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

97^{th} 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.

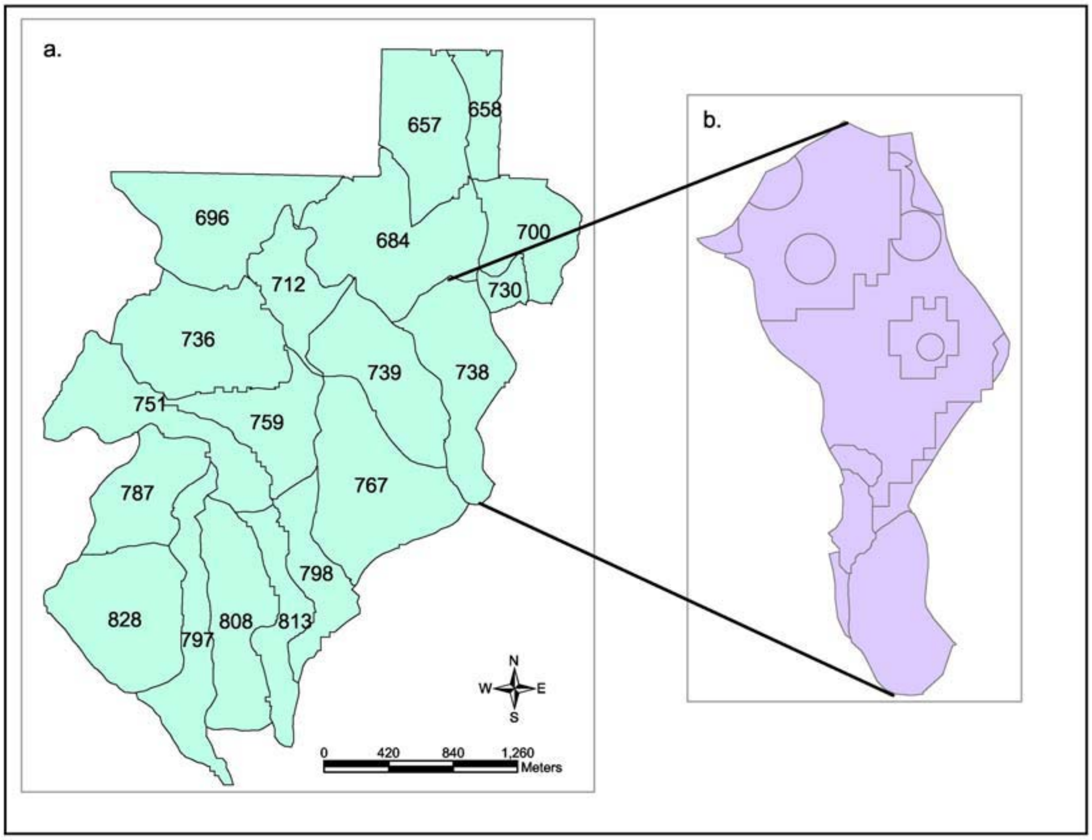


Figure 3-1 - Depicts of the bear_fen_6 management unit and its associated stands. Stand and plot level modeling was used to simulate effect in phase III modeling. Numbers represent a unique stand identifier used for planning (planid). Figure b - depicts plant aggregations used to simulate effects of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

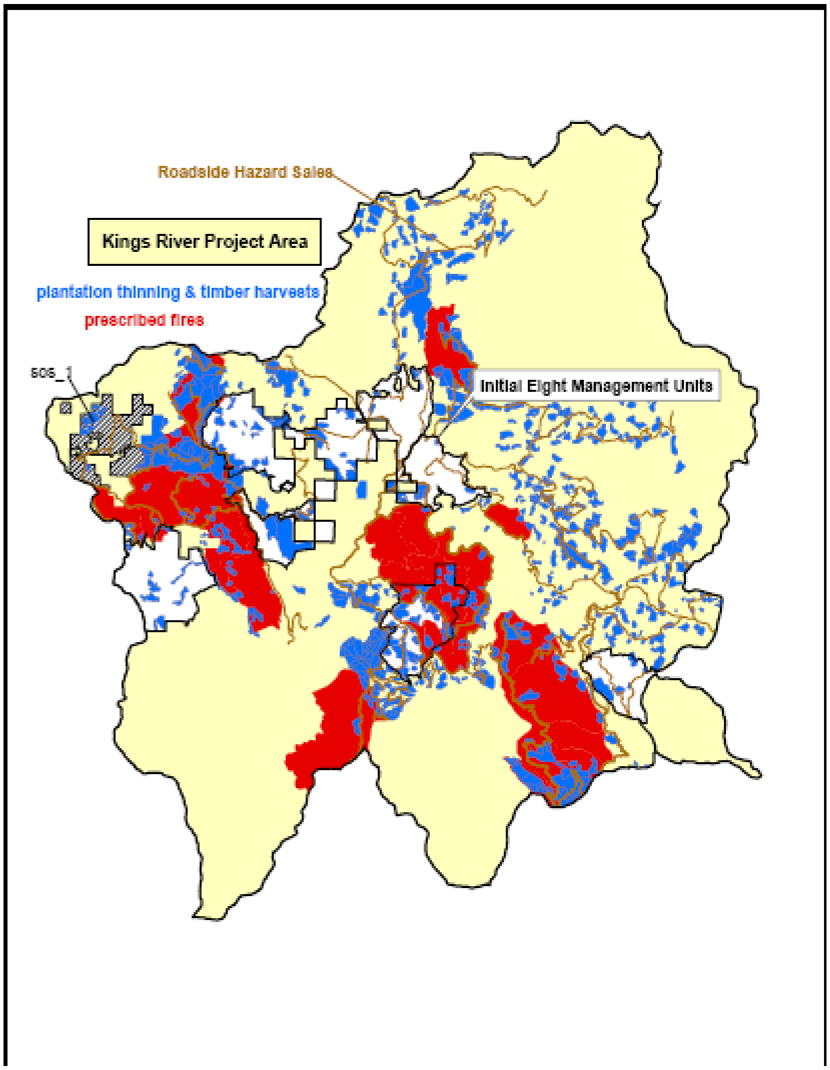


Figure 3-2 - Sierra National Forest ongoing activities in the KRP. Fuels projects are in red and timber harvest /plantation thinning projects in blue. Roadside hazard tree removal is in brown.

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.

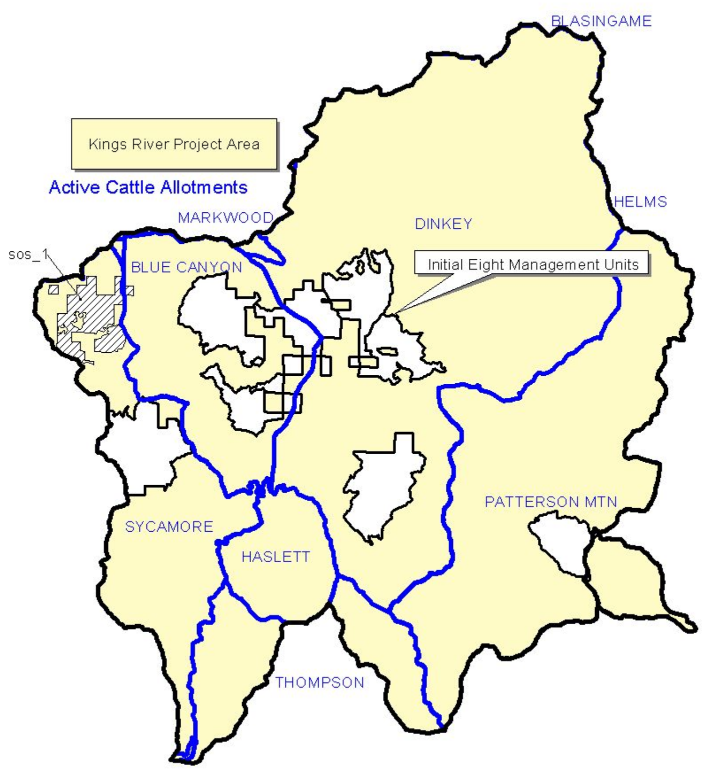


Figure 3-3 Active cattle allotments in the KRP

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.

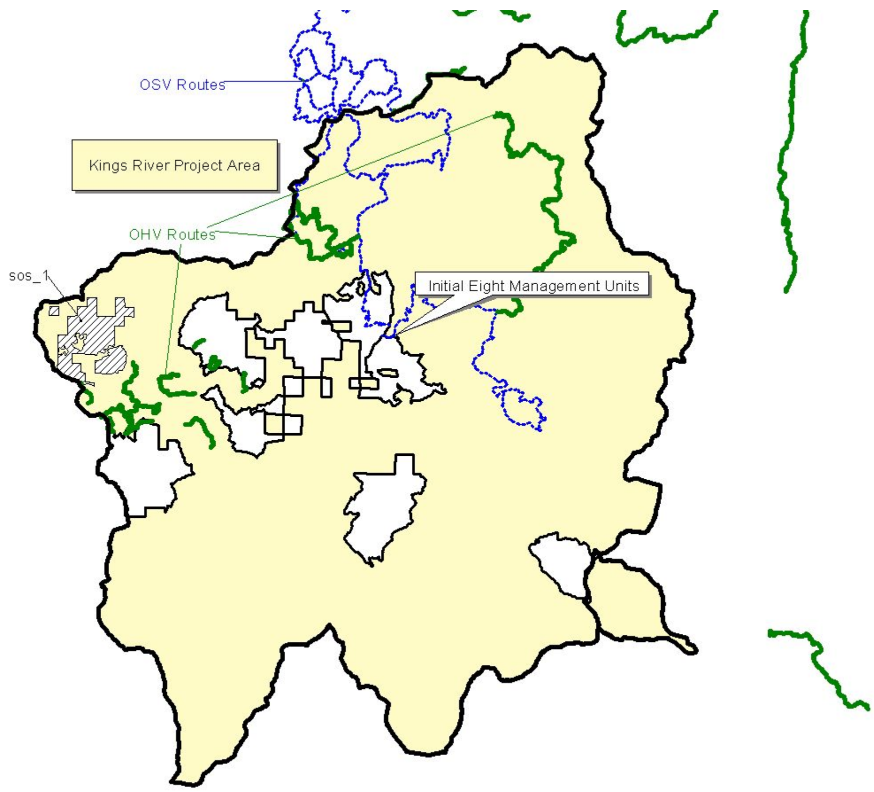


Figure 3-4 -The off-highway vehicle and over-snow vehicle routes that overlap the KRP area

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.

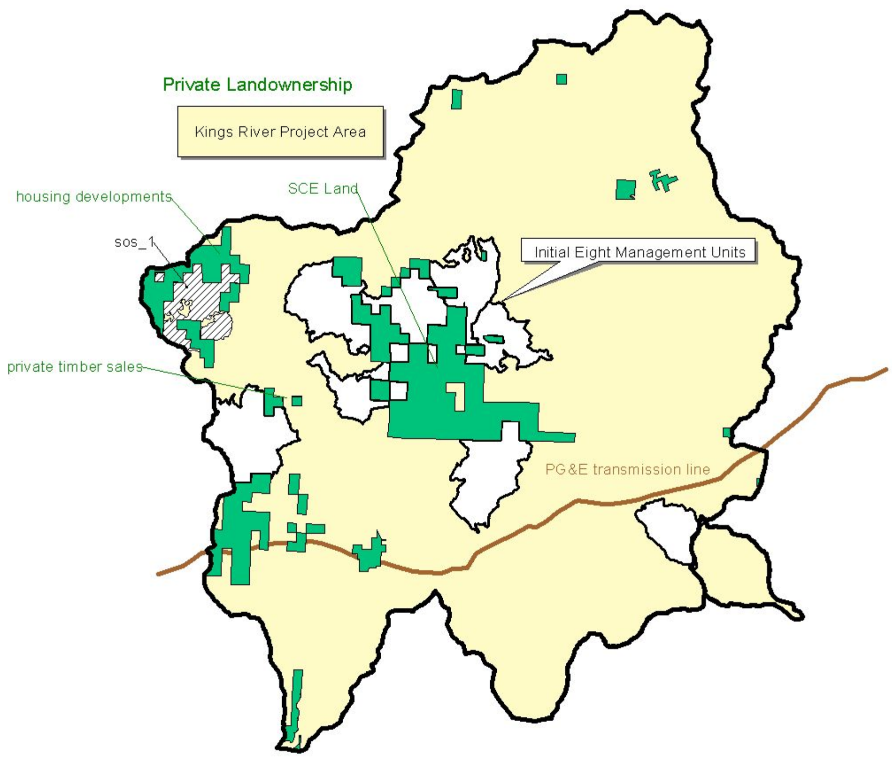


Figure 3-5 - Private land ownership within the KRP area

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).

