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1 Abstract and Summary

The purpose of this environmental assessment is to consider the impacts of implementing various long-term fire and fuel management alternatives in Sequoia and Kings Canyon National Parks (hereinafter called the parks). While each alternative presents a different path for the fire program, they all address the parks' goals of restoring and maintaining fire as a key ecosystem process while minimizing the threat to lives, property, cultural, and natural resources in a cost effective manner.

In addition to providing information required by law and the 2001 Federal Fire Policy, this environmental assessment will respond to the primary issues of concern raised during a series of internal and public scoping sessions.

This assessment analyzes four alternatives developed by an interdisciplinary planning team:

§ Alternative 1 – No Action –(Current Program)
§ Alternative 2 – Prescribed Fire Dominated
§ Alternative 3 – Wildland Fire Use Dominated
§ Alternative 4 – Multi-Strategy Program

After careful consideration of the four alternatives, the parks are proposing a preferred alternative – **Alternative 4 – Multiple Strategy Program**. This alternative appears to most fully balance park objectives with issues of concern, and is also the environmentally preferred alternative. This alternative applies a full range of fire management tools: wildland fire suppression (suppression of unwanted ignitions), wildland fire use (managing some unplanned ignitions such as lightning to achieve natural resource benefits), prescribed fire (management-ignited fires), and mechanical fuel reduction. Alternative 4 proposes levels of fire management activity that will result in meaningful restoration and maintenance of fire as a natural process in park ecosystems. The alternative maximizes flexibility in meeting critical goals while adopting the best available control measures for managing the effects of smoke on public health, and complying fully with Clean Air Act requirements along with other applicable laws and policies.

Under the National Park Service (NPS) Organic Act and the General Authorities Act, as amended, the NPS may not allow the impairment of park resources and values except as authorized specifically by Congress (*NPS Director's Order 55* or DO-55). Impairment is an impact that, in the professional judgement of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of

those resources or values. Park managers have examined each potential impact of the preferred alternative and determined that the combination of actions provided for in this environmental assessment will not result in the impairment of any park resources and values.

2 Introduction

PURPOSE AND NEED

Wildland fire has long been recognized as one of the most significant natural process operating within and shaping Sierra Nevada ecosystems. Virtually all vegetation communities show evidence of fire dependence or tolerance. Many forest types in the parks have short to moderate natural fire return intervals (6-17 years) as evidenced by extensive research. At the same time wildland fire has the potential to threaten human lives and property. Consequently there is a need to manage wildland fire so that threats to humans and property are reduced, while at the same time restoring and/or maintaining its function as a natural process. Due to its powerful nature, wildland fire is the only natural process whose management – by NPS policy – is subjected to environmental analysis.

NPS policy directs that every park having vegetation capable of burning must have a fire management plan, and that the fire management plan must be accompanied by an environmental assessment to document the environmental consequences of proposed actions *(NPS Director's Order 18)*. The parks are currently operating under a fire management plan and environmental assessment written in 1989. Once approved, the new plan and environmental assessment will supercede and replace the 1989 plan. Once implemented a new plan will remain in force subject to minor annual and extensive 5-year review until superceded by a subsequent plan.

The fire management program in the parks does not stand alone, but implements direction provided in higher level policy and planning documents such as the *Master Plan* (1971)*, Natural and Cultural Resources Management Plan* (1999), *NPS Management Policies* (2001), the National Fire Plan (based on *Managing the Impact of Wildfires on Communities and the Environment, A Report to the President in Response to the Wildfires of 2000*), and the 10-Year Comprehensive Strategy (*A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment*). As these higher level policy and planning documents are revised over time (such as the current effort to draft a new General Management Plan for the parks), the fire management plan will be reviewed for consistency. If new directions are indicated by these higher level plans or policies, the Fire and Fuels Management Plan would be amended to conform to that direction. The fire program must also conform to laws such as the NPS Organic Act, park enabling legislation, Clean Air Act, Clean Water Act, Wilderness Act, and the National Historic Preservation Act. This environmental assessment will screen each proposed alternative for compliance with these policies, plans, and laws.

Responding to direction provided by the documents mentioned above, the parks' fire and fuels management program has three primary goals:

1. **Protect and restore the parks' ecological, cultural, and social values.**
   Resource values include: vegetation, water, wildlife, natural processes, and air resources, along with prehistoric and historic cultural sites, historic structures, and contemporary structures, both government-owned and private. Social values include protecting park employees, visitors and neighboring communities, and providing for recreational opportunities including wilderness experiences.

2. **Reduce fire hazards in park ecosystems.**
   Fire hazard is defined as those attributes that affect the ability to control fires, or contribute to extreme fire behavior. Only one attribute of fire hazard, *fuel conditions* (amount, arrangement, and continuity) can be effectively altered by management actions and are therefore the focus of most fuel hazard reduction activities.

   Certain other elements that contribute to hazardous fire conditions, such as steep slopes and the amount of solar radiation heating fuels and drying vegetation, cannot be effectively changed by management actions.

3. **Reduce risk of unwanted wildland fire.**
   Risk is defined as the probability of new fire starts, whether by human or natural ignition (lightning). Since lightning ignition risk is outside the realm of management control, the focus of risk management in the fire program is to reduce the probability of unwanted human ignitions through a program of education, detection, and pro-active fuels management.

INTERDISCIPLINARY PLANNING TEAM

An 8-person interdisciplinary planning team that shared responsibility for scoping, research, and writing produced this environmental assessment. The team was compromised of staff specialists in the following disciplines: fire operations, fire fuels, fire behavior, fire ecology, smoke modeling and management, fire history, research, cultural resource management, and public information and education. Other subject matter experts contributed technical expertise for specific sections. A list of planning team members and other consultants is included in Chapter 7.

DECISIONS TO BE MADE

The parks' superintendent will choose among the alternatives presented to guide long-term fire and fuels management activities in the parks.

The chosen alternative then becomes institutionalized in the parks' *Fire and Fuels Management Plan.*

ISSUES CONSIDERED

An "issue" is a concern that must be considered when designing and evaluating alternatives in an environmental assessment. Some issues come from requirements found in policy and law. For example, the parks must consider wilderness, firefighter/public safety, plants and animals inclusive of special status species and their habitats, water, soil erosion, wetlands, wild and scenic rivers, air quality, and cultural resources. Additional issues to be analyzed are identified through public and internal scoping meetings and input.

Employees had an opportunity to identify issues of concern during two scoping sessions in the parks. Other agencies and federal partners were also consulted through targeted scoping meetings and information requests. The U.S. Fish and Wildlife Service was contacted to obtain lists of special status species to be considered in the analysis. Local tribal groups were given the chance to outline their issues of concern through scoping meetings in conjunction with the parks General Management planning process.

Input was sought from the general public by publishing a Scoping Notice in the Federal Register. Press releases to regional media outlets were also used to notify the public of the fire planning effort and to encourage submission of ideas or concerns. Finally, the public was invited to participate in a series of scoping sessions that were offered in five cities throughout California.

Since fire management actions have the potential to differentially affect local communities, a mail-in survey was conducted in the greater Three Rivers area in 1998 to better define the issues and concerns of local residents. Through that effort, the park gained valuable insight into the overall perception and understanding of the fire management program. These insights, such as the community's desire for more direct and current public information on fire activity, have been incorporated into the current fire management planning effort and proposed action.

All issues identified during scoping were documented, and are contained in Appendix C. Some issues appeared to be of widespread interest and formed the focus of the analysis contained in this document. Other issues with limited interest or applicability were raised and considered but not subjected to extended analysis.

Significant issues emphasized in the public scoping process and analyzed along with other issues in this environmental assessment include:

1) air quality and public health
2) managing the risk of catastrophic fire events
3) firefighter and public safety
4) the financial cost/benefit of different alternatives
5) impacts on local economies.

3 Alternatives

The alternatives presented in this document were developed according to requirements of the National Environmental Policy Act (NEPA). The best available science and information was applied to describe the effects of the alternatives.

The alternatives presented are programmatic in nature, and not site specific. Since virtually all of the vegetated lands within the parks are subject to the effects of naturally occurring fire, and since the exact locations where those events might occur are unknown, the alternatives and the analysis of effects that follow in Chapter 5 apply to all vegetated parklands.

DEVELOPMENT OF ALTERNATIVES

After compilation of all scoping comments, the interdisciplinary team developed a reasonable range of alternatives that responded to park goals and addressed major issues and concerns. Six alternatives were initially crafted to respond to the full range of comments.

The six alternatives were structured around the primary tools available to accomplish program goals and objectives. This structure responds to the wide range of comments offered in scoping. Most people who commented agreed with the need for proactive fire management and understood the role of fire as an essential natural process needed to perpetuate park ecosystems. Many comments focused on the tools they preferred the park use to implement a program (prescribed fire, wildland fire use, etc.). For example, comments ranged from “all natural starts should be allowed to burn unimpeded” to “prescribed fires are much less impacting than bulldozers carving control lines.” Consequently alternatives were developed that responded to the continuum of views expressed by the public. The initial six alternatives were:

- Alternative 1 – No Action (Current Program)
- Alternative 2 – Prescribed Fire Dominated
- Alternative 3 – Wildland Fire Use Dominated
- Alternative 4 – Multi-Strategy Program (Preferred Alternative)
- Alternative 5 – Mechanical Fuel Reduction Dominated
- Alternative 6 – Wildland Fire Suppression Dominated

Once the six alternatives were defined and described, a preliminary analysis was conducted. The initial analysis highlighted two alternatives (5 and 6) that, for a variety of reasons, were not capable of achieving fundamental park goals. Their inability to

achieve goals was primarily due to constraints. For example, Alternative 5 is constrained by the presence of designated and proposed wilderness and consequent limitations on activities in those areas outside the direct control of park management. Alternative 6 is constrained by ecological considerations such as the inability to protect and maintain the health of giant sequoia groves through aggressive fire suppression alone.

ALTERNATIVES CONSIDERED BUT REJECTED

As a result of an initial analysis, Alternatives 5 and 6 were considered but rejected. See Appendix A for additional details.

The primary considerations that led to the elimination of these two alternatives were:

- An analysis of the maximum acres treatable under each of the two eliminated alternatives showed that optimum accomplishments under those alternatives still fall well short of achieving natural resource and fire management goals. Ecologically based desired future conditions for the resources have been developed, and the level of activity needed to move toward those conditions over time has been established through a comparison of existing conditions and desired conditions. See Chapter 4, Affected Environment, for additional details regarding that analysis.

- Relating specifically to Alternative 5 (Mechanical Fuel Reduction Dominated), the designation of 96% of the park as proposed or designated wilderness is a primary constraint on mechanical fuel reduction, limiting its application to less than 4% of parklands (approximately 35,000 acres). Even within the non-wilderness portion of the parks, many areas are in developed areas such as campgrounds or lodging where mechanical methods are already applied to manage tree hazards, or are too steep or otherwise environmentally sensitive to apply mechanical treatments to any great degree. Many giant sequoia groves are located in remote wilderness areas precluding proactive management of those remote groves under Alternative 5, placing them at substantial risk. Wilderness and other sensitive area issues aside, serious questions remain as to whether the outcomes of large-scale mechanical fuel treatments could produce ecological effects that sufficiently mimicked the effects of fire to meet park goals.

- Relating to Alternative 6 (Full Suppression of all Fires), while some wildfires under the alternative would create local beneficial ecological effects at times, most areas of the park would be expected to suffer negative effects. Negative effects would result from areas accumulating unnaturally high fuel loads (which would eventually include much of the parklands under these alternatives) exposing those acres to large-scale high-intensity catastrophic fire events that would be damaging to the natural resources including

giant sequoia groves. These high intensity fire events would be hazardous and expensive to manage, compromise firefighter and public safety, and create long duration smoke events at random times. Aggressive suppression actions, including the creation of firelines, fire camps, and helispots, would have serious cumulative effects on park resources and wilderness conditions.

The interdisciplinary planning team forwarded the conclusions of the preliminary assessment to the parks' Environmental Management Committee for review and advice. The committee ultimately recommended that Alternatives 5 and 6 be removed from further analysis since they could not be implemented in any fashion that would result in significant resolution of issues, nor would they fulfill fundamental fire management and natural resource objectives. The Superintendent concurred with this determination in a memo dated April 19, 2000.

Alternative 1 represents the current fire management program. Like Alternatives 5 and 6, Alternative 1 also fails to fully achieve fire management goals as they are currently understood, but it was retained in the final assessment as the "no action" alternative for comparison purposes. The current program was developed 10 years ago using the best available research at the time. Over the past decade using new spatial analysis tools and research results, the parks have applied new findings on natural fire regimes to refine the goals and objectives guiding the fire management program. Fire management actions in the current plan fall short of the levels of activity now understood to be necessary to fully restore ecosystem function and provide for safety. The current program does move toward ecosystem restoration and maintenance in select areas of the parks, but at a rate insufficient to fully restore all parklands.

DESCRIPTION OF ALTERNATIVES

Four alternatives are fully analyzed in this environmental assessment. To increase understanding of the preferred alternative, Alternative 4, the companion *Fire and Fuels Management Plan, Sequoia and Kings Canyon National Parks 2002* describes how the program would be implemented.

Definition of Terms

Numerous terms are used throughout this document that describe the different tools used by fire managers. These tools are described in depth in the companion *Fire and Fuels Management Plan* (Chapter 3). Since the alternatives in this assessment are also organized around these tools, it is important to understand the terminology:

1) Prescribed Fire – management-ignited fires
2) Wildland Fire Use –the management of unplanned ignitions, such as lightning-caused fires for resource benefit. Also referred to as simply "fire use"

3) Wildland Fire Suppression –the suppression of an unwanted wildland fire from any ignition source, natural or human-caused. Also referred to as "fire suppression," or simply "suppression"
4) Mechanical Fuel Reduction –reducing hazardous fuels with equipment, such as chainsaws, or piling and burning woody debris. Also referred to as "mechanical projects," or "mechanical treatments"

The following table (Table 3-1) summarizes the alternatives.

Table 3-1 – Summary of Alternatives

Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
General Description The No Action alternative would continue the current direction and accomplishments of the fire management program that has been in place since 1968, including a revision written in 1989 to meet post-Yellowstone fire policy requirements. This alternative would utilize the full range of fire management strategies, including prescribed fire, fire use, mechanical treatments, and fire suppression activities where appropriate.	**General Description** Under Alternative 2 the program would focus on the intentional use of fire through the application of prescribed fire to meet ecological restoration and maintenance objectives, and to reduce hazardous levels of fuels throughout the park. All other fires would be suppressed, including natural ignitions. Limited mechanical fuel reduction would occur in and around developments and along park boundaries to buffer these sites from unplanned events or to aid in prescribed fire management.	**General Description** Alternative 3 would focus on managing unplanned fires to accomplish hazard fuel and resource management goals. Few, if any, unplanned fires in the park would be suppressed unless they presented an immediate hazard to human safety, were likely to affect non-park lands, or where resources to manage the long-term events would not be available. A very limited amount of prescribed burning would occur only to facilitate the use of natural ignitions. Limited mechanical fuel reduction would occur in and around developments and along park boundaries to buffer these sites from unplanned events.	**General Description** Alternative 4 would use a full range of strategies to achieve hazard fuel and resource management goals. More acres would be targeted for treatment each year. The alternative is similar to the No-Action alternative, but would be more extensive, and focus on restoration and maintenance of natural resource and fuel conditions. Prescribed fire and fire use would increase to a level that best analysis shows would result in full restoration and maintenance of fire in park ecosystems. Limited mechanical fuel reduction would occur in and around developments and along park boundaries to buffer these sites from unplanned events or to aid in prescribed fire management.

Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Prescribed Fire Prescribed fire projects would focus on hazard fuel reduction around developments and park boundaries, and in high priority resource areas such as giant sequoia groves. Other projects necessary to restore and maintain ecosystem structure and function would be accomplished as time and funds allowed.	**Prescribed Fire** Prescribed fire would be extensively used as the primary strategy to both restore and maintain ecosystem function and to reduce hazard fuels throughout the park. Prescribed fire size and extent would simulate, to the extent possible and known, the historic fire regime.	**Prescribed Fire** Prescribed fire may be used to replace unplanned ignitions that were suppressed. This action would occur inside the park only when modeling of suppressed ignitions show that a fire resulting from the ignition would likely have had significant positive resource impacts. Prescribed fire would not be used to reduce areas of unnaturally heavy fuel buildup prior to allowing unplanned fires to burn through. Some use of prescribed fire would be applied to secure firelines or implement holding actions during fire use projects.	**Prescribed Fire** Increased use of prescribed fire would occur over the next 25 years with up to 10,000 acres per year treated. Most of the increase in burning would result from prescribed fire projects implemented to restore natural fuel load and reduce stand density. The increased prescribed burning activity would focus on the portions of the ecosystem with the greatest deviation from natural conditions, which represent approximately 109,000 acres of the parks. Other prescribed burn projects would be implemented to maintain restored areas.
Wildland Fire Use Many unplanned fires in zones that have been restored, or that are currently in a natural condition, would be managed for resource benefit. As new areas are restored to natural fuel load, structure, and function, management of those areas may change from prescribed fire dominated to fire use dominated to continue to shape the ecosystems into the future.	**Wildland Fire Use** All unplanned fires would be suppressed in a manner consistent with firefighter safety.	**Wildland Fire Use** Most unplanned fires would be allowed to burn within park boundaries.	**Wildland Fire Use** Most unplanned fires in areas that have been restored or that are currently in a natural condition would be managed for resource benefit. Under carefully prescribed conditions, wildland fire use ignitions may also be managed to meet restoration objectives. As new areas are restored to natural fuel load, structure, and function, management of those areas may change from prescribed fire dominated to fire use dominated to continue to shape the ecosystems into the future.

Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Wildland Fire Suppression All unwanted natural ignitions would be suppressed.	**Wildland Fire Suppression** All unplanned fires would be suppressed.	**Wildland Fire Suppression** Very few unplanned fires would be suppressed.	**Wildland Fire Suppression** All unwanted fires would be suppressed.
Mechanical Fuel Reduction Limited mechanical fuel reduction would occur in developed areas and along boundaries.	**Mechanical Fuel Reduction** Limited mechanical fuel reduction would occur in developed areas and along boundaries.	**Mechanical Fuel Reduction** Limited mechanical fuel reduction would occur in developed areas and along boundaries.	**Mechanical Fuel Reduction** Limited mechanical fuel reduction would occur in developed areas and along boundaries.

ANNUAL PROGRAM ACCOMPLISHMENTS BY ALTERNATIVE

The following tables (Tables 3-2 and 3-3) predict *average* annual accomplishments of each alternative at two different benchmarks in time – 10 years and 25 years. Table 3-4 depicts the extent of the average program accomplishment by vegetation type. Acres projected in the tables reflect expected accomplishments averaged over long periods of time. Past experience has shown that due to large-scale climatic variations such as El Niño and La Niña, fire activity varies widely from year to year. Therefore the numbers included in these tables are only intended for comparison between alternatives over long time periods, and not as specific annual targets to be achieved. These projections, representative of average accomplishments expected for each alternative, will be used as the basis for analysis purposes throughout the document.

To develop these projections, the interdisciplinary planning team evaluated the best available information on pre-Euroamerican fire cycles. That information provided the best estimate of ecological targets needed to minimally restore natural ecosystem condition and function. Evaluation of past fire program accomplishments allowed an assessment of operational requirements necessary to meet the targets. (See discussion of Fire Return Interval Departure, FRID, in Chapter 4-D.)

Under each alternative, the team estimated the acreage that would be treated using each tool (prescribed fire, wildland fire use, wildland fire suppression, and mechanical fuel reduction) for each vegetation type since each type in the park has a unique natural fire cycle.

One assumption was that with any increase in prescribed fire or wildland fire use there would also be the possibility of an increase in the number of escapes or unwanted events. This increase is

reflected in the suppression figure for each alternative. The increase in risk of escapes is most obvious in the wildland fire use alternative (Alternative 3) where it is assumed that fewer acres would be pre-treated with prescribed fires to facilitate management of these random unplanned events.

The two different timeframes (10 and 25 years) were developed to assess the effect of program changes over time. The overall acres treated by each alternative remain relatively constant between the two temporal benchmarks for each alternative, however, the mix of acres treated under each tool change. For example, under Alternative 3, acres that would require suppression action decrease between 10 years and 25 years while the wildland fire use acres increase in that same timeframe. This shift in tools over time results from Alternative 3's proactive treatment and restoration of natural fuel conditions through the liberal management of unplanned ignitions supplemented by some prescribed fire. The different timeframes also allow an analysis of changes in smoke production over time as a result of different management alternatives.

Acres for Alternative 1 are based on actual accomplishments of the parks fire management program over the past 10-25 years. The acre estimates for other alternatives were developed with the objective of treating the fewest number of acres each year while still maintaining natural ecosystem function within the range of the natural fire regime. Missing from the acreage estimates, because it is nearly impossible to model, is a reflection of increased risk of large catastrophic wildland fire events such as those experienced by Yosemite National Park several times over the past 15 years, and by the Sequoia National Forest in the summers of 2000 and 2002. As program accomplishments fall short of minimum goals, the risk of this type of unwanted and destructive fire event increases. This concept is developed fully in Chapter 5.

The parks acknowledge that there are numerous factors that could prevent the full attainment of fire management achievements in any given year, or through time. Limited funding, diversion of fire staff to local or national suppression priorities, and air quality constraints all may result in fewer acres treated. In such a case, the program will most likely resemble Alternative 1 – No Action in both accomplishment and environmental effect.

Large variations in the size and number of fire events, both in modern times and in reconstructed pre-Euroamerican fire regimes for the parks illustrate the variability that can be expected year to year. For example, in a reconstruction of the East Fork Kaweah fire regime, the average fire size over a 200-year period was approximately 240 acres. During extended droughts that reoccur several times each century, large fire events in the 6,000-10,000 acre range are found (Caprio 2000). Modern experience shows a similar pattern in the size of natural fire events with the largest natural fire event in the parks, the Ferguson Fire at 10,420 acres in 1977.

Table 3-2 – Projected annual program achievement by alternative over first 10 years.

Treatment Acres per year	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Mechanical Fuel Reduction	4	10	10	10
Wildland Fire Suppression	561	1311	3167	1379
Prescribed Fire	2486	13965	150	7300
Wildland Fire Use	1227	0	10489	6638
Grand Totals	4278	15286	13816	15327

Table 3-3 – Projected annual program achievement by alternative at 25 years.

Treatment Acres per year	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Mechanical Fuel Reduction	10	16	30	16
Wildland Fire Suppression	886	726	2245	986
Prescribed Fire	1478	14490	164	2225
Wildland Fire Use	1293	0	11349	12055
Grand Totals	3667	15232	13788	15282

Table 3-4 – Estimated Annual Acres by Alternative & Vegetation Type – 10-Yr. Targets

Acres by:	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Red Fir				
Mechanical	0	0	0	0
Suppress	6	10	20	15
Prescribed	390	1900	0	800
Fire Use	181	0	1900	1100
Sub total	577	1910	1920	1915
Lodgepole				
Mechanical	1	1	1	1
Suppress	38	10	20	20
Prescribed	50	440	0	140
Fire Use	152	0	440	300
Sub total	241	451	461	461
Xeric Conifer				
Mechanical	0	0	0	0
Suppress	3	33	40	30
Prescribed	99	590	0	200
Fire Use	153	0	590	390
Sub total	255	623	630	620
Montane Chaparral				
Mechanical	0	0	0	0
Suppress	10	20	120	80
Prescribed	52	350	0	50
Fire Use	60	0	220	220
Sub total	122	370	340	350
Sub-alpine Conifer				
Mechanical	0	0	0	0
Suppress	1	5	5	1
Prescribed	0	125	0	0
Fire Use	188	0	125	188
Sub total	189	130	130	189
Meadow				
Mechanical	0	0	0	0
Suppress	0.1	0.1	10	0.1
Prescribed	12	160	0	60
Fire Use	15	0	140	100
Sub total	27.1	160.1	150	160.1
Foothills Chaparral				
Mechanical	1	1	1	1
Suppress	118	60	180	70
Prescribed	190	240	100	225
Fire Use	0	0	20	5
Sub total	309	301	301	301
Foothills Hardwood				

Mechanical	0	0	0	0
Suppress	124	100	200	100
Prescribed	113	1000	50	1000
Fire Use	0	0	20	0
Sub total	237	1100	270	1100
Mid Elevation Hardwood				
Mechanical	0	0	0	0
Suppress	1.4	3	2	3
Prescribed	68	290	0	275
Fire Use	14	0	14	15
Sub total	83.4	293	16	293
Ponderosa Pine Mixed Conifer				
Mechanical	0	3	3	3
Suppress	98	700	2200	700
Prescribed	747	5000	0	2500
Fire Use	80	0	3500	2500
Sub total	925	5703	5703	5703
White Fir Mixed Conifer				
Mechanical	1	1	1	1
Suppress	150	350	350	350
Prescribed	581	3400	0	1700
Fire Use	328	0	3400	1700
Sub total	1069	3751	3751	3751
Giant Sequoia Mixed Conifer				
Mechanical	1	1	1	1
Suppress	11	20	20	10
Prescribed	184	470	0	350
Fire Use	56	0	120	120
Sub total	252	491	141	481
Totals	**Alt 1 No Action (Current Program)**	**Alt 2 Prescribed Fire**	**Alt 3 Natural Fire**	**Alt 4 Multi-Strategy (Preferred Alternative)**
Mechanical	4	10	10	10
Suppress	561	1311	3167	1379
Prescribed	2488	13975	160	7310
Fire Use	1227	0	10489	6638
Grand Totals*	4278	15286	13816	15327

Table 296- Totals rounded up to next whole number.

