03 tons/yr	0.67 tons/yr

Comparison of these sediment production rates shows that the WEPP model predicts sediment production an order of magnitude greater than predictions based on local data. These estimates represent a potential range of sediment production, with Korte and MacDonald representing short term rates and the WEPP model representing potential long term rates.

Road/channel crossings were determined in GIS by intersecting roads and streams in the project area. There are approximately 658 crossings in the eight management units. There are approximately 116 crossings on gravel surfaced roads: 132 on native surface roads, 15 on paved roads, and 395 on roads whose surfaces have not been determined in the project area. Sediment production rates on the 395 crossings were determined using both native surface and gravel surface sediment production rates to provide a range. The total estimated sediment production from roads in the project area is 828 to 1890 tons/yr based on the WEPP model and 62 – 193 tons/yr using Korte and MacDonald’s sediment production rates.

There are approximately 188 crossings in the eight sub-watersheds that are over their lower TOC: 13 on gravel surfaced roads, 105 on native surface roads, and 70 on roads whose surfaces have not been determined. The total amount of predicted sediment production from roads in the eight CWE sub-watersheds is 422 - 630 tons/yr based on the WEPP predictions and 39 – 59 tons/yr using Korte and MacDonald’s sediment production rates.

The analysis method for evaluating the effects of roads includes literature review and the results of the WEPP sediment modeling to inform a qualitative assessment.

Cumulative Watershed Effects (CWEs) Analysis

The CWE analysis has two components consisting of the R5 Baseline and Detailed CWE Assessments following the direction in FSH 2509.22, and a qualitative discussion about how the direct and indirect effects are likely to be transmitted through the stream system.

The Baseline Assessment (Gallegos 2005a) was conducted using the Equivalent Roaded Acres (ERA) model to determine if the ERAs in any sub-watersheds are currently at or over their lower Threshold of Concern (TOC).

In the ERA model, the percent ERA in a sub-watershed is used as an index of watershed disturbance and the risk of impacts to watershed health. Each acre of activity is multiplied by a coefficient to express its level of disturbance to watershed function. The coefficients for vegetation management activities are determined by silvicultural prescription, logging system, and soil types. ERAs are prorated by their age, assuming a recovery period of 30 years (USDA 1990: Chapter 20).

Major assumptions that were used in the CWE analysis include:

1) The size of the sub-watershed is equivalent to a HUC 8 watershed, which for the Kings River Project ranges from 400 to 2200 acres.
2) Sub-watersheds vary in their sensitivity to management based on their watershed characteristics that include percent of unstable lands, percent of sensitive soils, and the bifurcation ratio of the channels in the sub-watershed.
3) An upper limit to tolerance to disturbance exists for each watershed. This limit, or upper TOC, has been estimated to be 14% for each watershed measured in terms of ERA. The risk of initiating adverse CWE greatly increases as this upper limit is approached and exceeded.
4) A lower limit to tolerance to disturbance exists for each watershed based on its watershed sensitivity. This limit, or lower Threshold of concern (TOC), has been estimated to be 4% for highly sensitive watersheds, 5% for moderately sensitive watersheds and 6% for watersheds with a low sensitivity. The purpose of the lower TOC is to identify those watersheds where the risk of CWE could occur to conduct a detailed, field based, cumulative watershed effects analysis. Sub-watersheds currently under the lower TOC have been determined to not have concerns for CWE and are not further analyzed in the detailed CWE analysis.
5) Management activities can be measured in terms of equivalent roaded acres (ERA). This is referred to as the ERA Model.
6) Key indictors of unacceptable degradation can be identified for watershed processes. An indicator of a cumulative watershed effect response could be one or more of the following: filling of channel pools with fine sediment; unstable channel banks; and/or poor aquatic habitat.
7) Activities causing land disturbance recover in 30 years.
8) The potential for initiating adverse CWE can be reduced by:
    a. Dispersing land disturbing activities in time and space.
    b. Controlling the physical size, shape, location and timing of land disturbing activities.
    c. Implement Best Management Practices to mitigate adverse on-site effects.
9) Watersheds will not reach or exceed the upper TOC of 14%.

The Baseline Assessment established that past impacts had raised some sub-watersheds to percent Equivalent Roaded Acres (%ERA) levels that exceeded their lower Threshold of Concern (TOC). As a result of the baseline assessment, nine sub-watersheds were identified to have a detailed CWE assessment. The detailed CWE assessment included field evaluation of channel conditions and aquatic habitat. Field data considered in the detailed analysis includes: channel condition in terms of channel bank stability and pool frequency and size, watershed improvement inventory data in terms of the number of sites found and the amount of erosion and sediment they may be contributing to the fluvial system, and aquatic species observed during aquatic surveys. These findings were documented in a report dated June 10, 2005 by Sanders and Hopson. Review of the data between the draft and final EIS determined that sub-watershed 519.0057 is also over the lower TOC. The detailed assessment for sub-watershed 519.0057 is summarized in a report dated August 8, 2006 by Gott and Sanders. In addition, the Detailed Cumulative Watershed Analysis Report for the 2000 Bear Meadow Project was also used to document available data and existing conditions. The ERA calculations from the Baseline Assessment are displayed in Table 3-56.

Table 3-56 – Summary of ERA by sub-watershed.

Sub-watershed Number	Size (ac)	Natural Sensitivity	TOC	Existing (2006) ERA	2007 ERA	2008 ERA	2009 ERA	2011 ERA	2036 ERA
519.0005	1140	High	4%	3.16%	*4.28%*			3.79%	2.11%
519.0006	630	Moderate	5%	2.71%		2.59%		2.41%	1.91%
519.0007	1719	High	4%	3.75%	*12.72%*			*13.79%*	2.53%
519.0008	1976	Low	6%	3.90%	*13.79%*			*11.57%*	2.31%
519.0009	**1335**	**High**	**4%**	**7.72%**			**7.11%**	**6.50%**	**3.51%**
519.0011	1246	Moderate	5%	3.91%	*11.82%*			*9.76%*	1.47%
519.0055	1574	Moderate	5%	3.55%	4.14%			3.59%	2.43%
519.0056	914	Moderate	5%	3.56%	*6.55%*			*5.78%*	3.46%
519.0057	**1078**	**Moderate**	**5%**	**7.16%**	**13.73%**			**11.44%**	**2.58%**
519.2001	2228	Moderate	5%	3.41%		3.38%		3.23%	2.89%
519.2002	2173	Moderate	5%	1.53%				1.43%	1.41%
519.3001	1484	Moderate	5%	2.69%			4.21%	4.05%	2.76%
519.3002	534	Moderate	5%	4.71%			*5.11%*	*5.07%*	4.74%
519.3003	716	Moderate	5%	2.08%			*7.46%*	*6.92%*	2.41%
519.3004	746	Low	6%	4.66%			*11.61%*	*10.91%*	5.12%
519.3052	727	Low	6%	1.97%			*10.00%*	*9.20%*	2.51%
519.3053	**2083**	**Moderate**	**5%**	**8.85%**			**9.16%**	**8.25%**	**2.31%**
519.4001	1828	Moderate	5%	1.13%	1.24%			1.10%	0.85%
519.4051	**1402**	**High**	**4%**	**4.69%**	**10.20%**			**8.06%**	**1.74%**
520.0013	439	Moderate	5%	3.26%	3.26%			2.58%	2.46%
520.0014	**1066**	**Moderate**	**5%**	**5.54%**	**10.22%**	**10.81%**		**9.30%**	**2.32%**
520.0015	2014	Low	6%	2.51%	*6.31%*			5.33%	1.38%
520.0016	591	Low	6%	2.71%	5.60%	*12.11%*		*10.81%*	3.03%
520.0017	1952	Moderate	5%	1.99%	3.84%	*7.67%*		*6.80%*	1.89%
520.0053	2189	Low	6%	2.34%		2.56%		2.17%	1.51%
520.0054	959	Low	6%	2.62%		2.87%		2.60%	1.67%
520.0055	1757	High	4%	2.26%		2.28%		2.12%	1.75%
520.0056	1209	Moderate	5%	2.98%	*13.99%*	*13.97%*		*12.39%*	3.33%
520.0057	1431	Moderate	5%	4.19%	4.72%	*9.75%*		*8.76%*	3.43%
520.1002	**1878**	**High**	**4%**	**6.22%**		**9.80%**		**8.18%**	**2.51%**
520.1051	**1411**	**High**	**4%**	**5.10%**		**11.72%**		**9.82%**	**2.52%**
520.1101	**1258**	**High**	**4%**	**7.02%**		**11.53%**		**10.08%**	**4.51%**
520.1151	**837**	**High**	**4%**	**4.33%**		**8.16%**		**7.40%**	**3.76%**
520.2001	2010	Moderate	5%	1.70%		1.73%		1.71%	1.67%
520.2051	2020	High	4%	2.34%		2.35%		2.30%	2.18%
520.3002	1661	Moderate	5%	4.87%		*10.26%*		*9.32%*	4.43%
520.3052	2206	Low	6%	2.45%		2.47%		2.46%	2.44%
520.3151	1317	Low	6%	2.57%		2.60%		2.49%	2.42%
520.4001	2023	Low	6%	1.81%	1.84%			1.61%	1.48%
520.4051	176	High	4%	1.34%	*5.07%*			*4.27%*	1.23%
520.4052	1309	Low	6%	3.10%	3.13%			2.62%	2.09%
520.5051	1582	High	4%	1.77%		2.13%		1.81%	1.34%

ERAs that exceed the lower TOC are shown in italics. Sub-watersheds that exceed the lower TOC prior to project implementation are shown in bold.

Nine of the 42 sub-watersheds, found to be over the lower TOC in the Baseline Assessment, were evaluated in the CWE Detailed Assessment (Gallegos 2006a). The information on the current condition of these areas that was gathered for the Detailed Assessment is presented in Table 3-57. The following is a summary of physical and biological conditions of the eight sub-watersheds where CWE are a concern.

Table 3-57 - Information gathered for the Detailed Cumulative Watershed Effects Analysis for the nine sub-watersheds identified as over their lower Threshold of Concern.

Sub-ws ID	Lower TOC	Existing ERA	Proposed ERA	Channel Condition	V*	Aquatic Species Observed	WIN Sites[16]
519.0009	4%	7.72%	7.11%	Mixed Stable & Unstable	25%	WPT/CN/PTF/ GS	8
519.0057	5%	7.16%	13.73%	Unstable	20-60%	TRT	10
519.3053	5%	8.85%	9.16%	Mostly Stable	70-90% [1]	WPT/CN/PTF/ GS/TRT Poor to moderate aquatic habitat	6
519.4051	4%	4.69%	10.20%	Stable	18%	WPT/RSS/GS/ TRT	8
520.0014	5%	5.54%	10.81%	Stable	10% [1]	No Data	7
520.1002	4%	6.22%	9.80%	No Data	58%	No Data	12
520.1051	4%	5.10%	11.72%	Unstable	51% & 49%	No species observed	25
520.1101	4%	7.02%	11.53%	Mixed		GS	
520.1151	4%	4.33%	8.16%	Unstable	45% & 61%	TRT	4

[1] = V* value visually estimated, not measured.

Aquatic Species Observed: WPT = Western Pond Turtle; CN = California Newt; PTF = Pacific Tree Frog; GS = Garter Snake; TRT = Trout; RSS= Relictual Slender Salamander

Sub-watershed 519.0009 - Approximately 3.3 acres of treatment stand 553 in the n_soapro_2 Management Unit is located on a ridge top in this sub-watershed. The Detailed Assessment found a mixture of stable and unstable channel banks in Ackers Creek. V* measured in 1996 met the DC. Surveys in 1999 noted that the sub-watershed's channels contain mostly small, shallow pools. A V* reach located at the confluence of this channel and Big Creek found residual pool filling of 25% in 1996 (Gallegos 2004). Watershed improvement needs inventories (WINI) collected between 1991 and 2004 indicate there are eight erosion problems documented in the sub-watershed. Seven of the problems were associated with system and non-system roads and one site is associated with grazing. The small acreage is insignificant and will not add to CWE. Therefore, this sub-watershed will not be discussed further in this analysis.

Sub-watershed 519.0057 is located in the providen_1 Management Unit and includes a reach of Big Creek between Summit Creek and Providence Creek and an unnamed tributary to Big Creek. Channel reaches in Big Creek are unstable, and some channel types are characterized as sensitive to disturbance. A survey performed in an ephemeral tributary suggests that large quantities of fine

[16] WIN = Watershed Improvement Needs, an established USFS program whose purpose is identifying, tracking, and repairing and monitoring watershed erosion problems.

sediment are being transported in that channel. The road system in this area (10S75) is badly gullied and crosses drainages in 45 locations. A large proportion of the sediment that has been removed from these roads is likely to have been delivered to tributary channels. V* measurements taken in Big Creek in 1995 indicated that pools were up to 60% filled with sediment in the upper portion of the sub-watershed, which exceeds the DC. Measurements near the downstream end of the sub-watershed were taken in a transport reach, where V* was just over the desired condition. Fourteen WIN sites have been documented in this sub-watershed, most of them describing erosion associated with roads or bank erosion in Big Creek. Of these sites, four were not found to be problems in 2005, which leaves 10 sites un-addressed. Based on the available data it appears that this sub-watershed is experiencing CWE.

Sub-watershed 519.3053 is located in the n_soapro_2 Management Unit in lower Rush Creek. The existing ERAs are 8.79%, which includes 367 acres of treatment in the South of Shaver Project. The CWE analysis for the South of Shaver Project concluded that it is unlikely to incur a CWE response. However, an additional review of two reaches of Rush Creek for this project indicated that a CWE response may already be occurring. It was estimated that channel pools are filled 70-90% of their volume with fines. This sub-watershed has mostly stable stream reaches with infrequent small pools. Inventories of watershed improvement needs (WINI) collected between 1991 and 2004 indicate six erosion problems. A 2004 air photo analysis identified thirteen skid trails/roads in the sub-watershed. Some of these trails are currently used by off highway vehicles; however no resource damage associated with these features has been reported (Morales and others 2004). Ongoing development of the Wildflower Subdivision, timber harvest on private land in the sub-watershed immediately upstream, and OHV use including the annual Mountain Toppers Blue Canyon OHV event, are likely some of the primary sediment sources. Based on the available data it appears that this sub-watershed is experiencing CWE.

Sub-Watershed 519.4051 is located in the providen_1 Management Unit. This sub-watershed has mostly stable stream reaches. V* collected near the mouth of Summit Creek in 1995 indicated that fine sediment in pools was approximately 12%, which meets DC (Gallegos 2004). V* in Big Creek was approximately 20% upstream and 60% downstream of the confluence. The only indication of excessive sediment in this sub-watershed is in the first perennial tributary on the east side of Summit Creek. Pool infilling (V*) was estimated in a 2004 survey to be 50% in this channel, and could be an effect from past management activities. Watershed improvement needs inventories (WINI) collected between 1995 and 2004 indicate eight erosion sites are present. Each site appears to be channel erosion initiated or influenced by culverts at road/stream crossings. Gully head cuts are located on an unnamed tributary to Summit Creek. Based on available data it does not appear that this sub-watershed is experiencing a CWE.

Sub-watershed 520.0014 is located in the el_o_win_1 Management Unit in Dinkey Meadow Creek. Approximately 75% of the 1066 acre watershed is privately owned. Southern California Edison has treated 320 acres of the private land as recently as 1995 and 2005. There is no evidence of a CWE response, or an increased risk of a CWE response, to these recent activities. Visual observations showed stable stream banks and little sediment in the channel. Large woody debris was common throughout the reach. Measurements of sediment depth in pools suggest that sediment accumulation is on the order of 10%, which meets DC. Embeddedness, a measure of fine sediment intrusion into the channel substrate (primarily gravels) was low throughout the reach. Aquatic species survey data is not available for this sub-watershed (Hopson 2005). Based on the available data it does not appear that this sub-watershed is experiencing a CWE.

Sub-watershed 520.1002 is located in the bear_fen_6 Management Unit in upper Bear Meadow Creek. This sub-watershed has no channel condition data or aquatic species survey data. A V* reach is located at the downstream end of the sub-watershed. Data collected in 1997 indicated that pools had residual pool filling of almost 60% (Gallegos 2004), clearly exceeding DC. Watershed improvement needs inventories (WINI) indicate several erosion problems. Twelve sites have been identified between 1989 and 1998. Most of the erosion problems are associated with roads or old skid trails. Based on the available data it appears that this sub-watershed is approaching a threshold for CWE and could be experiencing CWE.

Sub-watershed 520.1051 is located in the bear_fen_6 Management Unit in lower Bear Meadow Creek. Sub-watershed 520.1051 and sub-watershed 520.1001 have been combined into one sub-watershed because sub-watershed 520.1001 does not meet the criteria for watershed size for a cumulative watershed effects analysis. Bear Meadow Creek is the main channel in this watershed and it has a highly sinuous stream with unstable, down-cut banks and very fine particle size stream bottoms. Fence Meadow Creek is also located in sub-watershed. A channel analysis in 1999 indicated that this channel was fairly indistinct. In 1991, trample and chisel data collected for the Dinkey cattle allotment found 26% disturbance of the stream channel from cattle, which exceeded the DC of 20% maximum bank disturbance. In 1991 a channel analysis indicated that stream channel was poor, and the area was heavily cut-over from the 1989-1990 Fence Green timber sale. Two V* reaches established in 1995 and 1996 indicate that filling of pools was approximately 50%. Channel surveys of 1989 also showed the stream in poor condition. No aquatic species have been found in surveys to date in this sub-watershed. Watershed improvement needs inventories (WINI) indicate 25 WIN sites recorded between 1989 and 1998. Nearly all of the problems are associated with roads and skid trails. Only one site was non-road related, documenting heavy accumulation of fine sediment in Bear Meadow Creek.

A CWE analysis was conducted on March 16, 2000 for the Bear Meadow Project. The project proposed to mechanically treat vegetation in this watershed. The analysis concluded that the upper reaches of Bear Meadow Creek contain excessive sediment and have areas of channel down cutting. Extensive gullies and unstable channels are present in the upland watershed areas, upstream from reaches in Bear Meadow Creek containing high sediment loads. Soil compaction was found to occur over approximately 20% of past activity areas. Compacted soils located throughout the Bear Meadow project area have sufficiently decreased infiltration to increase runoff. This increases peak flows leading to channel adjustment including down cutting and greater sediment loading. These changes were concluded to constitute a cumulative watershed effect from past management activity (CWE Team, 2000).

Sub-watershed 520.1101 is located in the bear_fen_6 Management Unit and encompasses upper Oak Flat Creek. Channel surveys were conducted in 2004 along the 1,180 meter stream reach in section 5. The channel was characterized as a steep, deeply entrenched channel with mostly sands with flatter, unstable areas. Only a single garter snake was found during the survey. No Watershed Improvement Needs sites are recorded in District files.

Sub-watershed 520.1151 is located in the bear_fen_6 Management Unit and encompasses the lower half of Oak Flat Creek. Surveys between 1990 and 1999 indicate that fines in pools have been high since at least 1990, and may have increased from approximately 30% in 1995 to 45 – 60% measured in 2004. Surveys in 1999 described an unstable stream channel but some good fish habitat. Watershed improvement needs inventories (WINI) collected between 1989 and 2002 record four erosion sites in this sub-watershed. Three of the locations were related to road conditions. Two of the sites were repaired in 2003.

The conclusions of the Detailed Assessment are described in the Environmental Consequences section describing the Cumulative Effects of the Action Alternatives.

CWE – Erosion and Sediment Delivery Estimates

Sediment production was modeled for the Bear Meadow sub-watershed using GeoWEPP watershed modeling software (GeoWEPP, 2006). This sub-watershed was modeled as an example of the amount of sediment produced under several scenarios including the existing condition (No Action Alternative), the Proposed Action (Alternative 1), the No Action Alternative with a wildfire in the year 2015, and the Proposed Action with a wildfire in the year 2015.

The GeoWEPP software uses ArcView and digital elevation models (DEM) to create a channel network and catchments for a selected outlet point. In addition, the model uses climate data, soil data, slope data and management data to predict erosion and sediment under different scenarios. William Elliot provided assistance in customizing data input files including the soils and management files. Data from Yosemite National Park Climate was used as the climate data for the model. This climate file contains precipitation data similar to conditions in the proposed treatment area. Soils data from the Order 3 Soil Survey (Giger 1993) was used. Erosion and sediment prediction in the GeoWEPP model is sensitive to soil texture. Therefore, soil data from the soil survey was grouped into three classes based on soil texture. The Holland family taxonomic description was used to characterize fine textured soils. These soils represented other fine textured soils in the project area. The Shaver family taxonomic description was used to characterize coarse textured soils. The third class in the soils file is actually not a soil, but rock outcrop. Some outcrop exists in the project area and this rock outcrop sheds most of its precipitation, creating rapid runoff. Slope files were generated from 30m DEMs acquired from the Geospatial Spatial Data Center (GSDC). These files were processed and prepared in ArcMap. Management files were customized to model the proposed action. The most sensitive variable in the model that the proposed action would alter from the existing condition is soil cover.

The GeoWEPP estimate of the hillslope sediment production rate for the existing condition is approximately 2.8 tons/ha/yr (1.10 tons/ac/yr) with approximately 2,743 tons/yr of sediment produced in the bear_fen_6 management unit (see Table 3-59). Sediment production rates from the roads is estimated at 106 to 186 tons/yr (using WEPP:Road sediment production rates), or 10 to 20 tons/yr from roads using Korte and MacDonald's sediment production rates. Modeling for the existing condition used 99% cover for all slopes including the private land in the north part of the Bear Meadow Creek sub-watershed and the areas that are proposed for treatment. The model showed that most sediment is produced on the steeper slopes, especially the headwater slopes in the tributary channels of Bear Meadow Creek.

Environmental Consequences

The format of the discussion of Environmental Consequences includes a General Discussion of effects consisting of a literature review, followed by sections that describe the predicted effects of the various alternatives.

The effects of the No Action alternative will be described in terms of the potential effects of the modeled wildfire described at the beginning of Chapter 3 and in the Fuels section.

General Discussion

Effects of Timber Harvest on Flows and Water Quality: Most of the existing research on the effects of timber harvest on stream flows has examined the effects of clearcutting or other intensive treatments, and as a result, much of the understanding of the hydrologic effects of thinning is based on inference rather than direct study (Robichaud and others2006; Troendle and others 2006).

Researchers have concluded that if less than 10% of the basal area is removed, there is little impact on flows. This is supported by paired watershed studies and by modeling (Troendle and others 2006). With removal of between 10 and 20% of basal area, flow is affected but the change is not detectable due to the natural variability of flow. Many investigators have found that approximately 20% of the basal area must be removed before a statistical change in flow is detected (Troendle and others 2006). MacDonald and Stednick (2003) state that 15% basal area must be removed before a change in flow can be detected in small research watersheds, and detection becomes more difficult as watershed size increases. The percent change in basal area for each sub-watershed in each alternative is presented in Table 9. The maximum change is 12.1%. Most values are below 10%. This will be discussed further under the Environmental Consequences of each alternative.

There are several mechanisms by which timber harvest affects stream flows: changes in interception of precipitation, changes in snow accumulation and snowmelt (important in snow-dominated areas but less so in rain-dominated and 'warm snow' zones such as the project area), and changes in available soil moisture due to decreased evapotranspiration.

The change in interception is related to the change in canopy. Interception losses may account for 25-35% of the annual precipitation received in cold snow zone conifers, and 10-12% in deciduous forests (Troendle and others 2006). In the Rocky Mountains, any reduction in stand density will increase snowpack accumulation. This effect may occur in the project area, and would be most important in the glen_dw_1, el_o_win_1, bear_fen_6 and krew_bul_1 management units. The management units in the Big Creek watershed receive snow, but are not snowmelt dominated. Although this literature review found that interception changes were also reported as proportional to changes in basal area, the changes in canopy for the different alternatives are also displayed in Table 3-58. In general, canopy changes are slightly lower than basal area changes because the majority of trees removed are not the dominant canopy-forming trees. They are intermediate or suppressed trees that are growing under the dominant canopy.

Potential increases in peak flows are related to changes in snow accumulation and snow melt. This would apply mostly to the snow-dominated portions of the project area: el_o_win_1, glen_mdw_1, bear_fen_6 and krew_bul_1. Troendle and others (2006) note that there is debate over the effects of harvest on peak flows in maritime climates where mid-winter rain-on-snow events are responsible for the highest peak flows. They state that rain-on-snow events with warm wind increase snow melt the most, suggesting that changes in wind speed at the snow surface is a key element in determining the magnitude of the effect. Turbulence theory research has shown that widely-spaced objects can reduce turbulence at the bottom surface, so thinning may result in little increase from this process. In a study of the effect of the spatial arrangement of trees after thinning, Woods and others (2004) found that snow accumulation measured at the stand scale did not change in group selection cuts which left trees in patches, but increased by 35% when thinned trees were left evenly spaced. Both of their study units had 60% of the basal area removed.

In the group selection patches, the effects on snow accumulation would probably be similar to the effects of small clearcuts. Woods and others (2004) cite studies that found that small clearcuts (2 to 5 tree height diameters) accumulate more snow than the surrounding forest while large clearcuts (more than 20 tree heights in diameter) accumulate less snow because of wind scour and evaporation losses. The patch cuts proposed in this project are a maximum of 3 acres in size, which is similar to the small clearcut size. Therefore, these openings can be expected to accumulate more snow than prior to treatment.

Table 3-58 - Percent change in basal area and canopy cover for each of the three alternatives. The sub-watersheds that are currently over their lower Threshold of Concern for CWE are shown in bold.