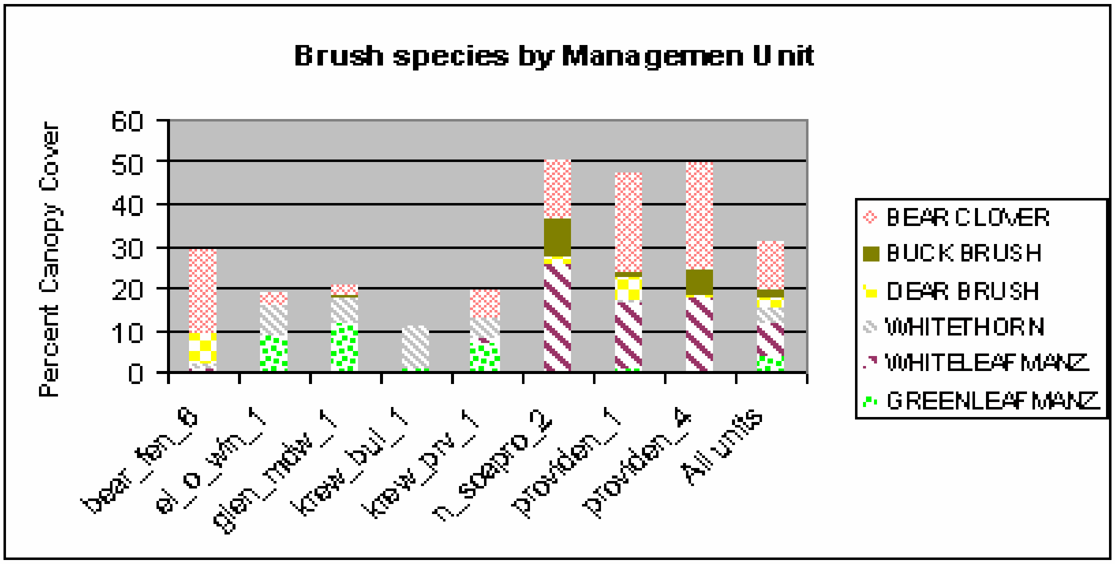


Figure 3-6 - Displays the average canopy cover of brush species by management unit and combined for all units

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

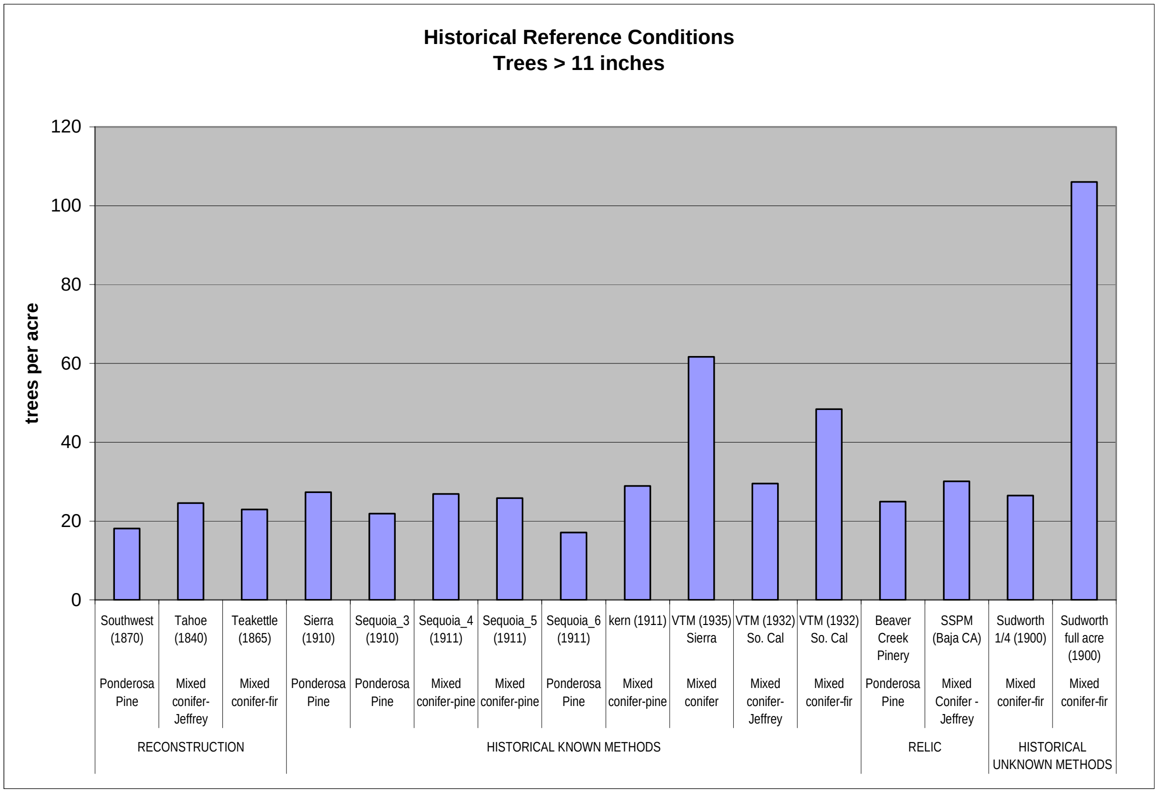


Figure 3-7 - Displays the number of trees per acre greater than 11" for reconstructed forests, relic forests in the Sierra Nevada and Baja California, and historical data sets with known and unknown collection methods. These data sets indicate that historical forest structures had relatively few trees. 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):

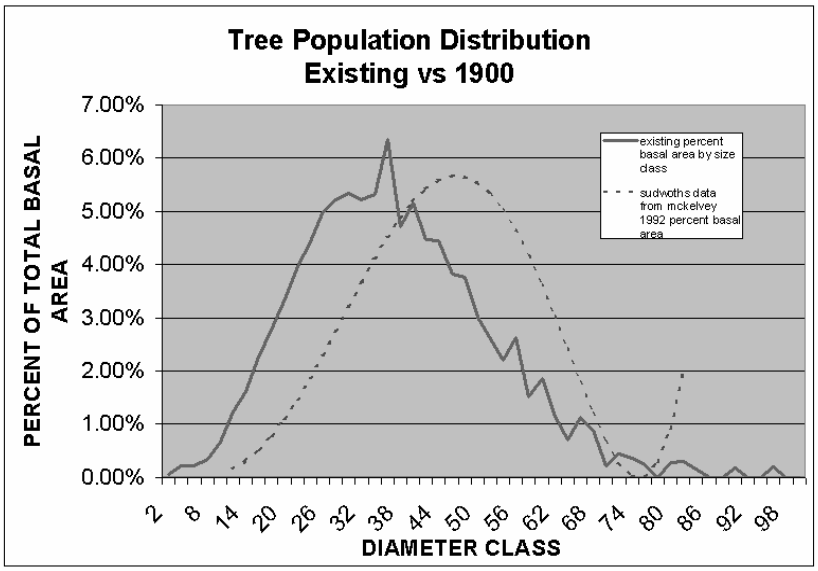


Figure 3-8 displays the proportion of stem area (basal area) by diameter class for the population of measured trees in the initial eight management units (existing) and those measured by Sudworth (1900a and 1900b) as analyzed by Mckelvey and Johnston (1992; 11J & 11L). This indicates an excess of trees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

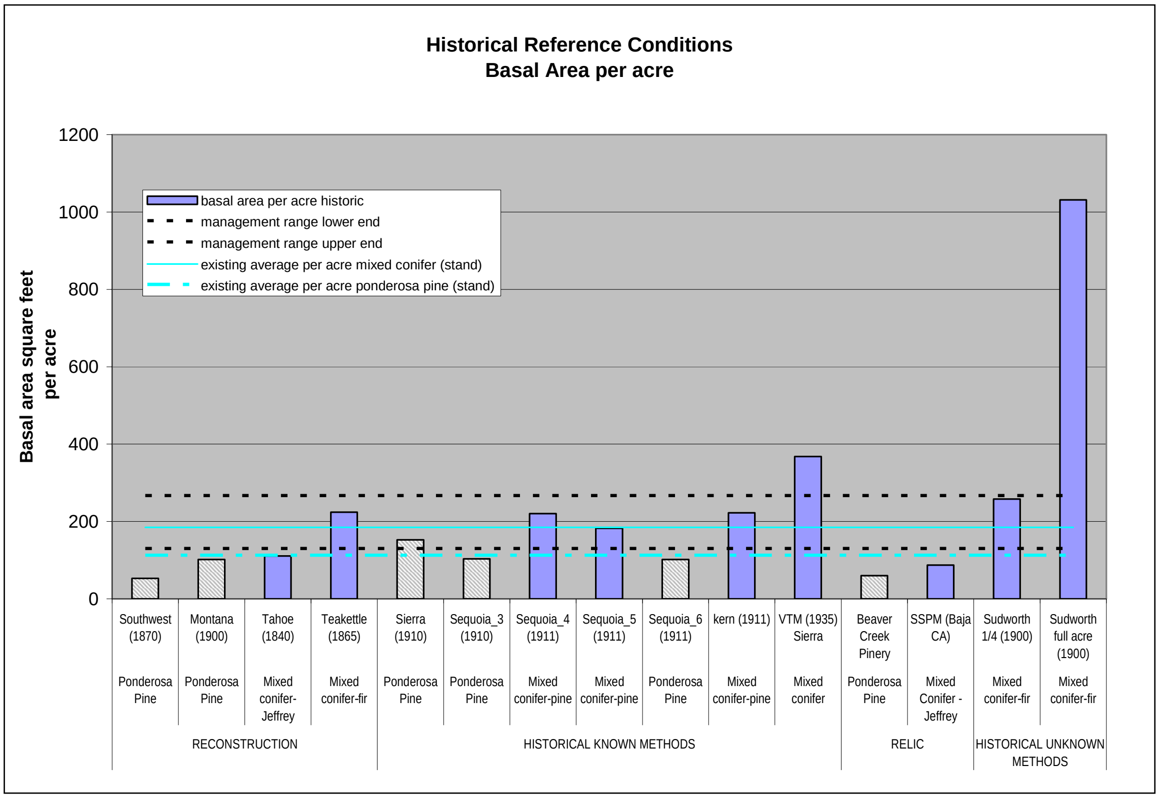


Figure 3-9 - Displays the basal area in square feet for trees greater than 4" of reconstructed historical forests, historical data sets with known and unknown methods, and relic forests of the Sierra Nevada and Baja California. The graph displays the basal area management range for uneven-aged stands 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.