Table 3-5 – Estimated Annual Acres by Alternative & Vegetation Type – 25-Yr. Targets

Acres by:	Alt 1 No Action (Current Action)	Alt 2 Prescribed Fire	Alt 3 Natural Fire	Alt 4 Multi-Strategy (Preferred Alternative)
Red Fir				
Mechanical	0	0	0	0
Suppress	34	10	10	10
Prescribed	179	1900	0	100
Fire Use	247	0	1900	1800
Sub total	460	1910	1910	1910
Lodgepole				
Mechanical	1	1	1	1
Suppress	15	5	5	5
Prescribed	20	440	0	25
Fire Use	181	0	440	410
Sub total	217	446	446	441
Xeric Conifer				
Mechanical	0	0	0	0
Suppress	33	5	5	5
Prescribed	54	590	0	25
Fire Use	92	0	590	560
Sub total	179	595	595	590
Montane Chaparral				
Mechanical	0	0	0	0
Suppress	61	10	60	10
Prescribed	41	350	0	50
Fire Use	78	0	280	300
Sub total	180	360	340	360
Sub-alpine Conifer				
Mechanical	0	0	0	0
Suppress	4	5	5	5
Prescribed	0.5	125	0	0
Fire Use	85	0	125	125
Sub total	89.5	130	130	130
Meadow				
Mechanical	0	0	0	0
Suppress	4	1	10	1
Prescribed	6	160	0	20
Fire Use	14	0	140	140
Sub total	24	161	150	161
Foothills Chaparral				
Mechanical	1	1	1	1
Suppress	123	60	170	65
Prescribed	172	240	100	225
Fire Use	0.4	0	30	10
Sub total	296.4	301	301	301
Foothills Hardwood				

Mechanical	0	0	0	0
Suppress	87	100	200	100
Prescribed	79	1000	50	1000
Fire Use	2	0	20	0
Sub total	168	1100	270	1100
Mid Elevation Hardwood				
Mechanical	6	6	20	6
Suppress	37	0	0	250
Prescribed	13	290	14	30
Fire Use	14	0	14	15
Sub total	70	296	48	301
Ponderosa Pine Mixed Conifer				
Mechanical	0	6	6	6
Suppress	247	350	1500	350
Prescribed	386	5350	0	400
Fire Use	152	0	4200	5000
Sub total	785	5706	5706	5756
White Fir Mixed Conifer				
Mechanical	1	1	1	1
Suppress	216	175	250	175
Prescribed	394	3575	0	250
Fire Use	406	0	3500	3325
Sub total	1017	3751	3751	3751
Giant Sequoia Mixed Conifer				
Mechanical	1	1	1	1
Suppress	25	5	30	10
Prescribed	133	470	0	100
Fire Use	22	0	110	370
Sub total	181	476	141	481
Totals	**Alt 1 No Action (Current Program)**	**Alt 2 Prescribed Fire**	**Alt 3 Natural Fire**	**Alt 4 Multi-Strategy (Preferred Alternative)**
Mechanical	10	16	30	16
Suppress	886	726	2245	986
Prescribed	1478	14490	164	2225
Fire Use	1293	0	11349	12055
Grand Totals*	3667	15232	13788	15274

* Totals rounded up to next whole number.

SCOPE OF INDIVIDUAL PROJECTS

Individual project size would vary based on weather, fuel load, controllability factors, expected smoke production, and proximity to park boundaries, developments, and smoke sensitive areas. All projects that include fire would be approved by the San Joaquin Valley Unified Air Pollution Control District, and would be managed in accordance with applicable laws and regulations. (Table 3-6 provides a summary of the following information.)

Mechanical Fuel Reduction Projects

In some areas of the parks, fuels would be reduced through direct removal. Typically this would entail piling and burning the excess fuel on the project site at favorable times of the year and with limited smoke impact. Some fuels may be chipped and left on site. Mechanical projects may include the removal of some live shrubs and smaller trees that would otherwise provide ladders for fire to move into larger tree canopies. Mechanical treatments would typically be used within 200 feet of structures and along park boundaries to provide a fire-safe zone between developments and the surrounding wildlands.

Alternatives 1, 2, and 4, propose mechanical projects that would typically be less than 30 acres in size, with the majority of projects ranging from 1-5 acres. Under Alternative 3, mechanically created fuel buffers would be larger than under the other alternatives to provide fire protection while increasing the use of wildland fire use in the vicinity of developments and along boundaries. Mechanical projects under this alternative would have a maximum size of 50 acres.

Under all alternatives, larger projects may be implemented if the perimeter of a developed area or boundary to be buffered (e.g. Wilsonia) is large, but in no cases would the width of the action exceed 200’. To maintain their effectiveness, mechanically treated areas that would serve as reduced fuel buffers would require re-treatment every 5-10 years in shrub and forest vegetation, and annually in grassland communities

As part of planning for mechanical projects, individual sites would be assessed by qualified park staff for the presence of special status species and for significant cultural resources. Site specific recommendations for protection of sensitive resources would be incorporated into project planning and implementation, and the project would proceed if there were a determination of no adverse affect of special status species or on significant cultural resources.

Should “adverse effect” or “incidental take” of any threatened or endangered species be expected by implementation of site specific projects, supplemental environmental compliance would be pursued.

Wildland Fire Suppression

Fire suppression would occur at varying levels under all alternatives. Suppression include the full range of tactics: confine, contain, and control. All suppression actions would follow minimum impact suppression guidelines (Addendum – *Fire and Aviation Management Operations Guide*) and would be followed up with appropriate burned area emergency rehabilitation of firelines and other effects of the suppression action.

Expected sizes of suppression projects range from extremely small for the large majority of ignitions (<0.1 acre) to large scale encompassing thousands of acres. Several recent suppression fires on public lands north and south of these parks have exceeded 50,000 acres in size.

When determining suppression tactics, collateral damage to park resources as a result of the proposed suppression action would be considered. Least cost or minimum acres would not be the sole determining factors in choosing tactics. Considering public and firefighter safety first, tactics selected would be those which create the least collateral damage.

Suppression actions are considered “emergency actions” under NEPA and are exempt from requirements prior to implementation. In these circumstances, issues of life safety for firefighters and the public take precedence over all other resource values (NPS Directors Order-12).

Prescribed Fire Projects

Prescribed fire would be used in all alternatives. Alternative 2 would place the most emphasis on this tool and Alternative 3 the least. Alternative 4 would initially be dominated by prescribed fire; transitioning over time to a predominance of wildland fire use as parklands were restored through prescribed fire and mechanical treatments. Alternative 1 would use prescribed fire at similar rates as in the past, focusing only on the highest priority areas.

Prescribed fire projects under Alternative 1 would continue to range from 0.5 to 6,000 acres. Projects under Alternative 2 would include areas up to 10,000 acres in size to simulate, to the extent feasible, the scale and pattern of natural fire events. Alternative 3 would have very few prescribed fire projects, and those would generally be under 100 acres in size. An exception to this size constraint for Alternative 3 would occur when a prescribed fire ignition was used to replace a suppressed natural ignition in the same year that would have grown larger than 100 acres under modeled circumstances. In that rare case, prescribed fires may be allowed to grow to the expected modeled extent of the original ignition.

Under Alternative 4, prescribed fires would be used in conjunction with unplanned ignitions and mechanical treatments. Prescribed fires would be implemented that would fall within the range of natural fire sizes to restore a natural pattern and mosaic to the landscape. Projects would vary in size from several acres to several thousand acres. Over time as more parkland was restored to natural function and structure, this strategy would decrease in importance and be replaced by wildland fire use projects.

Wildland Fire Use Projects

Alternatives 1, 3, and 4 include wildland fire use projects. Alternative 2 would suppress all unplanned ignitions and use prescribed fire parkwide instead to achieve ecosystem restoration and maintenance goals. Alternatives 1 and 4 manage wildland fire use primarily in areas substantially unaffected by past fire suppression or that have been previously restored through the use of prescribed fire. Alternative 3 uses wildland fire use projects to both maintain unaffected or previously restored parklands and as the primary method to restore fire onto remaining lands.

Wildland fire use projects are, by definition, random unplanned events. Park fire records and experience shows that most unplanned ignitions (>90%) remain quite small (<0.1 acres). The remaining ignitions may grow to an average of 240 acres, while very few ignitions each century may grow to 10,000 acres or more. The growth of most unplanned ignitions in the parks are limited in size by terrain features such as river canyons and rocky ridges that provide numerous natural fire breaks. While projects up to 20,000 acres in size are unlikely, they are conceivable in some areas of continuous fuels.

SCOPE OF ANNUAL PROGRAMS

Each year park managers would develop a detailed plan describing projects that are planned for implementation in that year and for four additional out-years. Individual projects would fall within the scope of the project descriptions above. Table 3-6 outlines the limitations or constraints that would exist for both projects and annual programs.

Table 3-6 – Summary - Scope of Individual Projects and Annual Program

Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Mechanical Fuel Reduction Individual Project Size: - 5 acre maximum Number of Projects/Year: - Up to 15	**Mechanical Fuel Reduction** Individual Project Size: - 30 acre maximum Number of Projects/Year: - Up to 15	**Mechanical Fuel Reduction** Individual Project Size: - 50 acre maximum Number of Projects/Year: - Up to 15	**Mechanical Fuel Reduction** Individual Project Size: - 30 acre typical Number of Projects/Year: - Up to 15
Prescribed Fire Projects Individual Project Size: - 6,000 acre maximum Number of Projects/Year: - Up to 10	**Prescribed Fire Projects** Individual Project Size: - 10,000 acre maximum Number of Projects/Year: - Up to 20	**Prescribed Fire Projects** Individual Project Size: - 100 acre maximum Number of Projects/Year: - Up to 5	**Prescribed Fire Projects** Individual Project Size: - 8,000 acre maximum Number of Projects/Year: - Up to 15 - Total prescribed fire acres not to exceed maximum expected under natural fire regime.
Wildland Fire Use Projects Individual Project Size: - 90% < 0.1 acre - Up to 10,000 acres Number of Projects/Year: - Variable	**Wildland Fire Use Projects** Individual Project Size: - None Number of Projects/Year: - None	**Wildland Fire Use Projects** Individual Project Size: - 90% < 0.1 acre - Up to 20,000 acres Number of Projects/Year: - Up to 50	**Wildland Fire Use Projects** Individual Project Size: - 90% < 0.1 acre - Up to 20,000 acres Number of Projects/Year: - Up to 40
Wildland Fire Suppression Actions Individual Project Size: - Any size Number of Projects/Year: - Variable/Unknown	**Wildland Fire Suppression Actions** Individual Project Size: - Any size Number of Projects/Year: - Variable/Unknown	**Wildland Fire Suppression Actions** Individual Project Size: - Any size Number of Projects/Year: - Variable/unknown	**Wildland Fire Suppression Actions** Individual Project Size: - Any size Number of Projects/Year: - Variable/Unknown

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is defined by the Council on Environmental Quality as the alternative that best meets the following criteria or objectives, as set out in section 101 of the *National Environmental Policy Act*:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Ensure for all Americans a safe, healthful, productive, and aesthetically and culturally pleasing surrounding.
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage and maintain, whenever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

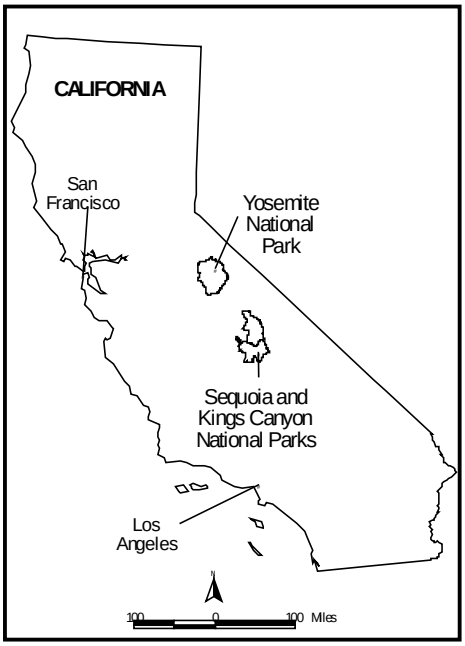
The environmentally preferred alternative is the alternative that causes the least damage to the biological and physical environment – the alternative that best protects, preserves, and enhances historic, cultural, and natural resources. This discussion summarizes the extent to which each alternative meets section 102(1) of the *National Environmental Policy Act*, which asks that agencies administer their own plans, regulations, and laws so that they are consistent with the policies outlined above to the fullest extent possible.

Alternative 1 in this *Environmental Assessment* would not "attain the widest range of beneficial uses of the environment without degradation...." or "preserve important natural aspects of our national heritage…." by only focusing on small, focused areas of the parks. It fails to adequately address current degraded natural resource conditions across a majority of the parks. Alternative 2 addresses the two requirements listed above better than alternative 1 by encompassing a larger area of the parks, but does so at the expense of the wilderness character and may result in unintended or undesirable consequences on ecosystem function and health. Alternative 3 has the potential to restore and maintain many portions of the ecosystem, though it also comes with a higher risk of catastrophic fire and as a result has a greater potential to damage park natural and cultural heritage than other alternatives. Alternative 4 is the environmentally preferred alternative since it has the greatest chance of restoring natural resource conditions across the parks without creating collateral undesired or unintended natural or cultural resource consequences.

4 Affected Environment

OVERVIEW

Figure 4-1 – California Map



Sequoia and Kings Canyon National Parks are located in the eastern part of central California. Park headquarters at Ash Mountain is located 175 air miles (282 km) north of Los Angeles and 215 air miles (346 km) southeast of San Francisco (see Figure 4-1). Both parks occupy the western slope of the Sierra Nevada, the four-hundred-mile-long (640-km) mountain range that forms the eastern edge of the California biological and cultural province. Combined acreage for the two parks is 865,257 acres (350,165 ha).

Sequoia and Kings Canyon are two separate national parks that were created by acts of Congress fifty years apart. Established September 25, 1890, Sequoia National Park is the second oldest national park in the United States. On October 1, 1890 Congress created the four-square-mile General Grant National Park to protect the General Grant Tree and surrounding forest. In 1940 Congress created Kings Canyon National Park. In addition to incorporating the four square miles of General Grant National Park and several other sequoia groves, the new Kings Canyon National Park also featured glacial canyons and alpine headwaters of the South and Middle Forks of the Kings River. Over time and up to the present, the parks have undergone substantial boundary changes and have increased in size. Today these parks are administered as a single unit.

Kings Canyon is the northern of the two parks and consists of two sections containing 5 giant sequoia groves. The small, detached General Grant Grove section of Kings Canyon National Park preserves several groves of giant sequoia including the General Grant Grove and the Redwood Canyon/ Redwood Mountain Grove, one of the largest remaining natural giant sequoia groves in the world. This section of the park is mostly mixed conifer forest, and is readily accessible via paved highways. Grant Grove is surrounded on three sides by Giant Sequoia National Monument, managed by the United States Forest Service.

The remainder of Kings Canyon National Park, which comprises over 90% of the total acreage, is located east of General Grant Grove in the subalpine and alpine region. This area forms the headwaters of the South and Middle Forks of the Kings River and the South Fork of the San Joaquin River. One portion of the South Fork canyon, known as the Kings Canyon, gives the park its name. The Kings Canyon, and its sole developed area, Cedar Grove, is the only portion of the main part of the park that is accessible by motor vehicle. The high country is accessible via rugged foot and horse trails that are usually snow free from late June until late October. The Sierra crest forms the eastern boundary of the park. Ninety-six (96%) of Kings Canyon National Park is designated wilderness.

Sequoia National Park lies south of Kings Canyon and adjoins it. The park consists of a single unit that rises from the low western foothills to the crest of the Sierra at 14,495-foot-high (4,418-m) Mt. Whitney, the highest point in the 48 contiguous states. The western third of the park is dominated by two natural regions – a zone of foothill vegetation below 5,000 feet (1,524 m), and an extensive band of mixed-conifer forest between 5,000 and 9,000 feet (1,524-2,743 m). The mixed conifer forest contains 34 separate giant sequoia groves, including the Giant Forest grove, which covers three square miles and contains the world’s largest tree – the General Sherman. Both the Generals Highway and the Mineral King Road provide vehicular access to this western third of the park. Immediately east of the forest belt is the Great Western Divide, a north-south ridge that runs through the middle of Sequoia National Park. Peaks in the vicinity of the Divide rise as high as 13,802 feet (4,207 m).

The eastern half of the park consists of the alpine headwaters of the Kern River, the glacial trench of Kern Canyon and the Sierra Crest itself, which runs north-south and forms the eastern boundary of the park. All of this area, which comprises approximately two-thirds of Sequoia National Park, is designated wilderness.

US Forest Service wilderness (72%), the Giant Sequoia National Monument (16%), and Bureau of Land Management (BLM) lands (7%) share a total of ninety-five percent of the parks’ boundary. An additional 4.6% of lands adjacent to the parks’ boundary are privately owned and less than 1% are managed by the state.

NATURAL RESOURCE VALUES

Sequoia and Kings Canyon National Parks contain resources of geological, biological, and cultural value. In addition to holding national park status, the two reservations are designated as International Biosphere Preserves. Eighty-five percent of the parklands are in designated wilderness with another 12% in proposed wilderness. The remaining 3% of parklands are dedicated to administrative and visitor developments such as campgrounds, scenic roads, picnic areas, and

overnight lodging. Both the Kern River and the middle and south forks of the Kings River are designated as Wild and Scenic Rivers.

Geological resources include river-cut canyons more than a mile deep, extensive and spectacular examples of glacial erosion including hundreds of alpine lakes, and several superlative examples of glacially eroded canyons. Within these canyons flow the largest remaining undammed rivers in the Sierra Nevada. Igneous rocks of Mesozoic origins underlie the majority of the two parks, but extensive bands of Paleozoic metamorphic beds also occur. Within the latter, beds of marble are common, as are caves.

Congress created Sequoia and General Grant National Parks in 1890 expressly to protect the giant sequoia. The General Sherman Tree, growing in Sequoia National Park's Giant Forest, is generally recognized as the largest sequoia and the largest living tree on earth. Three other trees in the Giant Forest and the General Grant Tree in Kings Canyon National Park complete the list of the world's five largest trees.

Sequoia trees do not grow continuously through the mixed conifer forest belt, but rather in geographically limited areas called groves. In the Sierra Nevada, the only present natural home of the sequoias, the trees grow in fewer than 90 separate groves. The two parks together contain roughly 33% of all naturally occurring sequoia grove acres.

The biological resources of the two parks are not limited to the sequoias. Extensive tracts of Sierran mixed conifer forest surround the sequoia groves. This forest belt, which generally clothes the mountains at altitudes between 5,000 and 9,000 feet (1,524 and 2,743 m), covers much of the southern Sierra. The parks contain the largest remaining old growth forest in the southern Sierra. Below the conifer forest, in the western portions of the Sierra, are the various plant communities and environments that together constitute the foothill region. This environment is typified by blue oak savanna, chaparral, and oak woodland.

The remainder of the parks, most of it above 9,000 feet (2,743 m) in altitude, can be described as "High Sierra." This environment is a spectacular land of rugged, ice-sculptured alpine ridges and sparsely wooded lake basins.

The preservation of native wildlife within the two parks results naturally from habitat protection and maintenance. While the wildlife found within the parks does not differ significantly from that found naturally on surrounding lands, those lands are undergoing profound change. As a result, the wildlife protection function of the parks is becoming increasingly important.

CULTURAL RESOURCE VALUES

In addition to their natural diversity the parks preserve a rich, unique cultural record of prehistoric and historic sites. It is estimated that five percent (5%) of the parks' collective acreage has been inventoried (surveyed) for the presence/absence of cultural resources. This figure translates into approximately 43,000 acres.

In general, the parks' known cultural resources span a time period of at least 3-5,000 years. These resources document prehistoric, ethnographic, historic, and even contemporary use of park areas. They include permanent bedrock mortars (grinding holes) log or lumber structures, rock art sites, expansive vistas, and wild plant resources visited discretely by contemporary Native Americans for spiritual or cultural purposes.

The earliest systematic inventories of cultural resources date from the late 1950s and early 1960s. Previous investigations, including interviews with Native Americans and early settlers, were infrequently conducted and tended to focus on the most highly visible sites and included extrapolations of knowledge from outside the parks. The compliance inventories of the mid-1960s to the 1990s have expanded the database of known cultural resources within the parks to 312 prehistoric sites, 110 historic sites, and 169 site leads. This database represents the best available information on the range of site types and human activities carried out over time in the parks. (See Appendix D for the National Register listing.)

Prehistoric Resources

Prehistoric cultural resources are those human-made sites, structures, features, or objects that pre-date the arrival of Euroamericans. By definition, these resources are synonymous with Native American or American Indian use. At the time of the first Spanish movements into the Great Central Valley of California (circa 1800), the native groups living in the valley and the western foothills of the Sierra Nevada were the Yokuts and Monache Indians (a.k.a. Western Mono). Prehistoric site types within the parks include small villages, lithic scatters (marking areas of stone tool production or use such as campsites), midden soils, bedrock mortars and basins, caves, stone circles and hunting blinds, pictographs, and petroglyphs.

Ethnographic Resources

Ethnographic resources are recognized as including combinations of natural resources and standard cultural resource types. The distinction traditionally made by agency managers between natural and cultural resources may not apply when focusing on ethnographic resources. These latter resource types can be locales where subsistence or religious (ceremonial) activities are conducted, by either groups or individuals, and include associated sites,

structures, objects, and landscapes that are assigned cultural significance by traditional users. Ethnographic resources within the parks can include such things as the sites of historic villages or campsites, caves, rock art sites, traditional plant gathering areas, graves, landscapes, vistas, and other natural features (e.g., monoliths and promontories).

Historic Resources

Historic resources are those human-made sites, structures, features, or objects that date from the time of the arrival of Euroamericans in approximately 1850, up until the middle of the 20th century (i.e., at least 50 years of age). Historic sites, by definition then, can be of Native American association but are most often associated with Euroamerican use and occupation. Aspects of all of the episodes of historic activity can be found in historic sites in the parks. The associated site types include cattle camps, trails, sawmills, logging camps, stumps, shake piles, mines, trash dumps, hydroelectric dams and water flumes, the Colony Mill Road, military campsites, Civilian Conservation Corps-era ranger stations and roads, and post-World War II homes.

CURRENT CONDITIONS

Extensive fire history studies show that most vegetation communities in the parks evolved and adapted under the influence of fire. Lower and mid elevation vegetation communities, including giant sequoia groves, have been subject to frequent lightning-ignited fires (every 6-17 years) over millennia.

Between 1891 and 1967, the parks attempted to suppress all fires, and met with a fair degree of success. Consequently, several park vegetation communities that evolved in the presence of frequent fires have experienced an unprecedented period without fire (Caprio and Graber, 2000). This lack of fire has resulted in important ecosystem changes. In the foothill grasslands, lack of fire encourages dominance by exotic grasses (Parsons and Stohlgren 1989). Additionally, due to a buildup of dense vegetation along foothill streams and in their upper catchments, lack of fire apparently has reduced annual streamflow in the foothills, probably to the detriment of aquatic communities. In foothill chaparral, richness of fire-dependent chaparral species seems to be unusually low following prescribed fires, perhaps due to the exhaustion of the soil seed bank during the long preceding fire-free period (Keeley 2000).

The consequences of fire exclusion have best been characterized by research in the mixed conifer zone. Both stream chemistry (Williams and Melack 1997) and stream flow (Moore 2000) in the mixed conifer zone have been altered by the lack of fire, with unknown consequence for aquatic ecosystems. Giant sequoia reproduction, which in the past

depended on frequent fires to expose mineral soil and open gaps in the forest canopy, had effectively ceased by 1967, and reproduction of other shade-intolerant species such as ponderosa pine has been reduced (Harvey et al. 1980, Stephenson 1994). Today more area is dominated by dense intermediate-aged forest patches, and less by young patches, than in the past (Bonnicksen and Stone 1978, 1982, Stephenson 1996). Forests have become denser in many areas, with increased dominance of shade-tolerant species. Shrubs and herbaceous plants are probably less abundant than in the past (Kilgore and Biswell 1971, Harvey et al. 1980). Perhaps most importantly, dead material has accumulated, causing an unprecedented buildup of surface fuels (Agee et al. 1978, van Wagtendonk 1985). Additionally, “ladder fuels” capable of conducting fire into the crowns of mature trees have increased (Kilgore and Sando 1975, Parsons and DeBenedetti 1979). One of the most immediate consequences of these changes is an increased hazard of wildfires sweeping through the mixed conifer forests with a severity that was rarely encountered in pre-Euroamerican times (Kilgore and Sando 1975, Stephens 1995, 1998).

Landscape scale changes in the fire regime are characterized by the parks’ *fire return interval departure* (FRID) analysis. This geographic information system based analysis assesses the ecological condition of all vegetation communities using deviations from the natural fire cycle as the indicator of change. In general, the further vegetation communities depart from their natural fire regimes the more unnatural conditions prevail and the higher the risk of catastrophic wildfire events. A full description of the FRID analysis can be found in Caprio et al (1997).

Results of the FRID analysis (Caprio and Graber 2000) indicate that 47% of park vegetation is considered to be in acceptable ecological condition (i.e. little to no deviation from natural fire regime) as of the year 2000. These areas are expected to remain in acceptable ecological condition as long as the natural fire regime is maintained. Another 30% of the park vegetation shows significant deviation from natural conditions, and over 22% of park acres are considered highly compromised by past fire suppression (see Figure 4-2). Most of the deviation from natural conditions occurs in the lower to mid-elevation conifer forests, including giant sequoia groves. Despite ongoing reintroduction of fire to groves over the past 30 years, progress has been slow with 57% of grove acres still in a highly compromised state. The analysis does show positive effects of the past proactive fire management on returning many acres to acceptable condition, but also underscores the extent of areas requiring attention.