Sub-watershed Number	Alt 1 Proposed Action		Alt 2 No Action		Alt 3 30-inch Alternative	
	BA	Canopy	BA	Canopy	BA	Canopy
519.0005	0.0	0.0	0.0	0.0	0.0	0.0
519.0007	3.6	2.7	0.0	0.0	3.5	2.6
519.0008	7.3	6.1	0.0	0.0	6.6	5.6
519.0009	**0.3**	**0.3**	**0.0**	**0.0**	**0.3**	**0.3**
519.0010	0.0	0.0	0.0	0.0	0.0	0.0
519.0011	8.0	7.4	0.0	0.0	7.5	7.0
519.0012	0.4	0.4	0.0	0.0	0.4	0.4
519.0055	4.1	3.6	0.0	0.0	3.7	3.1
519.0056	3.6	3.1	0.0	0.0	3.2	2.8
519.0057	**6.4**	**4.6**	**0.0**	**0.0**	**6.3**	**4.5**
519.2001	0.0	0.0	0.0	0.0	0.0	0.0
519.3001	5.6	3.0	0.0	0.0	5.5	3.0
519.3002	0.8	0.7	0.0	0.0	0.7	0.7
519.3003	4.0	3.4	0.0	0.0	3.8	3.4
519.3004	3.1	2.6	0.0	0.0	3.0	2.5
519.3005	5.8	5.1	0.0	0.0	5.3	4.7
519.3052	12.1	9.7	0.0	0.0	11.8	9.6
519.3053	**2.5**	**1.7**	**0.0**	**0.0**	**2.9**	**1.9**
519.4001	0.2	0.1	0.0	0.0	0.2	0.1
519.4051	**5.8**	**4.3**	**0.0**	**0.0**	**5.7**	**4.2**
520.0014	**3.8**	**3.3**	**0.0**	**0.0**	**3.4**	**3.0**
520.0015	1.8	1.4	0.0	0.0	1.6	1.3
520.0016	11.3	9.5	0.0	0.0	9.9	8.5
520.0017	4.8	4.4	0.0	0.0	4.2	3.8
520.0053	0.3	0.2	0.0	0.0	0.3	0.2
520.0054	0.8	0.8	0.0	0.0	0.8	0.7
520.0055	0.1	0.1	0.0	0.0	0.1	0.1
520.0056	10.0	9.2	0.0	0.0	8.8	8.2
520.0057	4.4	4.2	0.0	0.0	4.3	4.0
520.1001	2.0	1.5	0.0	0.0	1.9	1.5
520.1002	**1.8**	**1.6**	**0.0**	**0.0**	**1.7**	**1.5**
520.1051	**6.4**	**5.4**	**0.0**	**0.0**	**5.9**	**5.1**
520.1101	**6.2**	**5.1**	**0.0**	**0.0**	**6.0**	**5.0**
520.1151	**4.2**	**5.4**	**0.0**	**0.0**	**4.1**	**5.3**
520.2001	0.0	0.0	0.0	0.0	0.0	0.0
520.3002	4.5	5.1	0.0	0.0	4.0	4.7
520.3052	0.0	0.0	0.0	0.0	0.0	0.0
520.3151	0.0	0.0	0.0	0.0	0.0	0.0

Sub-watershed Number	Alt 1 Proposed Action		Alt 2 No Action		Alt 3 30-inch Alternative	
	BA	Canopy	BA	Canopy	BA	Canopy
520.4001	0.1	0.1	0.0	0.0	0.1	0.1
520.4051	9.9	8.7	0.0	0.0	8.9	8.1
520.4052	0.1	0.1	0.0	0.0	0.0	0.0
520.5051	0.3	0.5	0.0	0.0	0.3	0.5

Studies have found base flow increases after clearcutting. In Caspar Creek in northwestern California, after 67% of the timber volume in the watershed was removed, Keppeler and Ziemer (1990) found that the summer low flows were 14 to 55% higher than predicted based on the relationship between the watershed pre-harvest and an unlogged control. The number of days with flow lower than threshold value decreased by 40% after harvest. In Oregon, Hicks and others (1991) found that clearcutting increased low flow by 25% for 8 years, and then dropped below the unlogged control.

When a stand is thinned, the remaining vegetation captures at least a portion of the excess soil water, and the increase in water available for base stream flow is moderated. Troendle and others (2006) state that the potential for thinning to have an effect on streamflow due to reduced evapotranspiration depends on the amount of precipitation. In wet summers, there may be surplus water to contribute to increased stream flow, while in dry years; it is likely that the residual stand will use all of the available water. If the climate is dry in the summer and rainy in the winter, as in the management units in the Big Creek watershed, then the largest changes in runoff would occur during fall and early winter (Robichaud and others 2006). In snow-dominated areas such as the management units in the Dinkey Creek watershed, nearly all of the change in flows would occur during spring runoff, and spring runoff may occur slightly sooner if reductions in canopy allow faster melting of the snowpack. Any increase in flows that results from thinning is not likely to persist for more than 5 – 10 years (Robichaud and others 2006). Lewis (2001) found that under wet antecedent moisture conditions, flows in a partially clearcut watershed increased 3% compared to 23% in a clearcut watershed.

Effects of timber harvest on water quality could include increases in sedimentation caused either by the transport of eroded material out of harvested areas into stream channels, or by increased flows that result in channel erosion that in turn increases sedimentation. Best Management Practices (BMPs) are applied to minimize erosion and sediment delivery to streams. MacDonald and Stednick (2003) note that forest harvest and fuels treatments should have little effect on water quality if they are well-planned and BMPs are implemented.

Monitoring of BMP on Forest Service lands in California has shown that, when implemented, timber management BMP are 95-98% effective (USDA 2004). An exception is Streamside Management Zones, which were found to be 85% effective due to inadequate implementation (failure to properly identify SMZ on the ground). However, meadow protection was 98% effective. The Monitoring Report (USDA 2004) identifies a need to improve the implementation and effectiveness rates of timber management BMP, and presents a plan for accomplishing this goal that includes training and additional monitoring of these BMP. These measures are included in the Monitoring Plan for this project. The IDT has invested several days in refining treatments within SMZs (reflected in the SMZ prescription developed for Alternative 3), and in field checking the identification and application of SMZs.

Literature has shown that BMP are effective in minimizing the erosion in harvest units and at preventing sediment from reaching streams. In a study of sediment redistribution after harvesting, Wallbrink and Croke (2002) found that sediment eroded from skid trails was deposited in the harvest unit and the 23–30 m wide stream buffers. Water bars were found to be very effective at reducing coarse sediment loads, and finer sediment was deposited in the 5m below the water bar outlets. The stream buffers trapped more sediment per unit area than the harvested area. In a review of published studies of buffer strip effectiveness, Norris (1993) notes that studies he reviewed indicate that buffer zones are effective at reducing sediment concentrations in runoff.

<u>Effects of Mechanical Fuels Treatments on Flows and Water Quality:</u> Few studies have evaluated the effects of mechanical fuels treatments such as mastication, ‘brush crushing’, or tractor piling. Reid (2006) notes that the change in the density of live vegetation is not expected to be great enough to change stream flows.

A Hydro-Axe treatment reviewed by Robichaud and others (2006) increased wood groundcover slightly but also slightly increased bare ground. No runoff was generated from the site with 1.6 inches of rain within 30 minutes, at a maximum intensity of 2.4in/hour. Hatchett and others (2006) found that simulated rainfall on plots with post-mastication woodchip groundcover yielded no runoff during the normal rainfall rate of 2.9 inches per hour. Increasing the simulated rain intensity to 4.7 inches per hour (noted to be a high, rare intensity) did yield runoff and sediment from the plot, which they calculated to be 32% of the sediment yield from bare soil plots in their study.

According to Reid (2006), the impacts of mechanical fuel treatments on erosion and sediment yield are likely to result from direct soil disturbance where these activities affect swales and low-order stream channels. In this project, swales and Class V channels have no SMZs – mechanized access is not prohibited and could occur. Class IV channels have a 25-foot SMZ where equipment is excluded. BMP 1-19 prescribes practices to mitigate the potential effects, including requiring that stream crossings on Class IV and V streams be agreed to by the sale administrator. Unscoured swales that are dry during operations receive no special protection.

Activities that will be accomplished by hand, such as felling and leaving trees, hand piling, and planting, are assumed to have no effect on hydrology or water quality (Robichaud and others 2006). The Soils analysis concluded that these activities are not likely to increase erosion.

<u>Effects of Roads on Flows and Water Quality</u>: A synthesis of existing information on the effects of forest roads (Gucinski and others 2001) lists effects of roads on hydrologic processes: they intercept rainfall on the road surface and subsurface flow at cutbanks, and they concentrate flow on the road surface or in a ditch. Both of these effects divert water from the flow paths normally taken. When roads concentrate surface flow and deliver it to streams via surface flow paths, they operate as extensions of the drainage network and functionally increase drainage density (Wemple and others 1996). Areas with higher drainage density tend to have higher, faster peak flows as a result of precipitation. Wemple and others (1996) found 57% of the road length in their study was hydrologically connected to streams, which means that surface runoff was delivered directly into streams via stream crossings or gullies formed at culvert outlets. In a study of forest road segments on the Eldorado National Forest, Coe (2006) found that 25% of the road segments surveyed were hydrologically connected. Robichaud and others (2006) note that studies in the western US have found between 23 and 75% hydrologic connectivity of roads.

Robichaud and others (2006) describe three studies that were able to isolate the effects of forest roads alone (not in combination with other forest management actions) on stream flow. These studies in Colorado and Idaho were unable to detect a change in runoff from roads that occupied 2 – 4 percent of the watershed area. Jones and Grant (1996) suggested that roads could intercept increases in subsurface water resulting from clearcuts, convert it to surface water and deliver it to streams. The literature suggests that roads may affect peak flow timing and magnitude, but do not affect annual yield (Gucinski and others 2001).

Studies have consistently shown that roads produce more sediment than other forest management practices (Robichaud and others 2006). Schnackenberg and MacDonald (1998) found that fine sediment in their study stream channels in Colorado was more strongly correlated with the number of road crossings than with the Equivalent Clearcut Area (similar to the Equivalent Roaded Acres used in this analysis, but indexed to the effects of clearcuts rather than to roads) in the watershed.

Reid and Dunne (1984) found that road erosion rates tended to increase with increased traffic and with heavier vehicles. Timber harvest and other forest management projects can result in increases in the amount of heavy truck traffic.

Road design can mitigate these effects by controlling runoff and minimizing erosion. Maintenance is required on most roads to ensure that they function as designed, but Luce and Black (1999) found a short-term increase in erosion related to maintenance, especially cleaning inboard ditches. BMPs can also be used to mitigate the effects of roads. For example, Coe's study (2006) on the Eldorado NF found that native surface roads produced 10-25 times more sediment than rocked roads.

Rocking roads and reducing the length of roads hydrologically connected to the channel system will also reduce sediment. If half of the road crossings are redesigned to reduce hydrologic connectivity, sediment could be reduced by as much as 250 tons/yr based on WEPP:Road sediment production rates, or 25 tons/yr based on Korte and MacDonald's sediment production rates. This amounts to approximately 2 miles of road, and over ten years, sediment will be reduced by as much as 2500 tons (WEPP) to 250 tons (Korte and MacDonald).

Effects of Herbicides (Glyphosate and R-11) on Water Quality: A review of studies by Ghassemi and others (1981) states that glyphosate rapidly attaches to organic matter on top of or in the soil and its mobility is very limited. Because of its low mobility in soil, the only mechanism for off-site movement is soil erosion and transport. Normal hydrolysis in a stream will not break the attachment of glyphosate to soil particles. This means that even if glyphosate bound to soil particles reached surface water, it would not be in a form that could be taken up by plants or animals. It would not affect surface or ground- water quality.

From 1991 to 2000, surface water adjacent to seven projects using glyphosate on the Sierra, Stanislaus, and Eldorado National Forests was monitored. There were no detections (Bakke 2001) with detection limits ranging from 6–25 ppb, depending on the study.

Effects of Wildfire and Prescribed Fire on Flows and Water Quality: Many investigations of wildfire effects on hydrologic processes have found increases in stream flows and in sedimentation. MacDonald and Stednick (2003) state that wildfire poses the biggest threat to water quality in forested areas.

Changes in soil properties such as removal of organic ground cover and creation of water repellent (hydrophobic) conditions result in decreased infiltration capacity and increased runoff. This leads to larger and flashier peak flows and more erosion on hillslopes. Wondzell and King (2003) identify three mechanisms by which fire affects hydrology: 1) decreasing canopy interception increases the proportion of precipitation available for runoff; 2) decreasing evapotranspiration increases base flow; and 3) consuming ground cover increases runoff velocity and reduces infiltration and storage as soil moisture. Robichaud and others (2000) state that surface runoff can increase by 70% and erosion by three orders of magnitude when ground cover is reduced from 75% to 10%.

Fire severity has a large effect on erosion and sediment yields. Shakesby and Doerr (2006) report a study in Utah that estimated that in a burned area with 60-75% ground cover, 2% of rainfall contributed to overland flow while in an area where only 10% cover remained, over 70% of the rainfall ran off. In a study of post-fire erosion from simulated rainfall, Benavides-Solorio and MacDonald (2001) found that sediment yields from high burn severity plots was 10-26 times greater than from low severity and unburned plots. Ground cover accounted for 81% of the variability, including lower sediment yields found in older, recovering burned areas.

Sediment yield increases are usually the highest the first year following a fire (Robichaud and others 2000), then decease as groundcover increases, vegetation becomes established, and water repellency recovers (Neary and others 2005, Shakesby and Doerr 2006). Some studies have found that more of the observed sediment load increases were due to in-channel erosion than to hillslope erosion (Shakesby and Doerr 2006). Wondzell and King (2003) note that it is difficult to determine how large episodic sediment inputs factor into the sediment budget of a watershed, and that post-fire mass-wasting events such as landslides and debris flows exert lasting effects on stream channel morphology.

Post-fire peak flows increase more in smaller drainages than in larger ones. Bigio and Cannon (as cited in Neary and others 2005) found in their compilation of post-wildfire runoff data that the average unit area discharge from watersheds less than 1km^2 in size was 17,660 cfs/mi^2 (193 m^3/s/km^2), while the average for watersheds between 1 and 10 km^2 was 2,077 cfs/mi^2 (22.7 m^3/s/km^2). Intense rainfall produces the greatest increases in peak flows (Neary and others 2005). Wondzell and King (2003) note the steep gradients in intensity and total precipitation of convective thunderstorms, which seldom results in a watershed receiving equal rainfall intensity over its entire area. It is more likely that small watersheds would receive intense rainfall over their entire area than larger watersheds, which may help explain Bigio and Cannon's findings.

Robichaud and others (2000) found that summer peak flows in chaparral in Arizona increased 5 – 15 fold after a wildfire, but winter peak flows did not change. They attribute this to less intense precipitation and less water repellency during the winter season.

Empirical studies have often found it difficult to demonstrate increases in water yield due to fire (Clark 2001). However, a study in Arizona found that annual water yield increased eight-fold in a 20-acre drainage the first year after a wildfire; the increase dropped to 3.8-fold the following year (Campbell 1977, as cited by Shakesby and Doerr 2006). Reviews by Shakesby and Doerr (2006) and Neary and others (2005) note a study in Washington that found a 42% increase in water yield the year following a fire, and others that found 9 and 12% increases in water yield in Oregon and South Africa.

Because prescribed fire is planned and implemented in a manner to control burn severity and specifically to limit high burn severity, the effects of prescribed fire are much smaller in magnitude than those of wildfire. In a study comparing sediment production from different sources, MacDonald and others (2004) found that severely burned areas produced 1,000 times more sediment than prescribed burn areas. Little sediment yield was found in a study in the northern Sierra Nevada where ignition was allowed within the riparian area; Beche and others (2005) found that V* did not change significantly. Zwolinski (2000) reports that low-severity fires (such as most prescribed fires) generally have little or no hydrologic impacts, even though most contain a small proportion of high burn severity. Robichaud's investigation of post-timber harvest prescribed fires in Montana and Idaho found 5 and 15% of those areas burned at high severity (Robichaud and others 2006).

<u>Erosion and Sediment Delivery Analysis:</u> An erosion and sediment analysis was conducted for the proposed project area. The analysis consisted of two components: 1) erosion and sedimentation rates from roads in the project area; 2) and erosion and sedimentation rates from the watershed slopes under the existing conditions (no action), the proposed action, no action with

a wildfire fire, and the proposed action with a wildfire. The analysis was accomplished by using GeoWEPP to estimate watershed erosion, the WEPP:Road interface for estimating erosion from roads, and a site-specific study designed to estimate erosion and sedimentation from roads by Korte and MacDonald (2005). Sediment production rates were approximated by modeling the Bear Meadow Creek sub-watershed to demonstrate the impacts of the proposed action and the effectiveness of the measures that were designed to mitigate the impacts of the proposed action. The CWE analysis concluded that mechanical treatment of the proposed project area would not alter soil cover, therefore would not increase erosion. We assumed that prescribed burning would reduce soil cover by as much as 40% (North, personal communication, 2006[17]). Estimated sediment production rates from underburned watershed slopes are higher than estimated sediment production rates from hydrologically connected portions of roads.

The results of the analysis suggest that sediment delivery rates would be double the background hillslope delivery rate. Approximately 5.6 tons/ha/yr will be produced from underburning, with approximately 2,743 tons/yr of sediment produced in the Bear Meadow Creek sub-watershed (see Table 3-59). Modeling for the proposed action used 60% cover for all the proposed underburn slopes and 99% cover for all the private land in the north part of the Bear Meadow Creek. In addition, SMZs in Class I, II and III channels were assumed to have 75% cover in the outer 50 feet and 90% cover in the remaining inner portion. Sediment production the second year after the underburn treatment was predicted to return to background rates. As in the existing condition, sediment is mostly produced on the steeper slopes, especially the headwater slopes in the tributary channels of Bear Meadow Creek. This is probably due to the high density of channels and an assumed 60% soil cover in the steep headwater slopes. This may actually be higher and soil cover monitoring will validate this assumption.

Table 3-59 - Watershed analysis – Bear Meadow erosion and sedimentation analysis.

Scenario	Erosion (ton/ha/yr)	Sediment Yield (ton/ha/yr)	SDI	Sediment Discharge from outlet (tons/yr)
Existing	12.2	2.8	.231	2743
Proposed	46.28	5.6	.121	5424
Proposed 2nd Yr	30.11	2.8	.093	2688
Proposed w/ Fire	12.86	7.4	.575	8946
No Action w/ Fire	52.31	10.2	.195	12322

GeoWEPP analysis of the effectiveness of SMZs as sediment filter strips shows that SMZs filter 32% of sediment produced on treated slopes above (see Table 3-60). This sediment filtering effect seems to be low and may actually be higher especially since most of the ground is covered with bear clover and small woody debris. Monitoring will validate this assumption. Areas that are proposed for light-on-the-land harvest systems, like cut-to-length or whole tree yarding systems with grapple piling will result in at least 95% ground cover and sediment will not be increased over background rates.

[17] North conducted a study in 2002 in the Teakettle Experimental Forest, where he measured several soil and vegetation characteristics before and after mechanically treating and under burning forested areas. The results of his study will be published in the Journal Forest Ecology and Management pending review.

Table 3-60 - GeoWEPP hillslope analysis for selected SMZ.

Hillslope #	Location	Slope Length	Slope Grade (%)	Soil	Land Cover	Precip. (in)	Runoff (mm)	Erosion (ton/ac)	Sed Yield (SY) (ton/ac)
143 w/out	E. side BrMdw	1476	.1-31	SCL	60%	36.3	1.7	2.5	.9
92 w/out	W. side BrMdw	164	3-7	SCL	60%	36.3	1.7	0	0
173 w/out SMZ Rx	E side BrMdw Ck @ dog leg left	480	29-33	SCL	60%	36.3	1.8	1.6	1.6
172 w/out	W side BrMdw	304	23-32	SCL	60%	36.3	1.7	.6	.6
982 w/out	E. side BrMdw	751	15-27	SCL	60%	36.3	1.8	1.3	1.3
Total								**6.0**	**4.4**
143 w/					99%	36.3	1.8	2.4	.3
173 w/					75-	36.3	1.8	1.4	1.3
172 w/					75-	36.3	1.7	.3	.3
982 w/					75-	36.3	1.8	1.2	1.1
Total								**5.3**	**3.0**
SMZ Sediment Filter Effectiveness = SY w/out SMZ -Total SY w/ SMZ Rx - Rx times 100									**32%**

Sediment produced in the sub-watersheds that are over their lower TOC will be mitigated by implementing the watershed restoration component of the proposed action. In-stream sediment will be reduced by implementing restoration of the WIN sites identified in the proposed action. The estimated amount of sediment reduced by implementing the watershed restoration projects is approximately 10 -15 tons/yr. Rocking roads (as prescribed in the design measures for Alternative 1 and Alternative 3) and reducing the length of roads hydrologically connected to the channel system (as prescribed in the design measures for Alternative 3) will also reduce sediment. Prescribed burning cannot be mitigated to the same degree as other treatments. Increases in sediment will be mostly in the steep headwater slopes in the proposed underburn areas. Not treating in Class I, II and III SMZ will also have an effect of less fuel on the ground and more ground cover after under burning.

Riparian Conservation Objectives Consistency Analysis: An analysis was conducted to determine the level of consistency of each alternative with the Riparian Conservation Objectives outlined in the Sierra Nevada Forest Plan Amendment (2004). The results are described in the following effects section for each alternative (refer to the project files for the full report).

Alternative 1 – Proposed Action

Direct Effects

Direct effects from mechanized equipment operation and skidding of logs during timber harvest and mechanical fuels reduction will occur under this alternative in swales without channels and in Class V channels, because these areas are not protected by SMZ (see BMP 1-8). These impacts are not expected to affect flows, but may increase sediment available for transport downstream for a few years following activity (Reid 2006). Literature supports that the volume of sediment available generally drops dramatically after the first year and is recovered within three years (Stednick 2000). Based on the method for assigning SMZ described in Appendix E, the number, length, and location of these areas are unknown – the first order streams on the stream layer in GIS are assumed to be Class IV and will receive 25-foot SMZ. This approach should minimize the number of drainage features with no SMZ, and thereby minimize this potential effect. In addition, the Forest has consistently demonstrated the ability to maintain at least 50% ground cover during mechanical treatments, made up of small wood debris and resilient groundcover vegetation such as bear clover. The impacts are also minimized by having the sale administrator approve equipment crossing locations on Class IV and V streams (BMP 1-19), operating when these areas are dry (BMP 1-5) and by performing rehabilitation and erosion control prior to leaving the unit (BMP 1-19). The effect of these impacts would be a possible short-term increase in V* near these disturbances.

Class I, II, and III channels have specified SMZs where mechanized equipment is prohibited. Stream crossings for equipment must be approved by a hydrologist, aquatic biologist or soil scientist (BMP 1-19).

Road construction and reconstruction will result in short-term increases in channel disturbance and sedimentation, and long-term decreases in sediment delivery due to improvements in road drainage design and reduction of hydrologic connectivity. BMPs (listed in Table 2-18) will minimize the short-term increases. However, the WEPP:Road model suggests that sediment contributions could be reduced by up to 3.44 tons/yr at each native surface crossing by reducing the hydrologic connectivity of the road. The effect of these impacts would be a short-term increase in V* downstream of the disturbances, followed by a reduction in V* in the long-term. The length of time between the increase and the decrease will be dependent on the length of time needed for the disturbed area to stabilize- estimated to occur within 3 years, with sharp reductions after the first year – and the occurrence of stream flows that are capable of transporting the sediment produced prior to stabilization downstream. Sand-sized material is transported annually in this system, so the time period for reductions in V* are expected to occur within 3 years in the immediate vicinity of the disturbance, and in approximately 10 years in the lower reaches of Big Creek and Dinkey Creek .

There could be direct effects from water drafting, which requires a vehicle to approach very near to the stream bank and usually requires repeated access. BMP 2-21 specifies protective measures including measures to reduce erosion and the impacts to stream flow from water drafting. Direct impacts to stream banks would be minimized by BMP 2-21, and any unexpected or unacceptable impacts to stream banks would be rehabilitated after use.

There is a slight risk of direct effects from an accidental glyphosate spill reaching surface water. This risk is minimized by implementation of BMP 5-7, which limits the transporting of herbicides to designated routes and specifies batching and mixing locations, and BMP 5-10, which requires a Spill Contingency Plan that is approved by the Forest Service prior to operations. No increase in glyphosate concentration is expected. Glyphosate is not expected to be detectable in surface waters after application.

Prescribed burning is not expected to change stream flows but may increase in-channel sediment in the short-term. The results of the GeoWEPP analysis suggest that sediment will be doubled from background sediment delivery rates, and approximately 5.6 tons/ha/yr will be produced from underburning. However, these burns are planned with a low burn intensity objective, and there will be no fire ignitions within the SMZ (except in KREW study watersheds). Burn patterns typically form a mosaic with unburned or lightly burned areas inter-fingered with a few moderate severity areas. Although some proportion of the area is likely to burn at high severity, the proportion is expected to be small, as found by Robichaud (Robichaud and others 2006). Any overland flow or eroded material that leaves a severely burned spot will be filtered in the unburned, low or moderate severity areas down slope. It is possible that high severity burn could occur at or near stream banks. However, soil and fuel moistures are likely to be higher near stream channels, and this limits the potential for high burn severity. The effect of unfiltered overland flow from burned areas entering streams would be a potential increase in V*. Any such increase would likely occur in an isolated stream reach and is not likely to be measurable in the next higher-order channel downstream. Sediment production the second year after the underburn treatment was predicted by the GeoWEPP model to be at the same level as the existing condition. As in the existing condition, sediment is mostly produced on the steeper slopes, especially the headwater slopes in the tributary channels of Bear Meadow Creek.

Broadcast burning of 146 acres in the n_soapro_2 management unit is the highest intensity burn planned. These acres are not located within sub-watershed 519.3053, which is over the lower TOC. The potential for generating increased sediment is greater in this unit than in the other prescribed burn areas, therefore, the risk of increasing V* in these tributaries to Rush Creek is higher than elsewhere in the project area. However, the target intensity is still moderate severity rather than high severity, and at least 50% ground cover will be maintained. This is expected to minimize effects.

Burning piles will create small isolated spots of high burn severity. These spots will be completely surrounded by unburned area which is expected to provide an adequate filter for any runoff or eroded material leaving the spot. There will be no piles burned in the SMZ (or in the RCA where habitat for Western pond turtle or Relictual slender salamander habitat occurs, as described in the Aquatics section), which will provide adequate filtering for any overland flow and sediment leaving these areas.

Watershed restoration will reduce sediment by 10-15 tons/year. Various localized hydrologic problems will be corrected, and conditions will be restored to closer to natural.

Indirect Effects

This project has the potential to indirectly affect stream flows through various processes as a result of thinning trees, other vegetation manipulation actions, and road construction, reconstruction, and maintenance.

Thinning trees is not expected to affect annual yield or increase peak flows. Many studies have shown that basal area must be reduced at least 10% in small research watersheds to detect any effect, and generally a 20% reduction is required before a detectable change in flow occurs (Troendle and others 2006). This alternative will reduce basal area by a maximum of 12.1% in sub-watershed 519.3052 (See Table 3-61), and total of 4 sub-watersheds will have between 9.9 and 12.1% reductions. Eight sub-watersheds will have 5 to 8%, and the remaining sub-watersheds will have less than a 5% reduction in basal area. There may be a slight increase in snow accumulation in the group selection patches in the Dinkey Creek watershed (the sub-watersheds that begin with 520) where snow is a more dominant process. This may increase peak flows slightly, but not measurably. The overall effect on stream flow in terms of annual yield and peak flows is not expected to be detectable.

Base flows may be augmented by the reduction in vegetation, but the effect is not likely to persist into the dry summer season where it would be detectable. The increase in soil moisture will be utilized by the remaining vegetation, so it will not be available for stream flow.

Road construction could indirectly affect stream flow and sediment, especially where new roads cross stream channels. BMP 2-1, 2-3, 2-5, 2-8 and 2-9 will help to minimize the impacts to stream channels and reduce the potential for sediment to be generated both during construction and once the roads are in place.

Road reconstruction could also affect stream flow and sediment. Road reconstruction will result in fewer resource impacts by establishing an effective drainage design for the road. Watershed design measures specify that in sub-watersheds that are currently over the lower TOC for cumulative watershed effects, hydrologic connectivity will be reduced during road reconstruction. The effect on stream flow is not expected to be measurable, but theoretically reducing connectivity will reduce the impact of the existing roads on the magnitude and timing of peak flows. Controlling road drainage will reduce the amount of sediment delivered from the road to the stream network. In addition, any culverts that are added or replaced will be sized to current standards to minimize the risk of culvert failure.

High severity burn could occur in the riparian area during prescribed burning, and result in riparian mortality. This could reduce the effectiveness of the streamside buffer and allow overland flow and eroded material to enter a stream channel. This effect has a low probability of occurring as a result of any given burn operation; the probability becomes lower the larger the spatial extent (i.e., it is more likely to occur on a small area than a large area). The effect would last for 1 – 3 years until groundcover is reestablished and water repellency recovers (Robichaud and others 2006).