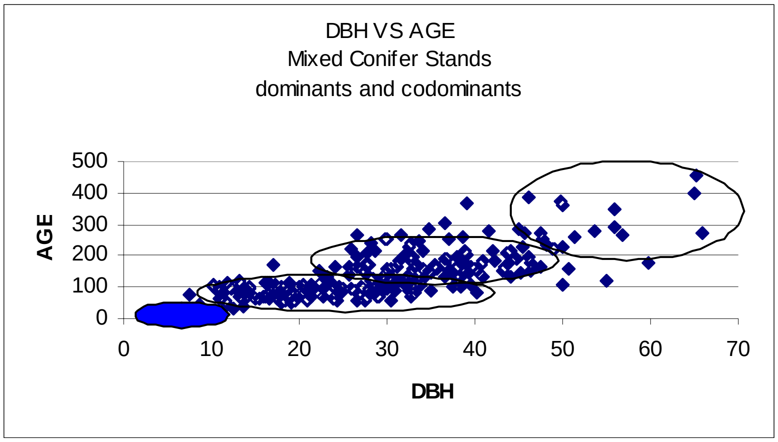


Figure 3-10 – The graph shows age vs dbh and the relative abundance of trees in the age sub-samples, with four cohorts represented, with the youngest age class a solid color.

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.

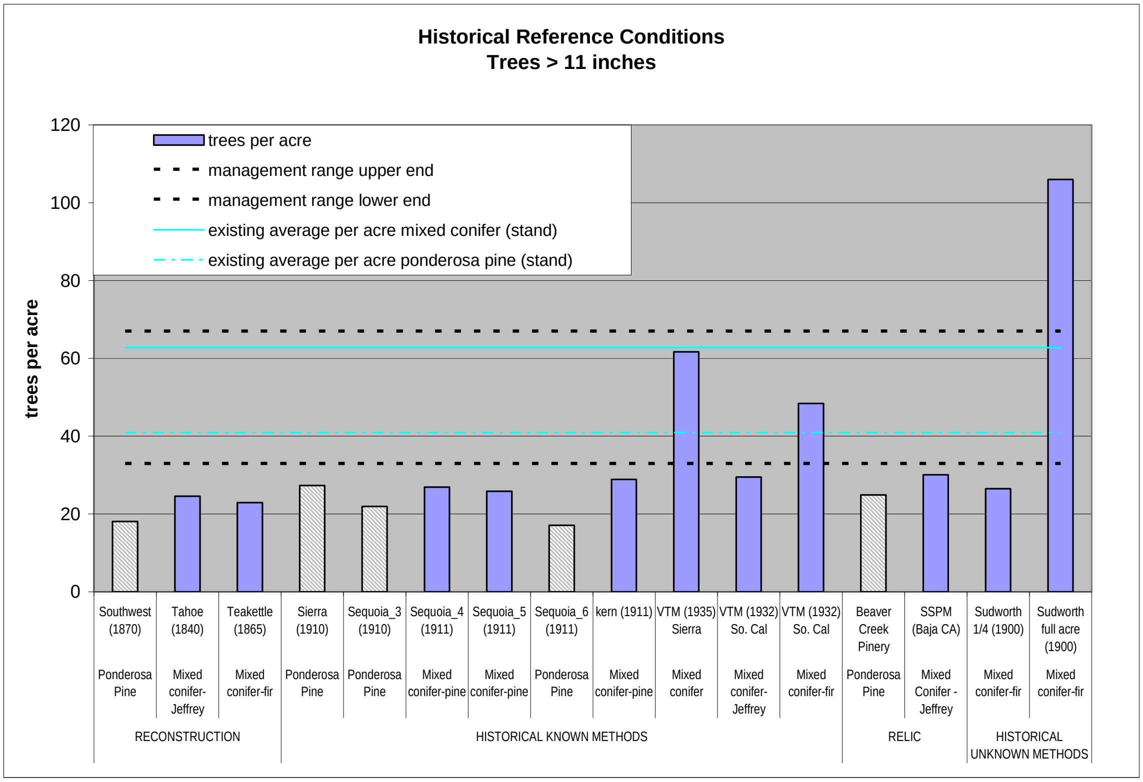


Figure 3-11 - Displays the trees per acre greater than 11" of reconstructed historical forests, historical data sets with known and unknown methods, and relic forests of the Sierra Nevada and Baja California. The graph displays the trees per acre management range for uneven-aged stands in the KRP (bold 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.

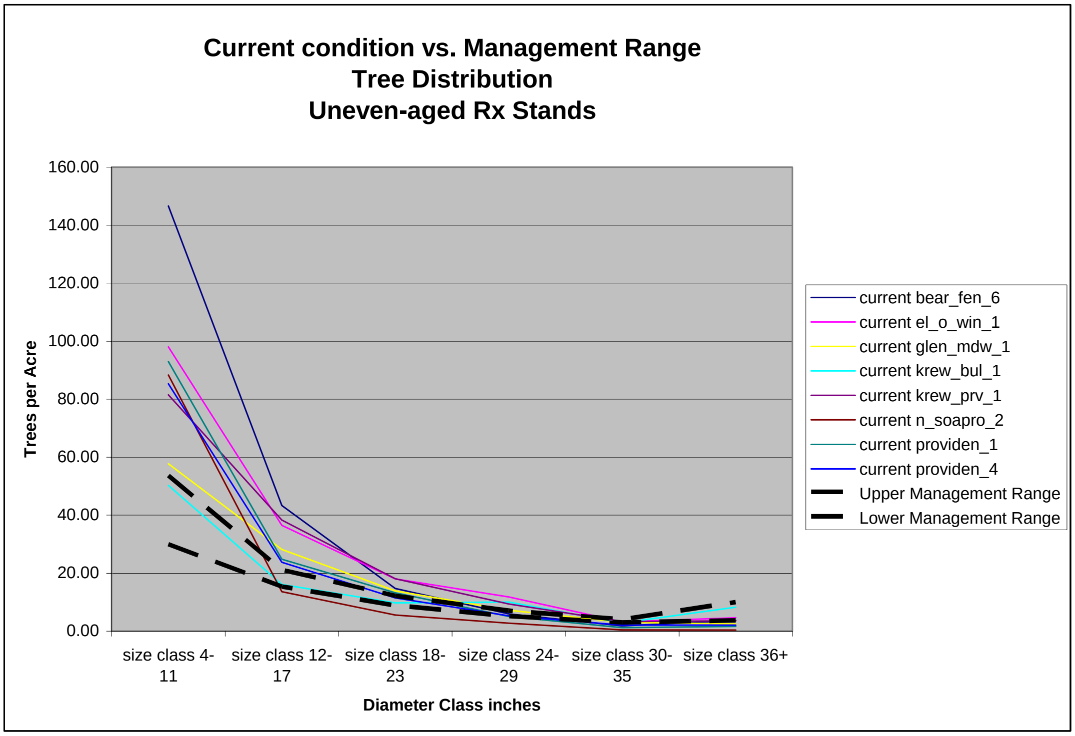


Figure 3-12 -Displays the current tree distribution for each management unit and the desired management range.

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.

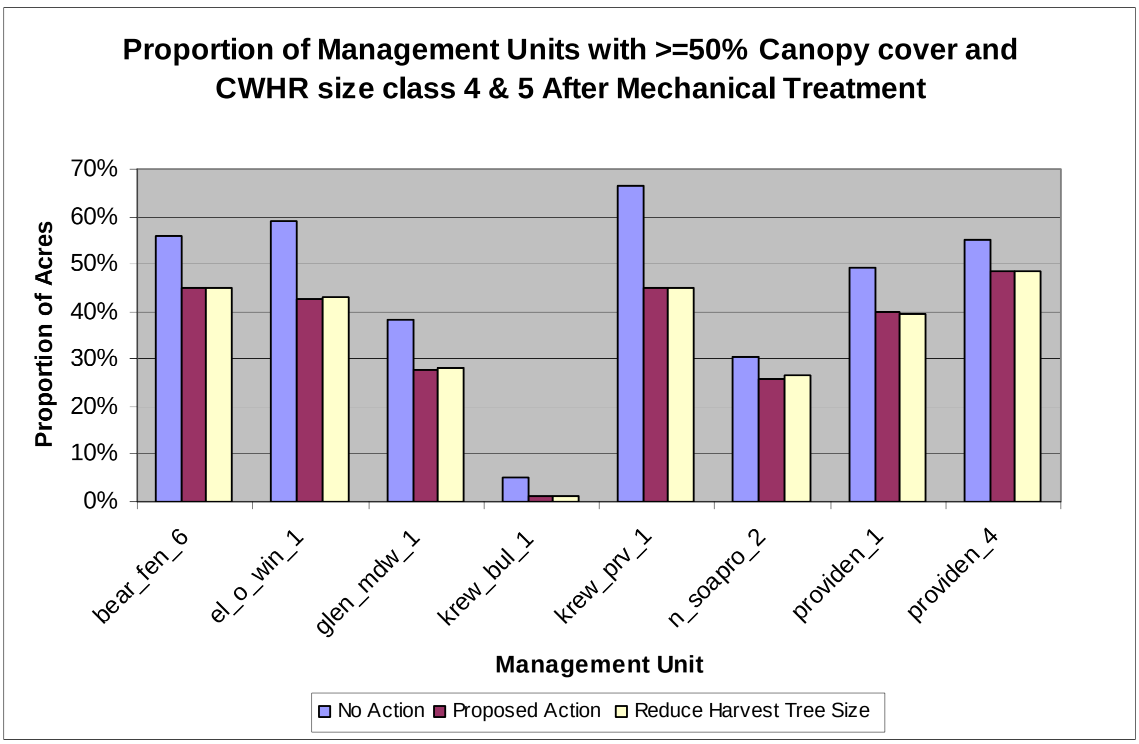


Figure 3-13 - The above graph displays the proportion of initial management units that meet the fisher habitat goal. The fisher goal is across the landscape; however data is present here by management unit to compare direct affect between management units.

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.

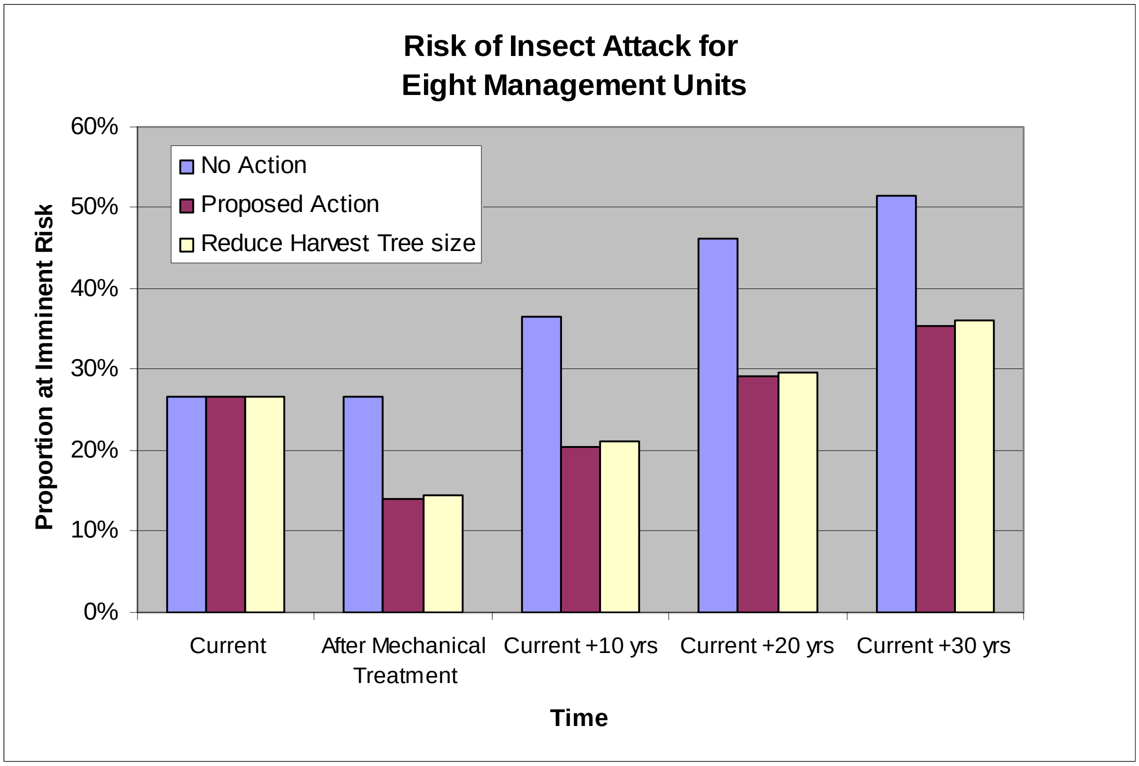


Figure 3-14 - Displays the proportion of plots that exceed the imminent (epidemic) threshold for insect attack and thus experience lower tree vigor. (Phase III model results)

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.