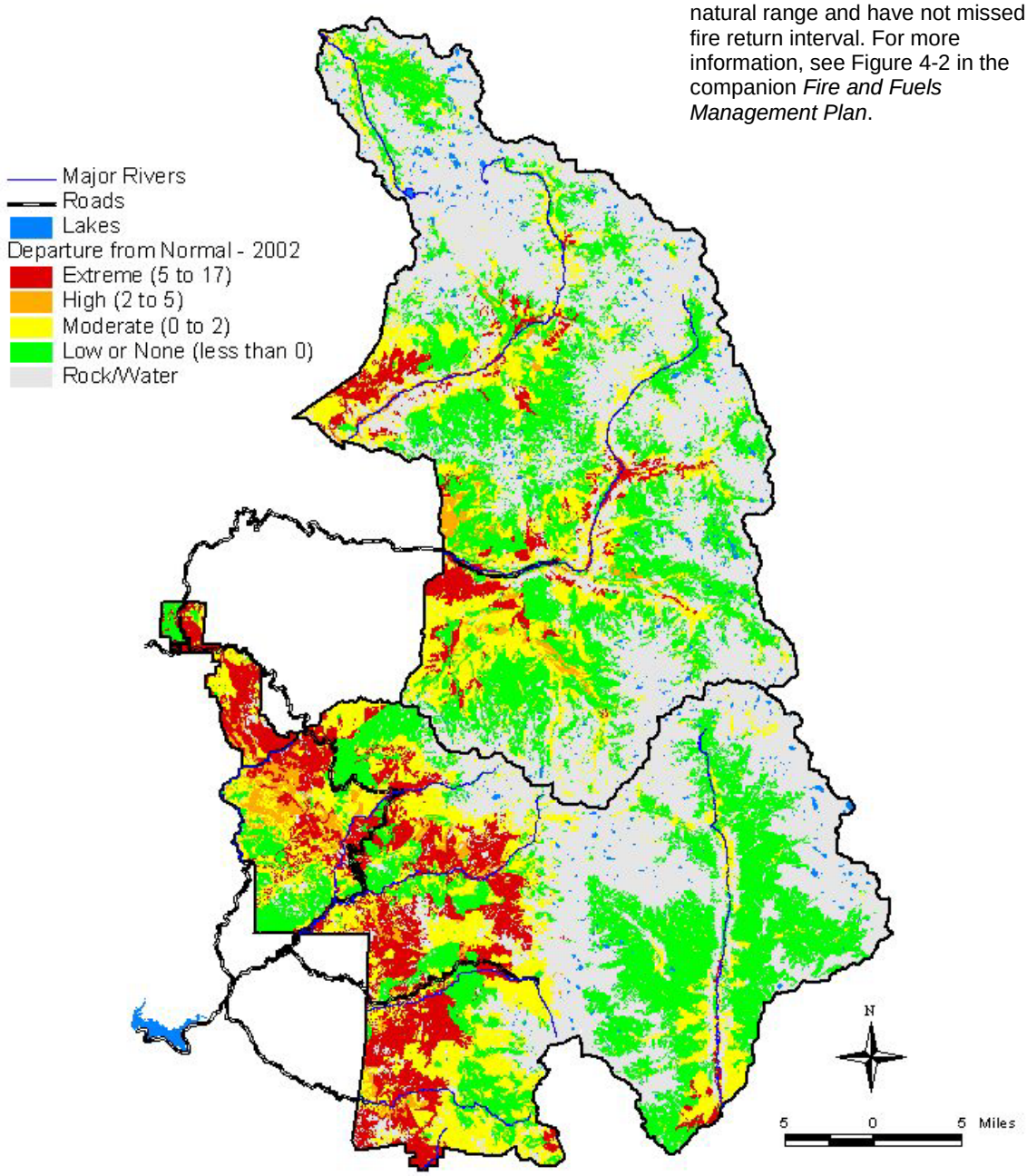
Lack of fire has also reduced habitat critical for certain wildlife species. In the absence of fire, the number and extent of forest openings has been reduced, with an accompanying reduction of key herbaceous and shrub species (particularly nitrogen fixers such as *Ceanothus*) (Bonnicksen and Stone, 1982). Wildlife that depends on these plants, such as deer, now has less available habitat. Black-backed woodpeckers have probably declined in the absence of fresh

fire-created snags. The effects of fire exclusion also can extend to higher trophic levels. For example, rodents are less abundant in areas within these parks where fire has been excluded (Werner, 1997), almost certainly leading to a reduction in the carnivore populations that depend on them.

Current unnatural fuel loads and vegetation densities have significant implications for the management of cultural resources. These include increased risk of direct damage to cultural resources from high intensity wildfire events, and from the emergency response operations necessary to manage such fires. Current conditions may also increase the risk of damage from indirect effects of large high intensity fires, such as increased erosion of soils containing surface and subsurface resources. Overly dense vegetation and fuel loads pose other challenges to pro-active management of cultural resources by making the detection and evaluation of potential cultural sites difficult in many areas of the parks. Beginning in 1968, the parks recognized the importance of fire in the parks' ecosystems and the increasing threat to cultural resources and public safety from the buildup of fuels. In that year the parks began a prescribed fire and wildland fire use program. However, after more than 30 years of proactive fire management, the parks still are far from restoring natural fire regimes to the entire park landscape, though significant inroads have been made (Caprio and Graber, 2000).

Figure 4-2 – Fire Return Interval Departure Map

The colors on this map correspond to the number of fire cycles, or fire return intervals, an area has missed. Red areas have missed 5 to 17 intervals, whereas green areas are within their natural range and have not missed a fire return interval. For more information, see Figure 4-2 in the companion *Fire and Fuels Management Plan*.



5 Impacts of Alternatives

This chapter discusses the potential impacts, including cumulative impacts, of each alternative on various park resources or issue of concern. Each resource and issue is described beginning with a general description followed by an articulation of the factors used to assess environmental consequences. The factors are based on applicable laws, NPS policy, and park resource goals. Impacts common to all alternatives are discussed as well as impacts specific to the individual alternatives. Each section ends with a discussion stating the relative effects of each alternative and assesses its potential to create or reduce impairment to park resources. A summary of the following information is contained in Chapter 6 (Tables 6-1 and 6-2).

While evidence suggests that global climate change may begin to affect park resources and ecosystems over the next several decades, there is still great uncertainty as to the extent and effect of the changes that may occur. As a result of this uncertainty, this plan assumes (with the concurrence of our USGS global change research partners (Stephenson - personal communication)) that our knowledge of past ecosystem condition and function will be adequate to guide the program for at least the next decade. A comprehensive fire effects monitoring program will be maintained, as will research efforts at the park to assess what, if any, changes are occurring as a result of rapid climate change. Once more is known about the effects of climate change on park resources, fire management strategies and practices can be amended to respond to those challenges.

A. VEGETATION COMMUNITIES

Extensive research chronicles a long history of naturally occurring fire in Sierran ecosystems, and many plants exhibit classic evolutionary adaptations to frequent fire events. In assessing the environmental consequences of the alternatives, the assumption was made that native plant populations that currently occur in the parks have evolved in the presence of fire under historic fire regime conditions, and that perpetuating a natural fire regime will have no effect or beneficial effect (see Chapter 9 in the companion *Fire and Fuels Management Plan*). Following this assumption, and in accordance with NPS policy, the loss of individual plants due to fire was not considered in assessing the environmental impacts of the alternatives, except for special status species that are discussed under section C of this chapter.

Factors Used to Assess Environmental Consequences

Maintenance of Natural Fire Regimes
Alternatives that most closely maintain and restore the natural fire regime, including fire return interval, fire severity, and landscape pattern, are favored over alternatives that alter or constrain those factors.

Acres Restored
Alternatives that promote more acres of proactive restoration to natural structure, composition and function are favored over alternatives that restore fewer acres.

Reduce Risk of Catastrophic Loss
Alternatives that result in a reduction of unnaturally large high-severity fire events are favored over alternatives that leave more acres vulnerable to damage from this source.

Impacts Common to All Alternatives

Mechanical treatment to reduce hazardous fuels in proximity to structures would affect the parks' vegetation in the same ways in all alternatives. Individual trees and shrubs would be removed, and grass would be cut to the extent necessary to protect structures from wildland fire in limited areas of the parks, therefore, only a small portion of the parks' vegetation is directly affected in all alternatives.

After the initial mechanical treatment in forest and shrub areas, impacts would be limited to removing some regeneration of trees and shrubs in future treatments; therefore, cumulative impacts to these areas would be minimal. In grassland areas where regeneration occurs annually, more frequent treatment to reduce grass would be needed.

Wildland fire suppression in all alternatives would result in limited direct impacts, including clearing or disturbing vegetation in localized areas of the parks. The average annual number of acres affected by fire suppression activities would be similar for Alternatives 2, and 4. Alternative 3 would have approximately five times the amount of average annual suppression acreage as the no action alternative. For all alternatives, minimum impact suppression techniques (Addendum – *Fire and Aviation Management Operations Guide*) would be used during all suppression efforts.

Beneficial cumulative impacts are expected due to planned fire management activities on neighboring United States Forest Service lands. The Inyo, Sequoia, and Sierra National Forests have rewritten, or are rewriting, their respective fire management plans. Their plans will all allow for wildland fire use activity. Depending upon the amount of acres treated through wildland fire use, a greater percentage of Southern Sierran vegetation and associated fire regimes could be restored or maintained, with decreased risk of catastrophic loss to vegetation associations. Wildland fire use could allow this

restoration or maintenance to occur across agency boundaries in wilderness areas. All alternatives would receive this beneficial cumulative effect.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
Under the current program, the vegetation in many areas of the parks' would receive beneficial effects of fire treatment, including restoring the natural structure, composition, and function of historically fire-maintained vegetation associations. At the current rate, however, much of the parks' vegetation would burn too infrequently to mimic historic fire return intervals. The long-term consequences of this change in fire regime would result in continued departure of vegetation conditions from the desired natural conditions in areas excluded from restoration or maintenance of the natural fire regime.

Adverse impacts would include an increase in fire-intolerant species, combined with a lack of regeneration of many fire-adapted species, resulting in further unnatural changes in vegetation structure, composition, and function. In addition to these changes, continued accumulation of fuels would lead to unwanted wildland fires with uncharacteristically severe fire effects, leading to increased mortality and inhibited postburn regeneration.

Alternative 2 – Prescribed Fire
A large increase in prescribed fire in Alternative 2 would beneficially affect the parks' fire-maintained vegetation by restoring fire-related ecological benefits, such as reduced competition for limited resources, enhanced nutrient cycling, and regeneration of fire-adapted plant species. In areas where heavy fuel loads have resulted from fire exclusion, prescribed fire would be used to reduce fuel loads to more natural levels to help prevent severe effects of unwanted wildland fire. However, with increased use of prescribed fire, the natural ignition and spread pattern of fire on the landscape would be replaced by less random ignition patterns, creating a less natural pattern of fire effects compared with wildland fire use. The long-term consequences of less natural fire patterns are unknown.

Alternative 3 – Wildland Fire Use
Due to the increase in acres treated with wildland fire use in Alternative 3, more of the parks vegetation would burn with a more natural pattern of fire effects compared with Alternative 1. These fire effects would be beneficial to the structure and function of much of the parks' vegetation that has evolved with fire over time. In many areas between approximately 4000-8000 feet (1200-2400 meters) in elevation, where heavy fuel loads have resulted from fire exclusion and prescribed fire was not used to first restore natural fuel loads in the area, uncharacteristically severe fire effects could occur. In these cases, the adverse impacts on vegetation would include

unnaturally high levels of mortality and disruption of plant succession, with slower postburn regeneration of species adapted to less severe fire effects.

Alternative 4 – Multi-Strategy (Preferred Alternative)
An increase in both prescribed fire and wildland fire use would have a beneficial effect on the parks' vegetation by restoring the structure and function of historically fire-maintained vegetation over a larger area of the parks compared to Alternative 1. Fire-related ecological benefits, such as reduced competition, nutrient cycling, and regeneration of fire-adapted plant species would occur in a larger portion of the parks. More natural patterns of fire effects on vegetation would occur with an increase in wildland fire use. In vegetation types that have been greatly altered by fire exclusion, fire would be reintroduced initially with prescribed fire to first restore fuel and vegetation conditions to minimize adverse effects of severe fire. Wildland fire use would then be used to the extent possible to maximize the benefits of natural fire patterns.

Conclusions

All alternatives provide some level of restoration or maintenance of park ecosystems and therefore have the potential to reduce the current level of impairment to park vegetation. However, Alternative 1 reduces impairment only locally while the other alternatives improve conditions across a larger area of the parks.

Under Alternative 1, vegetation conditions in many areas of the parks would continue to deviate from desired natural conditions, leading to uncharacteristically severe wildland fire that could cause permanent impairment of some vegetation resources. Further impairment of vegetation resources is less likely to occur in Alternative 2, 3, and 4, as those alternatives increase the area of the parks where fire would be restored. Potential severe fire effects leading to impaired vegetation resources would be more likely in Alternative 3 and less likely in Alternative 4, where prescribed fire would be used to reintroduce fire to highly altered areas under less severe conditions to minimize adverse impacts.

Table 5-A1 – Comparison of Effects on Vegetation Communities

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Maintenance of Natural Fire Regimes	0	+	+	++
Acres Restored	0	++	+	++
Reduce Risk of Catastrophic Loss	0	+	_	+

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

++ effects are **highly desirable** compared to Alternative 1 (No Action)

+	effects are **desirable** compared to the effects of Alternative 1 (No Action)
0	effects are **equal** to the effects of Alternative 1 (No Action)
-	effects are **undesirable** compared to the effects of Alternative 1 (No Action)
--	effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

B. WILDLIFE

In assessing the environmental consequences of the alternatives, the assumption was made that native wildlife populations that currently occur in the parks have evolved in the presence of fire under historic fire regime conditions (see Chapter 9 in the companion *Fire and Fuels Management Plan*). Following this assumption, and in accordance with NPS policy, the loss of individual animals was not considered in assessing the environmental impacts of the alternatives, except for special status species that are discussed under section C of this chapter. While some loss or displacement of individual animals would inevitably occur in areas treated with fire, long-term benefits to the populations or to other native species would occur as a result of restoration of fire-maintained habitat.

Factors Used to Assess Environmental Consequences

Maintenance of Natural Conditions and Habitat Diversity
Alternatives that most closely maintain and restore the natural fire regime, including fire return interval, fire severity, and landscape pattern, are favored over alternatives that alter or constrain those factors.

Acres Restored
Alternatives that promote more acres of active habitat restoration to natural structure, composition and function are favored over alternatives that restore fewer acres.

Reduce Risk of Catastrophic Habitat Loss
Alternatives that result in a reduction of unnaturally large high-severity fire events are favored over alternatives that leave more habitat vulnerable to damage from that source.

Impacts Common to All Alternatives

Mechanical treatment to reduce hazardous fuels in proximity to structures would affect the parks' wildlife to the same extent in all alternatives. Mechanical treatment would cause human disturbance, noise, and alter habitat within the immediate treatment area which could change wildlife use of the treated area. Only a small portion of the parks' vegetation, and therefore wildlife habitat, is affected in all alternatives.

Wildland fire suppression activities in all alternatives would have adverse impacts on some wildlife individuals. Fireline construction

would result in the removal of snags, temporary disturbance, and often new game trail formation as large wildlife use the firelines. Small animals would lose some habitat as brush, logs, and litter are removed down to mineral soil. Fire retardant used in fire suppression is toxic to fish and probably to other aquatic wildlife. In addition, in larger suppression efforts, large numbers of people brought in could result in food being made accessible to bears in fire camps and on the fireline, contributing to bear problems.

Beneficial cumulative impacts would mirror those described under the vegetation communities section. More wildland fire use in the Southern Sierra occurring across agency boundaries would benefit wildlife through restoration of acreage, increased habitat diversity, and reduced risk of catastrophic habitat loss.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
Under the current program, fire treatments would be less frequent than historic fire-return intervals in many areas of the parks. Without sufficient fire, the vegetation would continue to become more homogeneous resulting in wildlife habitat that is less varied. Wildlife would be adversely affected by the loss of some types of habitat that was maintained by historic fire regimes. In addition, the risk of uncharacteristically severe wildland fire would become greater over time, and would have the potential to threaten wildlife populations not adapted to more severe fire effects.

Alternative 2 – Prescribed Fire
The use of prescribed fire in a larger portion of the parks would occur in Alternative 2, creating more natural vegetation patterns across the landscape and a greater variety of wildlife habitat. More habitat conditions favorable to fire-adapted species would be created in Alternative 2, but not necessarily in the same patterns associated with natural ignitions. The distribution of habitat would be determined by prescribed burn timing, locations, conditions, and pattern and could result in less natural habitat conditions compared to wildland fire use. The long-term consequences of less natural fire patterns and corresponding habitat conditions are unknown. In the areas where heavy fuel loads have resulted from past fire exclusion, prescribed fire would be used to reduce the risk of uncharacteristically severe fire and corresponding radical changes to the habitat.

Alternative 3 – Wildland Fire Use
With an increase in wildland fire use in Alternative 3, a more natural distribution of habitat conditions would occur over a larger area than in Alternative 1, and many wildlife species would benefit. In areas where heavy fuel loads have resulted from fire exclusion, unnaturally severe fire effects could occur that might negatively impact specific wildlife species at a local scale, but may increase the landscape

heterogeneity, thereby improving wildlife biodiversity at the landscape scale.

Alternative 4 – Multi-Strategy (Preferred Alternative)
An increase in areas restored using fire in Alternative 4 would maintain a more natural distribution of wildlife habitat than in Alternative 1. A greater use of wildland fire use in Alternative 4 would increase landscape heterogeneity and improve wildlife biodiversity at the landscape scale. In the areas where heavy fuel loads have resulted from past fire exclusion, prescribed fire would first be used to reduce the risk of uncharacteristically severe fire and corresponding radical changes to the habitat.

Conclusions

All alternatives provide some level of restoration or maintenance of park ecosystems and therefore have the potential to reduce impairment to park wildlife. However, some alternatives reduce impairment only locally while others improve conditions across a larger area of the parks.

Under Alternative 1, wildlife habitat in many areas of the parks would continue to change from the desired natural condition, leading to uncharacteristically severe wildland fire that could cause permanent impairment of some wildlife habitat. Future impairment of habitat is less likely to occur in Alternatives 2, 3, and 4, as those alternatives increase the area of the parks where fire would be restored. Potential severe fire effects leading to impaired wildlife habitat would be more likely in Alternative 3 and less likely in Alternative 4, where prescribed fire would be used to reintroduce fire to highly altered areas under less severe conditions to minimize adverse impacts.

Table 5-B1 – Comparison of Wildlife Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Maintenance of Natural Conditions and Habitat Diversity	0	+	+	++
Acres Restored	0	+	+	+
Reduce Risk of Catastrophic Habitat Loss	0	++	+	++

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 1 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)
- -- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

C. SPECIAL STATUS SPECIES

The U.S. Fish and Wildlife Service provided a complete list of federal and state listed species in Tulare and Fresno counties, including endangered, threatened, rare, candidate, species of concern, and species of local concern. The species that are known to occur in the parks are analyzed in this section. See Appendix B for a list of the species not known to occur within Sequoia and Kings Canyon National Parks that were removed from further consideration.

The parks had historic occurrences of five species of wildlife that are listed as federally threatened or endangered, as well as one critical habitat designation requiring protection under the Endangered Species Act. Two of the five federally listed species, the grizzly bear and California condor, are extirpated from these Parks; but current restoration could result in Condors using the parks in the future. Two other species are candidates for federal listing as endangered, and California lists four additional species in addition to three of the federal species. There are no plant species in the parks that are federally listed. A number of additional species of wildlife and plants considered in this analysis are listed as “species of concern” by either the state or federal government.

The Endangered Species Act of 1973 requires consultation for any actions that may effect on all federally threatened or endangered species. NPS policy further requires consideration of effects on state-listed threatened, endangered, candidate, rare, declining, and sensitive species. For this environmental assessment, the Fire Effects Information System (USDA 2001) was used to determine potential impacts to special status species if the species was included in the system. If not, inferences were made based on knowledge of location or habitat, or knowledge of effects on similar species.

The effects of each of the alternatives on many of the special status species are currently unknown. However, for those that occur in areas that have experienced fire disturbance for at least the last 2,000 years, it is assumed that populations either benefit from fire or are tolerant of fire over the long term, despite possible short-term loss of some individuals.

Factors Used to Assess Environmental Consequences

Potential for Take of Individuals Protected as Threatened or Endangered

Each alternative is evaluated to determine whether it would be likely to result in the take of individual organisms protected under the Endangered Species Act.

Loss of Viable Protected Populations
Each alternative is evaluated to determine whether it would be likely to result in the loss or improvement of viable populations of special status species.

Loss of Critical Habitat Defined in Recovery Plans
Each alternative is evaluated to determine whether it would be likely to result in the loss of critical habitat as defined in 50 CFR 17.95.

Amount of Habitat Restored or Maintained
Each alternative is evaluated to determine whether it would promote or enhance habitat for special status species.

Reduced Risk of Catastrophic Loss
Alternatives that result in a reduction of unnaturally large high-severity fire events are favored over alternatives that leave more habitat or populations vulnerable to damage from this source.

Impacts Common to All Alternatives

Mechanical treatment to reduce hazardous fuels in proximity to structures would have no effect on the parks' special status species in any of the alternatives. Only a small portion of the parks' vegetation, and therefore wildlife habitat, is affected in all alternatives (an average of less than 100 acres treated annually) and no special status species are known to exist in close proximity to park structures. Each mechanical project proposal would undergo review and clearance by park subject matter experts prior to implementation.

Beneficial cumulative impacts would mirror those described under the vegetation communities section. More wildland fire use in the Southern Sierra occurring across agency boundaries would most likely benefit special status species through restoration and maintenance of more habitat, as well as reduced risk of catastrophic habitat loss.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
Fire restoration would occur in limited areas of the parks and would have no effect or potentially beneficial effect to most special status species adapted to fire in treated areas. In other areas, fire treatments would occur less frequently than in the historic fire regime, leading to further degradation of natural conditions. These altered conditions would create a greater risk of uncharacteristically severe wildland fire that would have the potential to adversely affect special status species. No direct loss of protected individuals, populations, or critical habitat is likely to occur under this alternative over the short term. Indirect loss through continued habitat change and direct loss through the increased risk of unnaturally large high-severity fire is likely in the future.

Alternative 2 – Prescribed Fire
An increase in areas restored with fire in Alternative 2 compared to Alternative 1 would benefit those special status populations that are enhanced by fire effects on vegetative mosaics and habitats. In addition, over time, the risk of adverse effects to sensitive species from uncharacteristically severe fire would decrease in treated areas. With the scheduled nature of increased prescribed fire activities under Alternative 2, a greater ability to locate and avoid the disturbance of fire-sensitive special status populations, if necessary, exists.

While individual plants and animals may be affected or displaced by fire events, restoration would have no effect or beneficial effect on overall populations of special status populations. No direct loss of populations or critical habitat is likely to occur under this alternative. Some indirect loss through continued habitat change and direct loss through the increased risk of unnaturally large high-severity fire is likely in the future.

Alternative 3 – Wildland Fire Use
An increase in areas treated with fire in Alternative 3 compared to Alternative 1 would benefit those special status populations that are enhanced by fire. In some areas, conditions altered by fire exclusion could lead to uncharacteristically severe wildland fire effects that might have an adverse effect on special status species not adapted to more severe fire. However, over time, the risk of adverse effects to sensitive species from uncharacteristically severe fire would decrease in treated areas. Due to the random location and timing of wildland fire use ignitions, sensitive populations might be impacted by fire before they could be located and protection efforts, if needed, would be more difficult. Species that are fire dependent would benefit from the occurrence of fire in a more ecologically desirable natural pattern of wildland fire use leading to natural vegetative mosaics.

While individual plants and animals may be affected or displaced by fire events, restoration would have no effect or beneficial effect on overall populations of special status populations. No direct loss of populations or critical habitat is likely to occur under this alternative. Some indirect loss through continued habitat change and direct loss through the increased risk of unnaturally large high-severity fire is likely in the future.

Alternative 4 – Multi-Strategy (Preferred Alternative)
An increase in areas treated with fire compared to Alternative 1 would benefit those populations that are enhanced by fire. The risk of adverse effects to special status species from uncharacteristically severe fire would decrease in treated areas. In areas where prescribed fire is used, species that are sensitive to fire could be located and protected if necessary. More natural ignition and spread patterns would result from wildland fire use, benefiting species that are adapted to the creation of these natural vegetative mosaics.

While individual plants and animals may be affected or displaced by fire events, restoration would have no effect or beneficial effect on overall populations of fire-adapted special status populations. No direct loss of individuals of species protected under the Endangered Species Act is likely to occur under this alternative unless there is a catastrophic fire in unrestored fuels. No direct loss of populations or critical habitat is likely to occur under this alternative.

Individual Species - Wildlife

Federally Listed Species including Candidates
The following federally listed endangered or threatened wildlife species or critical habitats are found within the parks. A summary of these species, and the effects of the alternatives on them, is found in Table 5-C1.

Bald eagle – While bald eagles are rare in the parks, fire in any of the alternatives would have a neutral effect on bald eagle habitat. Snags and dead branches used as hunting perches would be destroyed by some fire events, while at the same time others would be created.

California condor – The alternatives would have either no effect, or a beneficial effect, on condor potential habitat since condors forage primarily in open areas, especially grassy hills. When condors were present in the local area, they foraged primarily in the open areas west of the parks where there is designated critical habitat. Increases in fire frequency would help make park landscapes more desirable for condors by maintaining open landscapes within the foothills. Some records of condors nesting in sequoia trees exist and increased fire use would also help maintain sequoia forests for potential nesting sites. Chaparral fires would provide potential post-burn foraging up until there is significant regrowth. The fires would not create any threat of incidental take to the soaring condors.