More sediment in channels has the potential to result in increased channel erosion either due to aggradation or to the increased erosive power of sediment-laden high-flows, especially at the known locations with sensitive channel types identified in Table 3-53. These areas are the most likely to adjust to changes in flow and sediment that result from any cause, including natural disturbances such as fire or floods. Although this potential is slightly increased by this proposal in these locations (compared to the existing condition), it is not expected to occur widely across the project area nor to be severe enough to trigger adjustments of channel reach width/depth ratios or sinuosity.

Watershed restoration will increase the resilience of the restored areas to disturbances that could result from other events, such as large storm events or wildfire, and minimize the erosion that would occur as a result of such events.

<u>Indirect Effects with wildfire in 2015</u>:

The implementation of the fuels reduction activities will reduce the area that burns at high severity in the case of a wildfire (see the Vegetation and Fuels sections). Watershed damage including sedimentation rates would be less for the proposed action compared to the no action alternative in the event of a wildfire. Slopes would have at least 60% ground cover after treatment. Overland flows would remain normal and major channel modification would not likely occur. Modeling of the No Action alternative with a fire in the year 2015 predicted 10.2 ton/ha/yr or a total of 12,322 tons of sediment produced in the Bear Meadow Creek watershed. Modeling of the proposed action with a fire in the year 2015 predicted 7.4 tons/ha/yr, or a total of 8,946 tons of sediment. This comparison suggests that the proposed action would result in a smaller effect from wildfire. If a wildfire occurred in Bear Meadow Creek (bear_fen_6), sediment could be increased by 350%, whereas the proposed action followed by a fire would result in a predicted sediment increase of 250%. This suggests that treating the proposed area will result in a significant decrease in sediment production after a fire, compared to the No Action Alternative.

Cumulative Effects

For the purpose of this analysis, CWEs are all effects on beneficial uses of water that result from the synergistic or additive effects of multiple management activities within a watershed that are accumulated in the fluvial system. Effects can be adverse or beneficial. Adverse effects may result from multiple land use activities which combine to cause detrimental changes in watershed hydrology or sedimentation. Beneficial effects may result from management actions such as watershed improvement projects and special project mitigation. The CWE analysis is thoroughly documented in the Baseline and Detailed reports (Gallegos 2006a and 2006b). The results are summarized here.

Nine sub-watersheds in the analysis area (519.0009, 519.0057, 519.3053, 519.4051, 520.0014, 520.1002, 520.1051, 520.1101, and 520.1151) were identified as currently over their lower threshold of concern (TOC). Refer to Table 3-57 for a summary of the information considered in the Detailed Assessment of these nine sub-watersheds. Table 3-61 displays the conclusions of the Detailed Assessment for these same nine sub-watersheds. The potential for CWE to occur from increased sedimentation is a risk based assessment dependent on the occurrence of large storm events that occur in these sub-watersheds. If large storm events (10 or 20 year storm events) occur, the risk of CWE response increases. If a proposed treatment area has below normal precipitation the following winter, and storm events are less then 2-year events, the risk of CWE is reduced. The vulnerability of a sub-watershed for CWE is within the first year of the disturbance and significantly decreases after the 2nd and 3rd years. Risk is defined with 4 classes; “Unlikely” is expected to withstand a twenty-year storm event without incurring a CWE response, “Low” is expected to withstand a ten-year storm event, “Moderate” is expected to withstand a five-year storm event, and “High” is expected to incur a CWE response from a 2-year storm event.

Table 3-61 – Conclusions of the detailed CWE Assessment – Alternative 1

<table>
<tr><th>Sub-watershed Number</th><th>Management Unit</th><th>Main Stream Name</th><th>Risk of CWE Response</th></tr>
<tr><td>519.0009</td><td>n_soapro_2</td><td>Ackers Cr</td><td>Unlikely</td></tr>
<tr><td>519.0057</td><td>providen_1</td><td>Big Cr</td><td>Low</td></tr>
<tr><td>519.3053</td><td>n_soapro_2</td><td>Rush Cr</td><td>Low</td></tr>
<tr><td>519.4051</td><td>providen_1</td><td>Summit Cr</td><td>Low</td></tr>
<tr><td>520.0014</td><td>el_o_win_1
glen_mdw_1
krew_prv_1</td><td>Dinkey Meadow Cr</td><td>Unlikely</td></tr>
<tr><td>520.1101</td><td rowspan="4">bear_fen_6</td><td rowspan="2">Oak Flat Cr</td><td>Moderate</td></tr>
<tr><td>520.1151</td><td>Moderate</td></tr>
<tr><td>520.1002</td><td rowspan="2">Bear Meadow Cr</td><td>Low</td></tr>
<tr><td>520.1051</td><td>High</td></tr>
</table>

Design criteria and watershed restoration have been specified to reduce or offset the risk for CWE. In all sub-watersheds that are over the lower TOC, activities will be carried out using light on the land mechanical systems (i.e., cut-to-length harvest system, low ground pressure feller/buncher system, excavator debris piling).

The watershed improvement restoration described in the Proposed Action will be implemented, and monitoring of channel condition (SCI), sediment accumulation (V*), and other aquatic habitat indicators will occur according to the Monitoring and Adaptive Management Plan. These measures are summarized in Table 3-62. The discussion of the likelihood of cumulative effects responses in these sub-watersheds follows the table.

Table 3-62 - Mitigation measures for the sub-watersheds currently over their Threshold of Concern

Management Unit	Sub-watershed Number	Number of Watershed Restoration Sites	Other Mitigation
n_soapro_2	519.3053	4	Light-on-the-land harvest system Subsoiling compacted skid trails or landings in excess of 15% of area
providen_1	519.0057	9	
	519.4051	0	
el_o_win_1	520.0014	0	
glen_mdw_1		0	
Bear_fen_6	520.1002	0	
	520.1051	9	
	520.1101	0	
	520.1151	0	

*In this Alternative, standard road design measures would be applied which would result in some drainage improvements even though the design criteria that specifies reducing hydrologic connectivity does not apply.

The following is a summary of effects for Alternative 1 and conclusions about the CWE concern sub-watersheds.

Sub-watershed 519.0057 – Approximately 498 acres of mechanical treatment units in the providen_1 management unit is proposed to be treated in this sub-watershed, with 7 acres of underburning in an un-named tributary of Big Creek and Big Creek between Summit and Providence Creeks. The proposed treatments for this sub-watershed would result in ERA of 13.73%. Sediment could be increased by as much as 8 tons from underburning 7 acres. Sediment would be reduced at 9 WIN sites. CWE would be mitigated by using light-on-the-land harvest methods identified in the design measures. These measures will control current sources of sediment and reduce the risk of initiating an additional CWE response. There is a moderate risk that CWE will occur in this sub-watershed.

Sub-watershed 519.3053 – Approximately 60 acres of mechanical treatment and 0 acres of underburn in the providen_1 management unit are proposed in this watershed in Rush Creek. The proposed ERA is 9.16%. By the year 2011, the ERA value will be 8.25%, which is lower then the existing ERA. By the year 2033, the ERA would be 2.31%. Sediment should not be increased because under burning is not proposed in this sub-watershed and mechanical treatment impacts will result in no change in soil cover. Cumulative watershed effects will be reduced by mechanically treating the area with a light on the land harvest system, sub-soiling all major skid roads and trails to reduce runoff, and implementing the watershed restoration described in the Proposed Action (from the Soaproot Watershed Restoration Plan). Implementation of these mitigations will result in watershed improvement, a reduced risk of initiating additional CWE response, and recovery over a shorter time period. There is a low risk of CWE is this sub-watershed.

Sub-Watershed 519.4051 – Approximately 359 acres of mechanical treatment and 0 acres of underburning are proposed in the providen_1 management unit located on the south side of Summit Creek. The proposed treatment will increase ERA to 10.20%. ERAs are expected to be 8.06% in 2011, and 1.74% in 2033. Sediment should not be increased because under burning is not proposed in this sub-watershed and mechanical treatment impacts will result in no change in soil cover. Cumulative watershed effects will be reduced by mechanically treating the area with light on the land harvest methods, sub-soiling all major skid roads and trails to reduce runoff, and implementing the watershed restoration projects identified in the Proposed Action (from the Providence 1 Watershed Restoration Plan). Implementation of these mitigations will result in watershed improvement, a reduced risk of initiating additional CWE response, and recovery over a shorter time period. There is a low risk that CWE will occur in this sub-watershed.

Sub-watershed 520.0014 – Approximately 228 acres of mechanical treatment units from the el_o_win_1 and krew_prv_1 management units is located in this sub-watershed with 84 acres of underburn in Dinkey Meadow Creek. The proposed treatments would result in ERA 10.81%. By the year 2011, the ERA value will be 9.30% and by the year 2033, ERA would be 2.32%. Sediment could be increased by as much as 95 tons from under burning 84 acres. Cumulative watershed effects will be reduced by mechanically treating the area with light on the land harvest methods and sub-soiling all major skid roads and trails to reduce runoff. There is low risk that CWE will occur in this sub-watershed.

Sub-watershed 520.1101 – Approximately 656 acres of mechanical treatment are proposed in 2007 with 413 acres of underburn in upper Oak Flat Creek. ERA's will be increased to 11.53%. ERA's are expected to be 10.08% in 2011, and 4.51% in 2033. Sediment could be increased by as much as 468 tons from the underburning. Cumulative watershed effects will be reduced by mechanically treating the area with light on the land harvest methods and by sub-soiling all major skid roads and trails to reduce precipitation runoff. There is a moderate risk that CWE will occur in this sub-watershed.

Sub-watershed 520.1151 – Approximately 321 acres are proposed for mechanical treatment in 2007 with 321 acres of underburn in lower Oak Flat Creek. The ERA will be increased to 8.16% and would recover to 7.40% in 2011, and 3.76% in 2033. Sediment could be increased by as much 363 tons from under burning. Cumulative watershed effects will be reduced by mechanically treating the area with light on the land harvest methods and by sub-soiling all major skid roads and trails to reduce precipitation runoff. There is a moderate risk that CWE will occur in this sub-watershed.

Sub-watersheds 520.1002 – Approximately 301 acres of mechanical treatment are proposed in 2008 with 297 acres of underburn in the upper Bear Meadow Creek sub-watershed. ERA will be increased to 9.8%. ERA's are expected to be 8.18% in 2011, and 2.51% in 2033. Sediment could be increased by as much 337 tons from the under burning 297 acres. Cumulative watershed effects will be reduced by mechanically treating the area with light on the land harvest methods and by sub-soiling all major skid roads and trails to reduce precipitation runoff. There is a low risk that CWE will occur in this sub-watershed.

Sub-watershed 520.1051 – Approximately 559 acres of mechanical treatment are proposed to be treated in 2008, with 485 acres of underburn in the lower Bear Meadow Creek sub-watershed. ERA will be increased to 11.72%. ERA's are expected to be 9.82% in 2011, and 2.52% in 2033. Sediment production in this sub-watershed could be increased by as much as 323 tons. In addition, the sediment produced in sub-watersheds 520.1002, 520.1101 and 520.1151 will be transmitted downstream and into this sub-watershed. Cumulative watershed effects will be reduced after implementing the proposed "Bear Meadow Watershed Restoration Plan" (as detailed in the Alternative 1 and 3 descriptions). CWEs will be reduced by mechanically treating the area with light on the land harvest methods and by sub-soiling all major skid roads and trails to reduce precipitation runoff. There is a moderate risk that CWE will occur in this sub-watershed.

Other Sub-watersheds Affected by the Proposed Action

Fifteen sub-watersheds that are currently below their lower TOC for Cumulative Watershed Effects (CWE) will exceed their threshold after project implementation (see Table 3-56). These sub-watersheds will be evaluated in a "Detailed Assessment" after each phase of treatments included in the selected alternative in order to determine whether the project has resulted in a CWE response. If at any time these sub-watersheds are found to be at increased risk for CWE response, the design measures that apply to sub-watersheds that are over their TOC prior to implementation of this project will be applied to the remaining phases of implementation.

The fifteen sub-watersheds whose management will be adapted according to an adaptive management strategy are: 519.0007; 519.0008; 519.0009; 519.0011; 519.0056; 519.3002; 519.3003; 519.3004; 519.3052; 520.0015; 520.0016; 520.0056; 520.0057; 520.3002; and 520.4051.

Additional sub-watersheds may be evaluated for CWE response based on factors other than from the ERA model. This will be developed through adaptive management techniques.

Other Projects and Uses Considered in the Cumulative Effects Analysis – The ERA model addressed the vegetation management projects listed in Table 3-3 (Past, Present, and Reasonably Foreseeable Actions), and the discussion of cumulative effects includes all known conditions and problems that are related to other activities. The project file contains more information about the rationale behind the consideration of cumulative effects that could result from each action listed in Table 3-3.

Beneficial Uses - Hydropower uses at Pine Flat Dam could be enhanced by the small increase in annual water yield. However, the slight increase in sediment delivered to streams could also slightly increase the rate of sedimentation in Pine Flat Reservoir. The increase is not predicted to be large enough to significantly affect the rate of filling of the reservoir.

There is a slight potential for contact and non-contact recreation to be affected if CWE responses increase. The reaches most likely to affect recreational experience are in the main Big Creek channel, such as the reach adjacent to Bretz Campground in sub-watershed 519.0057, and others downstream where dispersed campsites are situated on the banks. However, these reaches have been identified as likely exhibiting a CWE response currently. An additional CWE response would be reflected as more fine sediment accumulation in the channel. Since these areas already have accumulated sand (pools are completely filled), the potential difference is not likely to further affect recreational experience. The potential for effects on beneficial uses related to aquatic habitat are discussed in the Aquatics section.

Summary of Effects of Alternative 1:

Peak flows, annual water yield, and base flows would not be altered. The water quality objective for the chemical constituent glyphosate would be met. The water quality objective for sediment may be compromised. Increases in V* could occur. Erosion of channel banks in reaches with high sensitivity to disturbance could be increased. The increase would probably not be enough to significantly affect channel function, but could increase V*. Watershed restoration and road reconstruction would both reduce existing sediment inputs, but may not be enough to offset the increases from other activities. There is a moderate risk of a cumulative watershed effects response occurring in the bear_fen_6 management unit. The beneficial uses related to hydropower and recreation would probably not be affected. See the Aquatics section for a discussion of the effects on beneficial uses related to aquatic habitat.

Indirect and Cumulative Effects if Wildfire occurs in 2015:

Peak flows and annual water yield would increase in the watershed affected by the wildfire for several years following the event. Base flows would be reduced in the watershed experiencing the fire due to decreased infiltration and soil moisture storage. The water quality objective for glyphosate would not be affected by the wildfire, it would be met. The water quality objective for sediment would be more likely to be compromised in the watershed where the wildfire occurred than without a wildfire. Modeling using GeoWEPP suggests that the sediment produced by the activities under this alternative plus the effects of the wildfire would be approximately 70% less than the sediment generated by the wildfire under the No Action Alternative. The beneficial uses related to hydropower would probably not be affected. Recreation uses could be affected in the short-term by ash and additional sediment in streams. See the Aquatics section for a discussion of the effects on beneficial uses related to aquatic habitat.

Alternative 2 - No Action

Direct and Indirect Effects

No actions would be taken; therefore, none of the direct effects described under Alternative 1 would occur. There would, however, be indirect effects related to this alternative. The roads that are in need of maintenance or reconstruction would not be treated and would continue on their current trend. In most cases the trend is road deterioration including erosion and contributing sediment to streams. In some cases the trend is towards recovery of the road, and contributions to stream flows and sediment are negligible.

The watershed restoration sites would not be repaired and would continue on their current trend until they become the District-wide priority of the watershed restoration program, and funding to repair them is in place. This could take many years because there are hundreds of sites currently on the District WIN inventory with more added each year, and each year between 3 and 10 sites are repaired. In all cases, the sites identified in Alternatives 1 and 3 are actively eroding and degrading watershed conditions. The amount of sediment that would continue to be contributed from these sites is approximately 10 -15 tons/year.

Cumulative Effects

The ERA model would show continuing recovery from previous disturbances. Other planned actions that are not part of this decision would still occur, but the total ERA in the project sub-watersheds would be lower than if this project was implemented.

Roads would continue their current sediment contributions to cumulative watershed effects. Some segments may deteriorate, but the overall cumulative impact from the roads probably would not change relative to the current condition.

Stream channel conditions in reaches identified as having high sediment loads would probably not change in most reaches. In Rush Creek (particularly in sub-watershed 519.3053), sediment may continue to accumulate as a result of construction of the Wildflower subdivision. This activity began recently and an increase in fines has been detected. The OHV uses described in this sub-watershed would also contribute to the maintenance of the elevated sediment loads.

Overall, peak flows, annual yield and base flows would not change under this alternative. V* would probably also not change, except in Rush Creek where recreation, actions on private land, and actions taken under other decisions (particularly South of Shaver) would continue and have the potential to cause an increase in V*.

Indirect and Cumulative Effects if Wildfire occurs in 2015:

Under the No Action Alternative, the increased wildfire severity described in the Vegetation and Fuels sections increases the risk of water quality degradation. The Vegetation section identifies bear_fen_6 and el_o_win_1 as the management units with the most pronounced wildfire effects under this alternative. This suggests that Oak Flat and Bear Meadow Creeks (in bear_fen_6) and Dinkey Meadow Creek (in el_o_win_1) are at highest risk for severe impacts from wildfire. This does not mean that fire is more likely to occur in these areas than in other areas, only that if a wildfire were to occur here, the effects are more likely to be severe than if a wildfire were to occur in other areas. The effects described below are general, but can be considered to be more pronounced in these two management units than in the others.

Within and downstream of the burned area, sedimentation rates could increase by orders of magnitude and V* would increase significantly. Some areas that currently meet the desired condition would probably exceed it for several years following the fire.

Infiltration would be reduced in areas that burned at high severity, which based on previous fires on the Forest could be in the range of 20 – 30% of the burned area[18]. This would result in increased overland flow which would increase peak flows, and in decreased soil moisture, which would reduce summer low flows. Post-wildfire peak flows have been found to increase by up to three orders of magnitude (Neary and others 2005). Baseflows have been reported to increase due to the reduction in evapotransipiration that results from vegetation mortality (Neary and others 2005) and to decrease due to increased overland flow and decreased infiltration, which results in lower soil moisture and less subsurface flow to streams. The effect on baseflows is likely related to site-specific factors including the degree or vegetation mortality and the degree of soil water repellency and increases in runoff, and how these relate to the site's water balance.

Modeling of the No Action alternative with a wildfire in the year 2015 predicted 10.2 tons/ha/yr with a total of 12,322 tons of sediment produced in the Bear Meadow Creek watershed, which is greater than the 7.4 tons/ha/yr (total of 8,946 tons) of sediment modeled for the proposed action with a wildfire. If a wildfire occurred under this alternative, sediment could be increased by 350%, whereas in Alternatives 1 and 3 a wildfire could increase sediment by 250%. These model results suggest that the effects of a wildfire on erosion, sedimentation, and increases in V* will be higher under Alternative 2 (No Action) than for Alternative 1 or Alternative 3.

Alternative 3 – Reduce Harvest Tree Size

Direct and Indirect Effects

The effects of this alternative would be the same as those described under Alternative 1, with the following exceptions:

Direct effects from mechanized equipment operation and skidding of logs during timber harvest and mechanical fuels reduction would be similar to those described under Alternative 1. However, grapple piling will be used in sub-watersheds that are over their lower TOC and in sub-watersheds that are determined to be at increased risk for CWE response after implementation of the harvest treatments (Refer to the Adaptive Management section of Chapter 2). Grappling piling will not reduce ground cover and has less compaction than tractor piling which is proposed for these areas in Alternative 1. Application of the riparian silvicultural prescription described in the Watershed Design Measures for Alternative 3 (Chapter 2) would further reduce the potential for impacts and would provide additional protection to the SMZs of Class I and II streams in sub-watersheds that are over their TOC by prohibiting harvest in these areas.

As in Alternative 1, road reconstruction could affect stream flow and sediment. However, watershed design measures for Alternative 3 specify that in sub-watersheds that are currently over the lower TOC for cumulative watershed effects, hydrologic connectivity will be reduced during road reconstruction. The effect on stream flow is not expected to be measurable, but theoretically, reducing connectivity will reduce the impact of the existing roads on the magnitude and timing of peak flows. Controlling road drainage of peak flows will reduce the amount of sediment delivered

[18] Some of the fires that have occurred on the Sierra National Forest include Kirch Fire (high burn severity was 15%), Balch Fire (high burn severity was 30%), and North Fork Fire (high burn severity was 27%). Burn severity information is from "Burned Area Emergency Rehabilition"

from the road to the stream network. According to the WEPP model, sediment could be reduced by as much as 0.35tons/year from hydrologically connected crossings on native surface roads.

Cumulative Effects

Additional design measures are specified for this alternative which reduces the potential for CWE compared to Alternative 1. The differences between the cumulative effects under Alternative 1 and this alternative are described below.

The risk of a CWE response would be reduced under this alternative. This would be especially true in sub-watershed 520.1051, which is at high risk for Alternative 1 and at moderate risk for Alternative 3 for a CWE response. The additional design measures help to balance the possible effects of the harvest, fuels, and burning actions. The risk for CWE could be further reduced in the bear_fen_6 management unit by implementing underburning in multiple years rather than in one year. The risk of CWE for each sub-watershed under this alternative is displayed in Table 3-63 (refer to Table 3-61 for the definition of risk). Table 3-64 shows the mitigation measures that would apply to each sub-watershed under this alternative.

Table 3-63 - Conclusions of the Detailed CWE Assessment – Alternative 3

<table>
<tr><th>Sub-watershed Number</th><th>Management Unit</th><th>Main Stream Name</th><th>Risk of CWE Response</th></tr>
<tr><td>519.0009</td><td>n_soapro_2</td><td>Ackers Cr</td><td>Unlikely</td></tr>
<tr><td>519.0057</td><td>providen_1</td><td>Big Cr</td><td>Low</td></tr>
<tr><td>519.3053</td><td>n_soapro_2</td><td>Rush Cr</td><td>Low</td></tr>
<tr><td>519.4051</td><td>providen_1</td><td>Summit Cr</td><td>Low</td></tr>
<tr><td>520.0014</td><td>el_o_win_1
glen_mdw_1
krew_prv_1</td><td>Dinkey Meadow Cr</td><td>Unlikely</td></tr>
<tr><td>520.1101</td><td rowspan="4">bear_fen_6</td><td rowspan="2">Oak Flat Cr</td><td>Moderate</td></tr>
<tr><td>520.1151</td><td>Moderate</td></tr>
<tr><td>520.1002</td><td rowspan="2">Bear Meadow Cr</td><td>Low</td></tr>
<tr><td>520.1051</td><td>Moderate</td></tr>
</table>

Table 3-64 - Mitigation measures for the sub-watersheds currently over their Threshold of Concern, Alternative 3

Management Unit	Sub-watershed Number	Miles of Stream whose SMZ has No Harvest	# Stream Crossings Subject to Design Criteria	Number of Watershed Restoration Sites to be repaired	Other Mitigation
n_soapro_2	519.3053	1.7	8	4	Light-on-the-land harvest system Grapple piling Subsoiling compacted skid trails or landings in excess of 15% of area Suggest multi-year underburning in bear_fen_6
providen_1	519.0057 519.4051	7.5 4.0	45 16	9 0	
el_o_win_1	520.0014	1.2	19	0	
glen_mdw_1		0.2		0	
Bear_fen_6	520.1002 520.1051 520.1101 520.1151	4.1 2.5 4.8 1.1	21 29 41 8	0 9 0 0	

The differences in Cumulative Effects between Alternative 1 and this alternative for the sub-watersheds that are over their lower TOC of concern are due to implementation of grapple piling and road design criteria for reducing the road hydrologic connectivity. Each sub-watershed is listed with an estimated number of road/channel crossings, the number of WIN sites, and associated sediment reduction.

Sub-watershed 519.3053 – Sediment could be reduced on 8 road/channel crossings and four WIN sites by as much 3 to 28 tons per year.

Sub-watershed 519.0057 – Sediment could be reduced on 45 road/channel crossings and nine WIN sites by as much 7 to 75 tons per year.

Sub-Watershed 519.4051 – Sediment could be reduced on 16 road/channel crossings and by as much 5 to 55 tons per year.

Sub-watershed 520.0014 – Sediment could be reduced on 19 road/channel crossings and by as much 2 to 21 tons per year.

Sub-watershed 520.1101 – Sediment could be reduced on 41 road/channel crossings and by as much 7 to 77 tons per year.

Sub-watershed 520.1151 – Sediment could be reduced on 8 road/channel crossings and by as much 2 to 22 tons per year.

Sub-watersheds 520.1002 – Sediment could be reduced on 21 road/channel crossings and by as much 5 to 51 tons per year.

Sub-watershed 520.1051 – Sediment could be reduced on 21 road/channel crossings and nine WIN sites by as much 4 to 55 tons per year.

Summary of Effects of Alternative 3:

The effects would be the same as in Alternative 1 with the following exceptions: the potential for V* to increase is lower; and the risk of cumulative watershed effects, particularly in the bear_fen_6 management unit, is lower.

Indirect and Cumulative Effects if Wildfire occurs in 2015:

The measures designed to reduce watershed impacts that apply to this alternative could reduce post-wildfire erosion at some sites, but overall the benefits will be negligible in the case of a wildfire. Therefore, the effects under this Alternative would be similar to those described under Alternative 1.

Table 3-65 – Summary of the Effects of each Alternative on the Indicators Selected for the Watershed Analysis

Indicator	Alternative 1		Alternative 2		Alternative 3	
	No wildfire	Wildfire	No wildfire	Wildfire	No wildfire	Wildfire
Peak flows	No measurable change	Increase	No change	Greater increase than under Alt 1.	No measurable change	Increase similar to under Alt. 1
Annual water yield	No measurable change	Increase	No change	Increase	No measurable change	Increase similar to under Alt 1.
Base flows	No measurable change	Decrease	No change	Potentially greater decrease than under Alt 1	No measurable change	Decrease similar to under Alt 1.
WQ: glyphosate	Not detectable – meets WQ objectives	Not detectable – meets WQ objectives	Not detectable – meets WQ objectives	Not detectable – meets WQ objectives	Not detectable – meets WQ objectives	Not detectable – meets WQ objectives
WQ: V*	Slight risk of increase, especially in bear_fen-6 management unit	High risk of increase, especially in bear_fen-6 management unit	No change, except slight risk of increase in 519.3053 due to other land uses	Higher risk of increase than under Alt 1.	Slight risk of increase, similar to under Alt. 1	High risk of increase, similar to under Alt. 1
Risk of CWE Response	One high risk and two moderate risk sub-watersheds occur all in bear_fen_6 management unit; all other units are unlikely or low	Any burned sub-watershed from a wildfire will result in moderate and high risk	All sub-watersheds would continue to recover from past management activities	Any burned sub-watershed from a wildfire will result in moderate and high risk	Three moderate risk sub-watersheds occur all in bear_fen_6 management unit; all other units are unlikely or low	Any burned sub-watershed from a wildfire will result in moderate and high risk

AQUATIC SPECIES

Affected Environment

There are ten federally listed aquatic species that may be affected by activities occurring within the Kings River Project (KRP) area. For general information and the rationale for inclusion or exclusion of all the listed aquatic species that are on the Sierra National Forest species lists refer to the Aquatic Species Biological Assessment and Biological Evaluation report for the Final Environmental Impact Statement (EIS) for the Kings River Project (KRP) – Initial Eight Management Units (Sanders 2006b) and the Resident Trout Management Indicator Species report (Strand 2006). Provided in this section are brief descriptions of the ten federally listed aquatic species and their habitats within the Kings River Project area, initial eight management units. The ten listed aquatic species are:

- **California red-legged frog** (Threatened; CRLF), *Rana aurora draytonii*
- **Foothill yellow-legged frog** (Forest Service Sensitive; RABO), *Rana boylii*
- **Lahontan cutthroat trout** (Threatened and Management Indicator Species; LCUTT) *Oncorhynchus (=Salmo) clarki henshawi*
- **Mountain yellow-legged frog** (Candidate and Forest Service Sensitive; RAMU) *Rana muscosa*
- **Relictual slender salamander** (Forest Service Sensitive; RSS), *Batrachoseps relictus*
- **Resident trout species** (Management Indicator Species; RTS)
    - Brown Trout, *Salmo trutta*
    - Eastern Brook Trout, *Salvelinus fontinalis*
    - Rainbow Trout, *Oncorhynchus mykiss*
- **Western pond turtle** (Forest Service Sensitive; WPT), *Clemmys marmorata* (Subspecies *marmorata* and *pallida*)
- **Yosemite toad** (Candidate & Forest Service Sensitive; BUCA), *Bufo canorus*

Of these ten aquatic species and their habitats, eight are found within the initial eight management units and two within other management units of the Kings River Project. Each species either is known to occur, has habitat within or adjacent to the project area, or historically (prior to 1980) is known to have occurred within the project area (Table 3-66).