Direct Effects of Group Regeneration: 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.

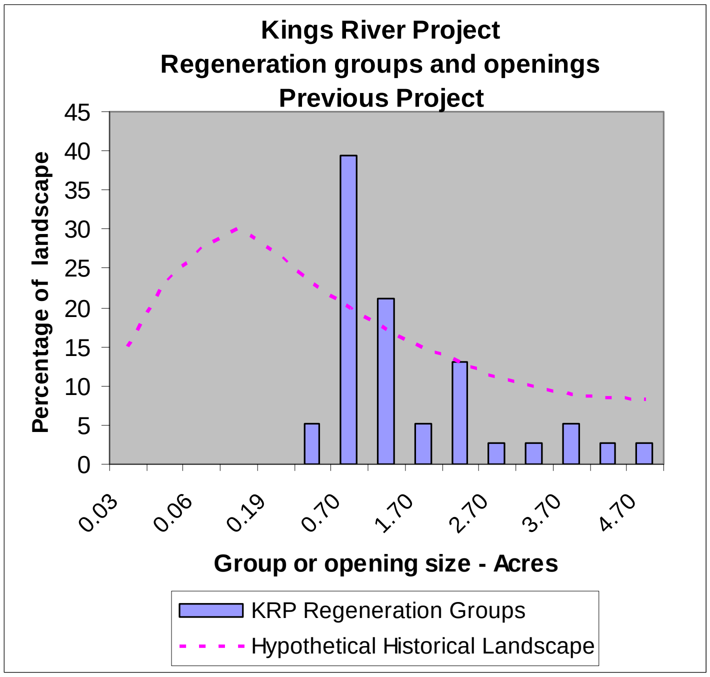


Figure 3-15 - displays the estimated canopy gaps for mixed conifer forest proposed by Stephenson (1996) and the size and frequency of regeneration groups created by the uneven-aged silviculture system in the KRP. Groups smaller than .7 acres occur, but these groups were not planted. Groups larger than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

Direct Effects of Groups and Competing Vegetation: 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.

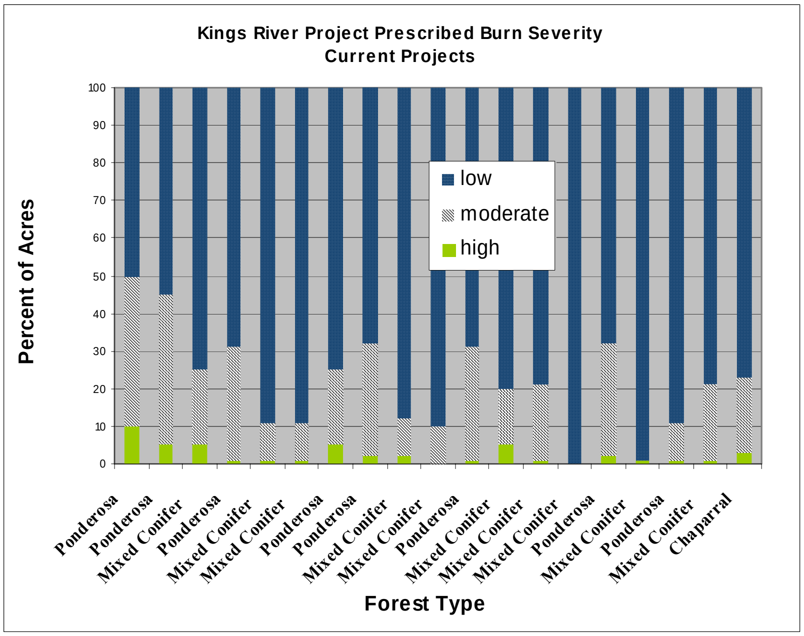
Green leaf manzanita and deer brush which sprout and whitethorn which does not sprout can also germinate from seed stored in the soil. Direct effects on ceanothus species and green leaf manzanita are reduction of above ground cover through mastication, tractor piling, and hand cutting (chainsaws and 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.



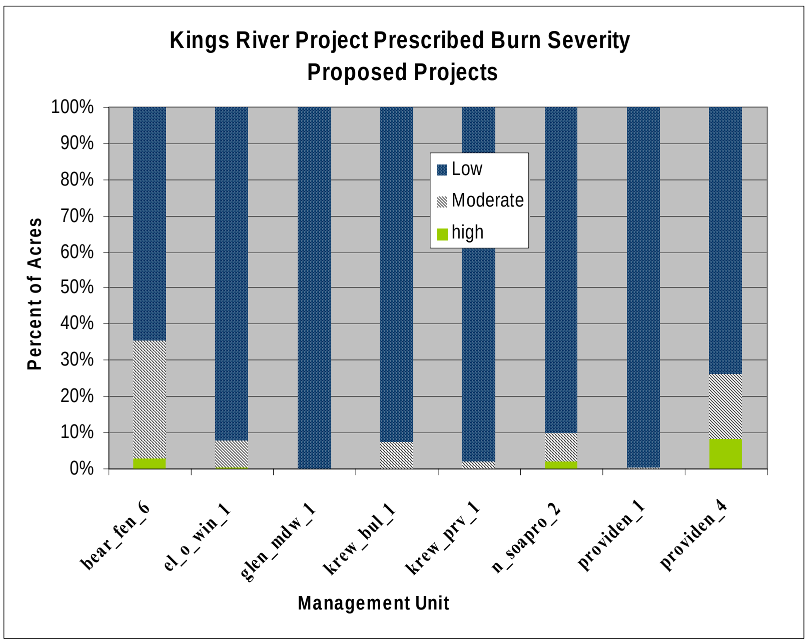


Figure 3-16 - Displays the severity of previous individual underburns by forest type. Each bar represents a singly underburn in the forest types displayed in the X axis. Figure b (lower) displays the severity of underburning simulated in the eight management units for the action alternatives. Burn severity 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

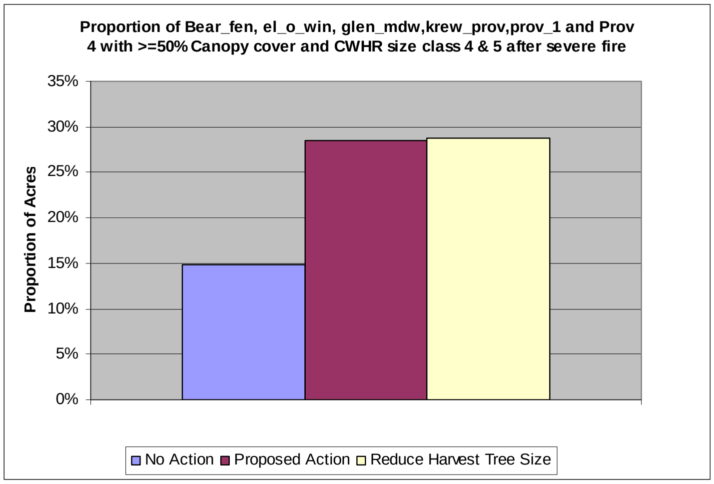
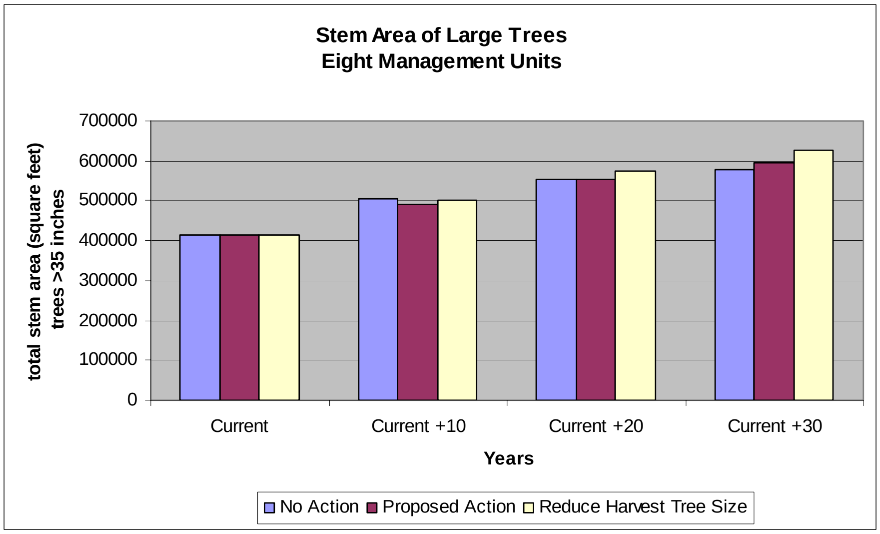


Figure 3-17 – Displays the effects of severe fire on canopy cover across all eight management units.

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.



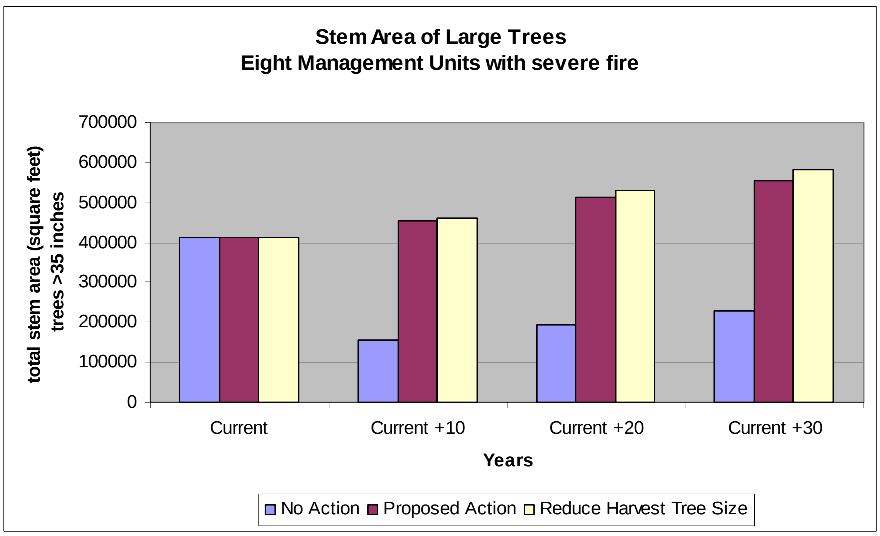


Figure 3-18 - Displays the total stem area for trees larger than thirty-five inches for eight management units without a wildfire and with a simulated wildfire over the thirty year analysis period.

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).