Little Kern golden trout /Critical Habitat – This threatened trout and a portion of its critical habitat occur in conifer forests at the southern end of Sequoia National Park. As in many other coniferous forest areas, fuel loads here are high due to past fire exclusion. Uncharacteristically severe wildland fire could endanger the species and its habitat through increased sediment transport, which would cause erosion, increase water temperature due to loss of canopy, and bury spawning gravel. Alternatives 2, 3, and 4 would provide greater opportunity for managing wildland fire or prescribed fire in Little Kern golden trout habitat than under Alternative 1, thereby decreasing the chance of severe fire impacting the species. Fire managers would use prescriptions intended to protect the habitat by removing fuels and help restore a more natural forest structure. These opportunities would be further enhanced as the U.S. Forest Service increases the role of fire in their management plans for adjacent areas.

Mountain yellow-legged frog – This candidate for federal listing occurs in alpine and subalpine areas of these parks that rarely encounter fire. Those fires are small and typically of natural origin. These frogs rarely leave their aquatic habitat which consists of lakes, ponds, marshes, and streams. Both the frogs and their habitat are unlikely to be effected by fire or any differences in the alternatives for the management of fire.

Sierra Nevada bighorn sheep – Sierra Nevada bighorn sheep and their habitat would not be directly or indirectly affected by any of the alternatives. The Sierra Nevada bighorn sheep habitat in the park occurs at high elevations, and is generally found above areas that burn. Any habitat that does burn would likely result in beneficial effect by providing increased quality forage as a result of nutrients released after fire. It is unlikely that extensive areas would burn at the high elevations of bighorn sheep habitat, therefore effects on habitat are unlikely. Also, increased fire would have beneficial effects by reducing cover for the bighorn's major predator, the mountain lion. Bighorn are highly mobile and would not have any problems avoiding fires in progress. A recovery plan for the Sierra Nevada bighorn sheep has been drafted and awaits final approval.

Valley elderberry longhorn beetle – While specimens from the parks' watersheds appear to be the unlisted California elderberry longhorn beetle, the U.S. Fish and Wildlife Service has historically considered the park population to be the federally-listed valley elderberry longhorn beetle. Thus they are addressed in this document. Elderberry plants with stems greater than 1" in diameter are required to provide high quality habitat for the valley elderberry longhorn beetle. Fire events in the range of the beetle would consume some stems in this size class. However, since elderberry resprouts vigorously following fire in all alternatives, fire would rejuvenate decadent elderberry plants, maintaining quality habitat for the beetle. Given the relatively long natural fire return intervals (15-80 years) at elevations where the beetles may occur, and the vegetation mosaic that would result from fire events, ample time would pass between fires to create an extensive mosaic of mature elderberry. Not burning during March through mid-June would avoid the period when adults emerge and breed.

Yosemite toad – This candidate for federal listing occurs in alpine and subalpine areas of Kings Canyon National Park. The tadpoles live in shallow water and the adults live in moist meadows and rocky areas. Fires are rare, small, and typically of natural origin within their park distribution, and are very unlikely to occur within their habitat. Fire is not a concern regarding management of the species within these parks, and the species would not be effected by any differences in alternatives for managing fire.

California State Endangered or Threatened Species (that are not also federally listed)

The following California State-listed wildlife species may occur within these parks. A summary of these species, and the effects of the alternatives on them, is found in Table 5-C1.

California wolverine – This species lives in a wide variety of habitats and little is known of the potential impacts of fire. Fire restoration efforts would likely minimize the risk of adverse impacts to wolverine habitat from uncharacteristically severe wildland fire.

Little willow flycatcher – Little willow flycatchers in general are very rare in the parks and occur in meadows that burn infrequently, therefore, fire restoration is not likely to have any adverse impacts.

Sierra Nevada red fox – This subspecies is believed to live at high elevations that do not burn often. In general, fire is believed to benefit red fox by enhancing food supplies.

Swainson's hawk – This valley bird of open country would only rarely be found in the parks. Fire restoration would help maintain an open habitat to help them spot food and probably also help elevate their rodent food supply.

Table 5-C1 – Federal and State listed wildlife species (and Candidates)

Common Name	Species	Status	Effects For All Alternatives
bald eagle	*Haliaeetus leucocephalus*	Fed – T / State - E	0
California condor	*Gymnogyps californianus*	Fed – E / State - E	0/+
California wolverine	*Gulo gulo luteus*	State – T	+
Little Kern golden trout/critical habitat	*Oncorhynchus aquabonita whitei*	Fed - T	+ (- for Alt 1)
little willow flycatcher	*Empidonax trallii brewsteri*	State – E	0
mountain yellow-legged frog	*Rana muscosa*	Candidate Fed - E	0
Sierra Nevada Bighorn Sheep	*Ovis canadensis californiana*	Fed – E/State - E	0/+
Sierra Nevada red fox	*Vulpes vulpes necator*	State – T	+
Swainson's hawk	*Buteo Swainsoni*	State – T	+
valley elderberry longhorn beetle*	*Desmocerus californicus dimorphus*	Fed - T	+
Yosemite toad	*Bufo canorus*	Candidate Fed - E	0

Key:

Fed	Federal status
State	State of California status
E	Endangered: Listed as in danger of extinction.
T	Threatened: Listed as likely to become endangered within the foreseeable future.
*	Considered present by USF&WS

Candidate: Federal listing warranted but precluded
Critical Habitat: Area essential to the conservation of a species.

0	no effect
-	adverse effect
+	beneficial effect

Species of Special Concern

In addition to the federal and state listed endangered and threatened species, there are 36 special concern wildlife taxa that may be located in the parks. Impacts on these species have also been considered (Table 5-C2). As with other native species, it is assumed that the restoration of a natural fire regime and the maintenance of a mosaic of old growth forest conditions throughout much of the park would result in no effect, or beneficial effect on populations of these species.

Table 5-C2 – Other special status wildlife species

Common Name	Species	Status	Effects For All Alternatives
American marten	*Martes americana*	SC	0
American peregrine falcon	*Falco peregrinus anatum*	D	+
Bells sage sparrow	*Amphispiza belli belli*	SC	?
black swift	*Cypseloides niger*	SC	?
California spotted owl	*Strix occidentalis occidentalis*	SC	0
California thrasher	*Toxostoma redivivum*	SC	+
Denning's cryptic caddisfly	*Cryptochia denningi*	SC	?
ferruginous hawk	*Buteo regalis*	SC	+
Foothill yellow-legged frog	*Bufo boylii*	SC	+
fringed myotis bat	*Myotis thysanodes*	SC	?
greater western mastiff-bat	*Eumops perotis californicus*	SC	?
Kern River rainbow trout	*Oncorhynchus mykiss gilberti*	SC	+
Lawrence's goldfinch	*Caruelis lawrencei*	SC	?
Lewis' woodpecker	*Melanerpes lewis*	SC	?
loggerhead shrike	*Lanius ludovicianus*	SC	?
long-eared myotis bat	*Myotis evotis*	SC	+/?
long-legged myotis bat	*Myotis volans*	SC	?
Mount Lyell salamander	*Hydromantes platycephalus*	SC	0
northern goshawk	*Accipter gentilis*	SC	+
northwestern pond turtle	*Clemmys marmorata marmorata*	SC	0
Nuttall's woodpecker	*Picoides nuttallii*	SC	+
olive-sided flycatcher	*Contopus cooperi*	SC	?
Pacific fisher	*Martes pennanti pacifica*	SC	?
pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	SC	?
Prairie falcon	*Falco mexicano*	SC	0
red-breasted sapsucker	*Sphyrapicus ruber*	SC	?
relictual slender salamander	*Betrachoseps relictus)*	SC	?
rufous hummingbird	*Selasphorus rufus*	SC	?
silvery legless lizard	*Anniella pulchra pulchra*	SC	?
small-footed myotis bat	*Myotis cilioloabrum*	SC	?
southwestern pond turtle	*Clemmys marmorata pallida*	SC	0
spotted bat	*Euderma maculatum*	SC	?
Vaux's swift	*Chaetura vauxi*	SC	?
Volcano Creek golden trout	*Oncorhynchus mykiss aquabonita*	SC	+
white-tailed kite	*Elanus leucurus*	SC	?
Yuma myotis bat	*Myotis yumanensis*	SC	?

Key:

SC Species of Concern: Other species of concern to the USFWS.
D Federally Delisted: status to be monitored for 5 years.

0 no effect
- adverse effect

+	beneficial effect
?	unknown effect

Migratory Birds

In addition to the federal and state listed species above, managers must consider potential effects on certain migratory birds as stated in the Migratory Bird Treaty Act of 1918 (MBTA) and newly drafted Memorandum of Agreement between the National Park Service and the U.S. Fish and Wildlife Service. As with other native species, it is assumed that the restoration of a natural fire regime and the maintenance of a mosaic of old growth forest conditions throughout much of the park would result in no effect, or beneficial effect on populations of these species. (Information given below for peregrine falcons and California spotted owls following bold text was copied from the U.S. Forest Service fire effects web site http://www.fs.fed.us/database/feis).

Peregrine Falcon – This species is rare at Sequoia and Kings Canyon National Parks. While the species has made a remarkable recovery in most of the United States, it is not thriving in these parks and pesticides are still a concern. The species does attempt breeding at three known locations. Those sites should be avoided by low-flying aircraft during spring and early summer.

Direct Effects of Fire: Nichols and Menke (1984) reported that fires near nesting cliffs could disturb peregrine young or nesting pairs. No other direct fire effects on peregrine falcon have been noted.

Habitat-Related Fire Effects: The effect of fire on peregrine falcon habitat is best defined by how it affects their primary prey, other bird species. The California Department of Forestry concluded that peregrine falcons would benefit by chaparral burning if it resulted in an increase of other birds (Nichols and Menke 1984). Studies conducted on chaparral burning concluded that abundant food was available to raptors immediately following fire because of the vulnerability of prey species due to a cover reduction (Lawrence 1966). Bird species richness and diversity increase in the first few years following fire in chaparral communities (Wirtz 1982). Taylor and Barmore (1980) reported that following fire in Yellowstone and Grand Teton National Parks, air-soaring bird species were present by the second year and firmly established by the fifth year. (Peregrine falcons were not included on their species inventory list.) However, as the canopy closed (after 40 years), these species began to drop out and were replaced by other, but fewer, species. Total bird biomass here was at least 70 percent greater between 5 and 29 years following fire than it was after 40 years. They also concluded that canopy closure affected avifauna more than fire did. **Fire Use:** In California, Longhurst (1978) reported a greater diversity of bird species in young stands of chaparral regrowth (2-3 years old) or in chaparral interspersed with grassy openings than in stands that were older than 5 years. Frequent burning creates a mosaic of habitats and maintains abundant prey for peregrine falcons. Because peregrine falcons require open areas for

hunting, fires that create these open areas would probably be beneficial, provided burning led to an increase of prey species.

Flammulated Owl – This species lives in the mid-elevations of the parks occupying various coniferous forests varying from ponderosa pine to red fir. Observations are primarily during spring and summer. There is not much fire information on this species but because it lives in a combustible habitat and prefers open to intermediate canopy closure it is probably a fire adapted species and probably dependent on fire for long-term maintenance of its habitat.

California Spotted Owl – California spotted owls occupy both the conifer forests and some foothill habitat. Nearly all of their habitat within the park is fire dependent. The only exception may be large stands of canyon live oak growing in mesic sites and some foothill riparian habitat. While fires could cause some short-term disruption of their use of an area, the fire provides long-term maintenance of the habitat. Only stand replacing fires, as would occur from wildfires following long periods of fire exclusion, would be a direct threat to them. **Direct Effects of Fire:** No specific information regarding the direct fire effect on spotted owls was found. However, direct fire related mortality on spotted owls probably occurs. Fire may also destroy nests. **Habitat-Related Fire Effects:** Most spotted owl habitat owes its structure and species composition to fire (Lujan et al. 1992). Historically, spotted owls occupied a dynamic landscape that often consisted of large areas of burned and unburned forest. Today, however, habitat is greatly reduced and fragmented, and owl populations have become increasingly vulnerable to loss of habitat due to fire (Lujan et al. 1992, Thomas et al. 1990). Fires can cause further habitat fragmentation and loss of preferred suitable old growth. One study showed that areas that had been clearcut or burned within the previous 20 years were rarely used by spotted owls for foraging. Additionally, spotted owls usually avoided crossing burned areas by traveling through corridors of unburned timber around the area (Thomas et al. 1990).

Black Swift – Black swifts occur in the parks at most elevations, but primarily in the foothillls and conifer belt. They nest and roost in cliffs and near moist areas like waterfalls. They feed on aerial insects and may travel long distances to forage. Fires are unlikely to have any sustained effect on their nesting or roosting unless they are effected by the smoke, but fire could have local positive or negative effects on insect availability. Fire could flush insects increasing aerial insects along the fire’s edge or temporarily reduce insect availability after the fire passes. This in turn would effect their daily foraging patterns.

Rufous Hummingbird – The parks have summer reports of rufous hummingbirds from all elevations, but primarily from the mid-Sierran and high-Sierran elevations. Because the species is difficult to distinguish from Allen’s hummingbird, records could be in error. Assuming records are correct, the species occurs in both combustible

and rarely-burned environments like meadows. Where the species occurs in combustible habitats, the species should have a long-term habitat maintenance benefit from restoring fire to those areas as a natural process.

Lewis's Woodpecker – This species' occurrence within the parks is accidental at best. It occurs primarily at elevations lower than the park. It will not be effected by the fire and fuels management program.

Williamson's Sapsucker – This is an uncommon to locally common species of the montane conifer forests. The species lives within a fire dependent habitat and should be fire adapted. The species should have long-term benefit from restoration of fire. Because it is a woodpecker, the individual prescriptions probably have a direct effect on the availability and quality of food and nesting habitat.

White-headed Woodpecker – This is a common species in the montane conifer forests. The species lives within a fire dependent habitat and should be fire adapted. The species should have long-term benefit from restoration of fire. Because it is a woodpecker, the individual prescriptions probably have a direct effect on the availability and quality of food and nesting habitat.

Olive-sided Flycatcher – This species occurs at all elevations, but primarily in the conifer belt during the summer. It has a preference for sites that provide perches with extensive airspace to scan for insects. This species lives primarily in a fire dependent habitat. The species should have long-term benefit from the fire management program. There are probably short-term benefits from fires flushing insects on which they feed. Conversely, there may be a short-term loss of some prey after the fire passes.

Tricolored Blackbird – This species occurrence within the parks is accidental at best. It will not be effected by the fire and fuels management program.

Individual Species - Plants

Federally Listed Species
At this time, no federally listed or candidate plant species are known to occur within the parks.

Federal Species of Concern
The following federal plant species of concern are known to occur within the parks. A summary of these species, and the effects of the alternatives on them, is found in Table 5-C3. For each species, loss of individuals as a result of fire restoration either is not expected or would be minimal so as not to adversely impact the overall population.

Bodie Hill's rock cress – Bodie Hill's rock cress (*Arabis bodiensis*) is a small perennial herb in the mustard family. It is found in rock crevices and on open slopes at elevations between 8200' and 10170' (2500 and 3100 m). Two occurrences have been reported in the parks, both on rocky alpine slopes: Boreal Plateau in Sequoia National Park and Upper Basin in Kings Canyon National Park. Although fire effects on this species are unknown, it is unlikely that the alpine habitat it inhabits would be impacted by fire management activities in any of the alternatives.

Mouse buckwheat – Mouse buckwheat (*Eriogonum nudum* var*. murinum*) is a tall, erect herbaceous perennial in the knotweed family. It is a rare, highly restricted endemic known within the parks from only four populations in the Kaweah River drainage, where it colonizes rocky outcrops in the foothill woodland. The affects of fire on this taxa are unknown, and given its limited distribution it is a candidate for monitoring in areas that may be affected by fire management activities under all alternatives.

Raven's milk-vetch – Raven's milk-vetch (*Astragalus ravenii*, *A. monoensis* var*. ravenii*) is a slender delicate perennial herb in the pea family. It is known from approximately five occurrences, all of which are on dry alpine gravel flats. Although fire effects on this species are unknown, it is unlikely that the alpine habitat it inhabits would be impacted by fire management activities in any of the alternatives.

Kern River daisy – Kern River daisy (*Erigeron multiceps*) is a perennial herbaceous member of the Asteraceae family. Known from fewer than twenty occurrences on the Kern Plateau, it has a highly restricted distribution and is considered extremely rare by the California Native Plant Society. In 1955 it was collected from one location within Sequoia National Park, at an elevation of 6500 feet (1950 meters) at the mouth of the Big Arroyo. The species is found in dry, open areas within pine forests and also within meadows and seeps at elevations between 4920 and 8200 feet (1500 and 2500 meters). Little is known about the fire ecology of Kern River daisy. Surveys to confirm the occurrence and document the distribution and abundance of this plant within Sequoia National Park are scheduled for 2003.

Tehipite Valley jewelflower – Tehipite Valley jewelflower (*Streptanthus fenestratus*) is a small annual herb of the mustard family that invades disturbed sandy soils. It is endemic to the Middle and South Forks of the Kings River in Fresno County, and can form extensive stands following wet winter conditions. Populations within the park have been documented along the Middle Fork of the Kings River in the Tehipite Valley, and along the South Fork of the Kings River in the Cedar Grove environs. Park locations range in elevation from 4150 to 6000 feet (1265 to 1829 meters). It has been suggested that fire creates openings that are then colonized by *S. fenestratus*, but this has never been determined experimentally.

Alpine jewel-flower – Alpine jewel-flower(*Streptanthus gracilis*)is an annual herbaceous member of the Brassicaceae family that is endemic to the Sierra Nevada. Restricted to rocky granitic substrates in the upper montane and subalpine coniferous forests, it has been documented from thirty locations within the Kings River and Upper Kern River watersheds. Park locations range in elevation between 8295 and 11040 feet (2529 and 3366 meters). Little is known about the fire ecology of alpine jewel-flower.

California State Endangered Species
No California State endangered plant species are currently known to occur within the parks.

California State Threatened Species
No California State threatened plant species are currently known to occur within the parks.

California State Rare Species
The following California State rare plant species are known to occur within the parks. A summary of these species, and the effects of the alternatives on them, is found in Table 5-C3.

Tompkin's sedge – Tompkin's sedge (*Carex tompkinsii*) is a cespitose perennial herb of the sedge family that is restricted to river canyons of the western slope of the Sierra Nevada. It inhabits foothill oak woodland and chaparral areas and lower talus slopes. In the parks, it grows on gentle to steep slopes at elevations of 4160' - 6000' (1270 – 1830 m) in *Quercus chrysolepis - Umbellularia californica* and *Q. chrysolepis - Pinus monophylla* associations and mixed coniferous forest. Twenty-one occurrences of this sedge have been reported within the parks. The affects of fire on this taxa are unknown, and given its limited distribution it is a candidate for monitoring in areas that may be affected by fire management activities under all alternatives.

California State Species of Special Concern
No California State species of special concern are known to occur within the parks.

Table 5-C3 – Federal and state special status plant species

Common Name	Species	Status	Effects for All Alternatives
Bodie Hills rock-cress	*Arabis bodiensis*	Fed – SC	0
Raven's milk-vetch	*Astragalus ravenii (=A. monoensis var. ravenii)*	Fed – SC	0
Kern River daisy	*Erigeron multiceps*	Fed – SC	?
mouse buckwheat	*Eriogonum nudum var. murinum*	Fed – SC	?
Tehipite Valley jewel-flower	*Streptanthus fenestratus*	Fed – SC	?
alpine jewel-flower	*Streptanthus gracilis*	Fed – SC	?
Tompkins' sedge	*Carex tompkinsii*	State – R	?

Key:

Fed	Federal status
State	State of California status
R	Rare

SC	Species of Concern: Other species of concern to the United State Fish and Wildlife Service

0	no effect
-	adverse effect
+	beneficial effect
?	unknown effect

Species of Local Concern

The Fish and Wildlife Service also recognizes species of local or regional concern or conservation significance. Of the twenty-two species of local concern known to occur within Tulare and/or Fresno Counties, six are known to occur within Sequoia and Kings Canyon National Parks.

Hockett Lakes/Kaweah fawn lily – Hockett Lakes/Kaweah fawn lily (*Erythronium grandiflorum ssp. pusaterii)* is a perennial, bulbiferous herbaceous member of the lily family (Liliaceae)that is known from only five occurrences in Tulare County. It has been documented along the South Fork of the Kaweah River within Sequoia National Park, where it grows along both sides of the river in mixed red fir/lodgepole pine forest, between 8100 to 8320 feet (2430 to 2496 meters) in elevation. Related member of the species are fire resistant, although it is thought that frequent fires may suppress the species by eliminating the seed crop.

short-leaved hulsea – Short-leaved hulsea (*Hulsea brevifolia)* is a perennial herbaceous member of the Asteraceae, or sunflower family. A sierran endemic, it is found in both granitic and volcanic gravels and sands in upper and lower coniferous forests in Fresno, Madera, Mariposa, Tulare and Tuolumne counties. A single population has been documented within Sequoia National Park, near Dorst Creek campground; additional surveys are needed to better describe its distribution within the park.

field ivesia – Field ivesia (*Ivesia campestris)* is a perennial herbaceous member of the Rosaceae. Endemic to the Sierra Nevada, it is found in Fresno, Inyo and Tulare counties. In Sequoia National Park, it is found in upper montane and subalpine coniferous forests on the Hockett and Chagoopa Plateaus.

Purple mountain parsley – Purple mountain parsley (*Oreonana purpurascens*) is a prostrate perennial member of the carrot family. Seven populations are known to occur between elevations of 8260' and 9200' (2520 and 2800 m) within Sequoia and Kings Canyon National Park. It grows on coarse, sandy to gravelly soils on either granitic or metamorphic substrates in red fir, lodgepole pine, mixed coniferous, and yellow pine forests. Little is known about the response of purple mountain parsley to fire; park biologists recommend that post-burn response be monitored to gain insight into the potential effects of fire on this sensitive species.

aromatic canyon gooseberry – Aromatic canyon gooseberry (*Ribes menziesii var. ixoderme)* is a deciduous shrub in the Grossulariaceae. It is found in chaparral and cismontane woodlands in Fresno, Kern, and Tulare counties. Although specific data on the response of this species to fire is not available, other members of the genus are known to respond positively to fire, frequently re-colonizing areas post-burn.

Sequoia gooseberry – Sequoia gooseberry (*Ribes tularense*) is a low sprawling shrub of the gooseberry family. The Tulare county endemic is restricted to westernmost isolated stands of mixed coniferous forest between 5360' and 7040' (1630 and 2150 m). The parks' populations are known from the North, Marble, and Middle Forks of the Kaweah River. Little is known about the fire ecology of this species, but given its affinity for openings in the montane forest and vegetative reproduction, fire may have a beneficial effect. Norris and Brennan (1982 and 1984) recommended that experimental prescribed burns in and adjacent to Sequoia gooseberry populations should be conducted to note its response to fire.

Common Name	Species	Status	Effects for All Alternatives
Hockett Lakes/Kaweah fawn lily	*Erythronium grandiflorum ssp. pusaterii*	Fed – SLC	?
short-leaved hulsea	*Hulsea brevifolia*	Fed – SLC	?
field ivesia	*Ivesia campestris*	Fed – SLC	?
purple mountain parsley	*Oreonana purpurascens*	Fed – SLC	?
aromatic canyon gooseberry	*Ribes menziesii var. ixoderme*	Fed – SLC	?
Sequoia gooseberry	*Ribes tularense*	Fed – SLC	?

Key:

Fed	Federal status
SLC	Species of Local Concern: Other species of local concern to the United State Fish and Wildlife Service
0	no effect
-	adverse effect
+	beneficial effect
?	unknown effect

Park Species of Special Management Concern (Sensitive Species)

In addition to those taxa with either California State or Federal status, the park maintains a list of plant species of special management concern. Species of special management concern include those that may be: locally rare natives, listed by the California Native Plant Society, endemic to the park or local vicinity, at the furthest extent of their range, of special importance to the park (identified in legislation or park management objectives), the subject of political concern or unusual public interest, vulnerable to local population declines, or subject to human disturbance during critical portions of their life cycle.

Many of these taxa are recognized by the state of California as either requiring consideration according to the California Environmental Quality Act (CEQA), or are recommended for such consideration. Others have been officially delisted as candidates for federal status, but due to their limited distribution remain of concern to park management. In almost all cases, the effect of fire on individual species is unknown. However, in assessing the impacts of the alternatives, the assumption was made that native plant populations that currently occur in the parks have evolved in the presence of fire under historic fire regime conditions and therefore, would likely receive either beneficial or no effect. Plants occurring in alpine habitats are unlikely to be effected by fire management activities, and those taxa were subsequently removed from consideration (25 species). Of the remaining taxa (10 species), park biologists recommend that postburn response of the following plants be monitored to gain information about the response of these sensitive species to fire. These plants occur primarily in the mid-elevation areas of the parks where fire restoration is most active and little information is known about their response to fire. Table 5-C4 contains all 35 species of special concern, both alpine and mid-elevation species.

California pinefoot – California pinefoot (*Pityopus californicus*) is an achlorophyllous waxy-white saprophytic herb of the heath family. Rarely encountered, the plants require deep shade in the coniferous forests, and are known only from areas of moderately deep duff (~2″ or ~5 cm) overlying well-drained sandy loams. The two known park localities (Redwood Mountain and Grant Grove) represent southern disjuncts from a population center in the north Coast Ranges of California.

Call’s angelica – Call’s angelica (*Angelica callii*) is a robust perennial herb of the carrot family. It is found along streams at 3800' to 6500' (1160 to 1980 m) on the west slope of the Sierra Nevada in Tulare and northern Kern County; populations in Sequoia National Park range in size from as few as six to as many as 1,000 individuals.

Farnsworth’s jewelflower – Farnsworth’s jewelflower (*Streptanthus farnsworthianus*) is a small annual herb of the mustard family. It grows in dry, gravelly soil pockets in slate outcrops on steep, open grassy slopes in the foothill woodland, at elevations between 1900' and 5000' (580 and 1525 m) in the Middle Fork Kaweah River drainage in Sequoia National Park.