Table 3-66 - Aquatic species located within the Kings River Project (KRP).

Aquatic Species	Initial Eight Management Units								Adjacent to the Initial Eight MU & within the KRP Area
	Bear_fen_6	El-O-Win_1	Glen_mdw_1	Krew_bul_1	Krew_prv_1	N-Soapro_2	Providen_1	Providen_4	
CRLF	HA				HA	HA	HA	HA	HA
RABO					HA	HA	HA	HA	HA/HP
LCUTT									HA/SP
RAMU									HA/SP
RSS	HA/SP	HA	HA	HA	HA	HA	HA/SP	HA/SP	HA/SP
RTS	HA/SP	HA/SP	HA/SP	HA/SP	HA/SP	HA/SP	HA/SP	HA/SP	HA/SP
WPT	HA				HA	HA/SP	HA/SP	HA/SP	HA/SP
BUCA			HA	HA/SP					HA/SP

“HA” indicates habitat for the species is present, “SP” indicates the species is currently known to be present, and “HP” indicates the species was historically known to be present within the project area. Aquatic species names: California red-legged frog (CRLF); Foothill yellow-legged frog (RABO); Lahontan cutthroat trout (LCUTT); Mountain yellow-legged frog (RAMU); Relictual slender salamander (RSS); Resident trout species (RTS); Western pond turtle (WPT); Yosemite toad (BUCA).

The ten listed aquatic species occur in:

- Bear_fen_6 Management Unit – Habitat for the California-red-legged frog, relictual slender salamander, resident trout species, and western pond turtle occur within the management unit.

- El_o_win_1 Management Unit - Habitat for the relictual slender salamander and resident rout species occur within the management unit.

- Glen_mdw_1 Management Unit - Habitat for the relictual slender salamander, resident trout species, and the Yosemite toad occur within the management unit.

- Krew_bul_1 Management Unit - Habitat for the relictual slender salamander, resident trout species, and the Yosemite toad occur within the management unit.

- Krew_prv_1 Management Unit - Habitat for the California red-legged frog, foothill yellow-legged frog, relictual slender salamander, resident trout species, and the western pond turtle occur within the management unit.

- N_soapro_2 Management Unit – Habitat for the California red-legged frog, foothill yellow-legged frog, relictual slender salamander, resident trout species, and the western pond turtle occur within the management unit.

- Providen_1 Management Unit - Habitat for the California red-legged frog, foothill yellow-legged frog, relictual slender salamander, resident trout species, and the western pond turtle occur within the management unit.

- Providen_4 Management Unit - Habitat for the California red-legged frog, foothill yellow-legged frog, relictual slender salamander, resident trout species, and the western pond turtle occur within the management unit.

- Within other management units of the Kings River Project – Habitat for the California red-legged frog, foothill yellow-legged frog, Lahontan cutthroat trout and its Critical Aquatic Refuge, mountain yellow-legged frog and its Critical Aquatic Refuge, relictual slender salamander, resident trout species, western pond turtle, and the Yosemite toad occur within other management units of the Kings River Project.

A brief description of each of these species is described next, a complete species account can be found in the Aquatic Species Biological Assessment and Biological Evaluation report for the Final Environmental Impact Statement (EIS) for the Kings River Project (KRP) – Initial Eight Management Units (Sanders 2006b) and the Resident Trout Management Indicator Species Report (Strand 2006). A summary of the acres and miles of occurrences, suitable habitat, and dispersal habitat is presented in Tables 2 and 3.

California red legged frog

The California red-legged frog (*Rana aurora draytonii*) was federally listed as threatened on May 23, 1996 (61 **FR** 25813). Critical habitat was designated in 2001 (66 **FR** 14625), updated on April 13, 2004 (69 **FR** 19619), and a final recovery plan was published in 2002 (67 **FR** 57830; USFWS 2002). The California red-legged frog (CRLF) is the largest native frog in the western United States (Wright and Wright 1949), ranging from 4 to 13 centimeters (1.5 to 5.1 inches) in length (Stebbins 1985). CRLFs breed from November through March (Storer 1925). Populations of CRLFs are most likely to persist where multiple breeding areas are embedded within a matrix of habitats used for dispersal, a trait typical of many anuran species (Marsh and others 1999; Griffiths 1997; Sjogren-Gulve 1994; Mann and others 1991; Laan and Verboom 1990; Reh and Seitz 1990).

At any time of the year, adult CRLFs may move from breeding sites. They can be encountered living within streams at distances exceeding 2.8 kilometers (1.8 miles) from the breeding site and have been found greater than 100 meters (328 feet) from water in adjacent dense riparian vegetation for up to 77 days (USDI 2002), but are typically within 60 meters (200 feet) of water. During periods of wet weather, starting with the first rains of fall, some individuals may make overland excursions through upland habitats. Most of these overland movements occur at night. Newly metamorphosed juveniles tend to disperse locally July through September and then disperse away from the breeding habitat during warm rain events (USDI 2002).

The areas that might support CRLF breeding habitat within the project area (defined as stream slopes less than 4 percent with at least one pool deeper than 0.7 meters below 5,000 feet in elevation (USDI 2002)) was determined through habitat assessment surveys by Sierra National Forest in 1999 and 2000 (Eddinger 2000a and 2000b). The California Wildlife Habitat Relationships (CWHR) highly suitable habitats (CDFG 2002) for this species that occur within the KRP are riverine and fresh emergent wetlands with submerged organic, mud, and sand substrates and with short or tall herbaceous species and vegetation closures greater than 10%.

Foothill yellow-legged frog

The Pacific Southwest Region of the Forest Service designated the foothill yellow-legged frog (*Rana boylii*) as a sensitive species in 1998. The foothill yellow-legged frog (RABO) is moderate in size, measuring between 37-82 millimeters (1.5 – 3.2 inches). RABO are found in or near rocky streams and rivers in a variety of habitats including valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow types (Stebbins 1985). The CWHR highly suitable habitats (CDFG 2002) for this species that occur within the KRP are riverine and valley foothill riparian with mostly submerged and flooded gravels, cobble, boulders, and bedrock with trees greater than six inches in diameter and canopy closures greater than 10%. This species generally occurs at elevations below 6,000 feet in perennial streams with breeding areas defined by some shading (> 20%), water temperatures not exceeding 20'C for egg-laying and larval development, shallow riffles (≤ 0.21 meters), and cobble or larger substrates (Hayes and Jennings 1986; CDFG 2002; Lind and others 2003).

Breeding occurs in shallow, slow flowing water with at least some pebble and cobble substrate between March and June after high flows have receded. During breeding season and in the summer, RABO are rarely encountered far from permanent water. During the winter, RABO have been observed in abandoned rodent burrows and under logs as far as 100 meters (328 feet) from a stream (Zweifel 1988). Suitable habitat for this species in the Kings River Project area is being considered as the perennial streams and tributaries of the Big Creek and Rush Creek drainage below 6,000 feet in elevation.

Lahontan cutthroat trout and the Cow Creek Critical Aquatic Refuge
The Lahontan cutthroat trout (LCUTT; *Oncorhynchus (=Salmo) clarki henshawi*) is both a federally threatened species and a Sierra National Forest management indicator species (MIS). On the Sierra National Forest this species was introduced into only two watersheds; West Fork Cow Creek and West Fork Portuguese Creek. These two populations are managed under the species recovery plan and terms and conditions of two U.S. Fish & Wildlife Service Biological Opinions (1-1-94F-44 and 1-1-95-F-42). The West Fork Cow Creek population occurs within the Kings River Project area but outside the initial eight management units. A Critical Aquatic Refuge (CAR) was established for this species in 2001 (USDA 2001a; USDA 2004b). The LCUTT is monitored annually for population abundance and every five years for habitat characteristics based on the recovery plan objectives, the terms and conditions of the Biological Opinion, and from the Sierra National Forest LMP monitoring requirements. Currently this species is maintaining its population size though fishing pressure appears to be increasing over the last few years (USDA 2005). There are no defined CWHR habitats for this species (CDFG 2002).

Mountain yellow-legged frog and the Snow Corral Critical Aquatic Refuge
The Mountain yellow-legged frog (RAMU; *Rana muscosa*) is a federal candidate species and a Forest Service sensitive species. The USFWS found that listing was warranted as threatened or endangered for this species however the listing was precluded at the time based on other higher priority issues (68 **FR** 2283). On the Sierra National Forest there are roughly 30 known locations of this species with one known population occurring within the Kings River Project but outside the initial eight management units in the Snow Corral meadow watershed and Critical Aquatic Refuge (CAR).

This species is a high elevation species that only occurs in the Sierra Nevada Mountains of California from elevations of 4,500 feet to 12,000 feet (CDFG 2002). The mountain yellow-legged frog is mostly diurnal and hibernates in the winter beneath ice-covered streams, lakes, and ponds (CDFG 2002). This species may move up to 165 feet from their habitat. Breeding and egg laying occur after snowmelt from June to August (CDFG 2002). Tadpoles over-winter in their habitat making them more susceptible to fish predation and diseases. The CWHR highly suitable habitats (CDFG 2002) for this species that occur within the Kings River Project are lacustrine, montane riparian, riverine, and wet meadows with mostly submerged and flooded gravels, cobbles, and boulders with trees greater than one inch in diameter, short or tall herbaceous cover, and vegetation and canopy closures greater than 10%.

Relictual Slender Salamander

The Relictual slender salamander (RSS; *Batrachoseps relictus*) is a Forest Service sensitive species. The Relictual slender salamander was listed on the Regional Forester's sensitive species list in 1998 prior to research (Jockush and others 1998; Jockush and Wake 2002; Hansen 2006) which delineated the Relictual slender salamander into four separate species in the Sierra Nevada. Three of the species would have distribution south of Fresno County with one species, Kings River Slender Salamander (*B. regius)* within the Sierra National Forest and adjacent to the Kings River Project but outside the initial eight management units. The Gregarious Slender Salamander (*B. gregarius*) also occurs on the Sierra National Forest within the Kings River Project and the initial eight management units and has been considered as part of the relictual slender salamander group based on the original distribution of the Relictual slender salamander as described in the 1998 Regional Forester's Sensitive Species List. Therefore the Relictual slender salamander is analyzed as if the original description and range of the species was still valid from Fresno County, south to the Greenhorn Mountains and Kern River Canyon in Kern County (CDFG 2002). Elevations for this species range from 560 feet to 7,600 feet (Jennings and Hayes 1994).

Direct threats to the species include changes in canopy structure, and activities that affect hydrology or the soil moisture regimes around seeps and meadows (Hansen 2005). Practices such as opening seeps and springs with explosives to enhance habitat for upland species or capping of springs are potentially devastating to localized populations (Hansen 2005). The CWHR highly suitable habitats (CDFG 2002) for this species that occur within the KRP are blue oak woodland, blue oak – foothill pine, montane hardwood, montane hardwood – conifer, montane riparian, sierra mixed conifer, valley foothill riparian, valley oak woodland, and white fir. In riparian areas any size tree and greater than 10% canopy closure is highly suitable. In oak woodland areas trees greater than 11 inches in diameter and canopy closures greater than 40% is highly suitable. In montane and white fir areas trees greater than 24 inches and canopy closures greater than 40% is highly suitable.

Use by the RSS is in relatively small, mesic areas (e.g., swales, drainages, etc.) with an overstory of trees or shrubs and abundant rocks, litter, or woody debris (CDFG 2002). They are normally active at night, and return to cover during daylight (CDFG 2002). During periods of extended rainfall, they may remain on the surface during the day to feed (Hendrickson 1954). Surface activity is limited by extremes of temperature and unfavorable moisture conditions (CDFG 2002). For the relictual slender salamander there is no data detailing the movements of the species however in similar species adults of *B. attenuatus* moved within a mean of 1.5 meters (5 feet) from their home cover over 2 years, and 59% of the individuals were found repeatedly under the same cover (Hendrickson 1954; CDFG 2002).

Species surveys for the relictual slender salamander conducted in 2003 located one population in a small seep area within potential suitable habitat of the South of Shaver Fuels Reduction project (sos_1 management unit) area. In addition, a monitoring study conducted by the Pacific Southwest Research Station of the Forest Service (Bagne 2003) near the Blue Canyon workstation area of providen_1 and providen_4 management units found the species occurring along Big Creek and Summit Creek. In 1999 a relictual slender salamander was found in moist bark approximately 33 feet west of Oak Flat Creek just downstream of the bear_fen_6 management unit (in the bear_fen_1 management unit).

Suitable habitat is being defined conservatively as within 300 feet of any known sight records of the species and within 300 feet of any known seeps, springs, bogs, meadows, or perennial streams within the initial eight management units. There is potentially suitable habitat within any riparian conservation areas (RCAs) for any of the management units occurring below 8,000 feet in elevation. Since defining suitable habitat for this species across the KRP area is problematic an estimate using the RCAs was generated for those management units outside of the initial eight.

Resident Trout Species – Brown Trout, Eastern Brook Trout, and Rainbow Trout
Brown trout (*Salmo trutta*) are considered as one of three resident trout management indictor species for the Sierra National Forest. Brown trout are native to Europe and are fished for sport around the world (Moyle 2002). Adult brown trout are usually found at the bottom of pools between 0.7 and 3.5 meters (2.3 – 11.5 feet) deep while younger, smaller brown trout tend to inhabit riffle areas less than 30 centimeters (11.5 inches) deep (Moyle 2002). The optimum habitat appears to be medium to large, slightly alkaline, clear streams with swift riffles and large, deep pools (Moyle 2002). However, they can be found throughout any stream and/or lake system (Moyle 2002). The preferred water temperature range is between 12 and 20 degrees (°) Celsius (C), avoiding streams that do not reach 13°C (Moyle 2002). Smaller brown trout typically feed on terrestrial insects and aquatic invertebrates while larger brown trout tend to feed on other fish species, crayfish, and dragonfly larvae (Moyle 2002). Spawning occurs in November or December in streams with pea to walnut sized gravel (approximately 10 to 40 millimeters (0.4 – 1.6 inches; Moyle 2002).

Eastern brook trout (*Salvelinus fontinalis*) are the second resident trout species to be listed as a management indicator species for the Sierra National Forest. Eastern brook trout were originally native to the northern half of the Eastern United States and Canada (Moyle 2002). Eastern brook trout have been introduced into streams throughout most of the world, becoming most abundant in Sierra mountain streams and lakes (Moyle 2002). Eastern brook trout prefer clear, cold lakes and streams and have become well established in the small, headwater, spring-fed streams and isolated lakes (Moyle 2002). Water temperatures for Eastern brook trout often range between 14 and 17° C though being able to feed in as cold as 1°C (Moyle 2002). When water temperatures begin to exceed 19°C it starts to slow growth and may become lethal for this species (Moyle 2002). Eastern brook trout mature within the first year for males and second year for females, spawning in the fall and living only for a total of 4 or 5 years (Moyle 2002). They tend to feed on terrestrial insects and aquatic insect larvae in both streams and lakes, with zooplankton added in at lakes (Moyle 2002). As they become larger in lakes they may begin to feed on other fish species (Moyle 2002).

Rainbow trout (*Oncorhynchus mykiss*) are the third resident trout species to be listed as a management indicator species for the Sierra National Forest. Resident rainbow trout is a general term used for hundreds of non-anadromous wild and hatchery planted rainbow trout populations existing throughout California (Moyle 2002). Rainbow trout were originally native to Pacific coast streams from Alaska to Baja, California (Moyle 2002). Rainbow trout have been introduced into coldwater streams and lakes throughout most of the world, including waters that were originally fishless (Moyle 2002). Rainbow trout prefer cool, clear fast-flowing permanent streams and rivers where riffles dominate over pools, invertebrate species for food is abundant, and there is ample riparian vegetation, and undercut banks (Moyle 2002). Water temperatures for rainbow trout often range between 4° and 23° C (Moyle 2002). When water temperatures exceed 24° C it is usually lethal for this species (Moyle 2002). They prefer alkaline waters (pH of 7 to 8). Smaller rainbow trout will chose shallow areas (less than 50 cm (1.6 feet)) while juveniles tend to use deeper (50 to 100 cm (1.6 – 3.3 feet)) and faster areas of the stream (Moyle 2002). Larger rainbow trout will select the deeper areas of runs, pools and behind rocks searching for drifting invertebrates (Moyle 2002). Threats to rainbow trout include birds that prey on the fish if in shallow water and other trout species such as Brown trout (Moyle 2002).

Species surveys within the project area have indicated all three resident trout species (and other unidentified fish species) occur in all the major perennial tributaries of the initial eight management units. Suitable habitat is defined as all perennial streams within the project area and is considered as marginal to good habitat. Most fish species have access to and from Pine Flat Reservoir to Big Creek and from the Kings River to Dinkey Creek (and thus their perennial tributaries) within the project area and are subject to heavy fishing pressure. Since defining suitable habitat for these species across the KRP area is problematic an estimate using perennial streams was generated for those management units outside of the initial eight.

Western pond turtle

The Pacific Southwest Region of the Forest Service designated the western pond turtle as a sensitive species in 1998. The central Sierra Nevada Mountains are an area of overlap between two pond turtle subspecies, *Clemmys marmorata marmorata* (Northwestern pond turtle) and *Clemmys marmorata pallida* (Southwestern pond turtle). These pond turtles, collectively known as western pond turtles (WPT), are found from sea level to 4,690 feet in elevation (Jennings and Hayes 1994).

Habitat for WPT occurs in a variety of both permanent and intermittent aquatic habitats. This turtle is often restricted to areas near the banks or in quiet backwaters where the current is relatively slow and basking sites and refugia are available (CDFG 2002). Movements of WPT of over 1 mile have been reported when local aquatic habitat conditions change (e.g. drought), however most stay within 325 feet of the stream channel mainly moving during breeding and egg-laying (CDFG 2002). Holland (1991) references information indicating that a significant portion of the turtles occurring in pond environments move out into adjacent wooded or grassland habitats to over-winter, with two turtles found dormant under logs and others in duff and litter under trees. Aerial basking on logs and rocks occurs when air temperature exceeds water temperature (Holland 1985).

Mating occurs in late April to early May (Holland 1991). Young WPT are believed to over-winter in the nest (Holland 1985). When hatchlings leave the nest they occupy shallow water habitats where they feed on nekton (Holland 1985, 1991). In California, maturity occurs at about 8 years (CDFG 2002).

The CWHR highly suitable habitats (CDFG 2002) for this species that occur within the KRP are blue oak woodland, blue oak – foothill pine, fresh emergent wetland, lacustrine, riverine, valley foothill riparian, and valley oak woodland. Highly suitable areas include those with short or tall herbaceous plants and vegetation closures greater than 40% with trees larger than six inches in diameter and canopy closure greater than 10% is highly suitable. In stream, lakes, and pond habitats are highly suitable areas are those that range from mostly exposed to flooded cobbles, boulders, and bedrock.

Surveys conducted during the late 1990's and into 2003 for the WPT, within and adjacent to the project area, have occurred including mark-recapture studies, population abundance and presence/absence surveys. Numerous WPT sightings occur along Billy Creek, Lower Rancheria Creek, Rush Creek, Big Creek and a few other perennial and intermittent tributary streams. Suitable habitat within the project area is considered marginal to moderately good.

Yosemite toad

The Yosemite toad (BUCA; *Bufo canorus*) is a federal candidate species and a Forest Service sensitive species. The USFWS found that listing was warranted as threatened or endangered for this species however the listing was precluded at the time based on other higher priority issues (67 **FR** 75834). This species occurs above 6,000 feet in elevation in meadows, lake edges, and some stream habitats only in the central Sierra Nevada Mountains of California and can disperse up to 0.6 miles (CDFG 2002) to reach breeding or over-winter habitats.

The Yosemite toad is mostly diurnal and seeks cover during non-breeding seasons (approximately August to March) in abandoned rodent burrows (Jennings and Hayes 1994) or by moving into adjacent forested areas (CDFG 2002). Breeding and egg laying occur after snowmelt in mid-April to mid-July in shallow, quite pools in wet meadows, or shallow tarns surrounded by forest (CDFG 2002). Desiccation of pools before metamorphosis is a major cause of mortality in tadpoles (CDFG 2002). The CWHR highly suitable habitats (CDFG 2002) for this species that occur within the KRP are wet meadows that have short (< 12 inches) herbaceous plants with vegetation closures greater than 10%.

This species was inventoried for occurrence between 2002 and 2004 across the Sierra National Forest. In 2006 a new set of occupied meadows was found within the Kings River Project area in the Bear drainage 4 miles east of the El-o-win_1 management unit. There are currently seven meadows (within and directly adjacent to the krew_bul_1 management unit) that are occupied with Yosemite toad. These occupied meadows could be considered a source population for the distribution of Yosemite toads in the Bull Creek and Teakettle watersheds since they appear to be isolated from other populations of Yosemite toads.

Table 3-67 - Miles and acres of habitat for the ten listed aquatic species within the entire KRP area.

Species	Type of Habitat	Amount
California red-legged frog	Acres of suitable breeding habitat	1,353
Foothill yellow-legged frog	Acres of suitable habitat	9,572
Lahontan cutthroat trout	Acres of Critical Aquatic Refuge for the Lahontan cutthroat trout	4,472
Mountain yellow-legged frog	Acres of Critical Aquatic Refuge for the mountain yellow-legged frog	1,516
Relictual slender salamander	Acres of potentially suitable habitat within Riparian Conservation Areas	45,643
Resident trout species	Miles of potentially suitable perennial stream habitat	406
Western pond turtle	Acres of potentially suitable habitat	19,197
Yosemite toad	Acres of meadow habitat occupied	268
Yosemite toad	Acres of meadow habitat	955
Yosemite toad	Acres of dispersal habitat	17,112

Table 3-68 - Miles and acres of habitat for the ten listed aquatic species within the initial eight management units of the KRP.

Species	Type of Habitat	Amount
California red-legged frog	Acres of suitable habitat	297
Foothill yellow-legged frog	Acres of suitable habitat	1,832
Lahontan cutthroat trout	Acres of Critical Aquatic Refuge for the Lahontan cutthroat trout	0
Mountain yellow-legged frog	Acres of Critical Aquatic Refuge for the mountain yellow-legged frog	0
Relictual slender salamander	Acres of potentially suitable habitat within Riparian Conservation Areas	6,510
Resident trout species	Miles of suitable perennial stream habitat	33
Western pond turtle	Acres of suitable habitat	623
Yosemite toad	Acres of meadow habitat	68
Yosemite toad	Acres of meadow habitat occupied	22
Yosemite toad	Acres of dispersal habitat	1,008

Environmental Consequences

This section analyzes the effects of the three alternatives on the ten listed aquatic species and their habitats. The effects of the alternatives are discussed in terms of direct, indirect, and cumulative impacts. Affects on aquatic species and their habitats are fully described for this project in the Aquatic Species Biological Assessment and Biological Evaluation report (Sanders 2006b) and the Resident Trout Management Indicator Species report (Strand 2006) found in the project file for the Kings River Project – Final Environmental Impact Statement for the Initial Eight Management Units. Only a brief discussion is presented in this section for each of the alternatives.

There were two significant issue detailed in Chapter 1 that relate to aquatic species:

3) the use of herbicide/surfactant will create an adverse risk of harmful effects to people

and wildlife (issue #2), and

4) the proposed action will threaten the viability and cause degradation of habitat of the spotted owl, marten, fisher, and goshawk and will lead to high short-term risks on aquatic management (issue #3).

The factors for aquatic species for these two issues (as listed in Chapter 1) involves the tracking of population viability (e.g. population dynamics and life stages present) and the quality of habitat they require to over winter in, disperse from, breed in, and forage from (e.g. sediment V* ratings in pools (Hilton and Lisle 1993) and channel conditions (Frazier and others 2005) including water temperature, shading, and instream woody debris).

The combined treatments proposed for Alternatives 1 and 3 of the initial eight management units involves timber harvesting, small tree thinning, plantation upkeep, prescribed fires and fire lines, road construction and reconstruction, temporary roads and skid trails, herbicide treatments for noxious weeds and in other areas, and selected watershed improvements sites. Overlapped with these activities are a few studies that will look at the effects on the environment (e.g. the watershed study) and some wildlife species (e.g. the spotted owl study). All these activities individually and together will have risks and both short-term and long-term effects on aquatic species, even with the design measures in place. The degree of these risks and effects can differ by species and the locations of their habitats within the project area. However, in general there are some commonalities of effects for aquatic species for both Alternative 1 and 3.

Aquatic species live in a wide variety of wetland habitats. In general, the riparian condition, especially vegetation, is important for all aquatic organisms to complete their life cycles. These organisms hide and seek shade in riparian vegetation. In addition most rely on both terrestrial and aquatic insects for food. The riparian vegetation is important for production of prey items. Within the project area, all Class I and II stream channels (perennial steams; order 3 and higher) provide potential habitat for the resident trout species. For reptiles and amphibians, meadow edges, seeps and damp headwater areas as well as the riparian conservation areas surrounding streams provide potential suitable habitat.

All management activities can affect aquatic habitat quality. Some changes may be beneficial and some may be detrimental. Fires (especially large stand replacing wildfires) decrease the amount of vegetation thus increasing runoff and sedimentation into the stream (Swanston 1991). However over time aquatic species have become adapted to large fires and can rebound if enough dispersal and good quality local habitat exists (Rieman and others 2005). Management activities like those proposed in Alternatives 1 and 3 (i.e. timber harvesting with tractors and road construction) can increase the amount of sedimentation into streams (Chamberlin and others 1991; Furniss and others 1991). Herbicide treatments can minimize unwanted, competitive plants. However, they may pose a threat to aquatic species if use is not carefully applied and monitored.

Increased sedimentation can affect stream water temperature, channel width, macroinvertebrate habitat, and dissolved oxygen levels. These effects are similar from all sources of sedimentation including natural events, roads, introduced fire, grazing, timber harvest, or mining (Meehan 1991). Other alterations to the stream such as increased water temperatures, decreased vegetative cover, and changes to channel morphology are similar in effect to the aquatic habitat quality though causes may be different (Meehan 1991).