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

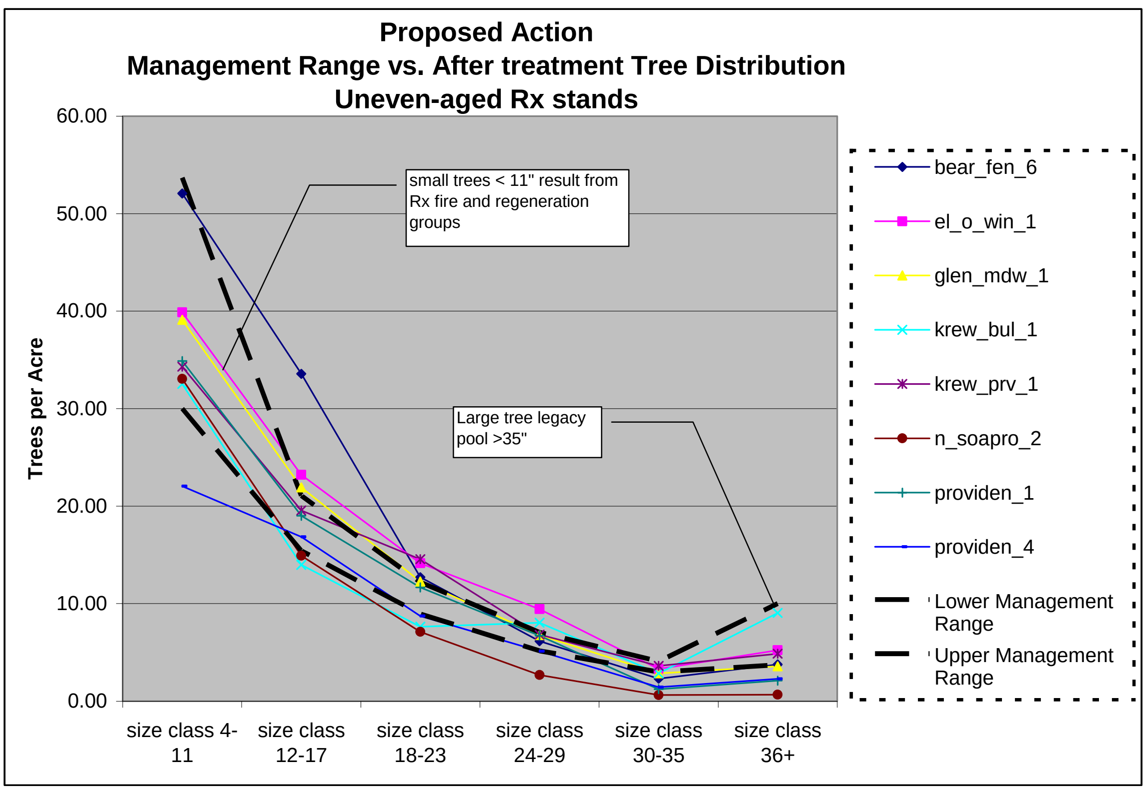


Figure 3-19 - Displays the tree distribution for each on the initial eight management units and lower and upper management ranges identified for the KRP. Stands managed with the uneven-aged management strategy are displayed.

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.

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

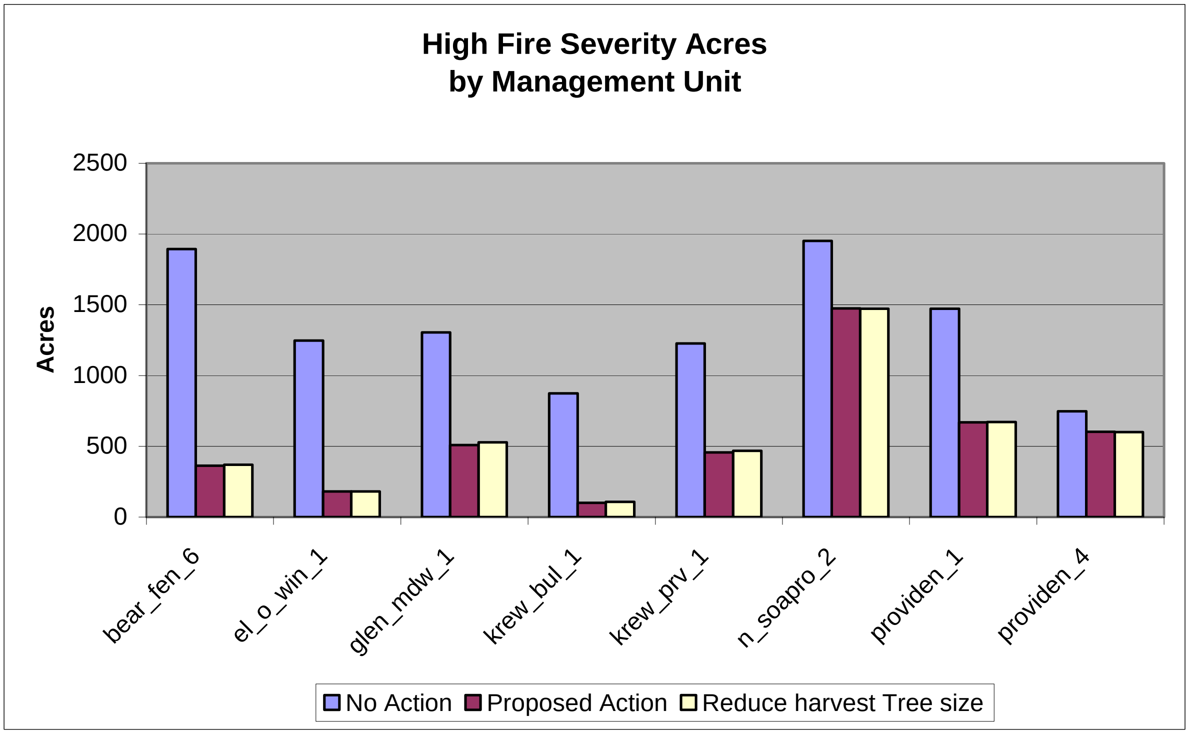


Figure 3-20 - Displays the acres experiencing high severity fire for each of the eight management units after mechanical treatment. The graph displays the acres for the proposed action, reduction of harvest tree size, and no action alternatives. High fire severity is basal area loss greater than 50%.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

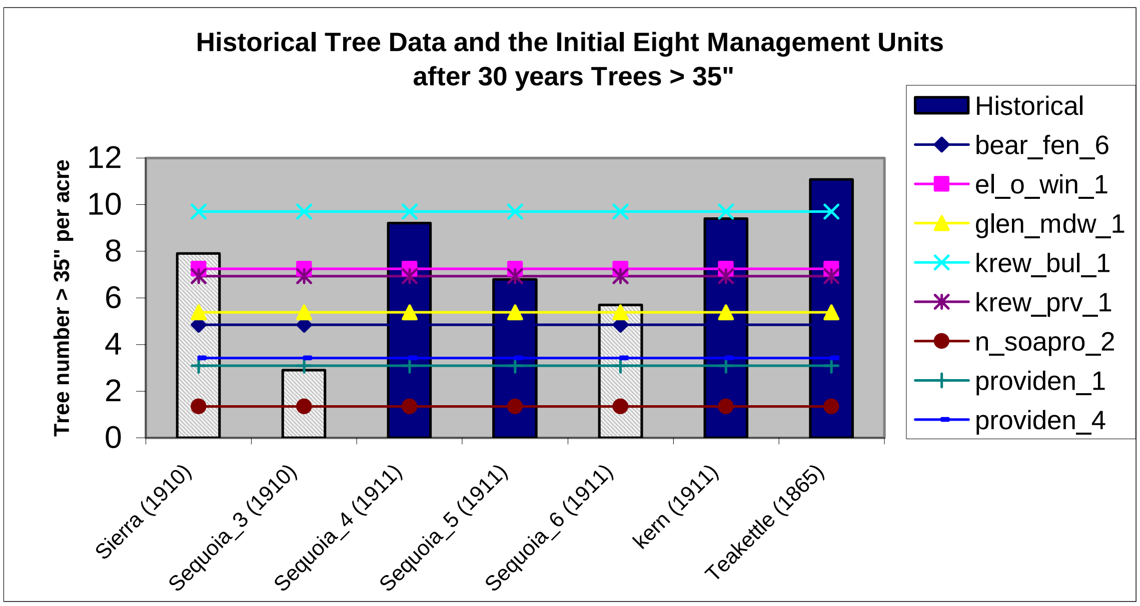


Figure 3-21 - Displays tree numbers for trees greater than 35 inches. Historical data from the southern Sierra Nevada and reconstructed historical forest at the Teakettle experimental forest are shown in bars. Hatch bars represent ponderosa pine and solid bars represent mixed conifer types. Lines represent 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.

Cumulative Effects to Conifers and Competing Vegetation: 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.

<u>Indirect Effects to Stand Density:</u> 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.

<u>Indirect Effects to Large trees</u> **-** 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.

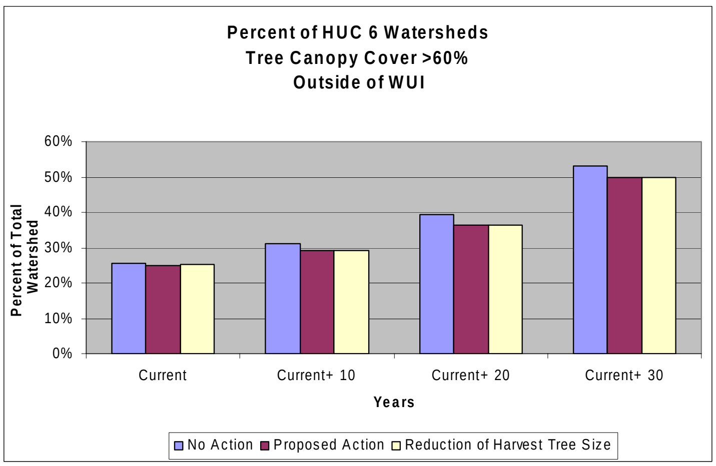
The continued persistence of stands dominated by understory incense cedar and white fir provide fuels ladders. Within the analysis time frame the species composition does not make large shifts toward pine species or black oak. The continued persistence of species more susceptible to fire such as fir 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.



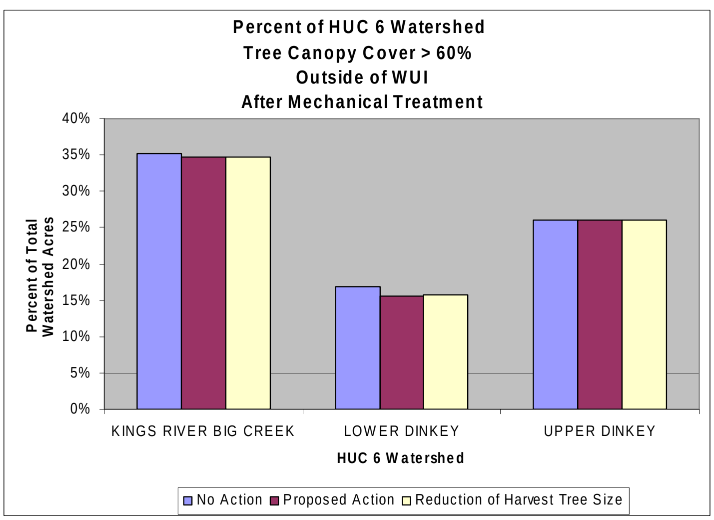


Figure 3-22 - Displays the change in the proportion of HUC 6 watersheds with greater than 60% canopy cover outside of the WUI.

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.