Hockett Meadows lupine – Hockett Meadows lupine (*Lupinus lepidus var. culbertsonii*) is a low growing perennial herb with short woody caudex in the pea family. In Sequoia National Park, Hockett Meadows lupine grows in lodgepole pine forests at elevations of 8500' to 9200' (1590 to 2800 m). It is found on gentle to level slopes of varied aspects, usually in partial shade of pines, but occasionally in full sunlight.

Muir’s raillardella – Muir’s raillardella (*Raillardiopsis muirii*) is a glandular, multi-stemmed perennial herb of the sunflower family. It

grows on both level sandy flats (as in the Tehipite Valley Area) and on granitic outcrops and steep, boulder-strewn gullies. Elevations in Sequoia and Kings Canyon National Parks range from 3900' to 7780' (1190 to 2370 m). The plant is found in open xeric sites surrounded by mixed coniferous forest and brush, with most populations on southerly exposures in full sunlight to partial shade.

Tulare County bleeding heart – Tulare County bleeding heart (*Dicentra nevadensis*) is a small, scapose perennial herb of the poppy family. It is almost exclusively restricted to Tulare County, where it often forms extensive patches at elevations between 7300' and 10400' (2225 and 3170 m) in red fir, lodgepole pine, and subalpine forests, and less commonly in mixed coniferous forest, montane chaparral, and alpine boulder fields.

Sugar pine – Sugar pine is not a federal or state special status species, however, park managers are interested in this species due to the current decline of mature sugar pine throughout much of its range. Anthropogenic factors, especially susceptibility to the introduced white pine blister rust, as well as natural factors, such as long periods of drought, may contribute to mortality of sugar pines. While sugar pine is generally known to be resistant to low- to moderate-severity fire, mortality following fire can occur, especially where heavy fuels from fire exclusion result in unusually severe heating of the trees' cambium. Further studies on effects and mitigation strategies would help provide the information needed to minimize additional stress to the species.

Giant sequoia – While not on the federal or state lists of special status species, giant sequoia (*Sequoiadendron giganteum*) is specifically identified as a primary natural resource in the parks' *Master Plan* (1971) and *Natural and Cultural Resources Management Plan* (1999). Much scientific research has been conducted on giant sequoias revealing the frequent occurrence of fire in sequoia groves, mature trees' resistance to fire, and their largely fire-dependent regeneration process. Research has shown that past fire suppression resulted in a near complete failure of giant sequoia reproduction. While research fully supports the restoration of fire in giant sequoia groves, continued monitoring of management actions affecting this species is critical because of the species' importance to the parks' creation.

Large-diameter trees – Promoting old forest characteristics, especially large-diameter trees, has become an important issue in the Sierra Nevada. Old forests that provide shading and relatively open forest floors provide habitat for several wildlife species of special concern, such as fisher (*Martes pennanti*), marten (*Martes Americana*), and spotted owl (*Strix occidentalis*)In addition, individual large trees, snags, and logs provide important ecological amenities such as food, cover, thermal and moisture moderation, to a substantial list of reptiles, amphibians, mammals, and birds that occur in much lower numbers or not at all when these ecosystem elements are not present.

While most of the parks' forests have not been affected by past commercial large tree removal, the scarcity of old forest throughout the range of these wildlife species adds importance to protecting the existing old forest characteristics found within the parks. Moreover, fire in unnaturally dense forest stands is more likely to kill large trees than would occur naturally. While specific mandates do not currently exist for management of large diameter trees in the parks, maintaining old forests as part of the larger Sierran ecosystem is of great interest to the parks. To address this issue, the parks' target conditions include a target range for large-diameter trees and the monitoring program is designed to assess whether these target ranges are achieved (see Fire Monitoring Plan and Target Conditions in Appendix C of the companion *Fire and Fuels Management Plan*). If the monitoring results indicate significant unwanted changes in the number of large diameter trees in areas where prescribed fire activities have occurred, the management actions will be reviewed and additional studies will be initiated, if needed. A study to determine the effectiveness of fuel removal around the base of large-diameter pines in reducing mortality in prescribed burns has already begun (see Fire Monitoring Plan and Target Conditions in Appendix C of the companion *Fire and Fuels Management Plan*). In addition, a review of past research and monitoring work related to giant sequoia mortality in prescribed burns indicates that large-diameter mortality of giant sequoia is rare, and therefore, not a concern at this time. Ongoing forest demography research by local USGS scientists will provide information about large-tree mortality resulting from non-fire factors which will also help to inform the fire management program.

Table 5-C4 – Other park plant species of special management concern.

Common Name	Species	Status	Effects for All Alternatives
three-bracted onion	*Allium tribracteatum*	SPC	0
Call's angelica	*Angelica callii*	SPC	?
Tulare County rock cress	*Arabis pygmaea*	SPC	0
Mineral King draba	*Draba cruciata*	SPC	0
Mount Whitney draba	*Draba sharsmithii*	SPC	0
Hall's daisy	*Erigeron aequifolius*	SPC	?
Sharsmith's stickseed	*Hackelia sharsmithii*	SPC	0
Hockett Meadow's lupine	*Lupinus lepidus var. culbertsonii*	SPC	?
Kaweah monkeyflower	*Mimulus norrisii*	SPC	0
mountain phacelia	*Phacelia orogenes*	SPC	?
California pinefoot	*Pityopus californicus*	SPC	?
Muir's raillardella	*Raillardiopsis muirii*	SPC	?
Farnsworth's jewelflower	*Streptanthus farnsworthianus*	SPC	?
northern spleenwort	*Asplenium septentrionale*	CEQA	?
Sweetwater Mountains milkvetch	*Astragalus kentrophyta var. danaus*	CEQA	0
Congdon's sedge	*Carex congdonii*	CEQA	0
meadow sedge	*Carex practicola*	CEQA	?
Sierra corydalis	*Corydalis caseana ssp. caseana*	CEQA	?
	Deschampsia atropurpurea	CEQA	0
Tulare County bleeding heart	*Dicentra nevadensis*	CEQA	?
Tulare County buckwheat	*Eriogonum polypodum*	CEQA	0
wooly yarrow	*Eriophyllum lanatum var. croceum*	CEQA	?
Yosemite ivesia	*Ivesia unguiculata*	CEQA	?

Sierra Nevada linanthus	*Linanthus oblanceolatus*	CEQA	0
copper-flowered bird's foot trefoil	*Lotus cupreus*	CEQA	?
small-flowered monkeyflower	*Mimulus acutidens*	CEQA	?
cut-leaved monkeyflower	*Mimulus laciniatus*	CEQA	0
Yosemite bulrush	*Scirpus clementis*	CEQA	0
weak mannagrass	*Torreyochloa pallida var. pauciflora*	CEQA	0
Sugar pine	*Pinus lambertiana*	P	0/?
Giant sequoia	*Sequoiadendron giganteum*	P	+

KEY:

SPC Species of park concern
P Specifically identified in park legislation
CEQA Species has no current state or federal legal standing but evaluation is recommended according to the California Environmental Quality Act

0 no effect
- adverse effect
+ beneficial effect
? unknown effect
Highlighted species = recommended for postburn response monitoring

Conclusions

All alternatives provide some level of restoration or maintenance of park ecosystems and therefore have the potential to reduce impairment to special status species. However, some alternatives reduce impairment only locally while others improve conditions across a larger area of the parks.

Under Alternative 1, sensitive plant and wildlife habitat in areas of the parks would continue to deteriorate, leading to uncharacteristically severe wildland fire that could cause permanent impairment of some sensitive resources. Future impairment of sensitive plant and wildlife habitat is less likely to occur in Alternative 2, 3, and 4, as those alternatives increase the area of the parks where natural conditions would be restored. Potential severe fire effects leading to impaired sensitive resources would be more likely in Alternative 3 and less likely in Alternative 4, where prescribed fire would be used to reintroduce fire to highly altered areas under less severe conditions to minimize adverse impacts.

None of the alternatives would result in the loss of individual species protected under the Endangered Species Act. Critical habitat for species with recovery plans would be enhanced under all alternatives. None of the alternatives would threaten populations of other species of concern. All alternatives provide some protection from large-scale catastrophic fire events.

Table 5-C5 – Comparison of Special Status Species Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Potential for Take of Individuals Protected as Threatened or Endangered	0	0	0	0
Loss of Viable Protected Populations	0	0	0	0
Loss of Critical Habitat Defined in 50 CFR 17.95	0	0	0	+
Amount of Habitat Restored or Maintained	0	+	+	+
Reduce Risk of Catastrophic Loss	0	++	+	++

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

++ effects are **highly desirable** compared to Alternative 1 (No Action)
+ effects are **desirable** compared to the effects of Alternative 1 (No Action)
0 effects are **equal** to the effects of Alternative 1 (No Action)
- effects are **undesirable** compared to the effects of Alternative 1 (No Action)
-- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

D. NON-NATIVE/INVASIVE SPECIES

Non-native species are of management concern since they may invade following disturbances such as fire, and have the potential to alter natural ecosystem structure and function. Of 1,495 known taxa of vascular plants in Sequoia and Kings Canyon National Parks, 183 (12%) are considered introduced according to the Jepson Manual (Hickman, ed. 1993).

Factors Used to Assess Environmental Consequences

Area Treated
Increases in area treated in proximity to non-native seed sources may result in more area at risk of invasion.

Area Exposed to High Severity Fire
Decreases in proactive treatment of many areas result in more area exposed to the risk of high severity fire, leading to the potential for increased non-native invasion.

Impacts Common to All Alternatives

Mechanical treatment to reduce hazardous fuels in proximity to structures would disturb vegetation in developed areas to the same extent in all alternatives. Heavy ground disturbance, which tends to promote non-native/invasive species, would be minimal. In addition, these areas are already disturbed by nature of their development and therefore, mechanical treatment would have limited or no-effect on non-native/invasive species in those small areas of the parks' for all alternatives.

Wildland fire suppression in all alternatives would result in limited direct impacts, including clearing or disturbing vegetation in localized areas of the parks. The average annual number of acres affected by fire suppression activities would be similar among Alternatives 1, 2, and 4. Alternative 3 would have approximately twice the amount of average annual acreage as the other alternatives. Ground disturbance in these areas could promote non-native/invasive species, therefore, limited, indirect impacts could occur which might increase non-native/invasive species.

In most cases, fire disturbance is not the ultimate cause of non-native species invasions, however, exposure of mineral soil resulting from fire can create an environment that is conducive to invasion by pioneer species, including non-natives. These invasions cannot occur without a seed source, therefore most increases in non-native populations in all alternatives would occur where species are already established or where seed is made available (proximity to roads, developed areas, and wildlife corridors).

If increases in non-native/invasive species occur due to either mechanical fuel reduction or the presence of fire on the landscape, efforts to remove these populations could be initiated under any of the alternatives. Early detection and eradication of non-native/invasive populations when they are small can prevent a time-consuming, expensive eradication effort. Therefore, identifying and surveying potential sites for new introductions annually is the most efficient way to prevent large-scale non-native species invasions.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
With only some areas of the parks treated with fire in the current program, the potential for uncharacteristically severe wildland fire is greater, providing more opportunity for non-native/invasive species that respond positively to severe fire disturbance.

Alternative 2 – Prescribed Fire
An increase in areas restored with fire in Alternative 2 compared to Alternative 1 would increase the potential for establishment and spread of non-native species promoted by fire disturbance, but limit the areas disturbed by severe wildland fire.

Alternative 3 – Wildland Fire Use
An increase in areas treated with fire in Alternative 3 compared to Alternative 1 would increase the potential for establishment of non-native/invasive species that are enhanced by fire, but limit the areas disturbed by severe wildland fire.

Alternative 4 – Multi-Strategy (Preferred Alternative)
An increase in areas restored with fire in Alternative 4 compared to Alternative 1 would increase the potential for non-native/invasive populations that are enhanced by fire, but limit the areas disturbed by severe wildland fire.

Conclusions

Since non-native species tend to follow disturbance, the effects of different fire management alternatives have offsetting effects. Alternatives that minimize the acres treated such as Alternative 1 reduce the risk of immediate invasion, but at the same time increase the risk of larger more severe fires in the future. Post burn conditions created following a severe fire may result in conditions more favorable to opportunistic non-natives, while inhibiting or eliminating native species not adapted to high severity fire. Such effects hold true for cumulative impacts as well. In general, reduced chances of large catastrophic fire through additional acres treated should reduce the chances of establishing non-native species on severely disturbed sites, but increase opportunities for non-native species which can occupy light to moderately burned areas.

Under all alternatives, increased monitoring and ongoing research could mitigate the adverse indirect effects of potential increases in non-native/invasive species under all alternatives by providing early detection and eradication of new invasive populations.

Table 5-D1 – Comparison of Non-Native/Invasive Species Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Area Treated	0	0	0	0
Area Exposed to High Severity Fire	0	0	0	0

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

++	effects are **highly desirable** compared to Alternative 1 (No Action)
+	effects are **desirable** compared to the effects of Alternative 1 (No Action)
0	effects are **equal** to the effects of Alternative 1 (No Action)
-	effects are **undesirable** compared to the effects of Alternative 1 (No Action)
--	effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

E. AIR

There are two significant air quality issues that interact with the proposed actions. First, the presence of Class 1 airshed designation for much of the park represents aesthetic, ecological, and social air quality related values. Second, the designation of the regional air basin as serious non-attainment for several criteria pollutants including ozone and PM-10 (particulate matter less than ten microns) are public health and safety concerns, though ozone in particular is also a pollutant with significant ecological consequences. Carbon dioxide is also a criteria pollutant that must be considered. Of the air quality related values to be considered in this environmental assessment, the production and management of PM-10 is the most significant. (See related sections: Chapter 5-H: Health and Safety, and Appendices I & J of the companion *Fire and Fuels Management Plan*.)

Factors Used to Assess Environmental Consequences

Conformity to Existing Law
Extent to which the alternatives conform to existing law regulating air quality and related values.

Conformity with Local and State Implementation Plans
Extent to which the alternatives conform to state and local implementation plans for criteria pollutants.

Extent to Which Alternatives Minimize Air Quality Effects while Achieving Park Goals
Alternatives are evaluated to assess their ability to balance competing objectives (clean air and ecosystem health).

Air Resources and Values Analyzed

Class 1 Airshed
The Congressionally designated wilderness covering 85% of parklands is classified as a Class 1 airshed under the Federal Clean Air Act (FCAA). The designation is intended to prevent further degradation of the airshed from human made pollutants such as those generated by transportation (vehicles) and stationary sources such as industrial emissions and burning of agricultural waste.
The extent to which smoke events occurred as part of the natural background conditions in the parks prior to European settlement is not fully known, but can be inferred from research characterizing natural fire regimes (See Chapter 9 in the companion *Fire and Fuels Management Plan*).

Since all alternatives propose levels of burning comparable to or less than those burned under pre-Euroamerican settlement conditions, and consistent with the Environmental Protection Agency’s Interim

Guidelines on the management of wildland fire, the assumption is made that levels of smoke generated by naturally occurring fires common in the Sierra Nevada under pre-Euroamerican fire regimes are similar to or greater than the levels that would occur under all alternatives proposed. The occurrence of smoke in park Class 1 airsheds as a result of the alternatives will therefore be considered part of the natural background. No further analysis of the impacts of the alternatives on Class 1 airsheds will be undertaken.

Criteria Pollutants

Carbon monoxide is a byproduct of combustion that breaks down quickly as smoke plumes travel away from immediate fire areas. Generally, carbon monoxide from wildland vegetative fires is not considered a significant contributor to urban carbon monoxide levels, and none of the alternatives would produce regionally significant amounts. Therefore carbon monoxide will not be further discussed.

The parks are within the San Joaquin Valley air basin. The basin is classified as serious non-attainment for two criteria pollutants of health concern (ozone and PM-10) as defined by the Federal Clean Air Act. **Ozone contribution** from wildland vegetative fires at the levels proposed in this environmental assessment is very small, and none of the alternatives would produce regionally significant amounts of ozone. Therefore ozone will not be further discussed.

PM-10 is the pollutant of primary concern in relation to the actions proposed in this environmental assessment. To manage the health effects of PM-10, the San Joaquin Valley Unified Air Pollution Control District (hereinafter referred to as the District) is required to implement Best Available Control Measures (BACM) in order to meet established deadlines set for complying with PM-10 National Ambient Air Quality Standards (NAAQS). BACM is implemented in the air basin by requiring all burners within the air basin, including the parks, to comply with a series of emission control measures that are some of the most stringent in the nation. BACM requirements are articulated in various rules (particularly Rule 4106) that describe the practices and procedures agencies need to implement BACM. BACM may also be further refined and described through the development of a workplan. The workplan would be developed in cooperation between the District and federal and state land management and fire agencies to encourage continued development of BACM practices.

Smoke management requirements are dynamic and require considerable consultation with the District. All elements of BACM defined by the District would be followed under all alternatives. Specific procedures to implement the requirements of BACM are contained in the parks' *Smoke Management Plan* (see *Smoke Management Plan* in the companion *Fire and Fuels Management Plan*, Appendix J.)

Since wildland fires may contribute regionally significant levels of PM-10, an analysis was undertaken to assess the PM-10 emissions generated under each alternative as a means of comparison.

Levels of PM-10 emissions proposed under all alternatives fall within the emissions inventory contained in the District's *Implementation Plan for PM-10* currently under review by the EPA. All alternatives are within the scope of, and in full conformity with, the District *Implementation Plan for PM-10.*

Elements Affecting Smoke Management

For all projects, smoke behavior, and its corresponding impacts, is a complex issue involving the following 8 dynamic elements:

1. **The amount and type of fuel that will burn** – a) Restoration areas have the highest fuel loading. Much of the fuel load in those areas (up to 50%) consists of 100 years of accumulated duff that burns mostly in the smoldering phase and produces more particulate than an equivalent number of tons burning in the flaming phase. b) Maintenance areas have less fuel overall and much less duff (less than 25% total fuel load) per acre than restoration burns. A higher percentage of fuels burn in the flaming phase resulting in a significantly lower rate of emissions.

2. **The type of fire situation and controllability** – Prescribed burn operations are the most controllable and predictable of all fire events. Wildland fire use fires generally provide opportunities for careful planning and management, though their random nature and, often, long duration make them somewhat less predictable to manage than prescribed burn operations. Generally, large unwanted suppression fires are the most uncontrollable and least predictable.

3. **The time of year smoke is produced –** Fall and early winter generally have climatic conditions least favorable to smoke dispersion, while spring and summer generally have better conditions for dispersing smoke.

4. **The exact behavior of the smoke plume** – a) The behavior of the plume is highly dependent on elevation and dynamic meteorological conditions occurring at the time of the fire event. b) Complex geography and weather patterns complicate the ability to exactly predict the quantity and destination of smoke particles in the plume.

5. **The direction and elevation that the smoke plume moves, and resulting concentrations at ground level –** Generally, the higher the elevation of the burn, the greater the mixing volume of air to dilute it. Higher elevation winds also tend to better dilute and disperse smoke at lower concentrations. High level winds may transport dispersed smoke particles long distances.

6. **The cumulative interaction of smoke from park fires with pollution sources in the San Joaquin valley (including other fires in the**

area) – The District regulates all prescribed fire and wildland fire use activities from all land management sources as part of BACM. Therefore, any activity generated by the parks would require prior approval from the District, who would be reviewing all other activity in the District at the same time.

7. **The ability to effectively model all variables in a dynamic environment** – a) As with most meteorological forecasting, the best and most accurate information is available close to the time of interest. While long-term climatic models are valuable in advance fire program planning, it is conditions that exist at the time of the actual fire event that are the best indicators of potential smoke impacts. b) As individual fire events occur under constantly changing environmental conditions, and many occur randomly through space and time, sophisticated air quality modeling beyond the scope of this environmental assessment and current technology would be needed in order to determine whether the estimated increases in smoke emissions proposed in these alternatives would cause actual exceedances of annual and 24-hour National Ambient Air Quality Standards within the San Joaquin air basin at any point in time. c) In lieu of such modeling, implementing BACM, complying with burn/no burn day designations issued by the District, and by using the best available meteorology and forecasting at the time of ignition are techniques that would be used to manage local and regional smoke effects and maintain emissions within the NAAQS under all alternatives. The District provides significant input into park decisions as individual projects are proposed for implementation. Modeling and forecasting meteorological conditions related to smoke dispersion and assessing potential impacts on regional conditions, assist the park in determining whether to proceed with ignition.

8. **Dense smoke would likely occur in the vicinity closest to fire operations –** Unhealthful concentrations of smoke would be most likely to affect fire personnel immediately adjacent to the fire. Most smoke plumes from fire operations would disperse at middle to upper elevations (6,000 to 12,000 feet) into remote, low population areas or wilderness.

Analysis Procedures

Calculating PM-10 Emissions

PM-10 emission estimates for this environmental assessment were based on an analysis that involved several steps described in detail in Appendix E. The first step in the analysis was a conversion of proposed program accomplishments by vegetation type for each alternative into measurable amounts of fuels consumed. Fuel consumption amounts were then used as inputs to a widely accepted emissions software package (FOFEM, First Order Fire Effects Model) to estimate emissions by alternative. To arrive at the best possible estimates, both fuel load information and the percent of fuel consumed by fire events utilized park specific data where it was available. The

resulting emission estimates were used to make comparisons between alternatives.

The estimates that follow were generated at two time steps, 10 and 25 years, to evaluate long-term changes that occur as fuels are altered by the management actions proposed under the alternatives.

Analysis Results: Tons of fuels per acre for each alternative
Table 5-E1 shows the estimated tons of fuel treated per year by fuel model under each alternative at two time steps. Figure 5-E2 and Table 5-E3 shows the sum of all fuel models treated to allow easier comparison between alternatives.

Alternative 1, though it fails to achieve significant resource and fuels management objectives, does have a modest proactive fuels management component and so shows some long-term reduction in consumption between 10 and 25 years. Alternatives 2, 3, and 4 all show higher levels of fuel consumption than Alternative 1 at both time steps. These alternatives reflect a more proactive treatment of fuels and restoration of ecosystems. The figures for 2, 3, and 4 also reflect a downward trend in fuel consumption over time (between 10 and 25 years) as areas of heavy fuels are treated and more parklands are converted to fuel types with lower average fuel load.

Table 5-E1 – Estimated tons of fuel treated per year by fuel model under each alternative at two time steps.

	Alt 1 No Action (Current Program)		**Alt 2 Prescribed Fire**		**Alt 3 Wildland Fire Use**		**Alt 4 Multi-Strategy (Preferred Alternative)**	
Fuel Model	Total Load 10 Year	Total Load 25 Year	Total Load 10 Year	Total Load 25 Year	Total Load 10 Year	Total Load 25 Year	Total Load 10 Year	Total Load 25 Year
1	0	0	0	0	0	0	0	0
2	0	8	1572	2452	420	436	1368	1388
3	0	0	0	0	0	0	0	0
4	5931	6364	4344	4296	6845	7181	6925	8127
5	1040	854	3871	3077	1323	1236	3416	3171
6	0	0	0	0	0	0	0	0
8	21082	21942	107860	143801	77189	114229	162413	222638
9	5222	3784	17936	15968	984	2270	17104	20812
10	178375	141109	513168	316059	643500	439945	344563	78763
14	34393	18499	136007	136007	136702	136007	58276	7990
18	13947	9274	40672	38555	40526	36875	15845	2629
25 year		201833		660215		738179		345518
10 year	259989		825431		907489		609910	

Figure 5-E2 – Estimated tons of fuel treated each year by alternative at two time steps

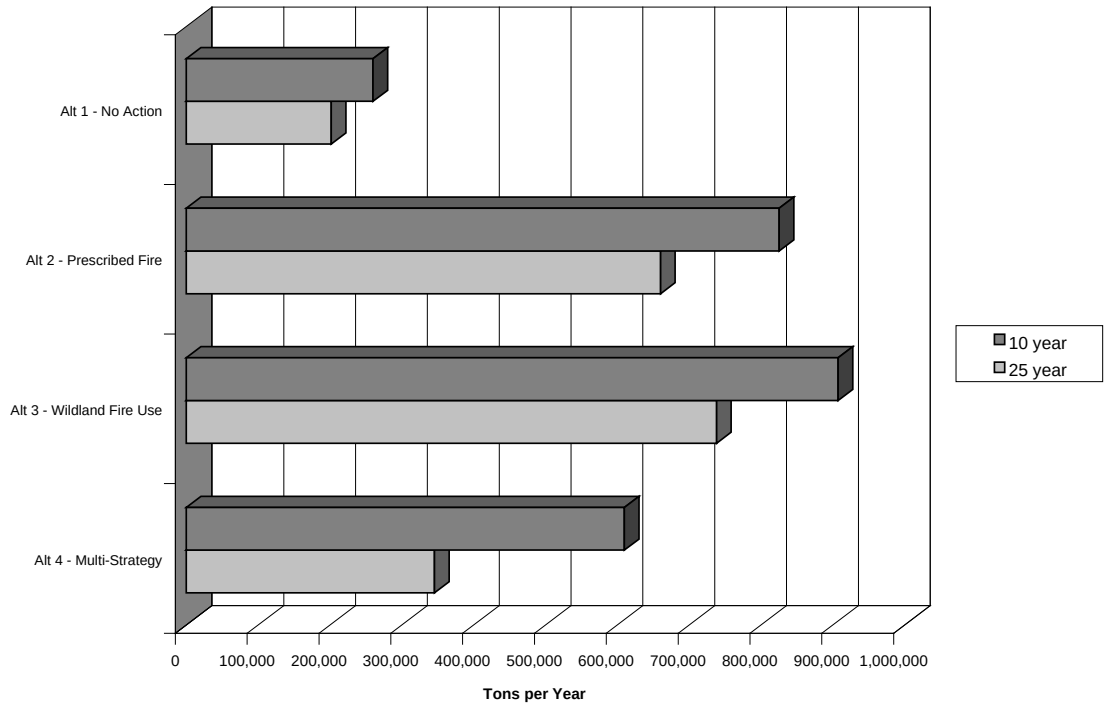


Table 5-E3 – Estimated tons of fuel treated each year by alternative at two time steps

	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
10 year	259,989	825,431	907,489	609,910
25 year	201,833	660,215	738,179	345,518

To best represent fuel loads, information used in the model was based on park wide fire effects plots and fuels inventory plots data, where such information was available. Fuel consumption estimates were made based on data from park fire effects plots collected on prescribed burn projects over the past 18 years. Where no local data was available, standard fuel model descriptors were applied.