Streambank vegetation is instrumental in maintaining the proper functioning of riparian areas and suitable habitat for fisheries and other aquatic life. Cover from streambank vegetation can help increase fish production (Boussu 1954; Hunt 1969; Hanson 1977; Binns and Eisermann 1979). Streambank vegetation provides for cover, streambank stability, stream temperature control and production of prey (Platts 1991). It also buffers the stream from incoming sediments and sediments from flood or high water events. It is essential for building and maintaining streambank structure. Natural erosion and rebuilding of streambanks occur as equilibrium over time. If this equilibrium is upset, streambank breakdown can occur faster than banks can be rebuilt (Platts 1991). If streambank vegetation exists, streambanks can remain more in equilibrium as it buffers high flow events and traps sediments to rebuild the banks. Streambank vegetation also shades the stream and contributes terrestrial insects and detritus to macroinvertebrates. This is critical to the basis of the aquatic food chain. Streambank vegetation provides directly organic material which can make up to 50% of the streams nutrient energy supply (Cummins 1974).

The effects of management activities from Alternatives 1 and 3 on aquatic resources are of concern within the Kings River Project. The quality of the aquatic ecosystem is dependent on many factors, such as low percentages of fine material or sediment, stable, well vegetated streambanks with instream woody debris and shading, and low water temperatures. These indicators of health for aquatic ecosystems directly and indirectly contribute to the viability of aquatic species.

Alternative 1 - Proposed Action

Direct Effects

Direct effects to aquatic species as a result of Alternative 1 include crushing (e.g. killing) or disturbing (e.g. noise disturbance and disruption of breeding cycle) amphibian and reptiles in their burrows and sheltering habitats, or as they disperse from upland habitat to aquatic habitat for breeding or feeding as a result of all the ground disturbing activities proposed. Amphibian and reptile species can move several hundred feet from streams and ponds to shelter in burrows or under logs that would not be protected during road building, road reconstruction, prescribed fires, or timber harvesting. In some cases, as in the relictual slender salamander, an unknown population may be so isolated (to within a few feet for dispersal for an entire population (CDFG 2002)), that a single activity such as tractor timber harvesting or construction of a new road, could kill a localized population. Watershed restoration projects may also produce direct effects on all aquatic species since egg masses can be dislodged or covered with fine sediment which will suffocate the eggs and larvae during instream restoration.

Of the activities being proposed by Alternative 1, commercial harvesting and underburning have the potential to directly affect canopy cover and / or stream shading. If forest harvesting occurred in streamside areas there could be an increase in solar radiation to the stream channel. Additionally, underburning could result in tree mortality and openings within the riparian canopy. Streamside shading affects the amount of solar radiation that filters to the surface of the water. Commercial harvesting would occur on over 6,200 acres under this alternative, which represents canopies over 45% of the project area potentially being altered. Underburning is proposed over approximately 4,700 acres (33% of the project area), with some of those acres overlapped with the commercial harvesting (treated % are not cumulative). Currently the levels of stream shading (based on 2005 data; Strand 2006) are currently within the desired condition of > 50%.

During late summer, when solar radiation potential is greatest, air temperatures are warmest, and stream flows are lowest, is the period when canopy cover is essential in moderating water temperatures. Typically only perennial channels flow during this period, thus concerns over water temperature focus on these stream channels. Base flows may be augmented by the reduction in vegetation, but the effect is not likely to persist into the dry summer season where it would be detectable (Gott 2006). The increase in soil moisture will be utilized by the remaining vegetation, so it will not be available for stream flow.

Perennial streams have a Class I streamside management zones (SMZs) of 100-feet prescribed for each side (1,240 acres) of the stream channel. Within portions of the California red-legged frog habitat, there would be no harvesting (50 acres). The Class I SMZs also have a 50-foot "No treatment" buffer on the inner 50-feet of the stream channel (590 acres), except for 70 acres that would be commercially harvested and yarded by helicopter. The remaining outer 50-feet exclude heavy mechanical equipment (600 acres) and would be treated under one of two harvest prescriptions. Under the "Old Forest Linkage" prescription (320 acres – including helicopter), basal area would be maintained at a minimum of 280 square feet and stand composition would focus on attributes for fisher (maintain large and decadent trees). The remaining Class I SMZs (350 acres) would be treated consistent with silvicultural prescription for the entire stand. These treatments would reduce the basal area between 0 - 70%, although most would retain more than 60% of current basal area. Basal area guidelines for these areas were developed based on the silvicultural objectives of the stand. For intermittent channels classified as Class II SMZs (they have flow during later summer) they are treated in a similar manner to perennial streams, although their SMZs are 75 feet (each side) and have a 25 feet "No Treatment" zone along the inner portions of the stream channel.

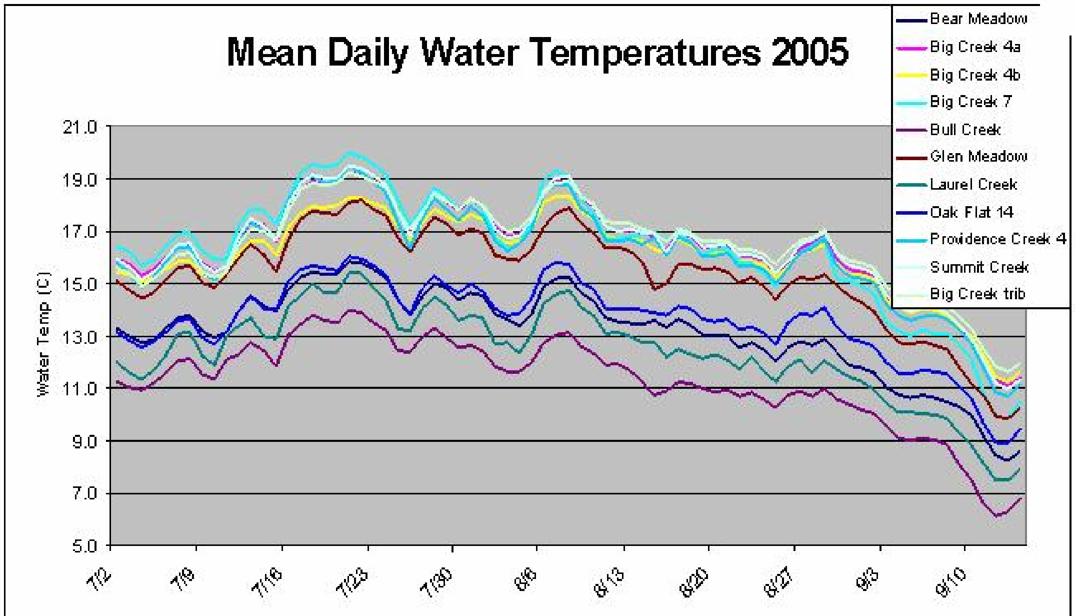
Beschta and others (1987) noted that buffers of 30 meters (98.4 feet) or more would generally provide the same level of shading as an old growth stand. Within buffers, mean air temperature rates decreased from a rate of -1.6º C/10 meters to -0.2º C/10 meters beyond 30 meters (98 ft), while relative humidity rates declined from +3.8%/10 meters to +0.6%/10 meters beyond that same distance as reported by Ledwith (1996). SNEP (Moyle and others 1996b) notes the benefits to riparian function and microclimate vary by the distance from the stream channel. Riparian shading appears to be maximized at one tree-height distance from the stream channel. Kattleman (1996) notes several studies have demonstrated that communities of aquatic invertebrates changed significantly in response to upstream logging, with some of these effects persisting for two decades.

Much of the food base for stream ecosystems is derived from adjacent terrestrial ecosystems with litter fall from deciduous stands exceeding that of coniferous stands. Deciduous input (leaves) generally breaks down in less than half the time necessary for the breakdown of coniferous input (needles; Gregory and others 1991). Buffer strips 30 meters (98.4 feet) wide are noted as protecting invertebrate communities from logging induced changes (Gregory and others 1987; EPA 1991).

Dwire and others (2006) suggest that prescribed fire may top-kill some riparian trees and shrubs. A study at Blodgett Forest in northern California introduced prescribed fire into the riparian zone and found that a 4.4% mortality rate resulted, occurring in trees 11 – 40 centimeters (4.5 - 15.7 inches) dbh (diameter at breast height; Bêche and others 2005). Prescribed fire is not proposed for introduction into the Class I/II SMZs for this project, it would be allowed to creep within the SMZ. Personal observations of past prescribed burning under these criteria on the High Sierra Ranger District are that it has not resulted in a noticeable decline in streamside canopy cover.

Some alteration of the existing stream shading (currently > 75%) is anticipated from Alternative 1. The inner "No Treatment" cores of the Class I and II SMZs (970 acres) would not be implementing commercial harvesting. Helicopter treatment areas would remove timber from within 140 acres adjacent to perennial streams. The helicopter acreage is part of the "Old Forest Linkage" Management Prescription with basal area retention of 280 square feet focusing on attributes desirable for fisher (large, decadent trees). It is not anticipated that large changes in overhead canopy would occur in this 10% of the streamside acreage. Stream shading would meet the desired condition of >50%.

There are no direct effects on water temperature anticipated from Alternative 1. Resident trout occupy approximately 33 miles of stream, out of 51 miles of perennial streams within the project area. Water temperature data collected from the project area in 2005 and lifestages of resident trout present during that period are displayed in Figure 3-60.



	Jul	Aug	Sep
YOY	x	x	x
Subadult	x	x	x
Adult	x	x	x

Figure 3-60 - Water temperature data from Stream Condition Inventories in 2005 and resident trout life stages (X) that would be present (YOY = young-of-year)

As measured during the summer of 2005, daily mean water temperatures were less than 21°C. This period of time represents that of highest air temperatures and lowest stream flow, thus it represents the most stressful time for coldwater resident trout. Climatological data from the Big Creek Powerhouse No.1 (NOAA COOP station 040755) indicates that the summer of 2005 was hotter than the mean (period 1999-2005) during most of the monitored period, except for August 10 through 25, 2005. The weather station is located at an elevation of 4,880 feet and is the nearest weather station with an elevation comparable to the midpoint elevation of the KRP analysis area, with a period of record more than 5 years. The data from 2005 is indicative of water temperatures during a period of above average heat, but not necessarily drought. Big Creek Powerhouse No.1 maximum air temperature data averaged 8° F (4.4° C) warmer than 2005 weather data collected by the Pacific Southwest Region Forest Service Research Station on Lower Bull Creek (5,800 ft elevation) in the month of August.

The hourly maximum water temperatures during the 2005 monitoring period showed some maximum water temperatures were above the upper bound preferences (generally < 20ºC) for resident trout, but no maximum was approaching the level of incipient mortality (26ºC) identified under the habitat descriptions.

Large woody debris (LWD) is of both physical and biological importance within stream channels and riparian zones (Bisson and others 1987; Sedell and others 1988). Modes of delivery are influenced by stand density; stand composition; bankfull channel width; management practices; tree proximity; lean and direction; wind patterns; valley form; degree and evenness of cover; and wood recruitment pathway (Bragg and Kershner 2004). Recruitment pathways can be chronic (ongoing mortality; channel adjustment) or episodic (avalanches, fires, floods, slides, disease). The project area is slightly lower than desired criteria for large woody debris. Summit Creek stands out as being low in both LWD and stable LWD. The element within the SMZs that represents the most immediate source of LWD is snags.

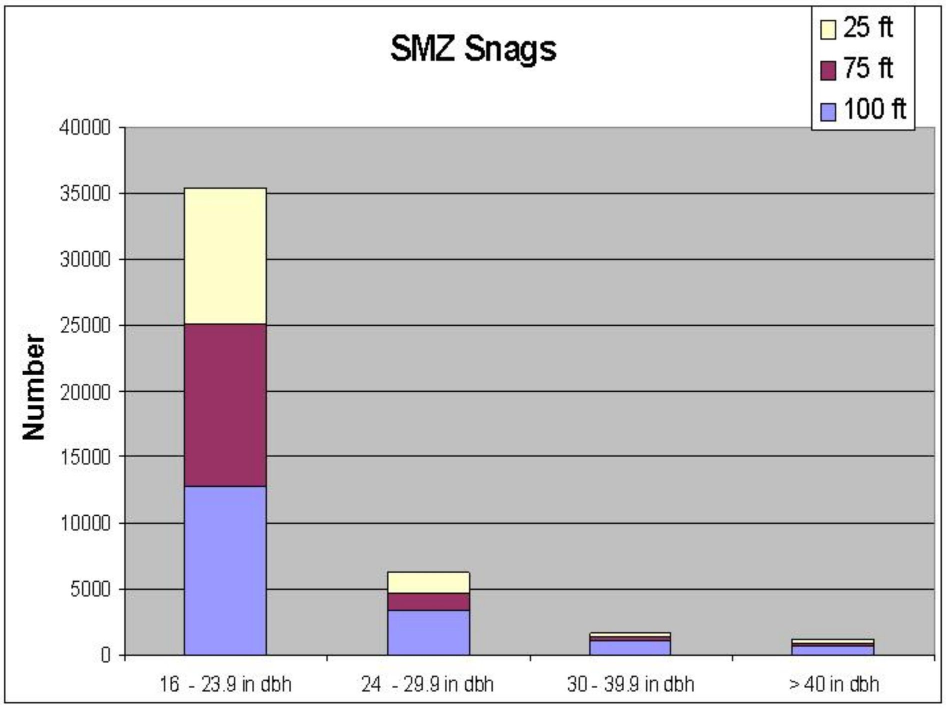


Figure 3-61 - Number of snags within project area streamside management zones (SMZs).

If Alternative 1 were to remove snags from SMZs there would be a direct affect. An approximate number of snags within SMZs (based on stand plot data) is displayed in Figure 3-61. These snags represent short-term potential LWD recruitment. Removal of snags is not being proposed, thus there is no direct effect on LWD recruitment from Alternative 1.

Herbicide use would occur on 1,183 acres under this alternative or approximately 8.5% of the project area. Two factors determine the degree of adverse impacts of herbicide application on aquatic species: the toxicity of the herbicide; and the likelihood that an organism would be exposed to toxic levels of the herbicide. The recovery plan for the California red-legged frog (USDI 2002) indicated the following for the use of glyphosate that would be applicable to the aquatic species covered here:

"Glyphosate does have the potential to contaminate surface waters due to its use patterns and through erosion, as it adsorbs to soil particles suspended in runoff. If glyphosate

reached surface water, it would not be broken down readily by water or sunlight. Toxicity tests performed under standard conditions at the Columbia National Fisheries Laboratory indicated that this compound is "moderately toxic" to rainbow trout (U.S. Environmental Protection Agency 1993). Some formulations may be more toxic to aquatic species due to the different surfactants used in formulation."

With ground application of the herbicide it is expected that drift would be negligible and streamside buffers would prevent herbicides from being applied too close to streams thus reducing the probability of direct effects of kill on resident trout.

It is highly unlikely that spraying with glyphosate formulated as Accord and R-11 would be harmful or toxic to aquatic species except in the case of an accidental spill or when project design measures are not followed. Precautions in handling of herbicides, explained in the Watershed Section, would help to prevent accidental spills. Monitoring results, referenced in the Watershed Section, from 1991 to 2000 of surface water adjacent to projects involving the use of glyphosate on seven projects on the Sierra, Stanislaus and Eldorado National Forests resulted in no detections.

Since glyphosate would not be applied to or near open water and it has very low mobility in soil as noted in the Soils Section, any direct effects to resident trout or other aquatic species in Big, Dinkey or other perennial creeks is highly unlikely. There appears to be no systematic differences in toxicity among species when doses of glyphosate are expressed in units of mg/kg body weight. (SERA 2003, p. 3-6). The results show glyphosate residues when applied aerially were 10,000 times less than would be necessary to produce acute mortality (Trumbo 2000).

R-11, the surfactant that would be used with glyphosate, is labeled for application to water and has a history of satisfactory use in aquatic situations by California agencies such as the Dept. of Water Resources and the Dept. of Boating and Waterways. Testing of R-11 has been limited because none is required by EPA and the Dept. of Pesticide Regulation only requires testing on fish and insects. The results of the Dept. of Fish and Game study referred to in the previous paragraph show R-11 residues when applied aerially were 100 times less than would be necessary to produce acute mortality (Trumbo 2000).

Indirect Effects

Alternative 1 has a risk of compacting soil and increasing both short term and long term sediment delivery to riparian and aquatic habitats. Since this alternative uses conventional tractor harvesting along with helicopter logging, there is a high likelihood of disturbing soil, thus contributing to higher increases in sediment delivery to the riparian and stream systems. This increased sediment may decrease available pool habitat for fish, amphibian species like the California red-legged frog, and for aquatic insects over time.

Though mechanical harvesting equipment within the streamside management zones are prohibited, cutting and pulling (i.e. grapping the top of a tree outside the SMZ with a grapple skidder) trees out of riparian zones and along streambanks will occur. Pulling trees out of riparian areas will greatly affect aquatic species both in and out of the water system. Bank trees provide key components for the aquatic ecosystem such as microclimate (shade, temperature, moisture) control, large organic material (i.e. large woody debris providing cover for fish species), and rooting strength. The act of pulling trees out of riparian areas and near meadows can also severely damage or eliminate burrow habitat for aquatic species, particularly for the Yosemite toad, which over time will reduce the viability of localized populations. A design measure protects these bank trees from removal thus reducing the chances of bank damage and protects riparian areas.

Watershed restoration projects should reduce sediment delivery to riparian and aquatic systems by improving watershed conditions. New and temporary roads and prescribed fire can reduce vegetative cover therefore there may be increased overland flow and sediment delivery to the aquatic ecosystem. Prescribed / understory burning, thinning, and fuelbreak construction / maintenance can furnish short-term (3 to 5 years) sediment supplies. This sediment can affect aquatic organisms by reducing the amount of suitable habitat by increasing stream width to depth ratios, increasing water temperature and reducing streambank stability. Where more ground is disturbed the potential for increased short term effects exist but the benefit from the fuel reduction is also reduced over time.

The indirect effect on the resident trout species and western pond turtle will be most seen in those sub-watersheds that are over their lower thresholds of concern both before and after project implementation. Filling of pools with fine sediment will reduce and perhaps eliminate over time the necessary pool habitat required by these aquatic species thus reducing the viability of the populations.

Elevation, aspect, stream width, channel roughness coefficient, riparian shading, solar radiation, air temperature, cloud cover, and stream discharge levels can affect water temperature. Of these elements, solar radiation has the most effect on water temperature (Beschta and others 1987; USGS 1997, 2000). Shading effects from forest canopies are important during the summer months due to high levels of radiation (high sun angles, long days, clear skies) accompanied by low stream discharges (Beschta and others 1987). Solar radiation through forest canopies depends on the heights of the crowns and density, along with the foliage (Moore and others 2005).

Underburning would take place through and within Class I SMZs. When this occurs there are design measures that allow for creeping into the SMZ, but not active introduction of fire. It is expected underburning would occur within the 100-foot zone and some understory trees could be killed as a result. It is not expected that trees contributing to stream shading and blocking solar radiation would be killed by the underburning.

If forest harvesting occurred in streamside areas there could be a direct increase solar radiation (reduction in canopy cover) to the stream channel. However, in evaluating possible project direct effects to canopy cover it was noted that large changes in overhead canopy from stands adjacent to perennial streams would not be anticipated. Stream shading would meet the desired condition of > 50%. However, in addition to direct solar radiation, Beschta and others (1987) addresses possible affects from angular solar radiation and describes how canopy cover can be evaluated as angular canopy density. Figure 3-62 provides a rough portrayal of solar radiation effects on a perennial stream. There would be no harvesting under any prescription within the inner 50-feet of the Class I SMZ, except for 70 acres of helicopter yarding. In the outer 50-feet of treated SMZs there is a possible increase of open space within the understory and intermediate components of the treated stand. This provides an opportunity for increased angular solar radiation. It is anticipated that the majority of the trees would be retained and the inner 50-foot "No Treatment" zone will intercept this angular solar radiation and there would be no change to water temperatures.

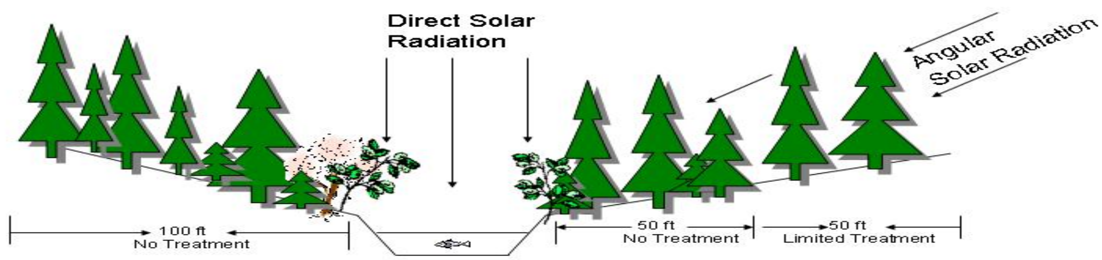


Figure 3-62 - Possible avenues of solar radiation for treated and untreated Class I SMZs (concepts from USGS 2000).

Helicopter yarding from Class I SMZs represents a possible change in angular radiation over 70 acres (inner 50 feet) adjacent to perennial streams. The helicopter yarding would occur over 5 stream segments: Bear Creek; an unnamed tributary to Big Creek (sub-watershed 519.0011); Providence Creek; Duff Creek; and Big Creek. To evaluate possible changes to stream temperature, these reaches were modeled using SSTEMP (USGS 1997, 2000) to characterize the extent of possible thermal heating resulting from treatments reducing vertical canopy by up to 20% in these areas. It is not anticipated that this level of reduction (20%) would actually occur as most trees providing overhead canopy would be maintained and basal area limits (280 square feet) for "Old Forest Linkage" would maintain overhead density. The projected results from SSTEMP for August 17 (the date with warmest mean temperatures during late summer period when flows are lowest) are provided in Table 3-69, which indicates an approximate increase of 0.2° F to Dinkey Creek and 1.18° F increase to Big Creek.

Table 3-69 - SSTEMP predicted affect on stream temperatures from helicopter treatments.

Stream Segment	Current Mean Temp (° F/C) 8/17	Post treatment SSTEMP modeled Mean Temp ° F (SD)/C 8/17	Estimated mixing affect at confluence (° F)
Bear Creek	54.5/12.5	55.4 (0.29)/13.0	0.20 (to Dinkey Creek)
Unnamed Big Creek trib	62.8/17.1	64.3 (0.34)17.9	0.15 (to Big Creek)
Providence Creek	62.2/16.8	64.5 (0.46)/18.1	0.3 (to Big Creek)
Duff Creek[1]	62.6/17.0	64.7 (0.42)18.2	0.33 (to Big Creek)
Big Creek	62.61/7.0	63.8 (0.30)17.7	1.18 Pine Flat Reservoir

[1] Used Providence Creek water temperature from adjacent watershed

Of the remaining elements that may affect water temperature, only stream discharge level could be affected by the proposal. Changes to stream discharge would be an indirect effect from the proposal due to decreases as basal area (and evapo-transpiration) decline due to changes in stand density (Chamberlin and others 1991; Kattleman 1996). If more water were available as baseflow during the late summer, there would be a possible reduction in stream temperature. Potential increases in peak flows are related to changes in snow accumulation and snow melt. This would apply mostly to the snow-dominated portions of the project area: el_o_win, glen_mdw, and krew_bull. The management units in the Big Creek watershed receive snow, but are not snowmelt dominated.

Class II stream channels (1,000 acres) are intermittent and are generally not expected to contribute flow during the late summer period when water temperatures are of greatest concern, although it is possible that some normally intermittent stream may flow into later summer for several years after implementation. Class II streams have 75 foot SMZ (on each side). Within the 1,000 acres of Class II SMZ, there are no treatment zones within the inner 25 feet (330 acres). These SMZ also provide protection from changes to direct solar radiation during the periods they flow water because of no activity within the inner zone that provides stream shading. The 25-foot "No Treatment" buffers may allow for an increase in angular solar radiation. Based on field observations, and SSTEMP modeling of helicopter SMZ it is not expected the amount would be sufficient to affect stream temperatures in the intermittent streams. Any changes would likely be ameliorated when mixing with the larger perennial streams occurs. It is anticipated that project design measures for Alternative 1 would maintain water temperatures within the current and desired condition (< 21° C), within the project area.

Of the treatments that would be implemented under Alternative 1, delivery of large woody debris could be affected by reduction in stand density through commercial harvest or underburning. There are approximately 3,130 acres of SMZ within the project area. However, this evaluation focuses on the perennial and intermittent stream channels (total 2,240 acres). Resident trout, western pond turtles, and amphibian species occupy the perennial channels (Class I SMZ), however intermittent channels (Class II SMZ) also contribute habitat to these species and water over half of the year. Additionally, intermittent channels may have sufficient flow to transport smaller pieces of LWD, thus influence LWD in the perennial channels. The ephemeral channels are more likely to retain LWD rather than transport it due to limited channel capacity.

There have been a number of models developed over the past decade attempting to project LWD recruitment. Modeling has been challenging considering that tree fall patterns may be chronic or episodic and influenced by geomorphology; tree or snag angle; bank steepness; prevailing wind direction; fragmentation; decomposition; mortality rates; and stem failure (Van Sickle and Gregory 1990; Bragg and others 2000; Bragg and Kershner 2002, 2004; Mellen and Ager 2002; Meleason and others 2002). The models attempt to address direction of tree fall and assign probability to angle of fall or assume angle is random. The random scenario could occur if tree failure is not influenced by disturbance or geomorphology. The variability from one channel reach to another has been difficult to model. It appears the more mature and intact the adjacent riparian forest is, the greater the likelihood of sustained LWD recruitment (Bragg and others 2000).

If forest harvesting occurred in streamside areas there would be a decrease in stand density, which is one of the elements that affect LWD recruitment. McDade and others (1990) indicated that 70% of LWD originated within ½ stand height (20 meters in that study) of the stream channel and approximately 85% of LWD would have been provided within a 30 meters (98.4 feet) buffer. Meleason and others (2002) noted that 90% of woody inputs were found to originate within 26 meters (85 feet) for mature conifer stands. To maintain LWD recruitment, the SMZs should be between 0.75-1.0 tree heights.

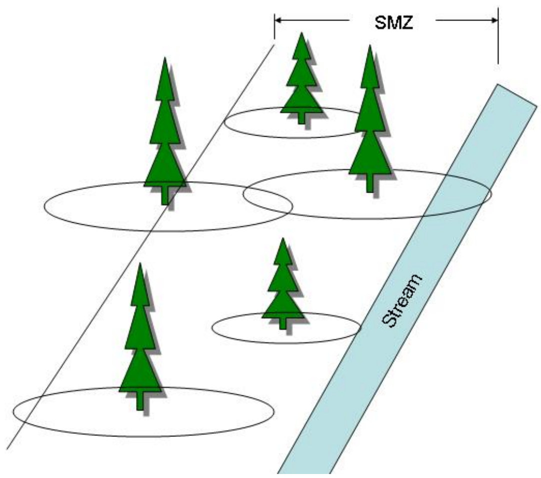


Figure 3-63 - Potential (independent of angle of fall probability) for large woody debris recruitment into stream channels.