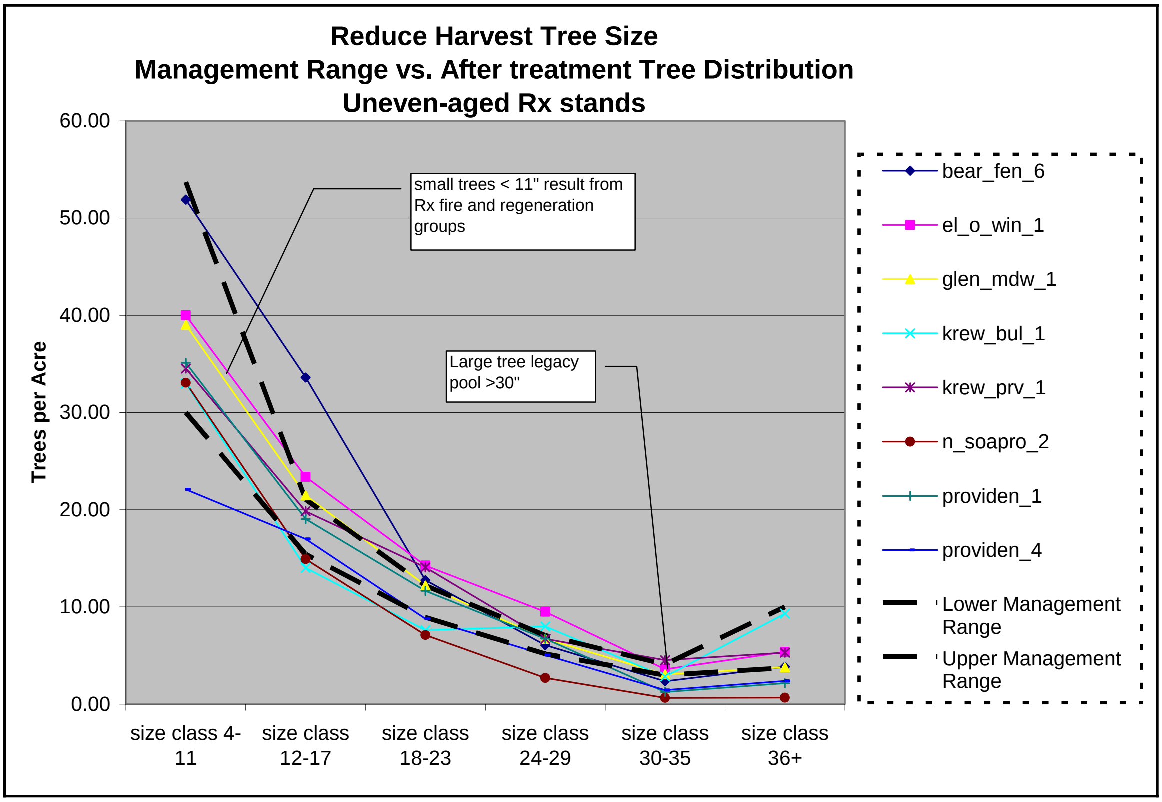


Figure 3-23 - Displays the tree distribution for each management unit and lower and upper management ranges identified for the KRP. Stands managed with the uneven-aged management strategy are displayed.

<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.

Indirect Effects to Vegetation from Wildfire and Prescribed Fire: 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.

Indirect Effects on the Historical Forest Conditions: 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.

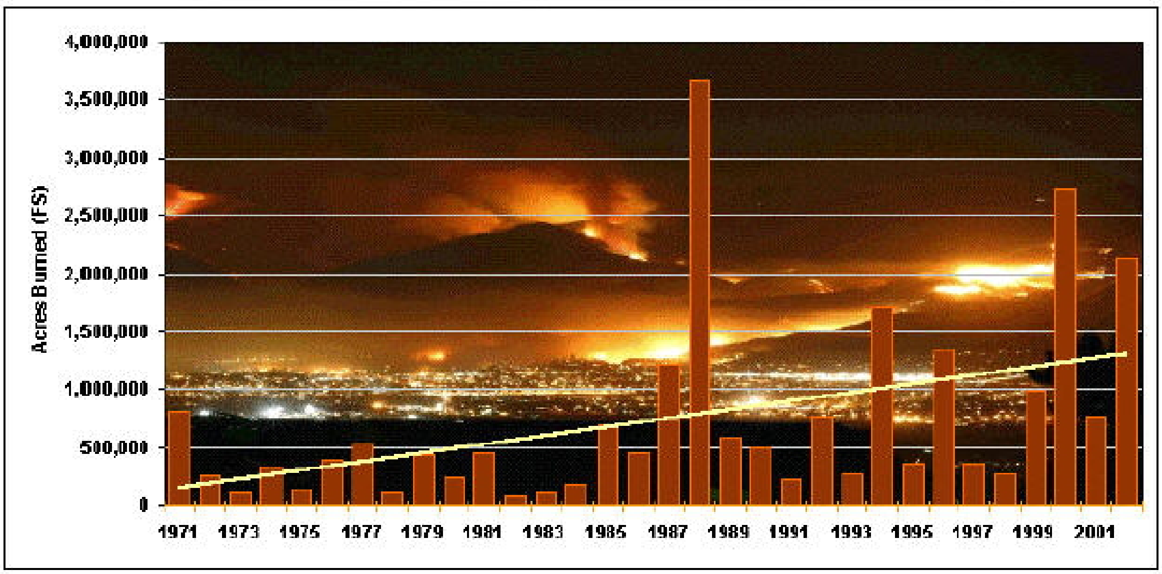


Figure 3-24 - Escalating Wildland Fire acres Burned (Forest Service Only) (www.fireplan.gov, 2004)

"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

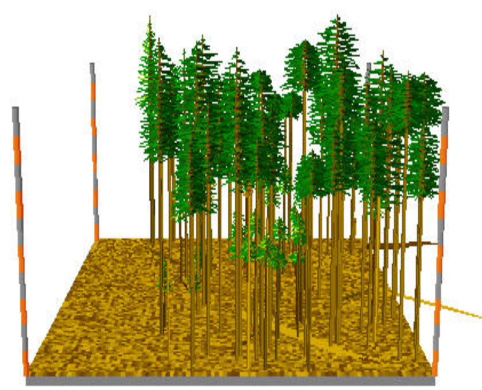


Figure 3-28- Ponderosa Pine/Brush Year 2025

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 Mike Pasillas

Figure 3-29 – North Fork fire, 08/01

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.

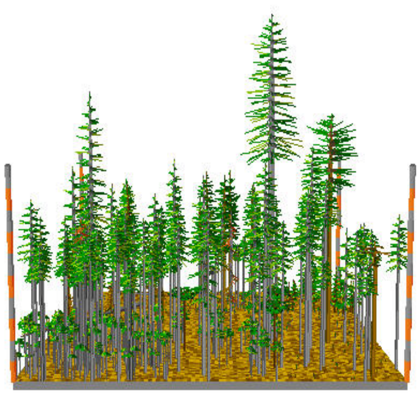


Figure 3-31 Sierra Mixed Conifer

Figure 3-32 bear_fen_6 Existing Condition

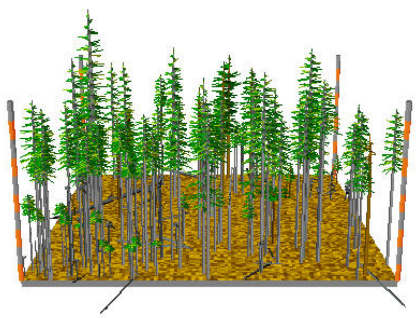


Figure 3-33 Sierra Mixed Conifer Thinned

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.

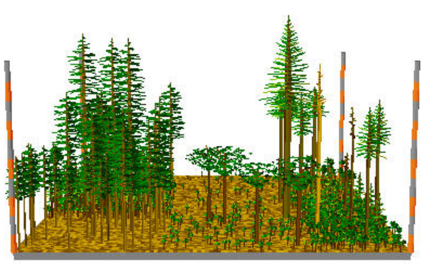


Figure 3-36 Red Fir Existing Condition

Figure 3-37 Krew_bul_1 Existing Condition

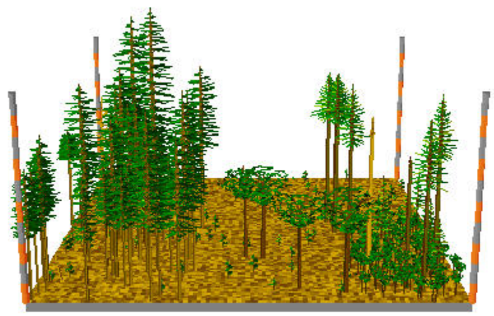


Figure 3-38. Red Fir Thinned

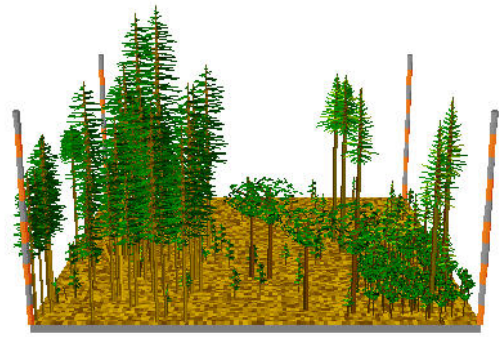


Figure 3-39. Red Fir Year 2025

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

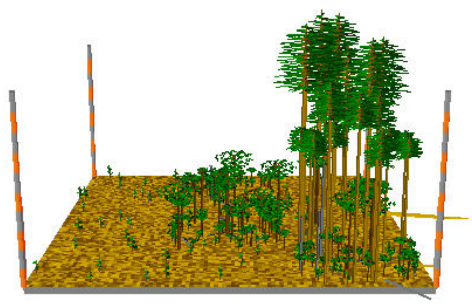


Figure 3-43. Chaparral/Hardwood Year 2025

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).