In order to produce smoke emission estimates based on fuel loading and consumption data the First Order Fire Effects Model version 4.0 (FOFEM) was used. In its present configuration FOFEM does not exactly duplicate the consumption measured in the field by fire effects plots. However, the model does have the benefit of using algorithms that approximate the relationship between fuels that are burned in the flaming and smoldering phases respectively. Modeling consumption using the two phases of combustion is important because significantly more smoke is produced in the smoldering phase than in the flaming phase given the same quantity of fuel burned.

Estimated smoke emission outputs for each fuel model from FOFEM were then used as a multiplier for the acres of fuel model that are estimated to be burned each year under the various alternatives. The results (Figure 5-E4 and Table 5-E5) show estimated tons of PM-10 produced each year by each alternative at 10 and 25 years.

Example of the methodology used:

- Information from park-specific data shows that heavy timber litter forest stands (fuel model 10) have an average total fuel loading of 101 tons per acre of burnable, dead and down fuel. This figure includes litter and duff, as well as fuels greater than 3″ in diameter.
- From park specific monitoring data, it is known that when fuel model 10 burns, the average fuel reduction is 76%.
- Based on the inputs above, the FOFEM model calculates that for each acre of fuel model 10 that is burned in the parks an average of 1,650 pounds of PM-10 is produced.
- Under Alternative 4 - 3,421 acres comprised of fuel model 10 would burn each year at 10 years producing about (1,650 pounds/acre x 3,421 acres) = 2,822 tons of PM-10 per year parkwide. The same analysis is repeated for each fuel model, and the totals added together to arrive at an annual program total.

Figure 5-E4 – Estimated tons of PM-10 produced each year by alternative at two time steps

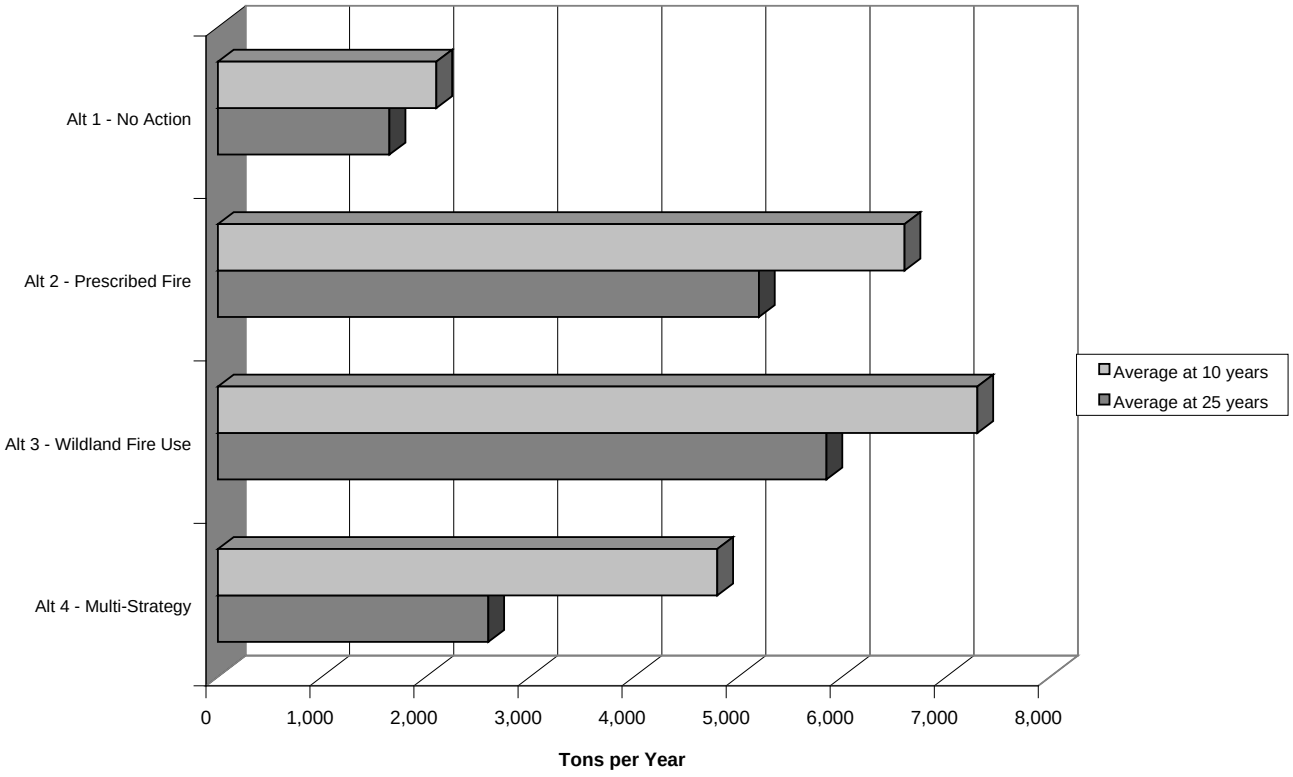


Table 5-E5 – Estimated tons of PM-10 produced each year by alternative at two time steps

	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Average at 10 years	2,100	6,600	7,300	4,800
Average at 25 years	1,650	5,200	5,850	2,600

Impacts Common to All Alternatives

Smoke emissions from unwanted wildland fires would continue to occur at some level every year under all alternatives. Some alternatives allow more control over when and where fires, and hence smoke events, occur. All individual wildland fire use and prescribed fire projects will be managed under the same conditions and constraints under all alternatives. Each project will be implemented only with the concurrence of the San Joaquin Valley Air Unified Pollution Control District, and managed to maintain smoke emissions in communities below the legal health thresholds as defined by the State of California and the Environmental Protection Agency. To accomplish this, smoke impacts would be managed, monitored, and mitigated according to requirements contained

in the *Smoke Management Plan* appended to the *Fire and Fuels Management Plan* and implemented following the sequence of approvals listed below or as directed by the District.

Prescribed Fire Approval Process

1. The park develops an annual list of prescribed fire projects and submits the list to the Air Quality District (AQD).

2. The park develops a detailed burn plan for each project, including a smoke management section that conforms to AQD requirements.

3. The park submits the individual burn plans and a *Smoke Management Permit Application* to AQD.

4. The park receives approval from AQD to proceed with burn implementation planning, or is required to revise the project and resubmit.

5. For projects approved by the AQD, the park requests weather and smoke dispersal forecasts 72 and 48 hours prior to planned ignition time.

6. 24 hours prior to planned ignition, the AQD gives the park a go or no-go decision based on current weather and smoke dispersal forecasts.

7. If AQD gives a “go”, the park proceeds with the project, subject to daily oversight by AQD. After ignition, the AQD may require that the project be held at current acreage, modified, or suppressed should regional air quality parameters change for the worse during implementation..

8. At the end of the season, the park reports total burned acres to the AQD and pays a smoke management fee (currently $5/acre). Evaluations and reports are submitted as required in Rule 4106.

Wildland Fire Use Approval Process

1. The park confirms a lightning ignition.

2. The park informs the AQD of the ignition. If it is a burn day for the zone, or a no-burn day and after consultation the AQD agrees to allow management of the ignition, the park proceeds with development of a *Wildland Fire Implementation Plan*.

3. If it is a no-burn day, <u>and</u> if required by the AQD, the park suppresses the fire using strategies commensurate with firefighter and public safety, and considering collateral damage to the resource.

4. If the ignition is allowed to be managed as a fire use project by the AQD, the park submits a *Smoke Management Permit Application* to the AQD within 72 hours of discovery.

5. The AQD approves or requires revision and resubmission of the smoke management permit.

6. Approved projects receive daily oversight by the AQD for conformity to the permit requirements. If projects are out of conformity with the permit or plan, the AQD may require suppression of the project using strategies commensurate with firefighter and public safety, and considering collateral damage to the resource.

7. At the end of the season, the park reports total burned acres to the AQD and pays a smoke management fee (currently $5/acre).

Suppression Fire Approval

1. An unwanted ignition is detected.

2. The park initiates suppression actions using strategies commensurate with firefighter and public safety, and considering collateral damage to the resource.

3. If the suppression action exceeds several days, the park consults with the AQD regarding potential smoke management concerns and suggested mitigating actions.

4. No smoke management plan or permit is required by the AQD, though smoke management actions and issues may be identified in the suppression action plan.

5. The AQD does not require suppression acres to be reported, and no smoke management fee is charged.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
PM-10 emissions would not significantly change in the short term. Modest levels of proactive fuels management with the opportunity to adjust timing would decrease smoke events in some areas of the parks over time. Occasional large unwanted fire events would continue to affect local communities and regional air quality one to several times each decade. Over the long-term fuels may continue to accumulate in untreated areas of the parks potential resulting in some larger, less predictable unwanted fire events.

Alternative 2 – Prescribed Fire
A threefold increase in annual PM-10 emissions would occur compared to Alternative 1 in the first 10 years of implementation as the 100-year backlog of fuels was reduced. After 25 years of proactive fuels management, emissions would decrease compared to the 10-year average.

Due to the exclusive use of prescribed fire in this alternative and the subsequent ability to select the timing and location of most fire events, the impacts of prescribed fire smoke events could be minimized.

The duration and intensity of smoke from large unwanted fire events would decrease over time as heavy fuel concentrations were systematically reduced across the parks.

Alternative 3 – Wildland Fire Use
Annual PM-10 emissions would be 3.5 times the current program outputs (represented by Alternative 1) during the first 10 years of implementation. After 25 years of proactive fuels management, emissions would decrease compared to the 10-year average.

Some large unwanted fire events could occur each decade, with declining duration and intensity of associated smoke events over time as fuels are proactively managed and fuel loads are reduced across the parks.

Due to the exclusive use of random natural events under this alternative, less control over the timing and placement of fire events would result in less opportunity to manage smoke impacts compared to all other alternatives.

Alternative 4 – Multi-Strategy (Preferred Alternative)
Average annual PM-10 emissions would be 2.3 times the current program outputs compared to Alternative 1 during the first 10 years of implementation. If annual programs levels were consistently achieved, after 25 years emissions would rapidly decrease to near the current program levels.

The use of natural fire in this alternative reduces the ability to manage smoke events in comparison to Alternative 2, but with the proactive management of prescribed fire, better control is effected over Alternative 3.

Some large unwanted fire events could occur each decade, with declining duration and intensity of associated smoke events over time as fuels are proactively managed and fuel loads are reduced across the parks.

Conclusions

Based on definitions and guidance provided by the EPA on the role of smoke from natural fire events on Class 1 airsheds, none of the alternatives would result in impairment of Class 1 airshed values. Properly managed under Best Available Control Methods (BACM), none of the alternatives would result in intentional exceedances of the NAAQS for criteria pollutants. Alternative 3, with its heavy reliance on random natural events, would be severely constrained by smoke management issues, and may be incompatible with good smoke management practices at this point in time.

In considering the impacts of the PM-10 produced by the various alternatives, both the gross amount of emissions along with the ability to manage the emissions under each alternative are important considerations. Alternatives that allow high levels of control over timing and placement of ignitions (e.g. Alternatives 1, 2, and 4) have less potential impact on air quality than alternatives that produce particulates on a random basis with little opportunity for management control (Alternative 3). This fact holds true from a regional cumulative effects standpoint as well. The more random and unplanned the ignitions, the greater the chance of smoke impacts upon the air resource.

Long-term effectiveness of the alternatives must also be considered. Assuming that best available control measures are applied to all alternatives, and that they can be successfully managed to keep emissions within the NAAQS levels to protect public health, the alternatives that show decreasing trends of emission production over time should be favored over those that indicate an increasing rate of emissions.

Alternatives 1 through 4 all show some long-term effectiveness in decreasing emissions over time, though it would be expected that Alternative 1, with only modest accomplishments, may begin to rise again over a longer timespan than assessed in this plan. Alternative 4 shows moderate increases in PM-10 emissions in the first 10 years but shows dramatic decreases occurring by year 25. Alternative 4 also exercises a great amount of control over the timing and placement of fire events, with most restoration burning occurring under controlled prescribed fire events.

Table 5-E6 – Comparison of Air Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Conformity to Existing Law	0	0	0	0
Conformity with Local and State Implementation Plans	0	0	0	0
Extent to Which Alternatives Minimize Air Quality Effects while Achieving Park Goals	0	+	+	+

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 0 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)
- -- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

F. WATER

The headwaters of the Kern, Kaweah, and Kings Rivers form the principal park watersheds. Minor watersheds include the Tule and San Joaquin Rivers. Over 1,700 miles of rivers and streams and more than 3,000 lakes and ponds exist within the parks. This aquatic system has important physical and biotic features and plays a major role in many ecosystem processes and the experiences of park visitors. Additionally, because these watersheds drain into the Central Valley they are ultimately important sources of water for recreation, agricultural, and industrial activities outside the parks.

At higher elevations in the parks, most precipitation occurs in the form of winter snow, which is stored in the snowpack and is released slowly through the spring and summer. At all elevations, spring and fall rains occur in a pattern typical of a Mediterranean climate. Annual drought occurs June through October with little or no precipitation during those periods. Occasional summer monsoons occur along the Sierra Crest that create intense hydrologic events in localized areas.

Important components of the water resources include the hydrologic cycle, streamflow regimes, sedimentation, and water chemistry (DeBano and others 1998). Prior to Euroamerican settlement fire played an important role in shaping how these components operated. Fire affects the quantity of water in streams, its chemistry, and its physical and biotic characteristics. Severity, size, season, location of fires, and the immediate postfire precipitation regime largely determine fire effects on watershed resources. The alteration of the natural fire regime by more than a century of anthropogenic intervention has been a significant stressor to park waters. Fire, or the lack of fire, has also affected nutrients, turbidity, buffering capacity, water temperature, and other water characteristics.

Primary sources of nutrients are geologic weathering and atmospheric input, which accumulate in biotic components of the ecosystem and are transported into or out of the ecosystem as part of the hydrologic cycle. Changes in the fire regime or the simple occurrence of a fire can alter the flux of nutrients associated with water. Following fire this alteration is usually manifested as increased nutrient flows through the aquatic system. For example, following a prescribed fire in a small mixed-conifer watershed in Giant Forest, researchers measured elevated concentrations of all solutes measured (NH_4, NO_2, NO_3, Na, SO_4, PO_4, Ca, Mg, K, Cl). The greatest proportional increases occurred in SO_4 and NO_3 (Chorover and others 1994; Williams and Melack 1997). Concentrations of most of these solutes remained elevated for three years. Alkalinity (ANC) doubled while no significant change was detected in pH. Anions increased to a greater degree than cations. After seven years Ca and Mg levels remained higher than preburn concentrations.

Increases in streamflow discharge rates also frequently occur following fire due to the combustion of vegetation and soil litter layers which decreases interception, ET, and infiltration while increasing overland and subsurface flows. In a Giant Forest mixed-conifer watershed, postburn flows continued to exceed preburn levels for 10 years (Chorover and others 1994; Williams and Melack 1997; Moore 2000). The continued high flows may be attributed to the continued mortality of dominant trees within the watershed. Shrubland stream systems may be similarly affected. Following the Kaweah wildfire in 1996, a formerly intermittent stream became active year-round with surface flows during even the hottest and driest periods (Werner, 1997, personal communication).

Sediment is eroded soil derived from watershed surfaces and transported into stream/river channels by overland flow. Sediment yield is dependent on supply of soil particles, magnitude and rates of streamflow, and physical characteristics of the sediment (DeBano and others 1998). Impacts of fire on sediments are greatest in areas of steep slopes, shallow soils, unstable geologies, and where high intensity rainfall events may occur. Postfire sediment yields are usually proportional to the amount of litter/soil organic matter removed by a fire and to what degree infiltration has decreased. Sediment yields are usually greatest in the first years following a burn and decrease as protective vegetation reestablishes and litter accumulates.

Factors Used to Assess Environmental Consequences

Actions Conform to Intent of Clean Water Act

Alternatives are evaluated to assure conformity with Clean Water Act provisions.

Actions Conform to Executive Orders 11988 and 11990

Alternatives are evaluated in relation to conformity with Executive Orders on wetlands and floodplain protection.

Alternatives Improve Resource Condition

Alternatives are evaluated to assess the extent to which they maintain or improve resource conditions.

Impacts Common to All Alternatives

All four alternatives reduce the overall impairment of water resources due to post-Euroamerican settlement reductions in fire frequency and would improve resource conditions over the long-term because they restore fire to park ecosystems. Changes in some water properties would occur with all alternatives, although the extent of the changes would vary with each. It can be expected that increases in flow, water temperatures, nutrient flux, and sediment transport would occur in localized areas or at the landscape-level depending on the

accomplishments of each alternative.

There is potential for these changes to result in either positive or negative impacts depending on factors related to fire severity, frequency, season, location (vegetation type), and magnitude of burns. Negative water impacts – those outside the normal range of natural variability – would tend to occur in areas of greater fire severity and larger fire size. These types of fires would not have occurred under pre-Euroamerican settlement conditions. Increases in runoff and nutrient flux would be expected to continue for multiple years (up to ten) particularly after restoration burns. Increased sediment yield and water temperatures would tend to be short lived unless a fire was of extreme severity.

Additionally, each alternative would have impacts resulting from fire related management activities, such as fireline construction or fire retardant use. The specific magnitude and longevity of the impacts on water resources would vary individually among the alternatives. Under each alternative, the use of retardant and fire fighting foam would follow restrictions contained in the *Fire and Aviation Management Operations Guide* (Addendum) which prohibit their introduction to open waters or wetlands.

None of the alternatives would result in a loss of wetlands, or affect floodplain characteristics.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
There may be temporary effects on water quality on a localized basis. Only moderate increases in run-off yield due to the reduction of vegetation result from prescribed burns because managers could control the location, timing, and severity of fire. However this alternative fails to fully restore fire as a process or achieve fuel reduction goals at a landscape scale (Caprio and Graber 2000). As a result there is a continuing backlog and accumulation of fuels with associated impacts of water resources and potential risk (moderate-to-high) of catastrophic fire events. Such events may be extreme with severe fire behavior over large areas, which would also result in adverse impacts to various water properties.

Alternative 2 – Prescribed Fire
A moderate increase in run-off yield would also be expected under this alternative due to the reduction of vegetation produced by prescribed burns. This alternative provides for the maximum control of fire – season, size, severity, and location (factors that reduce consumption of litter and above ground biomass) – of all the alternatives. However, initially there would be some potential for adverse unplanned fire events in unnatural fuels, similar to Alternative 1, but the risk of such occurrences would decline over time as the amount of area restored increases and fuel continuity is broken up. Significant long-

term impacts on water could occur through such activities as fireline construction, which is often necessary to control prescribed burns. Since these activities would be required in all portions of the parks under this alternative, there would be widespread impacts. Additionally, because prescribed fires would be used, which would be ignited under specific prescriptions, there is the potential that the full range of natural processes that acted on water in the past would not be restored.

Alternative 3 – Wildland Fire Use
Attributes and outcomes of fire and its impacts on park water resources would be more unpredictable under this alternative. This alternative would provide for the least control over such factors as size, severity, season, and location of fires. This unpredictability or variation may have either desirable or undesirable impacts for water depending on location, size, and intensity of burns. The effects would be more positive to the extent that the naturally-ignited fires would occur under the normal ranger of fuel and fire behavior conditions. Fires outside this range could potentially result in detrimental impacts with unnatural impacts on water resources and sedimentation. Such fires would have the greatest chance of occurring where unnatural fuels and vegetation currently occur. The potential effects would probably be most pronounced in the Kings and Kaweah watersheds. Impacts related to line construction and similar activities would be minimized relative to the other alternatives.

Alternative 4 – Multi-Strategy (Preferred Alternative)
The initial impacts of this alternative are similar to those for Alternative 2 due to the dominance of prescribed burning. Impacts would be minimized because sensitive drainages would be better protected from high intensity fire by prescribed burns. However, as forest conditions and fuels are restored prescribed burning would decline and natural fire would play an increasingly important role. Impacts of natural fire would be minimal because they would generally be confined to areas where unnatural fuel levels have been restored by prescribed burning (in contrast to Alternative 3) or to areas where forest conditions and fuels have remained within the range of pre-Euroamerican settlement conditions. Impacts from carrying out prescribed burns (line construction etc.) would be greatest at the onset of this alternative and decline over time. The amount of park area where natural variation in fire effects on water resources could occur would increase over time.

Conclusions

The reintroduction of fire would reestablish more natural properties to water in the parks. The overall impairment of water resources due to Euroamerican changes in the fire regime over the last 150 years would be reduced by all alternatives and resource conditions would improve.

Short-term impacts on water resources would occur under all alternatives. These impacts would most likely be manifested as increased flow, nutrient flux, stream temperatures, and sediment transport. The magnitude would depend on the alternative.

Long-term impacts would be more variable among the four alternatives. Alternatives 1, 2, and 4 control conditions under which fires burn and, thus, would tend to reduce impacts. However, long-term impacts of these three alternatives on water would differ. Alternatives 2 and 4 would accomplish desired conditions for restoring fuels and forest conditions while Alternative 1 would not. Under the latter alternative water conditions may continue to degrade on a local scale leading to continued impairment of park resources, although to a lesser degree than without fire. Alternatives 2 and 4, which fully and rapidly restore forest conditions and fuels to pre-Euroamerican levels, would reduce the probability of catastrophic fire events that could negatively impact water resources. The long-term outcome and success of Alternative 3 would be less certain due to the potential for the occurrence of severe fire events prior to restoration being achieved. Impacts of direct fire management activities (firelines etc.) on water would be greatest for Alternative 2 and least for Alternative 3.

Cumulative impacts from fire effects on water would be most likely in the Kern and Kings Rivers drainages. Both drainages contain sizable areas of Forest Service management below the parks. Wilderness occupies much of the Kern drainage below the park. Much of it burned in the 2002 McNally Fire. It is expected that water yield and sedimentation will increase in the short-term, and remain elevated for the drainage across all park alternatives due to the large size of the McNally Fire. Actions associated with alternatives 1, 3, and 4 would have the most effect since they may contribute additional wildland fire use acres. The Kings drainage has not had recent, large unwanted wildland fire below the park except for the 1997 Choke Fire. Actions associated with alternatives would follow the same pathway as described above for the Kern drainage, accept that chances for large unwanted wildland fire burning a large percentage of the drainage still remain across the landscape.

Of the four alternatives, long-term maintenance of water resources within a natural range of variability would be most likely obtained through Alternative 4 and would result in the least impairment.

Table 5-F1 – Comparison of Water Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Actions Conform to Intent of Clean Water Act	0	+	+	+

Actions Conform to Executive Orders 11988 and 11990	0	0	0	0
Alternatives Improve Resource Condition	0	+	+	+

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 0 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)
- -- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

G. SOIL

Soil is an integral component of most terrestrial ecosystems. The physical, chemical (nutrient), and biotic properties of soil are important in determining function, productivity, and other characteristics of these ecosystems (DeBano and others 1998). The three components interact in complex and often poorly understood ways. Important physical properties of soil include texture, composition (sand/silt/clay), bulk density, porosity, structure, infiltration, temperature, and water repellency. Chemical properties include characteristics, processes, or reactions derived from the chemical composition or reactions occurring in the soil. Biotic properties relate to functions or attributes of soils that reflect the role of living or dead organisms. Important biotic influences include many relationships between plants and microorganisms that enhance uptake of nutrients while in other cases soil organisms are responsible for diseases.

All fire, whether natural or human-caused, changes the cycling of nutrients and the biotic and physical characteristics of soils. The magnitude and longevity of these effects depend on many factors including fire regime, severity of a particular fire, vegetation and soil type, topography, season of burning, and pre and postfire weather conditions. Effects can also be indirect through changes in soil biota and changes in erosional rates. Sites that historically had frequent fires are generally better adapted to the reintroduction of fire and repeated burning.

Changes in soil nutrients due to fire occur in the form and shifts in composition, distribution, and amount. They are usually the result of the volatilization of elements during combustion of fuel and organic matter. The volatilization is temperature dependant, with nitrogen, and to a lesser extent sulfur and phosphorus, most readily lost. Other nutrients are generally lost as ash via convection. Changes in nutrients can also be a result of leaching through the soil. Changes in nitrogen availability, due to its volatility at low temperatures,

are usually considered the most important. Burning can decrease total nitrogen availability at a site while increasing nitrogen available for plant growth. Following prescribed burns in Giant Forest inorganic soil ammonium-nitrogen (NH_4^+ -N) levels increased from 1.90 mg/kg of soil under sequoias and 1.66 mg/kg of soil under sugar pines to 68.63 mg/k and 62.71 mg/kg respectively immediately after the fire (Haase and Sackett 1998). By five years, NH_4^+ -N had returned to preburn levels (1.54 and 1.60 mg/kg soil respectively) and by seven years had dropped below preburn levels (1.12 and 1.52 mg/kg soil respectively). Changes in nitrate-nitrogen (NO_3) were similar except peaks occurred two-years postburn. Other nutrients (Ca, Mg, K, and SO_4) also increased with SO_4 increasing by an order of magnitude (Chorover and others 1994; Williams and Melack 1997).