The generalized drawing portrayed in Figure 3-64 illustrates the basic premise presented by Robison and Beschta (1990) that the probability of LWD entering a stream by direct fall is 0 when the distance exceeds the tree height. Stand data indicates that mean height for dominant trees along perennial streams in the project area is approximately 100-110 feet (32 meters) in height along Class I streams and 90-100 feet for Class II streams (29 meters).

Table 3-70 illustrates the percent (%) of trees within different height criteria (based on project data plots within SMZs). Approximately 46% of Class I SMZs acres will not have commercial harvesting implemented. When commercial harvesting is to occur within Class I and II SMZs it is primarily removal of suppressed and intermediate trees classes. These trees are expected to generally be 40-80 feet tall. For Class I stream channels this represents potential removal of up to 20% of the trees. However, ½ of the SMZ would not have timber harvesting and the % actually to be removed has basal area minimums and would be less than 20%. Robison and Beschta (1990) discuss the concept of effective height of the tree, which is the height to the minimum diameter and length necessary to qualify as LWD. It is has previously been noted that there are not common definitions for LWD, in particular with relation to length. If the most common criteria for diameter of 10 centimeters (4 inches) is applied, the top 10 feet of the tree would not meet the LWD criteria. Thus, it is more probable that 60 feet is the minimum that might have a probability of contributing LWD to a stream channel from the edge of a 50-foot "No Treatment" zone. The 60 to 80 foot height classes represent approximately 14% of the trees within the Class I SMZ; again ½ of this area would not be treated. The potential for these trees ever contributing LWD to the stream channel is further reduced by the probability that they occur within a band from 50-70 feet (effective heights) from the streambank. All 30" dbh trees in the outer 50 have height potential to reach the stream channel. If the project rate of removal for 30 inch trees were applied across the treated acres of Class I SMZ, there could be approximately 350 30 inch dbh trees removed from this zone.

Table 3-70 - Percent of trees in SMZ of based on various height criteria.

Tree Height	**40+ ft**	**50+ ft**	**60+ ft**	**70+ ft**	**80+ ft**	**90+ ft**	**100+ ft**
100 ft SMZ	85%	83%	79%	74%	65%	46%	33%
75 ft SMZ	77%	72%	61%	57%	48%	38%	25%

Trees within the Class II SMZs are generally shorter and the "No Treatment" zone is 25 feet. Approximately 33 % of the Class II SMZ acreage would not include commercial timber harvest. The trees within the Class II SMZs are shorter, thus a higher percentage of them is represented by the 40-80 height classes when compared to Class I streams. The 40-60 foot band represents 16% of the trees within the Class II SMZ, and represents those most likely for removal. These trees have potential to reach the stream channel if they occur in the band between 25 and 50 feet from the stream channel and it is probable that some would have contributed to LWD. It is unlikely that all these trees would be removed due to basal area retention objectives. All 30 inch dbh trees in the outer 50 have height potential to reach the stream channel. If the project rate of removal for 30 inch trees were applied across the treated acres of Class II SMZ, there could be approximately 280 30 inch dbh trees removed from this zone.

Underburning would take place through and within Class I and II SMZ. When this occurs there are design measures that allow for creeping into the SMZ, but not active introduction of fire. Dwire and others (2006) speculate that fuel reduction could potentially directly and indirectly affect aquatic habitat by altering the recruitment of large woody debris. They further note that prescribed fire would not necessarily remove LWD from riparian areas, and that mortality resulting from prescribed fire would likely contribute LWD to aquatic systems. In a limited (60 acres) study of active burning within the riparian zone, Bêche and others (2005) noted a loss of 4.4% of trees, with mortally occurring between 11-40 cm (4.5-15.7 inches) dbh. In that study several snags fell after being burned, but no overall increase in the amount or movement of LWD relative to unburned control sites. These effects were similar to those theorized by Dwire and Kauffman (2003) that moister, cooler microclimates within riparian areas likely contribute higher moisture content in fuels and soils, which could lower the intensity and severity of burns. Skinner (2002) also noted that fire often consumes material in the advanced stages of decay, but also creates snags and downed logs. It is expected underburning would creep within the SMZ and some understory trees could be killed as a result and possibly contribute to LWD.

Approximately 46% of the perennial stream SMZ and 33% of the intermittent SMZ would have "No Treatments". There would be treatments within Summit Creek sub-watershed (520.4051) Class I and II SMZ, where LWD was noted as currently deficient in both number and stable pieces. Underburning may creep into SMZ and it likely to result in some mortality, but mortality would remain on site to potentially contribute to LWD. There is a band between 50-70 feet along Class I (240 acres) SMZ and 25-50 feet along Class II SMZ (330 acres) where intermediate and some suppressed trees have the potential to reach the stream channel.

Additionally, approximately 70 acres of SMZ would be yarded with helicopters from areas that have trees with potential to reach the stream channel. These bands represent approximately 28% of the Class I and II SMZ acreage (640 acres) where trees could be removed that might potentially reach the stream channel independent of the direction they may ultimately fall if not harvested. Based on average values for removal of 30 inch dbh trees it was projected that 630 30 inch dbh trees within the Class I and II SMZ could be removed. Also based on stand plots collected from SMZ, there are an estimated 14,480 30 inch dbh trees in Class I and II SMZ. Up to 4.4% of the 30 inch dbh trees would be removed from Class I and II SMZ under Alternative 1. These trees have potential to contribute to LWD due to their heights and age. The potential to remove 4.4% of 30 inch dbh trees from the SMZ does not represent a direct 4.4% decline in recruitment to stream channels (not all these trees would have fallen toward channel). However, this would reduce recruitment to some extent of a size (large, stable pieces) that is currently lower than the desired condition. LWD would be negatively affected although it would remain within the range of variability displayed in Table 3-71.

Table 3-71 - Large woody debris (LWD) data from central Sierra Nevada. Standard deviation shown in parenthesis

	Mean density per 100 meters	Range	Mean stable pieces per 100 meters	LWD per 100 meter Size (0.3 x 3 m)
Stanislaus Unmanaged Stands[1]	17.8 (11.2)	1-50	4.5 (4.1)	
Stanislaus Second Growth[1]	9.5 (6.7)	1-24	3.1 (2.3)	
Sierra (Whiskey Ridge)				4.9 (4.2)

[1] Ruediger and Ward 1996

There is little risk to resident trout if glyphosate is applied at the recommended rate. Recent studies have shown that some herbicides, but not glyphosate, have an estrogen mimicking effect on reptiles (Raloff 1994). Estrogen and other endocrines are mainly six carbon ring molecules (cyclohexane or benzene) while glyphosate has a distinctly different structure. It is a carbon chain based on a single phosphorous atom so does not have a ring structure. The likelihood of these distinctly different molecules mimicking one another or working in the same lock-and-key relationship is remote.

There has been concern expressed about the potential for surfactants containing nonylphenol polyethoxylate (NPE)[19], such as R-11, to cause endocrine disruption and other deleterious effects. However, in comparison to natural estrogen NPE is approximately 10,000 to 1,000,000 times weaker in eliciting an estrogenic response (USDA 2003, p. 9). NPE is classified as slightly or practically non-toxic to mammals and is not mutagenic (USDA 2003).

Cumulative Effects

In addition to the direct and indirect effects of Alternative 1, a cumulative effect is expected on the aquatic species due to the nature of the Kings River Project, the ongoing private landownership activities (e.g. timber harvests and housing developments), and other ongoing Sierra National Forest management activities that are contributing to negative effects on aquatic species viability (e.g. active cattle allotments (Sanders 2005), off-highway vehicle use and events (Eddinger 2003), and prescribed fires (Wells 2003)) that occur within the same time frame and location for the aquatic species and their habitats. These past, present and reasonably foreseeable activities are described near the beginning of Chapter 3.

With the other activities planned for the Kings River Project area (both those associated with the KRP and those not associated with it) combined with Alternative 1 all provide incremental effects onto aquatic species. Continued habitat fragmentation, sedimentation into stream systems, compaction of soil, changes in vegetation composition, decreases in streambank vegetation and bank trees, and loss of streambank stability as well as the potential to be harmed by herbicide applications, could be expected.

Cumulative affects on canopy cover would be similar to the indirect effects, but would be expressed across the watershed. Commercial timber harvest and underburning were the two activities from the Past, Present, and Reasonable Foreseeable actions (Chapter 3) that could have potential to cumulatively affect canopy cover. Approximately 19,000 acres has undergone or is proposed for prescribed fire through 2012. Additionally, Southern California Edison conducts 1,500 acres annually of harvesting. Harvest levels are indicated to average approximately 3,300 board feet/acre. Harvest of timber on private property is under the California Forest Practices Act. Kings River Project design criteria to protect aquatic and riparian resources are not applied on private property. Harvesting on private lands requires a Timber Harvest Plan (THP) that evaluates compliance with state and federal rules and laws (CDF 2005). The Cumulative Watershed Effects portion of the THP evaluates water temperature effect and includes consideration of streamside canopy. The importance of near water vegetation is also evaluated under the biological assessment component of the THP.

Kings River Project design measures for prescribed fire have been successful in the past at maintaining canopy cover and it is unlikely stream shading would continue to be maintained. Design measures exclude removal of trees that provide stream shading during the critical summer period and are expected to protect federal lands. Considering

19 The primary active ingredient in many of the commercially available non-ionic surfactants is a compound known as NPE. It is found at rates varying from 20 to 80 percent. NPE is formed through the combination of ethylene oxide and nonylphenol (NP). NP is a material recognized as hazardous and is included on EPA List 1. (USDA 2003, p. v) NPE is widely used in industrial applications, detergents, cosmetics, shampoos, surfactants and spermicides.

the relatively low volume/acre of timber being removed from SCE lands and the consideration of near water vegetation in the THP, it is not expected the addition of SCE harvesting to federal harvesting in the analysis area would cumulatively affect canopy cover along perennial streams.

If canopy cover were affected on a cumulative basis it would be expected that water temperature would also be affected. FEMAT (1993) discussed the "edge" effect resulting from the harvesting of timber adjacent to riparian zones, and possible additive effects on microclimate. This influence would vary by season, time of day, aspect, channel orientation, and extent of tree removal. Changes to microclimate could affect air temperature, which is one of the components affecting water temperature. When timber removal occurs in SMZ, it would be primarily from suppressed and intermediate trees that are creating fuel ladder conditions. It is not expected that overhead canopy reductions would result in large changes in solar radiation or air temperature. The treatments within helicopter units have the potential to increase water temperatures in Big Creek by approximately 1.18º F (0.66º C). It is not anticipated that this difference in water temperature would be detrimental to any life stage of resident trout. Water temperatures within the project area would be maintained within the desired condition (< 21º C). However, some portion of Big Creek downstream of the project area that currently provides coldwater habitat would be transitioned to warm water fishery. This could represent a loss of 1 mile of coldwater habitat and it is not anticipated that a cumulative effect on water temperature would occur by implementing Alternative 1.

Considering the scale of Alternative 1 and the other past, present and reasonable foreseeable actions, a cumulative affects would be expressed similar to the indirect effect on LWD. The difference would be an increase in LWD in the event that a CWE were to occur. This would be a result of channel instability and tree recruitment as bank trees are undermined by the adjusting stream channels.

Commercial timber harvest and underburning are the two activities from the Past, Present, and Reasonable Foreseeable actions (Chapter 3) that have potential to cumulatively affect LWD. If mortality occurs as a result of underburning it is expected the tree would contribute to LWD. Commercial harvest prescriptions would retain predominant, dominant, co-dominant, and trees with broken tops, which are the trees most likely to provide LWD (both by size and age). SMZs should retain much of the potential LWD on federal lands. Harvesting on private lands requires a Timber Harvest Plan (THP) that evaluates compliance with state and federal rules and laws (CDF 2005). The Cumulative Watershed Effects portion of the THP evaluates organic debris. The importance of large woody material is also evaluated under the biological assessment component of the THP. The state does not have diameter limits on harvest trees, although protection of old growth is part of the THP analysis. It is probable that some trees that might contribute to LWD would be removed from SCE harvesting. Considering the relatively low volume/acre of timber being removed from SCE, it is not expected the number of these potential trees would be large. The combination of the federal and SCE timber removal is not expected to cumulatively effect LWD recruitment, which would remain lower than desired and within the range of variability displayed in Table 6.

In-stream sediment will be reduced by implementing restoration of the WIN sites identified in the Proposed Action. If a large precipitation event in the form of rain or rain on snow occurs immediately after project ground disturbing activities, erosion will probably occur even with proper implementation of BMP. After a few months and the loose soil has stabilized, the BMP will protect water quality.

Prescribed burning is not expected to change stream flows or increase in-channel sediment. These burns are planned with a low intensity objective. Burn patterns typically form a mosaic with unburned or lightly burned areas inter-fingered with a few moderate severity areas. Although some proportion of the area is likely to burn at high severity, the proportion is expected to be small, as found by Robichaud and others (2006). Any overland flow or eroded material that leaves a severely burned spot will be filtered in the unburned, low or moderate severity areas down slope. It is possible that high severity burn could occur at or near stream banks. However, soil and fuel moistures are likely to be higher near stream channels, and this limits the potential for high burn severity.

Broadcast burning in the n_soapro_2 management unit is the highest intensity burn planned. The potential for generating increased sediment is greater in this unit than in the other prescribed burn areas. However, the target intensity is still moderate severity rather than high severity, and 50% ground cover will be maintained. High severity burn could occur in the riparian area during prescribed burning, and result in riparian mortality. This could reduce the effectiveness of the streamside buffer and allow overland flow and eroded material to enter a stream channel. This effect has a low probability of occurring as a result of any given burn operation; the probability becomes lower the larger the spatial extent (i.e., it is more likely to occur on a small area than a large area). The effect would last for 1 – 3 years until groundcover is reestablished and water repellency recovers (Robichaud and others 2006).

Road construction and reconstruction could affect stream flow and sediment, especially where it crosses stream channels. BMPs 2-1, 2-3, 2-5, 2-8 and 2-9 will help to minimize the impacts to stream channels and reduce the potential for sediment to be generated both during construction and once the roads are in place. Road reconstruction will result in fewer resource impacts by establishing an effective drainage design for the road. Watershed design measures specify that in sub-watersheds that are currently over their TOC for cumulative watershed effects, hydrologic connectivity will be reduced during road reconstruction. The effect on stream flow is not expected to be measurable, but theoretically reducing connectivity will reduce the impact of the existing roads on the magnitude and timing of peak flows.

More sediment in channels has the potential to result in increased channel erosion either due to aggradations or to the increased erosive power of sediment-laden high-flows, especially at the known locations with sensitive channel types. Nine sub-watersheds in the analysis area (519.0009, 519.0057, 519.3053, 519.4051, 520.0014, 520.1002, 520.1051, 520.1101, and 520.1151) were identified as currently over their lower threshold of concern (TOC). Indicators of cumulative watershed effects in this assessment include increased sedimentation that fills channel pools with fine sediment, unstable channel banks, and/or degradation of aquatic habitat. Design criteria and watershed restoration have been specified to reduce or offset the risk for CWE. In sub-watersheds where a CWE response is potential or probable, activities will be carried out using light on the land mechanical systems (i.e., cut-to-length harvest system, low ground pressure feller/buncher system, excavator debris piling). Cumulative watershed effects will be reduced by mechanically treating these sub-watersheds with light-on-the land logging equipment, reducing the hydrologic connectivity of the roads, redesigning roads to be outsloped; rocking of roads; and by sub-soiling all major skid roads and trails to reduce precipitation runoff. Implementation of these mitigations will result in watershed improvement, a reduced risk of initiating additional CWE response, and a recovery over a shorter time period.

Overall, Alternative 1 has a higher potential to adversely affect the aquatic species and habitat than Alternative 2 or 3 in the short term (3 to 6 years). Over the long term Alternative 1 may result in decreasing the risk of large stand replacing fires which is the same for Alternative 3. However Alternative 1 may also continue to provide stresses on the aquatic species and their habitats. If a large wildfire does occur within the Kings River Project area; initial eight management units as described at the beginning of Chapter 3, a cumulative effect on aquatic species and their habitats would be the reduction of streamside vegetation, increases in sedimentation to the stream channel, and an overall loss of habitat in the short-term for those aquatic species occurring in the wildfire area. However aquatic species populations can be resilient if other good quality dispersal and breeding areas are available and can be found by the species.

For the California red-legged frog and the Foothill yellow-legged frog, both of which are unlikely to occur in the area, it is expected that the instream habitat will be negatively impacted due to increases in sediment in stream habitats.

For the Relictual slender salamander the cumulative effect of all the activities may lead to the isolated unknown populations being harmed. It is extremely difficult to determine the locations of this species and thus areas that have been identified as potential suitable habitat may not provide adequate protection.

For the western pond turtle and resident trout species the greatest concern is with sediment filling pool habitats. Western pond turtles can also be greatly affected by management activities in the uplands and the area surrounding Big Creek, Rush Creek, Providence Creek, and Duff Creek which all provide upland habitats. The instream habitat for these species may be lost as well due to sediment from the proposed, ongoing, and future activities.

In the meadows that are occupied with Yosemite toad the cumulative effect of this project coupled with the future management activities within the Kings River project area surrounding the occupied meadows may be detrimental to the local population in the Bull Creek / Teakettle watersheds. It appears that a core population for the Yosemite toad occurs in the meadows of the krew_bul_1 management unit (Bull Creek and Teakettle watersheds) and dispersal into other nearby over-wintering and breeding habitats occurs but is limited to within their potential dispersal distance. Currently, these meadows of krew_bul_1 provide good breeding areas however with continued management activities contributing sediment, noise disturbance, compaction of burrow habitat, and direct kills expected, the Yosemite toad in this population may be lost and the habitat significant impacted, thus the core population may be reduced to a point where the species can no longer exist in that watershed (an irreversible effect). Other populations of Yosemite toad may not be able to repopulate the Bull Creek / Teakettle watersheds since they occur over 0.6 miles away (the distance estimated that the Yosemite toad can disperse).

The determinations for the ten listed aquatic species are shown in Table 3-72. The rationale for the determinations and further information on the project affects on aquatic species are in the aquatic specialist reports (Sanders 2006b; Strand 2006).

Table 3-72 - The summary of determinations for Alternative 1 - Proposed Action for the ten listed aquatic species.

Species	Status	Determinations for Alternative 1 – Proposed Action
California red-legged frog	Federal Threatened	***may affect, but is not likely to adversely affect***
Foothill yellow-legged frog	Forest Service Sensitive	***may affect individuals, but is not likely to lead to federal listing or loss of viability***
Lahontan cutthroat trout	Federal Threatened and Sierra National Forest Management Indicator Species	***no effect***
Mountain yellow-legged frog	Federal Candidate and Forest Service Sensitive	***no effect***
Relictual slender salamander	Forest Service Sensitive	***may affect individuals , but is not likely to lead to federal listing or loss of***
Resident trout species (Brown Trout, Eastern Brook Trout, Rainbow Trout)	Sierra National Forest Management Indicator Species	*no official determination is required for Management Indicator Species however a finding of effect concerning the impact of the project on MIS population trend is needed therefore* ***neither an upward nor a downward trend*** *is expected*
Western pond turtle	Forest Service Sensitive	***may affect individuals, but is not likely to lead to federal listing or loss of viability***
Yosemite toad	Federal Candidate and Forest Service Sensitive	***may affect individuals, and is likely to result in a trend toward federal listing or loss of viability*** *primarily in the Bull Creek & Teakettle watershed population*

Alternative 2 - No Action

There is discussion on the effects of wildfire under Alternative 2. There is no debate among Aquatic Ecologists that high intensity fires can severely disrupt aquatic ecosystems, and that these affects can be prolonged (up to 300 years for LWD). Specific influences may include decreased channel stability; greater and more variable stream discharge; altered woody debris delivery and storage; increased nutrient availability; higher sediment delivery and transport; and increased solar radiation and altered water temperature regime (Bisson and others 2003; Dunham and others 2003). There is debate among Aquatic Ecologists regarding the need to treat riparian areas, and the types of treatments. Part of the controversy is related to the diverse and complex effects that fire can have on aquatic systems (Dunham and others 2003). Researchers agree that aquatic systems have developed under a disturbance regime. The ecological diversity of riparian corridors is maintained by natural disturbance regimes including fire and fire-related flooding, debris flows, and landslides (Dwire and Kauffman 2003). Many species have adapted life histories that are shaped by, and may depend on disturbance events (Dunham and others 2003; Bisson and others 2003; Rieman and others 2005). Some aquatic biologists believe that wildfire poses additional risk to endangered species, while others feel affects from treatments are more likely to damage aquatic systems than fire (Erman 1996; Bisson and others 2003).

Little is known about fire history of most riparian areas in the west and it is expected these areas have a different fire regime than upland areas (Dwire and Kauffman 2003; Bisson and others 2003). Riparian areas differ in topography microclimate, geomorphology, and vegetation. They are further characterized as having cooler air temperatures, lower daily maximum air temperatures, and higher relative humidity. These characteristics contribute to higher moisture content of live and dead fuels, and riparian soils, which presumably lowers the intensity, severity and frequency of fire (Dwire and Kauffman 2003). There is agreement among researchers that the differences between upland and riparian systems need to be recognized.

Direct Effects

There would be no new direct effects on aquatic species as a result of the implementation of Alternative 2. It is expected that other, smaller projects would be proposed if Alternative 1 was not selected and these projects would be focused on reducing the risk of wildfires in the area because of directives that require the reduction of fuels in the urban intermix zones.

No commercial timber removal or underburning would occur under this alternative. No direct, indirect, or cumulative affects to riparian canopy cover (current stream shading > 75%) are anticipated from Alternative 2. Stream shading will meet the desired condition of > 50%.

In the event of a wildfire, there could be an effect on canopy cover. It would be difficult to model such an effect because of the numerous factors affecting fire in riparian zones. Riparian areas differ from surrounding upland areas by topography, microclimate, geomorphology, and vegetation. Riparian microclimates are characterized by cooler air temperatures, lower daily maximum air temperatures, and higher relative humidity (Dwire and Kauffman 2003). Based on personal observations, fire may creep through riparian zones having little effect on riparian canopy cover (Big Creek Fire 1994) or remove nearly all riparian cover over vast segments of stream channel (Hopkins and Strand 2002). There would be no direct effect on water temperature or from herbicides or watershed improvement projects as a result of the Alternative 2.

If a small low to moderate intensity fire were to occur, there would be no expected direct affects on water temperature. Hitt (2003) reported a probable 7.7° C (14° F) increase in water temperature during the Moose Creek Fire (2001) in Montana. Probability of direct fish mortality would increase for low order (small) streams having high fire severity through streamside vegetation. Rinne and Jacoby (2005) identified records of direct fish kills from fire in Idaho and from a controlled burn in Oregon. Rieman and Clayton (1997) noted dead fish immediately after high severity fire burned though streams in the Boise River system. Water temperature monitoring on the McNally Fire indicated direct thermal affects as the fire burned through Tobias Creek (although not at high severity), but not to the extent it was probable that direct mortality of trout occurred. Personal observations on the other streams within the McNally Fire (Hopkins and Strand 2002) suggest possible direct mortality on several segments, although no dead fish were observed and displacement was probable.

There are no direct effects on LWD recruitment. A fire (either large of small) could increase LWD recruitment. Bêche and others (2005) noted that underburning within a riparian area burned several snags, which fell. A small, low severity fire in a riparian zone could produce a similar effect. A large, high severity fire would likely produce tree mortality.

Indirect Effects

There would be no new indirect effects to aquatic species as a result of the implementation of Alternative 2. It is expected that other, smaller projects would be proposed if Alternative 1 was not selected and these projects would be focused on reducing the risk of wildfires in the area because of directives that require the reduction of fuels in the urban intermix zones.

No indirect effects on canopy cover for stand density alteration or fuel treatment previously considered would occur under Alternative 2. In the event of a wildfire occurrence there could be varied response depending on size and severity. A large, high severity fire could disrupt flow regime and alter stream channel dynamics. Soil water storage; baseflow; streamflow regime; peak flow; water quality (sediment, temperature, pH, ash slurry); and chemical characteristics can be affected by wildfire (Neary and others 2005). Riparian trees not subject to direct mortality could be undermined and toppled, leading to loss of their stream shading. Amaranthus and others (1989) reported a reduction of 60% stream shading following the Silver Fire (1987) in Oregon. The effects would last until trees became re-established to the extent they were able to provide shading, which could last 25-50 years. A small, low/moderate severity fire would not likely have an indirect affect on stream shading.

Macroinvertebrate populations have been noted to increase when more sunlight has been available. Impact of fire on the macroinvertebrate community varies by burn intensity and extent; steam size and gradient; precipitation and amount of runoff; vegetative cover; geology; and topography. Some indicators of community health may return to pre-fire conditions within 1-2 years, but the overall community will probably vary for 5-10 years after the fire (Minshall 2003; Reardon and others 2005a). Recovery is related to the relative quick recovery of riparian vegetation (25-50 years for full canopies).

Water temperature data collected from the project area in 2005 indicate they are within both the desired condition and within the tolerance limits identified for resident trout species. It is anticipated that Alternative 2 would maintain water temperatures within the desired condition (< 21° C) and there are no indirect, affects.

If a wildfire were to occur and burn at greater than moderate severity, there is potential to influence water temperature due to reductions in canopy cover over SMZ (loss of stream shading). The extent of this affect would vary depending on severity of the burn and the extent it burned through SMZ. A large fire could indirectly affect water temperature through increased direct solar radiation, increased air temperatures, and reduced stream depths (due to increased fines and widening of stream channel). Amaranthus and others (1989) reported increases of up to 10° C (18° F) after the Silver Fire (1987) in Oregon, with increases related to remaining components of shade, aspect, topography, and amount of flow. Sestrich (2005) found that streams temperatures increased with burn severity and that daily mean increased by approximately 3.5° C along high severity sites.

Temperatures could be reduced through mixing with cooler, unaffected tributaries. These effects could last several decades until trees were of sufficient size and density to screen direct solar radiation.

The extent of the effects on fish populations would be related to recover of suitable water temperatures, suitable water quality, and connectivity to population refugia. Trout are noted as being resilient and adapted to disturbance (Reiman and Clayton 1997; Dunham and others 2003; Rinne and Jacoby 2005), but recovery could take a decade or more. Sestrich (2005) reported that native trout populations recovered rapidly, with some sites exceeding pre-fire population levels within three years following fires in the Bitterroot River Basin (2000). Greswell (1999) considered the disturbance regime resulting from wildfire could facilitate invasion by nonnative fish species.

There are no anticipated indirect effects on LWD from Alternative 2. A large fire would provide indirect LWD through direct mortality of trees. Fire represents one of the recruitment pathways for LWD. The pulse of LWD resulting from tree mortality would be accompanied by possible stream channel adjustments due to channel adjustments undermining streambank snags left from the fire. This increase would likely last for several decades until all material was one the ground. Berg and others (2002) estimated that more than 50% of pre-fire LWD volume on Badenaugh Creek (Tahoe NF) was incinerated by the Cottonwood Fire (1994); that average length of LWD had decreased by half, but that LWD total pieces and volume increased following the first winter. After reviewing aquatic systems 20 years post-burn, Robinson and others (2005) noted that much of the standing dead timber had fallen, but that 80% was still bridging the channel (not in the stream). They expected fire-related LWD inputs to continue for another decade. Through decay, breakage, and transport the fire-generated LWD would be removed from the system, leaving 50-300 years until the ecosystem stabilizes and trees were large enough to contribute to LWD (Bisson and others 2003; Reardon and others 2005).