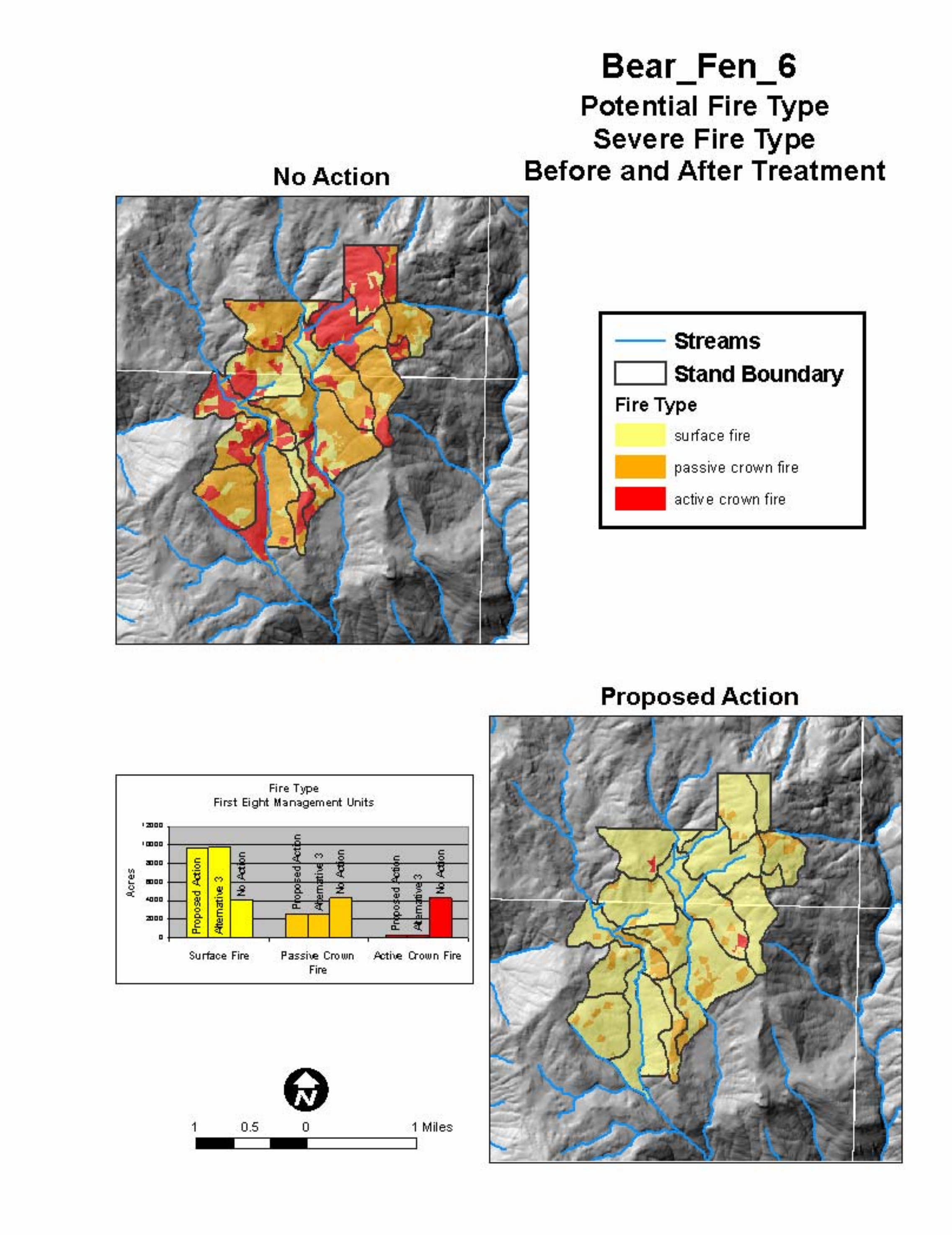
Environmental Consequences

Alternative 1 – Proposed Action

Direct Effects: 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.

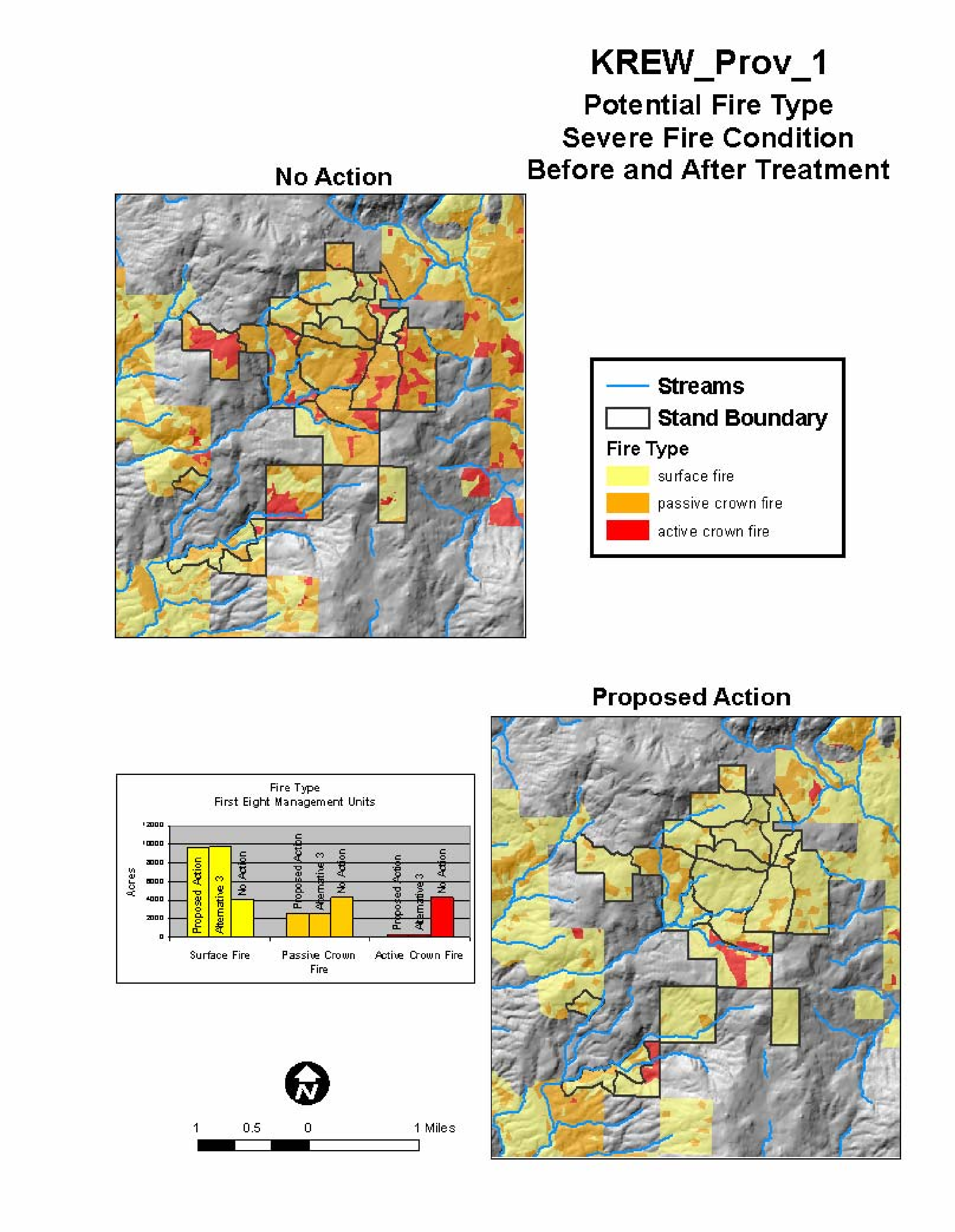

KREW_Prov_1
Potential Fire Type
Severe Fire Condition
Before and After Treatment
No Action
Streams
Stand Boundary
Fire Type
surface fire
passive crown fire
active crown fire
Proposed Action
Fire Type
First Eight Management Units
Acres
Proposed Action
Alternative 3
No Action
Surface Fire
Passive Crown 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).

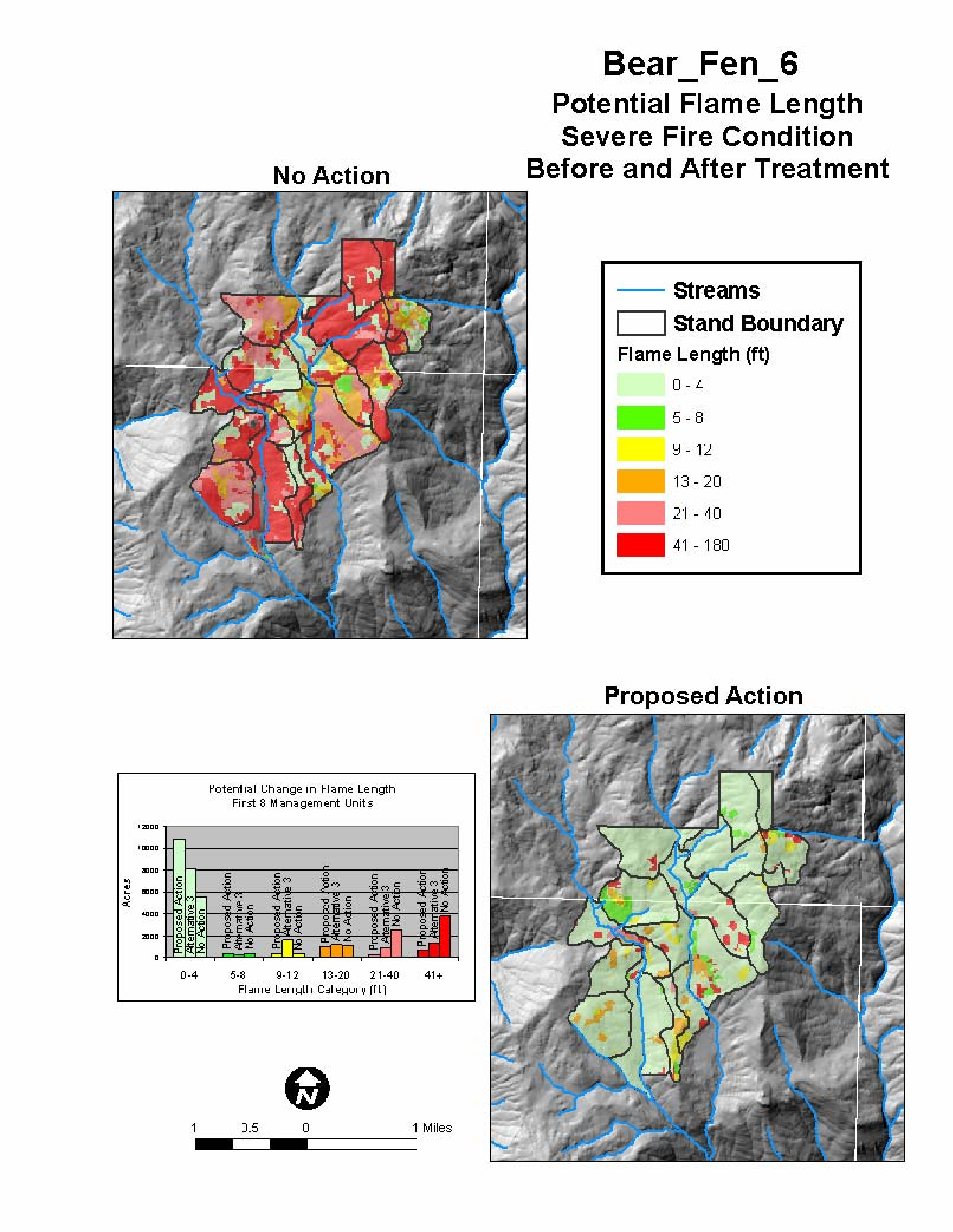
The removal of surface fuels, slash (activity and naturally created), and brush through thinning and piling, coupled with an increase in crown base heights dramatically alter post-treatment fire behavior and fire types in timbered stands. The reduction in height to live crown (crown base height) dramatically 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)
N
1
0.5
0
1 Miles