Biotic soil communities are complex and still poorly understood, particularly in relation to fire effects. Fire can influence soil biota directly by killing or injuring organisms, or indirectly by altering properties of the above- and below-ground soil environment. Burning generally results in declines in soil invertebrates and fungi while microorganisms such as bacteria increase in abundance. Changes in above-ground biotic communities due to changes in the fire regime may also impact soils and interact with soil nutrient status. For example, nitrogen-fixing plants are suppressed in some fire-excluded forests relative to areas where the presence of fire has been maintained (Newland and DeLuca 2000). Additionally, the effects of fire on cryptogramic crusts, (important nitrogen fixers in some ecosystems) have not been explored.

Changes in physical characteristics of soil following fire are a result of complex interactions among geomorphic processes, climate, vegetation, and landforms. Fire can affect changes in organic horizons, water repellency, infiltration capacity, porosity, structure, temperature, hydrologic properties, and various erosional processes. Changes in erosional properties and sedimentation rates are often considered the most important. Fire generally increases the potential for accelerating erosion through its effects on vegetation, organic matter, and the physical properties of soil. Increased fire severity generally increases the amount of change in these factors. Changes induced by fire events increase the amount of exposed mineral soil and potential for erosion and sediment transport. Recent studies show that the deliberate use of prescribed fire may dramatically reduce erosion potential when compared to uncontrolled wildfire events. In one study, erosion and sediment from a high intensity wildfire event was ten times higher than that measured off a low intensity prescribed burn (Wohlegmuth et al, 1999). These effects are further affected by site properties, such as soil erodibility, slope steepness, and the timing, intensity, and amount of precipitation. The magnitude of fire’s impact on soils is highly dependent on the situation and the concurrent timing of these factors.

Park soils are primarily granitic in origin with depths varying from several feet in a few low elevation areas to a very thin or

nonexistent soils at higher elevations. While the parks have no definitive soils map, Storie (1953) has classified the soils of this general area as upland residuals, which have formed in place by the disintegration and decomposition of the underlying parent rock. This upland category can be divided into two groups: 1) rolling, hilly-to-steep uplands in timbered portions of the parks where podzolic soils are common and characterized by depths of three to six feet to bedrock and a moderate to strongly acid reaction, and 2) residual soils of very shallow depth to bedrock found in the remainder of the parks, especially at the higher elevations.

In most park ecosystems prior to Euroamerican settlement, fire affected both the soils and the operation of many geomorphic processes. The alteration of the natural fire regime by more than a century of anthropogenic intervention can be considered a significant alteration of and stressor to soils (properties and processes). Understanding changes due to the loss of fire in these ecosystems and how current processes would change with the restoration of fire is important. For example, there is the potential for heightened erosion in areas of chaparral vegetation due to the complete removal of most above-ground biomass by fire. This differs from a Sierran conifer forest where overstory vegetation is generally maintained after fire. Because of the landscape scale of some effects, they could have significant impacts both inside and outside the parks. Impacts and processes within the parks may be considered within the natural range of variability for that change. In contrast, the same process may produce effects outside the parks that are considered undesirable and a negative impact. For example, it would be important to understand whether there are significant erosional and sedimentation risks associated with certain types of fire because of the existence of structures, such as dams, flumes and hydroelectric generation plants, at downstream locations on the Kaweah, Kern, and Kings Rivers.

Factors Used to Assess Environmental Consequences

Maintenance of Natural Processes

Alternatives that most closely maintain and restore natural process are favored over alternatives that alter or constrain those factors.

Acres Pro-actively Managed

Alternatives that promote more acres of pro-active restoration to natural function are favored over alternatives that restore fewer acres.

Risk of Catastrophic Loss

Alternatives that result in a reduction of unnaturally large high-severity fire events are favored over alternatives that leave more acres vulnerable to damage from this source.

Impacts Common to All Alternatives

Since all alternatives enable fire to occur within park ecosystems within specific bounds, they would reduce the overall impairment of soil ecosystems due to post-Euroamerican reductions in fire frequency. This would improve resource conditions over the long term. Under all alternatives fire would produce changes in soil processes and properties, although the extent of the changes would vary with each alternative. These changes would result in either positive or negative impacts depending on fire severity, frequency, season, location (vegetation type), and magnitude of burns. Negative soil impacts – those outside the normal range of natural variability – would tend to occur in areas of greater fire severity and larger fire size. These types of fires would not have occurred under pre-Euroamerican settlement conditions. Additionally, each alternative would have impacts resulting from fire related management activities, such as fireline construction or fire retardant use. The specific magnitude and longevity of the impacts would vary individually among the alternatives.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
In this alternative, because of the ability to control location, timing, and severity of fire, there would be moderate effects on soils. This alternative, however, fails to fully restore fire as a process or achieve fuel reduction goals at a landscape scale (Caprio and Graber 2000). As a result there is a continuing backlog and accumulation of fuels with associated impacts of soils and potential risk (moderate-to-high) of catastrophic fire events. Such events could be extreme with severe fire behavior over large areas that may result in adverse impacts to various soil properties. These impacts may be most severe in chaparral vegetation.

Alternative 2 – Prescribed Fire
Compared to all the alternatives, Alternative 2 provides for the maximum control of fire (season, size, severity, and location). Initially there would be potential for adverse fire events in unnatural fuels, similar to Alternative 1, but the risk of occurrence would decline over time as the amount of area restored is increased and fuel continuity is broken up. However, significant long-term impacts on soils could occur through such activities as fireline construction, which is often necessary to control prescribed burns. Since these activities would be required in all portions of the parks under this alternative, there would be widespread impacts. Additionally, because prescribed fires would be used, which would be ignited under specific prescriptions, there is the potential that the full range of natural processes that acted on soils in the past would not be restored.

Alternative 3 – Wildland Fire Use
Attributes and outcomes of fire and its impacts on park soil resources would be more unpredictable under this alternative. This alternative would provide for the least control over such factors as size, severity, season, and location of fires. This unpredictability or variation may have either desirable or undesirable impacts for soils, which would depend on location, size, and intensity of burns. The effects would be more positive to the extent that the naturally ignited fires would occur under the normal range of fuel and fire behavior conditions. However, fires outside this range could potentially result in detrimental impacts with unnatural rates of soil erosion and run-off. Such fires would have the greatest chance of occurring where unnatural fuels and vegetation currently occur. The potential effects would probably be most pronounced in the Kings and Kaweah watersheds. Impacts related to line construction and similar activities would be minimized relative to the other alternatives.

Alternative 4 – Multi-Strategy (Preferred Alternative)
The initial impacts of this alternative are similar to those for Alternative 2 due to the dominance of prescribed burning. However, as forest conditions and fuels are restored prescribed burning would decline and natural fire would play an increasingly important role. Impacts of natural fire would be minimal because they would generally be confined to areas where unnatural fuel levels have been restored by prescribed burning (in contrast to Alternative 3) or to areas where forest conditions and fuels have remained within the range of pre-Euroamerican settlement conditions. Impacts from carrying out prescribed burns (line construction etc.) would be greatest at the onset of this alternative and decline over time. Amount of area where natural variation in fire effects on soils occurred would increase over time.

Conclusions

The reintroduction of fire to the parks would reestablish natural erosion processes and soil properties, particularly in the mid-elevation zone where pre-Euroamerican fire was most frequent. Overall impairment due to Euroamerican changes in the fire regime over the last 150 years would be reduced by all alternatives and resource conditions would improve.

Short-term impacts on soil resources would occur under all alternatives. These impacts would most likely be manifested as increased sediment transport.

Long-term impacts would be more variable among the four alternatives. Alternatives 1, 2, and 4, which control conditions under which fires burn, would tend to reduce impacts. However, long-term impacts on soils of these three alternatives would differ. Alternatives 2 and 4 would accomplish desired conditions for restoring fuels and forest conditions while Alternative 1 would not. Under the latter

alternative, soil conditions would continue to degrade leading to continued impairment of park resources although to a lesser degree than without fire. The long-term outcome of Alternative 3 would be less certain due to the potential for severe fire events prior to restoration being achieved. Alternatives 2 and 4 that fully and rapidly restore forest conditions and fuels to pre-Euroamerican levels would reduce the probability of catastrophic fire events that could negatively impact soil processes. Impacts of direct fire management activities (firelines etc.) on soils would be greatest for Alternative 2 and least for Alternative 3.

Of the four alternatives, long-term maintenance of soil processes within a natural range of variability would be most likely obtained through Alternative 4 and would result in the least impairment of soil resources.

Table 5-G1 – Comparison of Soil Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Maintenance of Natural Processes	0	++	+	++
Acres Pro-actively Managed	0	+	+	++
Reduce Risk of Catastrophic Loss	0	++	+	+

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 0 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)
- -- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

H. HEALTH AND SAFETY

The health and safety of the public and fire personnel would be affected in varying degrees under all alternatives. There are two major concerns related to health and safety issues. The first is the actual danger of fire caused injuries or fatalities – firefighters, visitors, or residents becoming trapped and directly burned by fire, or injuries that are indirectly caused by the fire incident such as injury or death from falling rocks and trees, or losing balance and falling. The second health and safety concern comes from smoke inhalation - either by firefighters on the fireline or by the public in areas away from the fire.

Since smoke is produced by individual fire events, it must be managed and mitigated at that level. Important elements in considering appropriate smoke management actions include: distance of the fire from

the population of concern, local weather conditions affecting smoke movement, duration of exposure, and the type of fuel being burned.

Direct and Indirect Injury

The direct risk to the health and safety of personnel on the fireline is a major issue and is addressed through adherence to standards designed to limit wildland fire personnel exposure to health and safety threats. Firefighter and public safety is the first consideration on any fire event and all fire actions will be based on providing for safety. There is no history in the parks of death or injury to visitors or residents directly caused by wildland fire, although the potential for injuries or fatalities exists. The park's fire program works to mitigate long-term threats to public safety by reducing hazardous fuels with the use of prescribed fire and mechanical fuel reduction around developments and along roadways where visitors could become trapped by fire.

On an event level, mitigation measures are implemented to limit the public's direct exposure to fire. Mitigation includes temporary trail closures, trail cautionary signing, strict road visibility standards, and the temporary closures of facilities. These measures are included in the parks' *Fire and Aviation Management Operations Guide* (Addendum).

Smoke Effects

Firefighters are exposed to the highest health risk from smoke on or near the firelines. The risks are well studied and include carbon monoxide, hydrocarbons, and particulates. Standard firefighting practices are employed to minimize firefighter exposure. These practices include: planning the location of firelines to minimize exposure, rotating firefighters out of smoky segments of the fireline at frequent intervals, and providing rest and sleep areas away from areas of significant smoke on long duration events.

Most byproducts of wildland fire combustion of health concern are concentrated at the fireline, and decrease to negligible levels in very short distances. Fine particulates however, may travel much greater distance from firelines. While they also become diluted with distance, their ability to be transported away from the fireline makes this byproduct the one of most concern in relation to public health.

Since the health effect of smoke may occur some distance from actual fire events, the parks focus most attention on the effects of the alternatives on park visitors, employees, and local communities that experience indirect smoke impacts, particularly concentrations of fine particulates.

Generally, the greater distance from the fire, the larger the volume of air available to dilute smoke and particulates below levels considered harmful to humans. Higher elevation fires typically loft smoke into

mixing air masses, diluting the smoke further. Local weather patterns affect smoke mixing and movement, especially at night.

Smoke impacts are not directly related to increasing wildland fire acreage. For example grassland fires produce much less smoke per acre than do forest fuels. Even areas of similar vegetation types in forested areas may have significantly different amounts of emissions due to lower fuel load and smoke production in restored areas compared to areas that have missed several cycles of wildland fire and containing unnaturally heavy fuel loading.

Factors Used to Assess Environmental Consequences

Minimize Direct Exposure to Hazardous Environment
Alternatives are evaluated to determine which ones best minimize exposure of the public and firefighters to direct fire hazards.

Minimize Exposure to Secondary Effects of Fire
Alternatives are evaluated to determine which ones best promote the ability to control or manage the effects of smoke in local communities within State health standards.

Impacts Common to All Alternatives

Due to the abundance of flammable landscapes, plentiful natural and human ignition sources, and hot, dry summers, no alternative eliminates the health risk of smoke for firefighters, visitors, or communities. Unwanted wildland fires will occur and produce smoke under all alternatives. Alternatives that allow more control over the timing, placement, and conditions under which fires burn will be more successful at minimizing smoke impacts over the long term.

All individual wildland fire use and prescribed fire projects will be managed under the same conditions and constraints under all alternatives. Each project will be implemented only with the concurrence of the San Joaquin Valley Air Pollution Control District, and managed to maintain smoke emissions in communities below the legal thresholds as defined by the State of California and the Environmental Protection Agency. To accomplish this, smoke impacts will be managed and mitigated according to requirements contained in the *Smoke Management Plan* appended to the *Fire and Fuels Management Plan*.

While the park intends to manage all wildland fire use and prescribed fire projects so that established health limits are not exceeded, it is recognized that some individuals exposed to smoke may be sensitive or susceptible to smoke impacts at levels below the legal limits. Under all alternatives, the parks will manage this potential impact through a system of identification of sensitive individuals in the affected communities, advance notification to help affected parties mitigate or

avoid potential impacts, and any other actions deemed reasonable and/or as directed by the Air District.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
Public. There is no expected increase in fire caused injuries to visitors, employees, and the public. Under Alternative 1, fire operations would remain at current levels with intermittent visitor, employee, and general public exposure to ground level smoke particularly during late night and morning periods when smoke plumes collapse, descend and concentrate in low lying areas or canyon bottoms.

Fire Personnel. Since fire operations would remain at current levels, there would not be an immediate increase in the rate of exposure of fire personnel to hazardous conditions—both fire and smoke. Over time, as fuels continue to accumulate in untreated areas of the parks and the risk of catastrophic fire grows, fire personnel would be exposed to increasingly hazardous conditions.

Alternative 2 – Prescribed fire
Public. There is no expected increase in fire-caused injuries to visitors, employees, and the public. A significant increase in prescribed fire operations would occur which has the potential to increase the exposure of visitors, employees, and the public to ground level smoke particularly during late night and morning periods when smoke plumes collapse, descend and concentrate in low lying areas or canyon bottoms.

Fire Personnel. There would be a significant increase in the number and extent of prescribed fire operations that would cause an increase in the rate of exposure of fire personnel to hazardous conditions—both fire and smoke. An increase in injuries may occur but it is not possible to predict with any certainty the increased rate of injury. The planned nature of prescribed fire events should allow for a lower rate of injuries than Alternative 3 given its unplanned nature.

Alternative 3 – Wildland Fire Use
Public. There is no expected increase in fire-caused injuries to visitors, employees, and the public. A significant increase in wildland fire use operations would occur which has the potential to increase the exposure of visitors, employees, and communities to ground level smoke particularly during late night and morning periods when smoke plumes collapse, descend and concentrate in low lying areas or canyon bottoms.

Fire Personnel. There would be a significant increase in the number and extent of wildland fire use operations that would cause an increase in the rate of exposure of fire personnel to hazardous conditions—both fire and smoke. This exposure would be unplanned with the potential of a higher rate of injury than Alternative 2.

Alternative 4 – Multi-Strategy (Preferred Alternative)
Public. There is no expected increase in fire-caused injuries to visitors, employees, and the public. In the short term a significant increase in prescribed fire and wildland fire use operations would occur which has the potential to increase the exposure of visitors, employees, and general public to ground level smoke particularly during late night and morning periods when smoke plumes collapse, descend, and concentrate in low lying areas or canyon bottoms. Over the long term, exposure would be reduced as fuels are reduced and control efforts become more effective when applied.

Fire Personnel. There would be a significant increase in the number and extent of prescribed fire and wildland fire use operations which would cause an increase in the rate of exposure of fire personnel to hazardous conditions—both fire and smoke.

Conclusions

No alternatives eliminate all health and safety concerns, though the alternatives vary in their ability to manage and mitigate impacts. All actions under all alternatives would be managed to fully comply with legal requirements for protection of public health and safety, including smoke impacts. Public and firefighter safety is the highest priority for all actions.

Alternative 2 provides optimum management control over the timing and placement of fire events, and hence provides the greatest control over the amount of smoke produced and minimizes the number of riskier emergency responses. Using a combination of prescribed fire and unplanned ignitions, Alternative 4 allows somewhat less management control over the timing, placement, and size of fire events than Alternative 2, but is much better in this regard than Alternative 3. Since Alternative 3 relies heavily on random ignition events, the opportunity for management control over the timing and placement of fires is minimal and results in an increasing probability of unwanted smoke events. Alternative 1 minimizes smoke impacts in the short term, but does not significantly address the continued accumulation of fuels. Alternative 1 would be expected to produce more random and larger unwanted smoke events as resistance to control and fuels increase with time.

Table 5-H1 – Comparison of Health/Safety Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Minimize Direct Exposure to Hazardous Environment	0	++	0	+

Minimize Exposure to Secondary Effects of Fire	0	++	-	+

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 0 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)
- -- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

I. COMMUNITY ECONOMICS

Choosing different alternatives may affect the flow of dollars through the local economy. Fire programs affect local community economics through several avenues – the most important variables being: the size of the fire management payroll, the amount of goods and services purchased by the program from local businesses, and impacts of fire operations and smoke events on the number of visitors moving through the community and presumably purchasing goods and services from local businesses. A comparison of fire program costs by alternative may be found in this chapter, Section J. The analysis of program costs in Section J considers the full range of fire management activities, including the cost of infrequent large unwanted fire events such as the 1996 Kaweah fire which started on private lands adjacent to the park and eventually burned 4,000 acres of parklands. The analysis in this section (section I) primarily evaluates the costs associated with the core fire program envisioned under each alternative, which as a matter of course includes preparedness and initial attack suppression capabilities.

Factors used to Assess Environmental Consequences

Fire Management Payroll

The size of the fire management program payroll varies by alternative. Since most of the money paid to fire staff is spent in the local communities in the form of housing, food, and services, increases in total payroll would be expected to have a net beneficial effect on local community economics. Similarly, alternatives with smaller payrolls would have a less beneficial effect.

Program Support

In addition to payroll inputs to the community through its employee base, the fire management program also inputs dollars directly into the economy to support program operations. Purchases are made directly from local businesses for goods and services including food, supplies, and other items. Additional program funds could be infused into the local economy through the use of private contractors to implement fire and fuels projects such as mechanical fuel reduction.For this analysis, the assumption is made that the same *proportion* of payroll

and support dollars would be spent in the local communities under each alternative. Therefore differences in program budgets between the alternatives are used as a direct indicator of the effect of that alternative's potential economic impact on the local economy.

Tourism Impacts

Park visitation data from 1987 through 2000 shows the summer period (May through September) as typically the busiest tourist months. Those months coincide with the primary fire season. Since it is difficult to directly tie tourism spending to the fire management alternatives, this assessment addresses the relative expected impacts of alternatives on visitation. The level and extent of the effect on tourism due to fire operations is difficult to accurately quantify and convert directly into dollar figures. A survey of Three Rivers residents conducted in 1999 (Paul Schissler Associates, 1999) shows 22% of residents felt that fire management activity caused significant reductions in tourism. The same survey found also found that 14% of residents believed there was a significant economic effect on Three Rivers from road closures resulting from fire management activities. Though the survey indicates that there is little common agreement of the magnitude of effect that fire events have on the local economy, some assumptions may still be made regarding the relative impact of different fire management alternatives.

Direct effects on tourism from fire operations may come from road or facility closures due to fire operations. Over the past decade such road closures have occurred three times totaling about 10 days (one day per year average). Most of the closures were a result of fire suppression operations resulting from the need to fight unwanted wildfires. However, since there are several entrances to the parks and only one access route at a time has ever been closed due to fire suppression operations, it is difficult to assess whether visitors were displaced from one entrance and threshold community to another during the closures with no net gain or loss, or whether visitors rescheduled their visit or changed plans and traveled elsewhere resulting in a net loss to communities.

Offsetting potential tourism business lost in communities affected by closures is the financial impact of firefighting efforts that are usually associated with such closures. In all cases over the past 10 years where this has occurred, many commercial lodgings, restaurants, and other local business were kept at or near capacity providing for the needs of the firefighters involved in the suppression effort.

Indirect effects on tourism may come from the effects of smoke or loss of visibility in local communities, causing shortening or cancellation of visits. Over the past decade there have been several smoke events from both managed fires and wildfire events that affected local communities. These included the 1992 Suwanee prescribed fire, the 1995 Castle prescribed fire, the 1996 Castle wildland fire use fire, the 1996 Hospital II wildfire, and the 1996 Kaweah wildfire. How and to what extent these events affected a mobile tourist population is

unknown. Assumptions may be made that more, or more severe, smoke events may result in a reduction in length-of-stay negatively impacting local business, though several of the events, such as the 1995 Castle fire, occurred during November and December outside the primary visitor season.

Balanced against occasional impacts from fire that may limit a visitor’s stay in the area is the concept that alternatives which increase the amount of the parks ecosystems that are restored and maintained may have positive indirect effects on tourism by creating more resilient and functional natural systems for visitors to enjoy. Some fire effects, such as the regeneration of giant sequoia trees and rejuvenation of wildlife habitat, may provide positive visitor experiences. A similar concept may be applied to visitor enjoyment of wilderness areas where some alternatives allow more exposure of wilderness users to natural process such as natural fire events.

Recent research (Loomis et al, 1999) suggests that indirect effects of prescribed fire on recreational visits is slight, while the visual effects of large catastrophic fire events may cause significant decreases (up to 40%) in recreational use. Therefore, in this assessment it is assumed that alternatives that decrease potential for catastrophic events would have a more positive effect on recreational visits. Related research at Sequoia and Kings Canyon concluded that burned areas and smoke are generally visible to less than half of park visitors and neither has a significant impact on enjoyment of the visit. More visitors noticed fire scars on giant sequoias (87%) but stated that the sight enhanced the beauty of the trees (Quinn 1987).

Table 5-I1 depicts the anticipated relative effect of different alternatives on local business based on program expenditures. Table 5-I2 depicts the relative effect of each alternative on tourism.

Impacts Common to All Alternatives

The fire management program may have both direct and indirect effects on the local economy. Direct effects include the parks’ transactions with local businesses that supply goods and services for fire management activities. Additional direct effects come from employees on the fire program payroll who procure personal housing, food, goods, and services from local businesses. Indirect effects include the impact of fire management activities on tourism.

While there are some differences in payroll and support costs between the alternatives, it should be noted that the core program size and cost is primarily driven by the organization needed to effectively prevent and suppress unwanted fires. Those costs remain relatively constant across all alternatives. Most of the differences in cost across the alternatives reflect those necessary to both maintain an adequate suppression force as well as a proactive fuels management program. The costs for proactive fuels management programs are not

completely additive to suppression costs since some resources are shared between the two functions. Economies of scale are also achieved when combining suppression and proactive management actions.

For all alternatives, the economic impacts of mechanical fuel reduction would be negligible since the average acreage treated would be less than 30 acres per year under all alternatives.

Year 2000 visitor statistics for the parks during the primary visitor season (May through September) totaled 980,922. This figure is used as a basis for comparing the magnitude of potential impacts on tourism across the alternatives.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
Payroll costs for employees in the parks' fire management program under this alternative would be slightly over $1 million annually. Total additional dollars for program support and proactive fuels management would be $280 thousand annually.

Offsetting the local economic benefits from fire payroll and support spending are expected periodic negative effects for the tourism industry as fire projects are implemented and fire suppression occurs resulting in road or facility closure. Impacts resulting from unplanned fires requiring suppression are expected to increase as suppression acres increase.

Alternative 2 – Prescribed Fire
Payroll size would increase through the addition of another operations crew. Payroll would increase to $1.2 million annually. Total support dollars available under the prescribed fire alternative would increase to about $300 thousand annually.

Expected negative effects for the tourism industry would be greater initially than for Alternative 1, but decrease over time as fuels treatment leads to a reduction in fuels across the park. Negative effects could be partially mitigated through proper planning for prescribed fire events, reducing their randomness and subsequent impact upon the community.

Alternative 3 – Wildland Fire Use
Payroll size would increase with the addition of one operations crew. Total payroll and total support dollars available would be the same as Alternative 2.

A slightly higher level of negative impacts on tourism would be expected due to the random nature of the natural ignitions. Unplanned ignitions managed for resource benefit during the fire season without prior restoration of natural fuel loads could lead to more smoke production during the tourist season. Mitigation strategies would be

more limited than with prescribed fire treatment (Alternative 2) or combined strategies (Alternatives 1 and 4).

Alternative 4 – Multiple Strategy (Preferred Alternative)
Payroll size would increase by roughly one-third with the addition of operations crews and support staff. Total payroll would increase to $1.5 million annually while total support dollars available would increase to $320 thousand. The budget for this program would be the highest of all alternatives, resulting in more economic benefit to local economies from that source.

Anticipated negative effects on tourism would parallel the no action alternative. There would be a potential for an initial increase in impacts as treatment activity increased, but long-term effects from individual events would be reduced over time as fuels were restored to more natural levels.

Table 5-I1 – Program cost by alternative. Economic benefit to local communities would be proportional to program expenditures.

	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Direct Payroll	$1 million	$1.2 million	$1.2 million	$1.5 million
Support Costs	$280 thousand	$300 thousand	$300 thousand	$320 thousand
Total Program Expenditures	$1.28 Million	$1.58 Million	$1.58 Million	$1.82 Million

Table 5-I2 – Relative effect on tourism. A (-) indicates a potential negative effect and a (0) indicates a neutral effect relative to other alternatives.

	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Relative Effect on Tourism	-	-/0	--	-/0

Conclusions

Fire events may have some effect on tourism and related expenditures in the local economy. However, during fire events that are severe enough to affect local economics, there may be offsetting expenditures in the communities by fire forces. Alternatives 2 and 4 would have similar offsetting economic effects, while alternative 3 would have the most negative effect due to unpredictability and randomness of wildland fire use events. Direct and indirect fire program expenditures in the community would have a positive effect on local community economics, both at the programmatic and fire event level. Alternative 4 may create the greatest benefit to the local economy.