Cumulative Effects

There would be no new cumulative effects to aquatic species as a result of the implementation of Alternative 2. If a large wildfire does occur within the Kings River Project area – initial eight management units as described at the beginning of Chapter 3, a cumulative effect on aquatic species and their habitats would be the reduction of streamside vegetation, increases in sedimentation to the stream channel, and an overall loss of habitat in the short-term for those aquatic species occurring in the wildfire area. However aquatic species populations can be resilient if other good quality dispersal and breeding areas are available and can be found by the species.

It is not anticipated there would be cumulative effects on canopy cover or large woody debris under Alternative 2. If a large, high severity wildfire across multiple sub-watersheds were to occur there would likely be a cumulative effect to riparian canopy cover. This would be the widespread loss of stream shading due to direct mortality. Rinne and Jacoby (2005) described changes in water temperature due to plant understory and overstory loss, ash-laden slurry flows, increases in flood peakflows, and sedimentation due to increased erosion as the greatest long-term impacts to fish habitat after wildfire.

On a localized level for small fire, loss of riparian canopy cover would likely affect stream water temperatures. The effect would be diminished when unaffected tributaries provide cooler flow. The effects would last until trees became re-established to the extent they were able to provide shading, which could last 25-50 years. Effects on macroinvertebrate community would be similar that discussed under Indirect Effects.

There would not be a cumulative affect to water temperature through implementation of Alternative 2. A large fire could indirectly affect water temperature through increased direct solar radiation, increased air temperatures, and reduced stream depths (due to increased fines and widening of stream channel). Lack of cooling tributary flows would extend the effect downstream from the basin. The Indirect Effects on water temperature noted temperature increases ranging from 3.5° C (Sestrich 2005) to 10° C (Amaranthus and others 1989). Additionally, Neary and others (2005) cited increases up to 16.7° C reported following fire. Thermal increases are accompanied by decreases in dissolved oxygen, which in combination decreases the quality of resident trout habitat. These effects could last several decades until water quality had recovered, and trees were of sufficient size and density to screen direct solar radiation.

Project design criteria to reduce current levels of sedimentation from roads and implement watershed restoration projects would not occur under this Alternative. Sedimentation rates and levels in streams would be maintained at current levels. A high severity fire could result in water quality degradation. Sedimentation rates would increase many times over the existing rate. With slopes denuded of ground cover overland flows would be increased and channel modification would occur to carry the additional flows. Loss of cover would reduce infiltration and base flows would be decreased.

If a large storm or rain on snow event occurred accelerated erosion and increased sedimentation would result, but with no ground disturbance the affect will be less than if the ground is disturbed. If a wildfire followed by a large precipitation event occurred, accelerated erosion and increased sedimentation will occur and sediment will be transported to the stream system via overland flow from burnt slopes and roads.

Overall, Alternative 2 has the least potential to cause adverse affects to aquatic species and habitats than Alternative 1 or 3. The determinations for the ten listed aquatic species are shown in Table 3-73. The rationale for the determinations and further information on the project affects on aquatic species are in the aquatic specialist reports (Sanders 2006b; Strand 2006).

Table 3-73.

Species	Status	Determination for Alternative 2 - No Action Alternative
California red-legged frog	Federal Threatened	***No effect***
Foothill yellow-legged frog	Forest Service Sensitive	***No effect***
Lahontan cutthroat trout	Federal Threatened and Sierra National Forest Management Indicator Species	***No effect***
Mountain yellow-legged frog	Federal Candidate and Forest Service Sensitive	***No effect***
Relictual slender salamander	Forest Service Sensitive	***No effect***
Resident trout species (Brown Trout, Eastern Brook Trout, Rainbow Trout)	Sierra National Forest Management Indicator Species	*no official determination is required for Management Indicator Species however a finding of effect concerning the impact of the project on MIS population trend is needed therefore* ***neither an upward nor a downward trend*** *is expected*
Western pond turtle	Forest Service Sensitive	No effect
Yosemite toad	Federal Candidate and Forest Service Sensitive	No effect

Alternative 3 – Reduced Harvest Tree Size

The significant changes to Alternative 3 over Alternative 1 are the additions of design measures specifically to protect streamside management zones and to protect the Yosemite toad. The base information on effects is the same as in Alternative 1.

Alternative 3 proposes to reduce fire severity through reducing timber stand density (reforestation of existing openings, uneven-aged management and thinning); pile slash for burning; burn slash piles; reduce brush competition using herbicides; plant trees; reduce fuel loading through controlled burning; construct and reconstruct roads; and implement watershed restoration projects (matrix of possible affects at end of Appendix A in Strand 2006). The actions are similar to Alternative 1, with the exception that trees greater than 30” dbh would be retained, new openings for regeneration would not be created, the canopy cover retention objective in fisher habitat would be changed, protections measures provided by USFWS (Appendix D) would be implemented; no commercial harvesting would occur within Class I & II SMZ in the nine sub-watersheds currently exceed their lower Threshold of Concern; and Riparian Management Areas would be prescribed along perennial streams to be yarded with helicopters. Other design measures to reduce affects on resident trout habitat would be similar to Alternative 1

Direct Effects

With the exclusion of commercial harvesting within Class I & II stream channel within the nine sub-watersheds exceeding the lower Threshold of Concern and use of Riparian Management Areas within helicopter units, Alternative 3 has 340 fewer SMZ acres being treated. The 1000 acres of SMZ that could have commercial treatments are within the outer 50 feet of the SMZ. There would be 130 fewer SMZ acres treated under the "Old Forest Linkage" prescription (250 acres), but basal area would be maintained at a minimum of 280 square feet and stand composition would focus on attributes for fisher (maintain large and decadent trees). The remaining Class I SMZs (200 acres) would be treated consistent with the SMZ prescription that would maintain a minimum of 70% of the current basal area, focusing on retaining pre-dominant; dominant; co-dominant; trees leaning toward the stream channel; and those within broken tops. It is not anticipated that changes in overhead canopy would occur in SMZ acreage. Stream shading would meet the desired condition of > 50%. There are no direct effects on water temperature anticipated from Alternative 3. The element within the SMZ that represents the most immediate source of LWD is snags. There would be no removal of snags from SMZ under Alternative 3, thus no direct affect on LWD.

Indirect Effects

Indirect affects on canopy cover (stream shading) could occur if Alternative 3 results in an alteration to the hydrologic regime. Such alteration could be expressed in bank and channel instabilities, widening of the stream channel, and undermining of bank trees. The widening of the stream channel would increase the level of reduce canopy cover over the stream (less stream shading). The Watershed Analysis indicates this effect is not anticipated (Gott 2006). Herbicide treatments would be implemented under Alternative 3. Design criteria should keep herbicide application away from trees providing stream shading and aerial application is not being proposed. Herbicide treatment is unlikely to indirectly affect canopy cover in the project area streams.

Indirect effects on water temperature evaluated under Alternative 1 indicated that areas yarded utilizing helicopters had the potential to influence water temperature through reduction on angular canopy density. Alternative 3 provides a 50 foot "No Treatment" buffer along perennial streams within the helicopter areas. These no treatment zones should reduce the probability of changes to existing angular canopy density. There are no anticipated effects on water temperature from Alternative 3. It is anticipated that project design measures would maintain water temperatures within the current and desired condition (< 21° C), within the project area.

Of the treatments that would be implemented under Alternative 3, delivery of large woody debris could be affected by reduction in stand density through commercial harvest or underburning. As in Alternative 1, there are 2,240 acres of Class I and II SMZ. Approximately 64% (790 acres) of the perennial stream SMZ and 45% (450 acres) of the intermittent SMZ would have "No Treatments". There would be "No Treatments" within Summit Creek sub-watershed (520.4051) Class I and II SMZ, where LWD was noted as currently deficient in both number and stable pieces. Underburning may creep into SMZ and it likely to result in some mortality, but mortality would remain on site to potentially contribute to LWD. Similar to Alternative 1 there is a band between 50-70 feet along Class I SMZ and 25-50 feet along Class II SMZ where intermediate and some suppressed trees have the potential to reach the stream channel. These bands represent approximately 20% of the Class I and II SMZ acreage (200 acres less than Alternative 1) where trees could be removed that might potentially reach the stream channel independent of the direction they may ultimately fall if not harvested. The predominant,

dominant, co-dominant and broken top trees would be retained where timber harvest treatments occur in SMZ. Harvesting of 30 inch dbh trees is not included under Alternative 3. Maintaining trees >= 30 inch dbh would retain up to 630 trees (compared to Alternative 1) within SMZ that could potentially provide LWD. This does not necessarily mean these trees are actually expected to fall toward the stream channels, only that they have potential to reach the channel. However, this would not reduce recruitment of a size (large, stable pieces) currently lower than the desired condition.

Cumulative Effects

Effects from Alternative 3 would be similar to those discussed under Alternative 1 for canopy cover. The reduction in coldwater habitat in Big Creek downstream of the project area due to helicopter treatments discussed under Alternative 1 would not be anticipated under Alternative 3. No cumulative effect to water temperature is anticipated. Considering the scale of Alternative 3 and the other past, present and reasonable foreseeable actions, a cumulative affects would be expressed similar to the indirect effect on LWD. The difference would be an increase in LWD in the event that a cumulative watershed effect was to occur. This would be a result from channel instability and tree recruitment as bank trees are undermined by the adjusting stream channels. Cumulative effects from Alternative 3 on LWD would be similar to Alternative 1.

Overall, Alternative 3 has a lower potential to adversely affecting the aquatic species and habitats than Alternative 1 but higher than Alternative 2. The determinations for the ten listed aquatic species are shown in Table 3-74. The rationale for the determinations and further information on the project affects on aquatic species are in the aquatic specialist reports (Sanders 2006b; Strand 2006).

Table 3-74 - The summary of determinations for Alternative 3

Species	Status	Determinations for Alternative 1 – Proposed Action
California red-legged frog	Federal Threatened	***may affect, but is not likely to adversely affect***
Foothill yellow-legged frog	Forest Service Sensitive	***may affect individuals, but is not likely to lead to federal listing or loss of viability***
Lahontan cutthroat trout	Federal Threatened and Sierra National Forest Management Indicator Species	***no effect***
Mountain yellow-legged frog	Federal Candidate and Forest Service Sensitive	***no effect***
Relictual slender salamander	Forest Service Sensitive	***may affect individuals , but is not likely to lead to federal listing or loss of viability***
Resident trout species (Brown Trout, Eastern Brook Trout, Rainbow Trout)	Sierra National Forest Management Indicator Species	*no official determination is required for Management Indicator Species however a finding of effect concerning the impact of the project on MIS population trend is needed therefore* ***neither an upward nor a downward trend*** *is expected*
Western pond turtle	Forest Service Sensitive	***may affect individuals, but is not likely to lead to federal listing or loss of viability***
Yosemite toad	Federal Candidate and Forest Service Sensitive	***may affect individuals, and is not likely to result in a trend toward federal listing or loss of viability***

The differences in the determinations between Alternative 1 and Alternative 3 for the Yosemite toad is the addition of protection measures, outlined below for Alternative 3, that would help protect the life stages of the Yosemite toad and their habitat by creating both a buffer around occupied meadows and limiting the time activities can occur in and near their habitat.

- No mechanical treatments within 100 feet of meadows.
- Trees may be felled within 100 feet of meadows and removed by dragging them out without entering the buffer; around meadows used as breeding habitat by Yosemite toads, only trees 50 or more feet away from the meadow would be felled.
- Within 0.6 miles of occupied meadows, operations would start after breeding is over and end by October 1, and operations would cease for 24 hours after rainfall 0.1 inch or greater.
    - meadow occupancy and timing of breeding would be determined annually by an aquatic biologist
- Heavy machinery would be kept at least 50 feet from moist upland habitats where toads are likely to be present during the summer, such as willow and lupine patches, but trees may be felled within this area and removed by dragging them out without entering the buffer.
- No chemical treatments within 500 feet of occupied meadows. (in Alternative 1 also)
- No water drafting within 0.6 miles of occupied meadows. (in Alternative 1 also)

HERITAGE RESOURCES and TRIBAL RELATIONS

Affected Environment

Cultural resources of the KRP represent a record of human land use. This record is contained in properties with archaeological research value, locations of cultural importance to local Native American groups, and the intangible beliefs and values connected with Forest land use by various ethnic and occupational groups (LRMP FEIS 3.5.18.1 in USDA 1992). SNF LRMP direction (as amended by the 2004 Sierra Nevada Forest Plan Amendment and Record of Decision) for cultural resource management has two emphases: 1) meeting the legally mandated requirements of identification and evaluation to avoid or mitigate impacts from project activities; and 2) coordination of site and resource management with Native Americans to protect significant sites, and allowing access to and use of traditional resources (LRMP 4.3.18 and 4.5.2.15 in USDA 1992, USDA 2004a). The LRMP standards prescribe integration of significant cultural resource information into project planning processes.

The Kings River Project is managed for cultural resources in accordance with the direction of the *First Amended Regional Programmatic Agreement Among the USDA*

Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, and Advisory Council on Historic Preservation Regarding the Process for Compliance with Section 106 of the National Historic Preservation Act for Undertakings on the National Forests of the Pacific Southwest Region (Regional PA). The stipulations of the Regional PA satisfy the Forest's responsibilities for individual projects under the National Historic Preservation Act (NHPA) of 1966, as amended, and take into account the potential effects of undertakings on historic properties in lieu of the procedures of 36 CFR 800.

In accordance with the Regional PA, a cultural resource identification effort was conducted of the project area. The goal was to identify: archaeological research values, and other cultural values, especially contemporary Native American interests.

Archaeological Research Values: Archaeological research values are derived from data that reside in classes of archaeological constituents, typically found in archaeological sites, and that contribute to important research topics. Data are scientifically meaningful when they can be related to a theoretical framework that supports a coherent interpretation of the cultural past. An overarching research interest for the Sierran forests is the nature of human land use through time with regard to seasonally available resources, and how environments were modified, purposefully or inadvertently. Sierran research objectives should strive to define the role humans have played in structuring Forest ecosystems, and in turn, how those ecosystems may have prompted or affected human adaptation.

In the KRP area, the results of almost fifty years of cultural resource surveys and investigations have identified numerous archaeological properties that are associated with common themes of SNF history: prehistoric lifeways; Forest Service administration; exploration and settlement; grazing/range management; mining; water/hydropower manipulation; transportation, travel, tourism and recreation; and the forest products industry.

Results of these investigations are reported in *Archaeological Reconnaissance Report R2005051554005, Kings River Project* (Marsh 2005). This report, which describes the location and components of the archaeological sites, is kept administratively confidential under the provisions of the Archaeological Resource Protection Act (ARPA), 43 CFR 7. This report documents archaeological survey for the entire project area. There are 117 archaeological sites in the first eight units being analyzed. Within the KRP boundary, there are 422 archaeological sites, including 35 with historic-era components (8%), 354 with prehistoric components (84%), and 32 with multiple components (8%). One site is unknown.

The SNF has determined the significance of representative properties of these themes by evaluating their eligibility to the National Register of Historic Places (NRHP). The SNF manages those historic properties which are eligible to the NRHP. The Forest does not manage or protect ineligible properties in project activities, unless there is local interest in preservation. NRHP eligibility has been determined for five historic-era properties, including the Dinkey Creek Bridge, which is listed on the NRHP.

NRHP eligibility has been determined for ten sites representing prehistoric lifeways. Indian people managed the landscape to create and maintain preferred habitats (McCarthy 1993). The processes of subsistence, the hunter-gatherer lifestyle, and the resulting indigenous land use can be seen in the KRP archaeological record. These properties include features common to the material culture of the native people of the Sierra Nevada in habitation and subsistence sites (e.g. bedrock mortars, stone tool artifacts).

NRHP eligibility has not been determined for every archaeological property in the project area. Unevaluated sites are considered potentially eligible, and managed as if eligible. The Regional PA allows for deferred NRHP evaluation if the property would not be affected by the project, usually through application of the Regional PA Standard Protection Measures (Attachment B).

Other Cultural Values: Consultation with tribes, the local Native American communities, and other interested parties to identify other cultural values, including contemporary Native American interests, was initiated in 2004 in accordance with the Regional PA, NHPA, ARPA, and other laws and regulations. Consultation has consisted of meetings, letters, phone calls, field trips, and presentations, and is documented in the project record.

Relevant topics with respect to tribes associated with the SNF are 1) social and economic; 2) Federal responsibility to federally recognized and non-recognized tribes; 3) traditional knowledge; 4) reverence and links to the land for cultural survival; and 5) consultation and collaboration.

Social and economic: There are two Federally recognized tribes primarily associated with the study area (Cold Springs and Big Sandy Rancherias) and one tribe (the Dunlap Band of Mono Indians) having completed the federal recognition application process and awaiting determination of eligibility. The Federally recognized tribes operate from a politically sovereign position and may have different political, social, and economic needs from those tribes and individuals not federally recognized.

Federal Responsibility to Federally recognized and non-recognized tribes: Federally recognized tribal governments associated with the SNF, as elsewhere in the United States, have a special political and legal relationship with the Government of the United States. Tribes possess inherent powers of limited sovereignty.

Recognized tribes are also beneficiaries of a trust relationship with the Federal government. Federal agencies, such as the Forest Service, consult with tribes as with other governments and are responsible for protecting tribal interests. The Forest Service also consults with non-recognized tribes (USDA 1997).

Traditional Knowledge: Local Tribal communities have long-standing knowledge of and reliance on lands now managed by public agencies, including the SNF. This traditional knowledge is living and dynamic. When Euro-Americans first came to the Sierra Nevada, thousands of years of indigenous knowledge had already shaped the cultural landscapes of the area. In some areas, the effects of aboriginal resource management are fairly well understood; in others much research remains to be done (Anderson and Moratto 1996). Current research in several fields demonstrates that the Sierra Nevada was not an uninhabited, virgin wilderness. The use of fire played a key role (Lewis 1973) in establishing and maintaining the open, park-like forests and woodlands encountered at historic contact. The application of fire and its careful control were particularly important to the manipulation of the acorn and oak resources. Cultural factors, predominantly the aggressive burning by Indians, maintained the stability of mature black oak areas. The abundance of acorn-bearing trees in places like Oak Flat (T.11S, R.26E, Sections 16-17) may be remnant indicators of an Indian managed landscape.

Also significant were the techniques used by the Indians to manage plant communities, such as tillage, sowing, weeding, pruning, irrigation, and burning. Research with Indian elders in the Sierra Nevada documents that California Indians purposefully and selectively managed the Sierran landscapes for specific cultural purposes (e.g., to increase the quality and quantity of food, basketry materials, habitat for game species, fuel wood) (Anderson and Moratto 1991, Blackburn and Anderson 1993, Fowler 1994, Lawton and others 1976, Reynolds 1996).

A complex tenure system governed harvesting and management practices to regulate and distribute resources. This system ensured enduring access to culturally important plants and animals. Populations of certain plant species maintained their vigor and distribution within the landscape under traditional Indian management (Blackburn and Anderson 1993). Modern ecosystem management practices do not always take into account culturally significant species (e.g., Anderson 1997, Harris and Cox 1997, Wolfley 1998). Traditional knowledge tells that each species was put in place for a reason, a rationale that dovetails nicely with the ecologist's recognition that ecosystems be considered as interactive wholes.

Analysis of the contents of archaeological sites, pollen cores, and other paleoenvironmental data can provide information about environmental conditions and ecosystems that existed before contact (Woolfenden 1996), but the information derived is patchy. Tribal traditional knowledge regarding landscapes can improve societal understanding and management of ecosystems. Oral histories about ethnobotanical management from Indian people about past ecosystems and ecosystem components (e.g., the presence/absence of culturally important plants and the visual characteristics of landscapes) can provide important baseline data to describe and explain change and continuity of cultural landscapes. Information about landscapes cultured under traditional management and regulatory mechanisms can be critical for restoring and maintaining ecosystems today.

Reverence and Links to the Land for Cultural Survival: Wherever Indians from Sierra Nevada tribes might reside, many retain a deep, abiding concern about what occurs within their aboriginal territory, including the SNF. These lands are considered the center of their universe, their homeland; spiritual reverence for the land is often expressed by tribal members. Thus, land management affects not only cultural survival, but spiritual survival as well; among many Indian people the concepts are inseparable—inherently united. It has been expressed at several Forest Service/tribal meetings that Indian people also feel that they also have a responsibility to manage the land properly; that the Creator put them there to do just that.

The SNF honors the traditional ties that many tribal communities have to this portion of the Sierra Nevada. Access to and use of the SNF and other public lands is critical. For many Indian people, community identity and cultural survival are dependent on continued access to ceremonial and sacred places, and access to resources at a variety of locations on forest land. Certain plants (e.g., sedges), animals (e.g., deer), and locations (e.g., fishing spots) provide for many needs, including food, medicine, utilitarian type materials, and ceremonial items. Specific resources insure that significant cultural traditions, such as basket weaving, survive and continue.

How resources are managed by the SNF continues to be of concern to tribes and Indian communities. Urban development has decreased resources available on private lands; commitments for needed wildlife habitat protection may alter resource availability on public lands; competition with non-Indians for resources such as pinyon and mushroom; timber harvesting activities; road construction; fuels treatment; fire management; and herbicide use are all concerns voiced by the Indian population. The mix of the various activities and the level of disturbance have the potential, as has been demonstrated in the past, to affect the integrity of archaeological sites, plant communities (particularly black oaks), ceremonial locations/cultural landscapes and other areas significant to Indian people.

<u>Consultation and Collaboration:</u> An ongoing process of tribal consultation and collaboration for ecosystem management and specific projects is beginning to establish firmer institutional roots in the Sierra Nevada. For many tribal communities whose reservations lie next to National Forests, Forest Service management affects their quality of life. Since forested ecosystems extend beyond land ownership boundaries, it is essential that the Forest Service and tribes collaborate to protect everyone's interests in such issues as fire protection, water quality, air quality, and other resources in National Forests

The spiritual and cultural survival of Indian people is to a large extent dependent upon National Forest lands because areas of cultural importance to tribal people are located there; namely, ceremonial locations, cemeteries, traditional gathering areas, and archaeological sites. These areas contribute to the tribal communities' way of life, their identity, their traditional practices and cohesiveness. Because ecosystem management within the forest may affect tribes in various ways, there are some important aspects that need to be considered. The following are some tribal concerns that have been expressed, which are applicable to the KRP:

1. **Culturally important uses of natural resources**. Traditional gathering for food, medicine, dance regalia for ceremonial use, basket weaving material, materials used for ceremonies such as sweat lodges, and other activities continue today. Present needs and gathering practices are not fully known. The SNF is aware that resource gathering locations are often scattered in small areas throughout the project area. Indian people have expressed concern that plants of significance to the Indian people are neglected in forest management processes, such as plants used in basket weaving. A key effect of the inception of federal administration of most of the land in the project area around the beginning of the twentieth century was a change in fire management. Wildfires were suppressed. The loss of controlled fire or natural fire to maintain prehistoric vegetative conditions contributed to heavy fuel buildup and conifer dominance. A cursory examination of those areas where resources are needed by basket weavers suggests that the existing condition on forest lands is poor, often overgrown by vegetation or weeds. Areas that were historically used to provide the everyday resources for large villages of several hundred people can barely provide resources for a few weavers today. The plants have not been tended, pruned and managed systematically to be productive and useful, i.e., sourberry *(Rhus trilobata*) and bunch grass or deer grass (*Muhlenbergia rigens*). Insufficient cultural plants include sourberry and "white root" (specific species of *Carex spp*., commonly known as sedge).

   Another concern is the protection and management of black oak groves. Various tribal representatives have pointed out past gathering areas. In the past several years, the SNF

Heritage and Tribal Programs and Fuel Programs have under-burned a number of locations in an effort to enhance the oak trees. The removal or reduction of understory and groundcover in black oak areas has improved conditions for gathering collect acorn.

2. **Special lands and associated activities on NF lands**. Presently, ceremonial activities, such as traditional healing ceremonies and bear dance gatherings or visits to special places, happen on Forest Service lands, including within the KRP. Sometimes they are held with little notice; sometimes they consist of large numbers of families participating. Some of these activities need to be performed in an environment conducive to the activity. Possible conflicting activity needs to be considered in project planning. The activities require items used during the ceremonies, such as poles (cedar, willow), certain rocks, and plants.

3. **Archaeological sites including historic Indian locations and non-Indian historic sites.** Many of the archaeological sites located within the project area are familiar to local tribes, particularly the Holkoma Mono, mainly associated with the Cold Springs Rancheria; members of the Dunlap Band of Mono Indians and other Wobonuch Mono people.

   The project area illustrates cultural diversity, with evidence of multiple lifestyles and economies depicted in the archaeological record. Throughout history, human activities have created the present cultural landscape within the Big Creek and Dinkey Creek watersheds. The project area offers unique opportunities for research, enhancement, interpretation, management and contemporary use of significant cultural values.

Heritage Resource Management: As described in the project design measures (Chapter II), proposed activities within the Project area would be managed according to the provisions of the Regional PA for no effect to cultural resources, including both archaeological values and contemporary Native American values. The Standard Protection Measures of the Regional PA require that historic properties be avoided when undertaking activity within their boundaries, unless specifically identified in the Regional PA (i.e. controlled burning through sites). The nature and scope of this project are such that the potential effects of project activities to archaeological research values and contemporary cultural values can be reasonably predicted, and appropriate measures can be taken to ensure the significant values of these heritage resources are not adversely affected. Not every part of the proposed action would avoid heritage resources.

Contemporary Native American interests can 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. The SNF manages such known sites as cultural resources under the provisions of the Regional PA but where the interests of native people are considered to achieve a mutually beneficial outcome during project implementation. For example, some plant materials used in basketry respond positively to fire; sites containing these plants might be included in prescribed fire activities to promote their quality and abundance. The location of these sites is also kept administratively confidential. The SNF will maintain appropriate access to sacred and ceremonial sites, and to tribal traditional use areas, and has consulted with affected tribes and tribal communities to address access to culturally important resources and areas in this project analysis.

Environmental Consequences

Direct and Indirect Effects of Alternative 1 and 3

Cultural resources have been considered in all aspects of the proposed project, and in regards to the proposed actions. Since vegetation management and fuels reduction treatments involve ground disturbance, the proposed actions have the potential to damage or destroy cultural resources.

No direct effects to sites with archaeological value are anticipated from implementation of these alternatives. For archaeological sites, specific protection and management measures derived from the Regional PA would be applied as project design measures (Chapter 2, page 36). All National Register eligible and potentially eligible properties would be managed for No Effect (per the Regional PA) from project activities. No consultation on project effects with the California State Historic Preservation Officer is required.

Because of the entry into the project area with implementation activities, inadvertent effects to known and undiscovered heritage resources could occur. The management requirements derived from the Regional PA would be in place to ensure that this potential is minimized and to ensure appropriate consultation in the unlikely circumstance should inadvertent effects occur. The experience of SNF heritage resource managers and project implementation staff has proven that with careful application of the protection measures of the Regional PA, inadvertent effects to historic properties are the rare exception. According to the Regional PA, the Forest shall conduct monitoring to ensure the effectiveness of the protection measures or prevent the loss of unidentified heritage resources. Heritage Resource Managers will determine the schedule and requirement for any monitoring based on the timing of project implementation, the type of project activity, and the locations of known cultural resources. Monitoring results will be documented in the SNF annual Regional PA report.