Figure 3-46

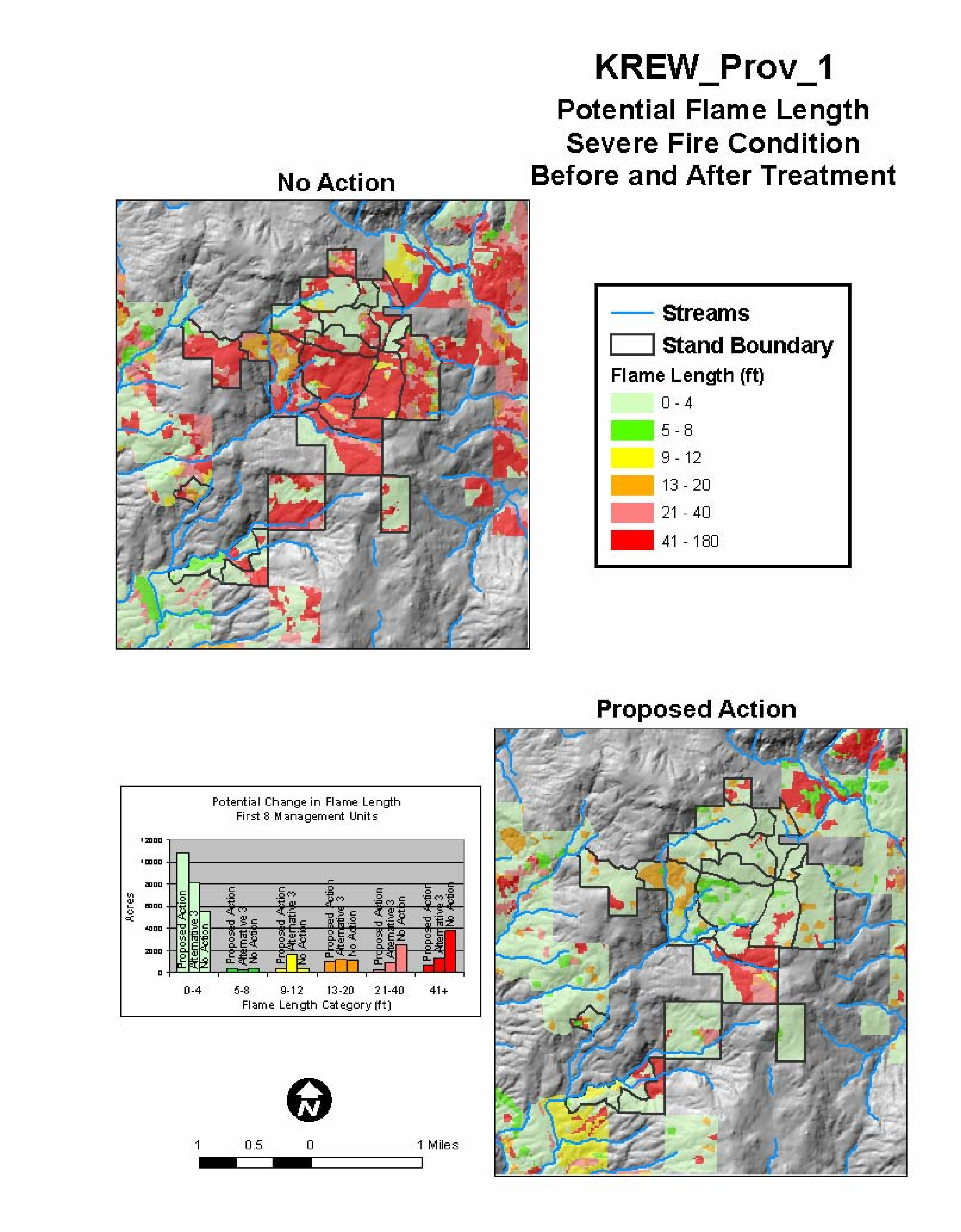

KREW_Prov_1
Potential Flame Length
Severe Fire Condition
Before and After Treatment
No Action
Streams
Stand Boundary
Flame Length (ft)
0 - 4
5 - 8
9 - 12
13 - 20
21 - 40
41 - 180
Proposed Action
Potential Change in Flame Length
First 8 Management Units
Acres
0
2000
4000
6000
8000
10000
12000
Proposed Action
Alternative 3
No Action
0-4
5-8
9-12
13-20
21-40
41+
Flame Length Category (ft)
N
1
0.5
0
1 Miles

Figure 3-47

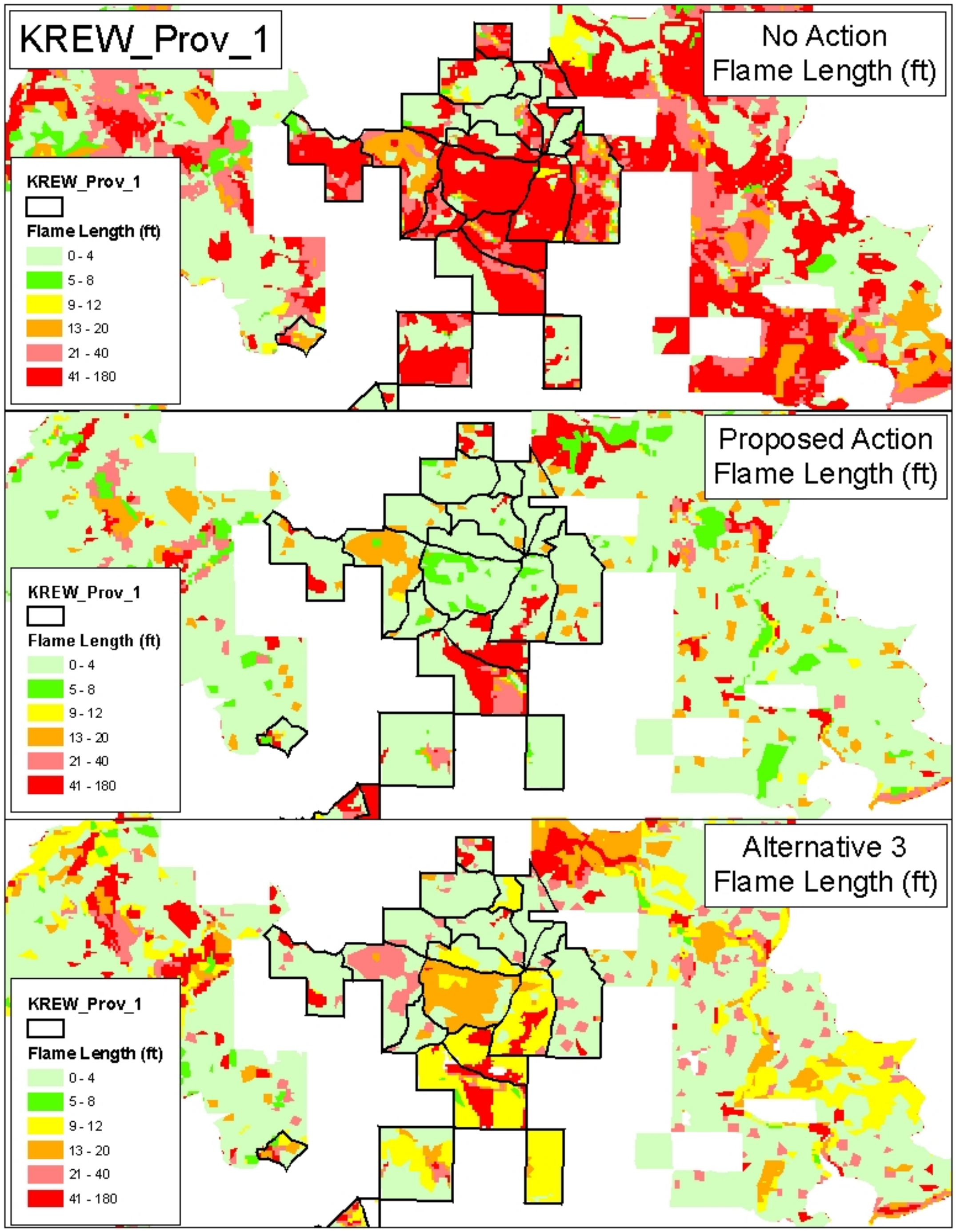

KREW_Prov_1
No Action
Flame Length (ft)
KREW_Prov_1
Flame Length (ft)
0 - 4
5 - 8
9 - 12
13 - 20
21 - 40
41 - 180
Proposed Action
Flame Length (ft)
KREW_Prov_1
Flame Length (ft)
0 - 4
5 - 8
9 - 12
13 - 20
21 - 40
41 - 180
Alternative 3
Flame Length (ft)
KREW_Prov_1
Flame Length (ft)
0 - 4
5 - 8
9 - 12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

<u>Indirect Effects:</u> 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.

<u>Cumulative Effects</u>: 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

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

Indirect effects: 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 97^{th} 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

<u>Direct Effects:</u> 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.

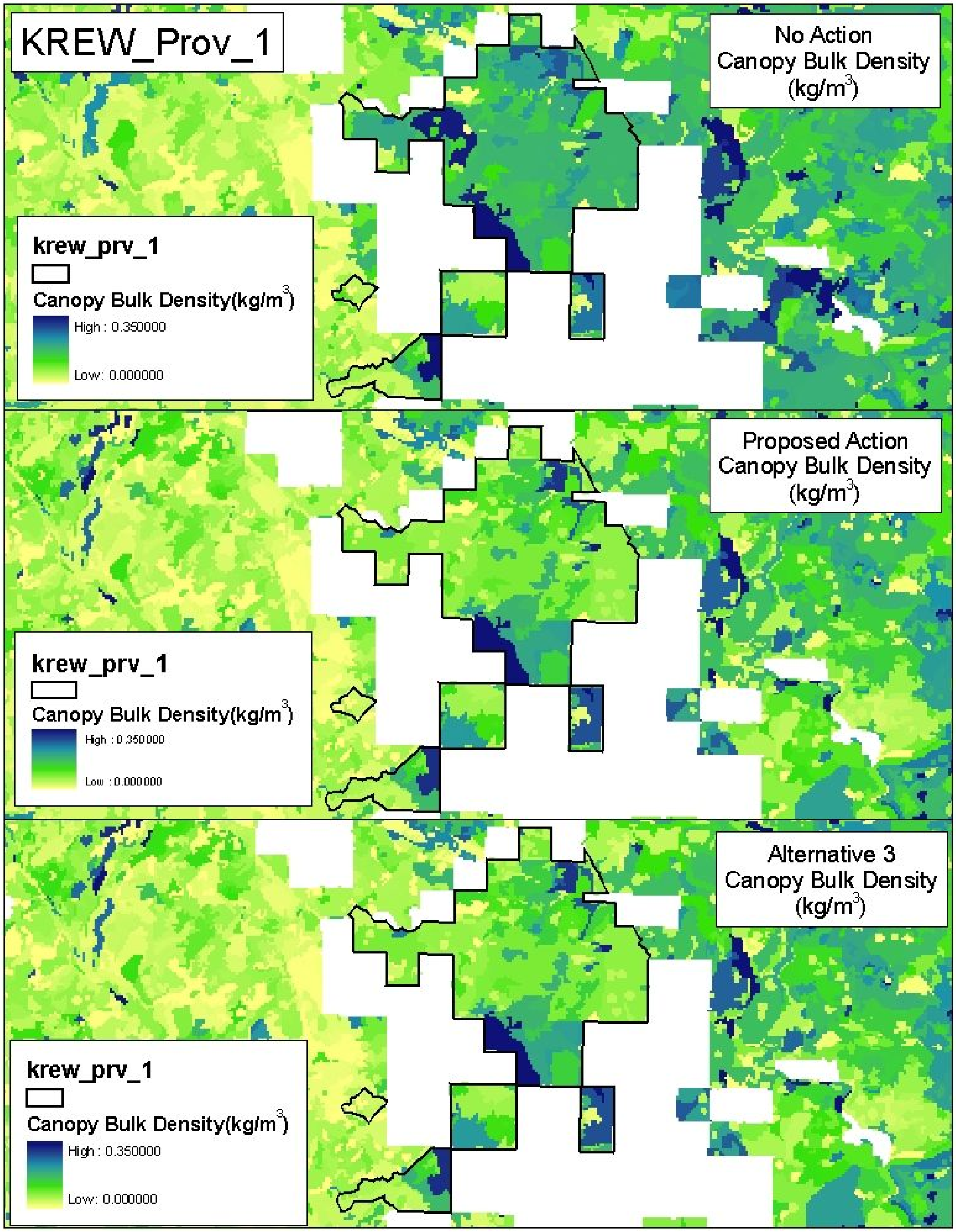

KREW_Prov_1
No Action
Canopy Bulk Density
(kg/m3)
krew_prv_1
Canopy Bulk Density(kg/m3)
High : 0.350000
Low: 0.000000
Proposed Action
Canopy Bulk Density
(kg/m3)
krew_prv_1
Canopy Bulk Density(kg/m3)
High : 0.350000
Low : 0.000000
Alternative 3
Canopy Bulk Density
(kg/m3)
krew_prv_1
Canopy Bulk Density(kg/m3)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