There is a high degree of likelihood of discovery of previously unknown archaeological resources during project implementation. There is a small risk of damage to any sites not yet discovered, including those sites that are located entirely sub-surface. The implementation contracts would contain provisions to protect such sites, in the event that they are discovered because of treatment activities, by the cessation of activities until a heritage resource specialist evaluates the discovery and provides for an appropriate level of protection, in accordance with the provisions of the Regional PA.

An anticipated indirect effect is an increased awareness by the public, implementation personnel, and implementation contractors of the nature and location of heritage resources of the KRP. This may result from the public project analysis, any short-term increase in ground surface visibility due to the loss of vegetative cover by proposed fuels reduction activities (especially prescribed fire), the projected increase in human activities in the project area during implementation, and visible site protection measures necessary for implementation. Increased awareness can increase the risk of site vandalism through disturbance and illegal collection. Such illegal artifact collection and damage has been continually occurring in the project area since many of the archaeological sites were first documented in the 1970s. The loss of artifacts can adversely affect the archaeological information potential and National Register eligibility. This risk is anticipated to be only slightly higher than the no action alternative, due to the short-term nature of any exposure the sites would have to personnel conducting the treatments.

For non-archaeological cultural resources, the appropriate Native American Tribes, tribal councils and individuals were consulted about the presence of traditional cultural properties and plant gathering areas within the project area. Identified gathering sites would not be directly or indirectly affected by project activities, as they would be afforded protection through management measures derived from the Regional PA, as project design measures (Chapter 2).

If there are gathering sites within the project area that Native Americans have chosen not to disclose, then there could be adverse direct effects from project treatments, particularly shredding and herbicide application, on some plant populations important to California Indian basket weavers or gatherers.

These project alternatives would have direct effects on populations of plant species important to California Indian basket weavers and other Native American gatherers, outside of identified gathering sites. Plant species targeted for removal or reduction in fuels and vegetation management prescriptions include brush and plant species (e.g. bear clover, manzanita, buck brush, deer brush) that are identified by Native American organizations, tribes, and individuals as species of traditional use and interest. This effect is limited by the scope of the project treatments, and by the abundance and region-wide distribution of these species.

Alternatively, the abundance of traditional food, basketry, or medicinal plants may ultimately be enhanced by the proposed treatments in terms of conversion to uneven-age vegetation management strategy, reduction of decadent fuels, and limiting the spread of noxious weeds. A discussion of botanical diversity and native plants is found above in the Botanical Resources section of this Chapter.

Cumulative Effects of Alternative 1 and 3

The geographical area considered in this cumulative effects analysis is the KRP area. The overall cumulative effects of the action alternatives to heritage resources are expected to be beneficial, as the prescriptions that were developed through the interdisciplinary process in consideration of the presence of cultural resources may ultimately enhance the cultural resources in the following ways:

A cumulative effect of the action alternatives would be to reduce the effects of future wildfires, fueled by brush and vegetation buildup, that damage or destroy heritage resources directly, or because of fire suppression. Impacts to sites burned in wildfire include destruction of artifacts, increased erosion, enhanced visibility to vandals, contamination by fire retardant, introduction of modern carbon and charcoal, and mechanical impacts from fire suppression equipment (U.S. Army Corps of Engineers 1992). Implementation of an action alternative would serve to reduce the threat of wildfire damage to archaeological sites in the long-term by creating conditions that reduce the spread and intensity of wildfires.

Careful application of controlled fire can be beneficial to heritage resources. Controlled burns can be effectively used to control vegetation on archaeological sites without damage to the cultural resources (U.S. Army Corps of Engineers 1992). The procedures of the *Interim Protocol* of the Regional PA are based on the assumption that low- to moderate-intensity prescribed fires generally have few direct impacts to non-flammable heritage resources that have previously burned over.

Implementation of the proposed action would serve to move the KRP toward the desired future condition (Chapter 1), more representative of the prehistoric natural setting.

Past actions, both natural and human caused, have had varying degrees of cumulative effects on the cultural values in the project area. These effects, which include damage or destruction to archaeological sites, are the result of historic activities (i.e. logging, road construction), illegal artifact collection, and in particular, from wildfires. Implementation of the action alternatives is not anticipated to negatively affect the archaeological or cultural stability of the project area.

Alternative 2 - No Action

Direct and Indirect Effects

Cultural resources have been considered in all aspects of the proposed project. No direct or indirect effects to identified sites with cultural values (archaeological research values or contemporary Native American interests) are anticipated under this alternative because no project activities would occur.

Cumulative Effects

Past actions, both natural and human caused, have had varying degrees of cumulative effects on the cultural values in the project area. These effects, which include damage or destruction to archaeological sites, are the result of historic activities (i.e. logging, road construction), illegal artifact collection, and in particular, wildfires. These trends would continue under this alternative.

In this alternative, there is the potential for adverse effects to cultural resources without management intervention to address or mitigate the potential threat of future wildfires with high burn temperatures if current fuel conditions persist. Future stand-replacing fire events would have a negative cumulative effect by causing damage to sensitive archaeological site features, as well as exposure to potential vandalism.

This alternative may have a beneficial effect to the archaeological values in that the current vegetation conditions would persist, providing a level of protection from human disturbance. Many of the archaeological sites are very difficult to locate, and surface artifacts are hidden by the ground cover, discouraging the potential for detection, illegal collection, and vandalism.

On the other hand, this alternative may have a negative effect to non-archaeological cultural resources, especially plants of contemporary Native American interest. Noxious weeds and other invasive species would continue to spread, crowding out native species. Fuels and brush would continue to accumulate, making access to and use of resources by Native Americans more difficult or impossible.

ECONOMICS

Affected Environment

The economic benefit of an alternative is dependent on the value of the standing tree volume at a point in time, the costs and benefits of active management proposed in the alternative and the cost of standing tree volume lost to a severe fire.

As explained at the beginning of Chapter 3, each alternative incorporates the concept of wildfire entering the landscape ten years after the record of decision for the purpose of modeling and analysis of effects. The ten year period was chosen not as a prediction but because it would test the effectiveness of the proposed action and reduction of harvest tree size alternatives after all treatments have been accomplished vs. the no action alternative and display a comparison to the decision maker of the indirect and cumulative effects of the alternatives.

A simple approach to weighing the economic benefits of alternatives is to compare the present net value of the reasonably foreseeable activities that can be quantified by referring to recent market transactions (selling timber, contracting for piling debris, etc.) at a common point in time. For the purpose of modeling and analysis, the point in time is after a wildfire has entered the landscape ten years after the record of decision.

Environmental Consequences

Alternative 1 – Proposed Action

For the Proposed Action, the reasonably foreseeable activities are as follows: the current harvest of standing tree volume – a benefit; the post harvest vegetation, fuels and resource improvement projects – costs; the road reconstruction and construction work associated with the projects – a benefit because the improved or new roads are an asset which has value for many years; the road maintenance work associated with the projects – a cost because routine maintenance has value for only the life of a project to a few years; the value of the standing tree volume after wildfire enters the landscape in ten years – a benefit

Table 3-75 - Present Net Value, Proposed Action

	bear_fen	el-o-win	glen_mdw	krew_bul	krew-prv	n_soapro	prov_1	prov_4
Timber Harvest Value	$247,058	$1,078,261	$590,887	$311,148	$980,300	$50,249	$266,546	$17,770
Roads	$252,418	$116,452	$226,349	$149,168	$415,685	$256,356	$179,896	$167,924
Post Harvest Costs	$558,560	$355,436	$339,789	$341,670	$470,172	$363,500	$475,494	$144,853
Post Fire Timber Inventory Value	$535,748	$907,795	$866,869	$803,621	$740,373	$141,378	$375,767	$52,087
PNV	$148,520	$1,595,684	$1,050,063	$728,350	$1,125,796	-$248,780	$112,851	-$125,374

The present net value from carrying out the Proposed Action and a wildfire entering the landscape after ten years for the initial eight management units is $4,390,000.

Alternative 2 – No Action

For the No Action, the only reasonably foreseeable activity is the loss of standing tree volume after wildfire enters the landscape in ten years.

Table 3- 76 - Present Net Value, No Action

	bear_fen	el-o-win	glen_mdw	krew_bul	krew-prv	n_soapro	prov_1	prov_4
Post Fire Timber Inventory Value	$327,401	$453,897	$591,555	$889,192	$587,834	$178,583	$502,263	$63,248

The present net value remaining after wildfire enters the landscape in ten years for the initial eight management units is $3,595,000.

Alternative 3 – Reduction of Harvest Tree Size

For the Reduction of Harvest Tree Size Alternative, the reasonably foreseeable activities are the same as for the Proposed Action.

Table 3-77 - Present Net Value, Reduction of Harvest Tree Size

	bear_fen	el-o-win	glen_mdw	krew_bul	krew-prv	n_soapro	prov_1	prov_4
Timber Harvest Value	$209,371	$82,609	$357,983	$219,634	$565,558	$41,874	$222,122	-$8,885
Roads	$252,418	$116,452	$226,349	$149,168	$415,685	$256,356	$179,896	$167,924
Post Harvest Costs	$558,560	$355,436	$339,789	$341,670	$470,172	$363,500	$475,494	$144,853
Post Fire Timber Inventory Value	$535,748	$907,795	$866,869	$803,621	$740,373	$141,378	$375,767	$52,087
PNV	$110,833	$1,380,032	$817,159	$636,835	$711,053	-$257,155	$68,426	-$152,029

The present net value from carrying out the Reduction of Harvest Tree Size Alternative and a wildfire entering the landscape after ten years for the initial eight management units is $3,315,000.

HUMAN HEALTH AND SAFETY

Affected Environment

Currently there are noxious weeds, invasive plants and undesirable vegetation in the form of brush competing with tree seedlings for moisture and nutrients in the project area that will present an opportunity for correction with the herbicides. See section on botanical resources and vegetation for more information on current vegetative condition.

A Region-wide environmental analysis entitled: Vegetation Management for Reforestation Final Environmental Impact Statement (VMFEIS) (USDA 1988) is incorporated by reference.

The use of prescribed fire as a fuels reduction technique increases the potential for the degradation of air quality. The potential impacts of fire-induced air quality degradation on public heath and welfare range from occupational short term exposure of smoke on firefighters and local residences to long term health effects from ambient pollutants and particulate matter and fugitive dust in smoke sensitive areas. See section on air quality for more information on prescribed fire and air pollutants including an effects analysis.

An Air Quality Determination has been prepared for the Kings River Project to determine conformity to The Clean Air Act, the California State Implementation Plan and Title 17 of the California Code of Regulations and is incorporated by reference.

A risk assessment to determine the site-specific risks to human health and safety of using glyphosate in the commercial formulation, Accord, was prepared for the project and is incorporated by reference. The risk assessment is on file at the High Sierra District Office[20].

Direct and Indirect Effects of Alternative 1 and 3

The hazard information, the application method (backpack spraying), and the number and characteristics of people that could come in contact with glyphosate is similar to many other projects undertaken by the District in recent years.

Hazard analysis was accomplished by reviewing toxicity data in the literature and the Vegetation Management for Reforestation Final Environmental Impact Statement (USDA 1988) and identifying established acute toxicity values (LD50s), no observable effect levels (NOELs) for systemic and reproductive health effects. These data are summarized in the Toxicity Summary Table on page 2 of the risk assessment. Glyphosate is considered to be slightly toxic to humans. It is non-irritating to the skin and only slightly irritating to the eyes. There is no evidence that glyphosate causes birth defects, cancer, neurotoxicity, immunotoxicity or endocrine disruption (SERA 2002 & 2003).

The application rate per acre is based on the estimate that glyphosate would be mixed with water at 5 percent by volume and applied to all the target vegetation involved with reforestation or noxious weed control activities, which is about 25 to 75 percent of the vegetation in the areas to be treated. On this project, glyphosate mixed at 5 percent and applied spray-to-wet to the target vegetation would result in 9 to 24 gallons of mix per acre or 1.8 to 4.8 pounds of active ingredient per acre. Following the same methodology used in the VMFEIS and this application rate, doses were calculated for potentially exposed workers and members of the public. The results are in the Summary of Exposure Scenarios Table on page 3 of the risk assessment.

A margin of safety (MOS) was calculated for each dose estimate for workers and the public by dividing the systemic and reproductive NOEL for the herbicides by the estimated dose. A benchmark MOS of 100 is commonly accepted by the scientific community, regulatory agencies, and the Forest Service for setting acceptable exposure

20 The Forest Service primarily relied on the Vegetation Management for Reforestation Final Environmental Impact Statement (VMFEIS 1988) for the methodology and some of the data used in the human health risk assessment. As stated in the risk assessment for the project, it uses "the standard methodology, widely accepted by the scientific community that is described in detail in Appendix F of the VMFEIS." The risk assessment for the project is current and utilized information from recent risk assessments such as Selected Commercial formulations of Glyphosate - Accord, Rodeo, and Roundup risk assessment final report (SERA 1996) and Glyphosate (SERA 2003). Otherwise, the VMFEIS was not used to assess the impacts of herbicide use. The Forest Service did use the experience gained by carrying out reforestation activities that flowed from the VMFEIS to craft the alternatives and estimate the effects in this EIS.

rates. Values of 100 or greater are considered to pose an acceptable or low risk to human health and safety. All MOS values calculated for doses resulting from this application rate are greater than 100. Therefore, the risks to workers and to members of the public are low.

The only inert ingredient contained in Accord is water. However, the herbicide would be mixed with R-11 surfactant and dye, usually Colorfast Purple. The EPA has categorized approximately 1200 inert ingredients into four lists. List 1 and 2 contain inert ingredients of toxicological concern (Fed. Reg. 54:48314-16). List 3 includes substances such as soaps and List 4 substances such as corn oil, honey and water. Neither R-11 or Colorfast Purple nor inerts included in formulating them are on List 1 or 2.

There has been concern expressed about the potential for surfactants containing nonylphenol polyethoxylate (NPE)[21], such as R-11, to cause endocrine disruption and other deleterious effects. However, in comparison to natural estrogen NPE is approximately 10,000 to 1,000,000 times weaker in eliciting an estrogenic response (USDA 2003, p. 9). Based on a planned application rate of one percent R-11, there is no evidence that typical applications of NPE in R-11 will lead to accidental or chronic exposures that exceed the level of concern (i.e. MOS exceeding 100) in workers or the general public. A possible exception would be eye and skin irritation from direct and prolonged exposure through an accidental or mishandling incident where personal protective equipment (eye protection) was not used and first aid was not administered (USDA 2003, p. v). NPE is classified as slightly to practically non-toxic to mammals and is not mutagenic (USDA 2003). So, there would be almost no risk to the health and safety of the workers or public from these additives.

Cumulative Effects of Alternative 1 and 3

Use of glyphosate could result in cumulative doses of herbicides to workers or the general public. Cumulative doses result from (1) additive doses from various routes of exposure from this project and (2) additive doses if an individual is exposed to other herbicide treatments.

Reforestation and noxious weed control activities in the project would have one to three glyphosate applications over the years, so a worker or a member of the general public could be exposed to a second dose during application plus any residual herbicide remaining on the site. Since the half-life of glyphosate is less than three months (SERA 2003), no additive herbicide doses from a second application are anticipated.

Southern California Edison applies less than 100 gallons of glyphosate mix annually to its lands in the project area and PG&E applies herbicides to about 200 acres annually on the Helms/Gregg 230kV Transmission line right-of-way. There are a few other adjacent landowners with small acreages in the project area that may apply similar amounts of glyphosate in the foreseeable future. However, an additive dose would be almost impossible because the applications would be geographically separated and glyphosate does not persist in the environment.

21 The primary active ingredient in many of the commercially available non-ionic surfactants is a compound known as NPE. It is found at rates varying from 20 to 80 percent. NPE is formed through the combination of ethylene oxide and nonylphenol (NP). NP is a material recognized as hazardous and is included on EPA List 1. (USDA 2003, p. v) NPE is widely used in industrial applications, detergents, cosmetics, shampoos, surfactants and spermicides.

There is no indication that glyphosate causes sensitization or allergic responses, which does not eliminate the possibility that some individuals might be sensitive to glyphosate as well as many other chemicals (SERA 2003; 3-51).

Synergistic effects of glyphosate with other chemicals are not anticipated in the project area because they have not occurred when it has been used extensively in other forestry and agricultural applications.

For all instances, cumulative effects would be negligible with the exception of where individuals use herbicides at home on the same day of an exposure resulting from the project which would double the human health risk.

Direct, Indirect and Cumulative Effects of Alternative 2

None

RESEARCH

Affected Environment

Why is research important? The quality of aquatic, riparian and meadow ecosystems is directly related to the integrity of nearby uplands and their watershed. Research scientists believe that these ecosystems are the most altered and impaired habitats of the Sierra Nevada primarily because of dams and diversions, overgrazing, roads, logging and physical alteration. Forest managers, private companies and public interest groups have all expressed interest in whether uneven-aged forest management can maintain the long-term viability of California spotted owl and other wildlife populations, improve forest health and develop a sustainable level of productivity. Substantial interest has always existed around reintroduction of fire into the Sierra Nevada ecosystem.

Current research plans intended to determine how California spotted owls and fisher respond to changes in vegetation structure from the application of the KRP uneven-aged management strategy and prescribed fire; better understand the spatial distribution of ozone and other pollutant deposition on forest health and water quality; quantify the characteristics of stream ecosystems and their associated watersheds; determine the effect of fire and fuel reduction treatments on riparian and stream physical, chemical and biological conditions; determine how effective current stream buffers are at protecting aquatic ecosystems; determine if prescribed fire changes the rate of soil erosion and if it affects soil health and productivity.

The KRP area is representative of forest conditions found throughout the southern Sierra Nevada and is the only adaptive management project established in the south half of the Sierra Nevada to address a diverse set of questions about uneven-aged silvicultural systems and prescribed fire.

Environmental Consequences

Direct and Indirect Effects of Alternative 1 and 3

The need identified in Chapter 1, "*for knowledge about the response of forests to a management strategy consisting of a specific uneven-aged silvicultural system and prescribed fire program designed to restore forests to historical pre-1850 conditions across a large landscape*", would be chiefly satisfied. This project could become a management model for other national forests that are looking at methods to recreate the historical pre-1850 forest conditions because of the knowledge that is produced.

The research is described in Chapter 2 on pages 18 thru 24.

Cumulative Effects of Alternative 1 and 3

None

Alternative 2 - No Action

Under the No Action alternative, the research planned would not occur and the research underway (KREW) could not be completed. Invested time in research projects, especially the Kings River Experimental Watershed, would be lost. Questions would remain as to the effects of management activities to riparian and stream conditions, the effectiveness of stream buffers, and the use of prescribed fire on rates of soil erosion. No information would be gained on CA spotted owl or Pacific fisher with regard to forest restoration.

Short-term Uses and Long-term Productivity

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 the 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 Section 101).

Maintenance and enhancement of long-term productivity is at the heart of beginning to restore the historical pre-1850 forest condition, the KRP purpose. Obviously, the pre-1850 forest was sustainable and resilient. This is demonstrated by its survival for thousands of years shaped by natural forces and management of certain plant communities by Native Americans for cultural purposes. All plant and animal species present today occurred in varying numbers during those years. By comparison, the present forest is not sustainable or resilient as described in the SNFPA 2004 Record of Decision (USDA 2004a, p.6). So, the short-term uses of man's environment described in the Proposed Action or the Reduction in Harvest Tree Size Alternative in Chapter 2 are intended to be the activities that lead to enhancement of long-term productivity by beginning to restore the pre-1850 forest condition.

All the needs for action described in Chapter 1 lead to enhancement of long-term productivity, especially:

- the need to increase the number of large trees for the benefits described to various species in the wildlife section,
- the need to reduce tree density to gain the benefits and avoid the consequences described in the fuels and vegetation sections,
- the need to control noxious and non-native weeds to avoid the consequences described in the botanical resources section, and
- the need to improve watershed conditions to gain the benefits described in the soils and watershed sections of Chapter 3 on Environmental Consequences

Unavoidable Adverse Effects

There are no unavoidable adverse effects described in Chapter 3.

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 rights-of-way or road.

Within the KRP area there may be an irreversible effect to Yosemite toad if Alternative 1 – Proposed Action is selected but not if Alternative 3 – Reduction in Harvest Tree Size is selected. The possibility is described in Chapter 3, Aquatic Resources.

Cumulative Effects

Cumulative effects are addressed by each resource area in the environmental consequences discussions in Chapter 3.

Legal and Regulatory Compliance

NEPA at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders." The proposed action and alternatives must comply with following:

Principle Environmental Laws

The following laws contain requirements for protection of the environment that apply to the proposed action and alternatives:

Endangered Species Act – This act applies to the proposal and the proposal will comply with the law through the conduct of Biological Assessments and Evaluations that analyzed effects of the proposed action and reduction in harvest tree size Alternative and made determinations on federally listed endangered, threatened candidate, and proposed species and their habitat. The analysis was conducted, in part, to determine whether formal consultation or conference is required with the United States Department of Interior (USDI) Fish and Wildlife Service, pursuant to the Endangered Species Act.

Clean Water Act – This act applies to the proposal and the proposal will comply with the law by adoption of Best Management Practices and other design measures as detailed in Chapter 2.

Clean Air Act - This act applies to the proposal and the proposal will comply with the law by implementation of the Best Available Control Measures (BACMs) for prescribed fire as required under section 190 of the Clean Air Act as amended in 1990.

National Historic Preservation Act - Project implementation will comply with the stipulations of the *First Amended Regional Programmatic Agreement Among the USDA Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, and Advisory Council on Historic Preservation Regarding the Process for Compliance with Section 106 of the National Historic Preservation Act for Undertakings on the National Forests of the Pacific Southwest Region* (Regional PA), dated 2001 (USDA 2001b). This project complies with Stipulations III.C. (2) and III.D.(3)., Undertakings Where Management Measures Are Necessary for the Protection of Historic Properties.

Coastal Zone Management Act – This act does not apply to this proposal due to its geographic proximity to the coast.

National Forest Management Act – This act does apply to the proposal and the reader can refer to Chapter 3 under several topics, especially Vegetation including Fire, Historical Forests, and Reforestation section.

Executive Orders

The following executive orders provide direction to federal agencies that apply to the proposed action and alternatives:

Indian Sacred Sites, Executive Order 13007 of May 24, 1996 – This order applies to the proposed action and reduction in harvest tree size alternative because of the historic and prehistoric uses known in the area. This is specifically addressed in Chapter 3 under the topic Heritage Resources and Tribal Relations. All three alternatives comply with this order.

Invasive Species, Executive Order 13112 of February 3, 1999 – This order applies to the proposed action and reduction in harvest tree size alternative. There is a risk of introducing invasive species as well as a risk of spreading an existing population without measures in place for prevention. The action alternatives comply by providing measures to prevent introduction and spread of invasive species.

Recreational Fisheries, Executive Order 12962 of June 6, 1995 - This order applies to the proposed action and reduction in harvest tree size alternative. By implementing Best Management Practices and other design measures as detailed in Chapter 2 and correcting existing resource problems, the action alternatives comply with this order.

Migratory Birds, Executive Order 13186 of January 10, 2001 - This order applies to the proposed action and reduction in harvest tree size alternative. It states that each agency, to the extent permitted by law and subject to the availability of appropriations and within Administration budgetary limits, shall "… ensure that environmental analysis of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern". To comply with this order, an analysis was conducted and the "Effects on Migratory Birds Specialist Report – Kings River Project" (Robinson 2006) was prepared. The effects are summarized as follows:

Immediately after implementation of the proposed activities (Alternatives 1 or 3), acres of coniferous forest (e.g., Ponderosa pine, red fir, Sierra mixed conifer) will remain unchanged with composition trending slightly to more trees in size classes 4 and 5 (i.e., larger trees), and a modest reduction in canopy cover. Acres of oak woodland habitat (e.g., montane hardwood and montane hardwood/conifer) remains unchanged with a slight increase in trees in size classes 2 and 3 (Tables 3mbta and 4mbta). These changes are small compared to the existing condition within the project area and the total number of acres of these habitats within the approximate 72,000 acres comprising all 80 management units of the KRP: 4235 acres of oak woodland and over 56,000 acres of coniferous forest (Tables 5mbta and 6mbta). Over the following ten years, considering all of the reasonably foreseeable and ongoing activities identified at the beginning of Chapter 3 of the FEIS, additional changes are expected; however, as shown above, the magnitude of these shifts is likely to be small compared to the total acres available.

Implementation of the proposed activities (Alternatives 1 or 3) may result in an unintentional take of individual birds. However, future management options for migratory birds would not be foreclosed because the overall change in available habitat is small, riparian areas and individual oak trees are well protected by project design measures and Best Management Practices, a long-term increase in the number of larger, older trees is projected, and fire would be reintroduced into the ecosystem thereby restoring a critical piece to the functioning of ecosystem processes that would result in a reduction of fuels and the threat of stand-replacement fires. In the absence of a natural fire regime, timber harvest along with prescribed fire can help mimic the natural disturbance regime that has created the diversity of habitat types and conditions that support the full compliment of avian species that breed in the Sierra Nevada ecosystem.

Floodplain Management, Executive Order 11988 of May 24, 1977 – This order does not apply because of the exclusions and buffers in place.

Protection of Wetlands, Executive Order 11990 of May 24, 1977 - This order does not apply because of the exclusions and buffers in place.

Environmental Justice, Executive Order 12898 of February 11, 1994 – This order applies to the proposed action and reduction in harvest tree size alternative. We have attempted comply with the order by making this document understandable and accessible.

Use of Off-Road Vehicles, Executive Order 11644, February 8, 1972 – This order does not apply to this proposal because no off road use is being proposed nor existing use changed.

Special Area Designations

The selected alternative will need to comply with laws, regulations and policies that pertain to the following special areas:

Research Natural Areas - There are no research natural areas in the project area. The Teakettle Experimental Forest lies adjacent to the KRP area but would remain unaffected and therefore this project would comply with the applicable laws, regulations and policies on this type of area.

Inventoried Roadless Areas – Adjacent to the project area in the north and again on the southern side are two separate designated roadless areas. Each occurs outside of any planned management associated with the initial eight management units. This project would comply with the applicable laws, regulations and policies on this type of area.

Wilderness Areas - The KRP area includes a small portion of the Dinkey Lakes Wilderness. This wilderness area is outside of any planned management associated with the initial eight management units. This project would comply with the applicable laws, regulations and policies on this type of area.

Wild and Scenic Rivers – No rivers designated as Wild and Scenic occur in the KRP planning area.

Municipal Watersheds (FSM 2540) - No municipal watersheds occur in the KRP planning area area.

Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs “to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders.”

No water is planned for impounding or diversion within this proposal and therefore the Wildlife Coordination Act does not apply.

Species surveys, review of recent literature and professional judgment have been incorporated into determinations of possible effects on species. Surveys provide information on species presence and habitat on a local scale, but there is an element of uncertainty for effects on species with distributions beyond the project or Forest boundaries. The Pacific fisher and Yosemite toad are Forest Service “sensitive species” that have also been designated by the U.S. Fish and Wildlife Service (F&WS) as “candidate species” for listing under the Endangered Species Act. A candidate species is determined by the F&WS through a 12 month finding as warranted for listing, but the listing process is precluded by other priorities. To address the uncertainty related to these candidate species, the Forest requested and received technical advice from the F&WS. The advice is integrated extensively throughout the Wildlife and Aquatic Species sections of Chapter 3.