J. PROGRAM COST

Annual program costs vary by alternative. To respond to emergencies and unwanted fires, under all alternatives, a core suppression program is assumed. While this core suppression capability remains constant across the alternatives, there would be a variation between alternatives due to changes in the tools used to achieve additional resource management and ecosystem objectives. Costs used in this section are based on past average costs utilizing park employees for labor. With continuing emphasis on contracting with private companies, certain functions (like mechanical fuel reduction projects) may be implemented by a non-federal workforce. Based on past projects in the parks, contracted projects have a higher cost per acre.

These figures contain estimates that take into account the funds needed to control and suppress infrequent, but expensive, large wildfires events. Such unwanted events are expected to occur several times each decade under all alternatives. Research conducted by Colorado State University show those alternatives that restore more park acres over time, and those that use fire more deliberately and less randomly, eventually result in a reduction in the rate of fires requiring aggressive suppression and a consequent increase in overall economic return (Omi et al, 1999).

Factors Used to Assess Environmental Consequences

Relative Cost of Alternatives
Less expensive alternatives are favored over more expensive ones.

Achieve Management Objectives
Alternatives that are more able to achieve management objectives are favored over those that achieve fewer objectives.

Analysis and Results

In order to estimate the cost of each alternative, average operational cost estimates for each strategy were derived from budgets based on the existing fire management program in the parks. Table 5-J1 lists the average costs per acre for each tool based on data from 1990-1999.

Table 5-J1 – Average costs per acre for each tool

Tool	Cost per acre	% of Fires in the 1990's	% of Acres in the 1990's
Mechanical Fuel Reduction	$1,700/acre *	N/a	N/a
Wildland Fire Suppression (Large) **	$1,300/acre for fires ³ 10 acres	5%	98%
Wildland Fire Suppression (Small) **	$5,900/acre for fires < 10 acres	95%	2%
Prescribed Fire	$45/acre	N/a	N/a
Wildland Fire Use Large Project ***	$87/acre for fires ³ 10 acres	11%	98%

Wildland Fire Use Small Project ***	$2,600/acre for fires < 10 acres	89%	2%

* This figure represents a typical mechanical treatment project and is based on estimates developed for proposed projects at the Lodgepole developed area. Mechanical treatment costs per acre are driven primarily by high labor costs.

**** Most of the parks' suppression fires are small (95% are less than 10 acres), but the few large fires account for 98% of the acres burned. The cost per acre differs between small and large fires, with the cost per acre dropping on larger fires as a result of economies of scale. Fire suppression costs are driven by high labor and equipment costs. Suppression fires generally entail additional premium (hazard) pay and overtime for firefighters due to their hazardous working conditions and random occurrence.

***** Most of parks' wildland fire use fires are small (89% are less than 10 acres), but the remaining 2% that become larger than 10 acres eventually account for 98% of the acres burned. The cost per acre goes down when the fire is larger as a result of economies of scale and the more effective use of natural boundaries for containment. Overall costs per acre are generally higher than prescribed fire due to remote locations and higher transportation costs to monitor and manage the project.

The per-acre figures in Table 5-J1 above were multiplied by the estimated acreage for each tool under each alternative (see Tables 5-J2 and 5-J4 below) and rounded to the nearest hundred dollars (see Tables 5-J3 and 5-J5 below).

Fixed program costs necessary to maintain core suppression capabilities and manage the program were then added to come up with a total program cost estimate for each alternative. Fixed program costs from the year 2000 ($1,415,000) were used for the first 3 alternatives. For Alternative 4, an estimated budget for the proposed program was derived from estimates by the national fire office, approximating the most efficient staffing level.

Table 5-J2 – Average acres per year treated by alternative over first 10 years.

Treatment Acres per year	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi Strategy (Preferred Alternative)
Mechanical Fuel Reduction	4	10	10	10
Wildland Fire Suppression	561	1311	3167	1379
Prescribed Fire	2486	13965	150	7300
Wildland Fire Use	1227	0	10489	6638
Grand Totals	4,278	15,286	13,816	15,327

Table 5-J3 – Average annual program costs by alternative over first 10 years.

Program Costs per year	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi Strategy (Preferred Alternative)
Mechanical $1700/ac	6,800	17,000	17,000	17,000
Suppression [3] 10 acres (98%) x$1300/ac	715,000	1,670,200	4,034,800	1,756,800
Suppression <	66,200	154,700	373,700	162,700

10 acres (2%)x $5900/ac				
Prescribed Fire $45/ac	111,900	628,400	6,800	328,500
Wildland Fire Use [3] 10 acres (98%)x $87/ac	104,600	0	894,300	566,000
Wildland Fire Use < 10 acres (2%)x $2600/ac	63,800	0	545,400	345,200
Fixed Program Costs	1,415,000	1,415,000	1,415,000	1,993,000
Grand Totals	$2,483,300	$3,885,300	$7,287,000	$5,169,200
Average Cost/Acre	$580	$254	$527	$337

Table 5-J4 – Average acres per year treated by alternative over 25 years.

Treatment Acres per year	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi Strategy (Preferred Alternative)
Mechanical Fuel Reduction	10	16	30	16
Wildland Fire Suppression	886	726	2245	986
Prescribed Fire	1478	14490	164	2225
Wildland Fire Use	1293	0	11349	12055
Grand Totals	3,667	15,232	13,788	15,282

Table 5-J5 – Average annual program costs by alternative over first 25 years.

Program Costs per year	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi Strategy (Preferred Alternative)
Mechanical $1700/ac	17,000	27,200	51,000	27,200
Suppression [3] 10 acres (98%) x$1300/ac	1,128,800	924,900	2,860,100	1,256,200
Suppression < 10 acres (2%)x $5900/ac	104,500	85,700	264,900	116,300
Prescribed Fire $45/ac	66,500	652,000	7,400	100,100
Wildland Fire Use [3] 10 acres (98%)x $87/ac	110,200	0	967,600	1,027,800
Wildland Fire Use < 10 acres (2%)x $2600/ac	67,200	0	590,100	626,900
Fixed Program Costs	1,415,000	1,415,000	1,415,000	1,993,000
Grand Totals	$2,909,200	$3,104,800	$6,156,100	$5,147,500

Average Cost/Acre	$793	$204	$446	$336

Conclusions

Alternative 1 shows the lowest overall program cost and highest cost-per-acre of all alternatives. However it fails to achieve significant natural resource objectives. Alternative 2, through optimizing the use of prescribed fire and eliminating random fire events provides a cost effective alternative while achieving most objectives. It has the second lowest cost and the lowest cost-per-acre of all alternatives. Alternative 3 has the highest overall cost due to the randomness of unplanned ignitions and lack of proactive fuels management in unrestored areas of the parks. It has the second highest cost-per-acre with less certain outcomes for achieving program objectives. Alternative 4 has the second highest overall cost and fully achieves all program objectives. It has the second lowest cost-per-acre.

K. WILDERNESS

Approximately 85% of the parks are designated wilderness. As of 2002, another 12% of parklands have been proposed for wilderness designation. By NPS policy, areas proposed for wilderness are managed exactly the same as designated wilderness.

Most wilderness use occurs during the relatively snow-free periods of July through September. Recent figures for the year 2000 show wilderness overnight use at approximately 75,000 visitor use nights by 22,600 different visitors. Backcountry users primarily utilize the nearly 800 miles of trails.

NPS Management Policy 6.3.9 directs that “fire management activities conducted in wilderness areas will conform to the basic purposes of wilderness. The parks’ fire management and wilderness plans together will identify the natural and historic roles of fire in the wilderness and will provide a prescription for response to natural and human caused wildfires. Actions taken to suppress wildland fire will use the minimum requirement concept and will be conducted in such a way as to protect natural and cultural features and to minimize the lasting impacts of the suppression actions and the fires themselves” (see *Fire and Aviation Management Operations Guide {Chapter III.c.3.a}* in Addendum).

NPS Director’s Order 41, Wilderness Preservation and Management (DO-41, Section 5) further states that “under ideal conditions, natural

fire should be considered as a fundamental component of the wilderness environment."

In conformity with direction in NPS Management Policy 6.3.9 and NPS Director's Order 41, the natural and historic role of fire in the parks' wilderness has been assessed and documented. In summary, lightning ignited fires have been found to be a natural process and primary driver of natural plant communities throughout the parks' wilderness. Native American use has also been documented, with the influence of such use in shaping vegetation communities largely unknown. (See Chapter 9 in the companion *Fire and Fuels Management Plan*).

Factors Used to Assess Environmental Consequences

Minimum Requirement
Are the proposed actions the minimum necessary to meet stewardship goals or efficiently administer this area?

Minimum Tool
Are the tools proposed the minimum necessary to accomplish the chosen actions?

Wilderness Character
To what extent do the actions proposed add to or detract from wilderness character as defined by the Wilderness Act?

Impacts Common to All Alternatives

The alternative ultimately selected as the preferred alternative for implementation under this environmental assessment will be considered the minimum requirement.

All alternatives may result in transient (short-term) impacts to wilderness character. These include the use of aircraft to detect, monitor, and manage fires, and noise and activity from firefighting staff and equipment during operations.

More persistent (long-term) impacts would result from alternatives that include prescribed fire or fire suppression in wilderness. Persistent impacts include line construction resulting in felled trees and trenching, and helispot construction resulting in felled trees and/or cut brush.

Operational impacts are mostly transient. All fire operations in the wilderness would consider preservation of wilderness character and experiences in their implementation. These would be addressed in the project plans for proposed prescribed fire and mechanical treatments. Wildland fire use impacts to wilderness would be described and

mitigated through site specific planning documented in the Wildland Fire Implementation Plans (WFIP).

All fire management activity in wilderness would be conducted according to minimum impact suppression guidelines found in the parks' Fire and Aviation Management Operations Guide (Addendum). Delegations of authority to incoming fire management teams will require that minimum impact suppression techniques be followed.

The use of chainsaws, portable pumps, and the landing of helicopters for all fire operations will be considered appropriate as the minimum tool, as will electronic devices including but not limited to global positioning units for mapping and locating fires, and cell phones and portable radios for communications (see Appendix H for the Record of Decision for Minimum Requirement and Minimum Tool). When using helicopters, the parks will consider operational periods, amount of flight time, and sensitivity of travel routes. When using stock, the parks will adhere to existing park regulations including party size restrictions and forage area regulations, and will consider the implications of competing for limited forage in relation to private and commercial stock users. Use of both stock and aircraft will be kept to the minimum necessary commensurate with meeting project objectives and providing for firefighter safety.

Burned area emergency rehabilitation plans may be implemented under the direction of a resource advisor following significant fire suppression actions. Emergency rehabilitation in wilderness will seek to restore areas impacted by fire suppression in ways that will restore and preserve wilderness character and conditions. Actions implemented under emergency conditions as part of immediate suppression and stabilization generally do not require pre-approval. Proposals for long term recovery actions would be submitted to the parks Environmental Management Committee, which will recommend and enforce the appropriate level of environmental compliance prior to implementation.

Fire related research and monitoring may occur to document and understand the effects of fire management actions in wilderness. Research and monitoring staff and equipment would create additional transient (short-term, infrequent) impact. Any proposal that required the installation of long term or permanent research or monitoring equipment in the wilderness would require a separate analysis and approval by the parks Environmental Management Committee.

Occasional trail or area closures may be required to safely manage wilderness fire management actions.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
Some transient (short-term) impacts would occur as a result of fire operations including: helicopter overflights and landings, temporary fire camps, pack stock used to support operations, motorized saws and pumps, and the presence of fire management personnel. More persistent (long-term) impacts would occur as a result of line construction to implement prescribed fire projects and suppression actions where needed.

Under this alternative, the wilderness character would be substantially maintained, and conditions would appear natural to most visitors. However unnatural levels of fuels may continue to accumulate throughout much of the lower and mid-elevation wilderness. Tree density and species composition would continue to change away from natural conditions. Unnaturally intense fires may occur over larger portions of the wilderness as a result of increasing fuel and tree density. While not immediately obvious to all wilderness visitors, these changes cumulatively result in a less natural environment that would be noted by some wilderness users.

Alternative 2 – Prescribed Fire
To implement prescribed burns throughout the wilderness, more extensive use of firelines (long-term impact) would be expected under this alternative than others, resulting in more visible and persistent evidence of human intervention. More activity related to active fire management (e.g. staff needed to construct, ignite, and defend firelines) would be required to simulate natural processes, and would result in increased levels of staff and equipment throughout the wilderness. This would result in frequent, but transient, impacts.

This alternative would use prescribed fire to mimic natural process, and most unplanned ignitions would be suppressed. The result would be a reduction or elimination of unplanned fire events and their effects resulting in an environment primarily shaped by humans. Though the wilderness would appear “natural” or “wild” to most visitors, it would in fact be substantially a product of deterministic human intervention. More evidence of human created firelines, and an increased human presence would affect wilderness character in areas of extensive fire activity.

Alternative 3 – Wildland Fire Use
Most management activity would take the form of transient (short-term) impacts necessary for monitoring natural fire events by aircraft and on the ground. There would be an occasional need to initiate suppression actions (long-term impact) to keep fires from directly affecting developments, boundaries, or other sensitive areas, or to meet requirements for preventing exceedances of air quality standards.

This alternative would allow the freest expression of natural processes in wilderness. Areas would appear substantially natural and affected primarily by natural forces. However at a local scale in areas that have been significantly altered by past suppression and

have unnaturally high fuel loads and/or tree density, the effects of an unplanned fire may result in unnaturally intense or extensive fire noticeable to some visitors

Alternative 4 – Multi-Strategy (Preferred Alternative)
This alternative would initially use extensive prescribed fire to restore those areas where unnaturally high fuel loads and/or tree densities are present. In all other areas, the natural role of fire would be perpetuated and only constrained as required to protect structures, protect people, or conform to air quality regulations. Over time, impacts from fireline construction and suppression actions in wilderness would decrease.

In the short term, most areas would appear unaffected by management, and most natural fire ignitions would be allowed to burn. In the long term, this alternative has high potential to restore natural conditions throughout the wilderness, and maintain them consistent with wilderness character.

Conclusions

The alternative ultimately selected as the preferred alternative for implementation under this environmental assessment will be considered the minimum requirement.

Due to numerous site factors, using hand tools alone is impractical for completing all the work proposed in an effective, time constrained, safe, and low impact manner. Operating under the guidelines of the minimum impact suppression tactics contained in the Fire and Aviation Management Operations Guide (FAMOG), the use of chainsaws, pumps, the landing of helicopters, and the use of electronic communication and mapping devices for this program – all with transient impacts - will serve to increase firefighter and public safety, decrease the duration and extent of resource and wilderness impacts, and result in a more aesthetically appropriate result with little lasting evidence of human intervention. Therefore, the equipment listed above will be considered the minimum tools required to implement proposed actions (see Appendix H for Record of Decision on Minimum Requirement and Minimum Tool).

To the extent that impairment of the wilderness condition can be defined as human caused deviation from natural conditions, all alternatives will serve to reduce impairment caused by the effects of past fire exclusion. In general, the more acres treated under a particular alternative, the more that impairment will be reduced in the long term. Alternatives 2, 3 and 4 restore significantly more of the wilderness to natural conditions than Alternative 1.

To the extent that wilderness can be considered as a place shaped primarily by natural processes, alternatives that optimize the use of natural ignitions and minimize human intervention will minimize the

chance of further impairment. Alternatives that suppress naturally ignited fires and favor human intervention (e.g. substituting prescribed fire for unplanned fire), as the primary means for perpetuating a model of natural systems increase the possibility of impairment.

Alternative 3 maximizes the management of natural ignitions, though the effects of natural ignitions in previously altered areas may result in impairment. Alternative 2 substitutes human intervention in place of natural process as a long-term strategy. Alternatives 1 and 4 emphasize the use of prescribed fire to restore natural conditions in the short-term, then favor the management of unplanned ignitions as a long-term strategy. Alternative 4 implements these strategies on a larger scale than Alternative 1, encompassing all wilderness areas.

Table 5-K1 – Comparison of Wilderness Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Minimum Requirement	0	0	+	+
Minimum Tool	0	0	0	0
Wilderness Character	0	0	+	+

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

++ effects are **highly desirable** compared to Alternative 1 (No Action)
+ effects are **desirable** compared to the effects of Alternative 1 (No Action)
0 effects are **equal** to the effects of Alternative 1 (No Action)
- effects are **undesirable** compared to the effects of Alternative 1 (No Action)
-- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

L. WILD AND SCENIC RIVERS

The park contains two rivers that were designated as wild and scenic in 1987, the Kings and the Kern. Both rivers are contained within wilderness, with the exception of the lower seven miles of the South Fork Kings which flows through the Cedar Grove developed area. The General Management Plan in progress as of 2002 may result in the designation of new reaches of Wild and Scenic River. Any new designations would be managed consistent with the alternatives discussed below.

The purpose of wild and scenic rivers as stated in legislation (Public Law 100-150) is that designated rivers “shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations.”

Factors Used to Assess Environmental Consequences

Impact on Outstanding Resource Values
Alternatives that minimize impact on outstanding resource values of the rivers will be considered more desirable.

Impacts Common to All Alternatives

Since all segments of the rivers in wilderness are in fire management zones that emphasize perpetuating fire as a natural process, none of the fire management alternatives would affect their free-flowing condition or involve new developments within their corridors.

Alternatives that restore and maintain more of the river corridors to a naturally functioning condition would be considered to have a greater positive effect on the protection of the wild and scenic river values. Those that restore or maintain fewer acres, or maintain areas primarily through aggressive human intervention (removing some measure of naturalness) would be considered less beneficial to wild and scenic values.

All riparian areas, including wild and scenic rivers, would be protected from contamination by fire fighting foams and aerial retardant following guidelines in the *Fire and Aviation Management Operations Guide* (Addendum).

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
This alternative would maintain or restore moderate amounts of wild and scenic river corridor, with emphasis on the segment flowing through the Cedar Grove developed area. Other areas of the wild and scenic river corridor not receiving treatment would be subject to greater unnatural change from high intensity wildfire events.

Alternative 2 – Prescribed Fire
Most areas along the wild and scenic river corridors would receive proactive fuels management and would be protected from damaging large-scale high intensity fire events. Some degree of naturalness would be lost as a result of the deterministic implementation of prescribed fire projects throughout the river corridor.

Alternative 3 – Wildland Fire Use
Some areas along the wild and scenic river corridors would be protected from damaging large-scale high intensity fire events. Some risk from damaging large-scale high intensity fire events would remain as most areas would not receive conservative fuels reduction (either through mechanical treatment or prescribed fire) prior to burning in unplanned fire events.

Alternative 4 – Multi –Strategy (Preferred Alternative)
Most areas along the wild and scenic river corridors would receive proactive fuels management and would be protected from damaging large-scale high intensity fire events. Areas would appear natural with minimal human intervention in wilderness areas.

Conclusions

None of the alternatives would impair wild and scenic river outstanding resource values as defined by legislation. Alternatives 2 and 4 would provide the greatest protection from unnatural effects, while Alternatives 1 and 3 leave the river corridors vulnerable to damaging fire events. Alternative 4 provides the best combination of protection and minimal intervention in the natural functioning and scenic values of the wild and scenic rivers.

Table 5-L1 – Comparison of Wild and Scenic River Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Impact on Outstanding Resource Values	0	+	0	+

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

++	effects are **highly desirable** compared to Alternative 1 (No Action)
+	effects are **desirable** compared to the effects of Alternative 1 (No Action)
0	effects are **equal** to the effects of Alternative 1 (No Action)
-	effects are **undesirable** compared to the effects of Alternative 1 (No Action)
--	effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

M. RECREATION

Approximately 1.5 million visitors come to the parks each year to enjoy the natural resources, participate in recreational and educational opportunities, and as a social experience. Primary recreational opportunities in the park include camping, hiking, backpacking, stock packing, sightseeing (by car and on foot), snow play, and wildlife viewing.

The average length of a recreational visit is 5 hours in the off-season (October – April) when visitors venture into the park for a short while to enjoy snow sports and catch a glimpse of the big trees. In the summer the average length of a visitor’s stay increases dramatically to 36 hours. This is the time of year when campgrounds are open and more extensive overnight lodging is available. Day use visitors in the summer also tend to stay longer due to comfortable mountain temperatures and extended daylight hours. In 2000, 22,600

visitors ventured into the parks' wilderness by pack stock or on foot for overnight trips averaging 3 nights per trip.

Factors Used to Assess Environmental Consequences

Provide High Quality Visitor Experience
Alternatives that most enhance unique park resource based experiences and resource conditions will be favored.

Minimize Interruption of Recreational Pursuits
Alternatives that maximize recreational opportunities while achieving resource and visitor safety goals will be favored.

Impacts Common to All Alternatives

All alternatives require some level of fire management operations that generally include fire detection, suppression, monitoring, igniting, and holding. Depending on location and time of year, these operations may cause temporary impacts to individual recreational experiences. Impacts include: 1) noise from aircraft and other power equipment such as chainsaws and portable pumps, and 2) temporary closures of roads, trails, or facilities to protect visitors from direct exposure to fire events. Smoke from fires may restrict visibility and impact viewsheds, or become heavy enough to become a nuisance. The health impacts to visitors from smoke are addressed in Section H, however, given the relatively short duration of the average visit and the ability to be both mobile and flexible enough in itinerary to avoid smoke, exposure during the typical visit is minimal.

Fire, when functioning to restore or maintain natural processes and conditions, helps to shape and renew the vegetation and wildlife habitats that are integral parts of many recreational pursuits in the parks. Fire events, especially prescribed burns in easily accessible areas, create unique opportunities for visitor experiences and educational opportunities. The effects of some fires, such as facilitating the germination of giant sequoia seeds and stimulating wildflower displays, may provide positive experiences.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
Same as "common to all", though only select areas of the parks would be restored to natural function.

Alternative 2 – Prescribed Fire
In the short term this alternative may result in slightly increased negative impacts to recreational use compared to Alternative 1 due to more aggressive implementation of a prescribed fire program. Impacts would take the form of occasional closures of roads or wilderness

areas to implement fire operations. Educational and unique visitor experiences related to viewing ongoing fire operations would increase. This alternative would have fewer negative impacts on recreational use than Alternative 3 due to more rigid control over timing and placement of ignitions. Over the long term, random and aggressive suppression actions would be reduced as more of parklands were restored to natural fuel loads and forest density, reducing the duration and number of closures and smoke events.

Alternative 3 – Wildland Fire Use
This alternative would result in the most negative impacts to recreational use of all the alternatives. More closures would be necessary due to the random nature of ignitions and lack of proactive fuels management. Few educational and unique visitor experiences related to viewing ongoing fire operations would be possible due to the increased risk and uncertainty involved in managing wildland fire use projects in comparison to prescribed fire projects.

Alternative 4 – Multi-Strategy (Preferred Alternative)
Same as Alternative 2 except that there would be less evidence of fire management activities in wilderness and backcountry areas due to management of some unplanned ignitions in place of more operations-intensive prescribed fire projects. Educational and unique visitor experiences related to viewing ongoing fire operations would increase.

Conclusions

None of the alternatives would cause long-term or broad-scale impairment of recreational opportunities. All alternatives have potential to cause short term localized negative impacts to recreational use, but these impacts would be transient. Alternatives that restore and maintain more of the park ecosystems in a naturally functioning state will provide the best quality environment for visitors, as well as optimize opportunities for educational and scientific pursuits.

Table 5-M1 – Comparison of Recreation Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Provide High Quality Visitor Experience	0	-/+	0	-/+
Minimize Interruption of Recreational Pursuits	0	-	--	0

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 0 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)

-- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

N. CULTURAL / HISTORIC

Cultural resources (including prehistoric, ethnographic, historic, and cultural landscapes) may be impacted to varying degrees by fire and fire management actions. The effects of fire on cultural resources can be divided into three broad categories: direct, operational, and indirect. However, mitigation efforts can prevent the impairment of the parks' known cultural resources, and lessen the chances of adverse impact to unknown sites. Due to limited data in the parks' cultural resources inventories, it is possible that some unknown sites, structures, or objects could be impacted by or lost during a fire under all alternatives.

General Fire Effects

Prehistoric Resources
The effects of fire on prehistoric sites, including potential landscapes, are variable, with particular concerns associated with rock art sites and those sites with dense, surface-visible scatters of obsidian. In general such sites, even those with shallowly buried deposits or features, tend not to be impacted adversely by low intensity fires. High intensity fire events associated with heavy fuel loads may cause serious impacts, such as the spalling of rock surfaces, the cracking or "crazing" of cherts or obsidian artifacts, the fracturing of ceramics or potsherds, and the disruption of hydration bands on obsidian surfaces.

Of significant concern is the ground disturbance associated with the placement of staging areas and the construction of firelines necessary to fight or manage fires. These actions have the potential to adversely impact cultural resources directly through ground disturbance.

Ethnographic Resources
The effects of fire on ethnographic resources, including potential landscapes, are variable and difficult to identify. Sites with fragile archeological features such as pictographs or petroglyphs would be affected similar to prehistoric resources. Sites where traditional access to particular natural resources of cultural significance (such as plants used for craft production or ceremonial purposes) could be affected as a result of fire (e.g., re-growth and health vs. loss or diminution of the plants) and may result in either positive or negative effects.

The loss or reconfiguration of culturally important landscapes or vistas may occur as a result of fire, especially high intensity wildfire.

Historic Resources
The effects of fire on historic era sites, including potential or identified landscapes, are variable. Located in and around developed areas of the parks, there is particular concern associated with wooden buildings and structures, logging debris (e.g., stumps and shake piles), and mining features (e.g., flumes and trestles). Many other sites are effectively sub-surface in their current appearance and thus relatively protected from adverse impact from fires, especially low intensity burns. Of greatest concern is the placement of staging areas and firelines needed to fight or manage fires. The associated ground disturbance can have direct and adverse impacts on historic sites.

Factors Used to Assess Environmental Consequences

Minimize Surface Disturbance
Alternatives that minimize surface disturbance will be favored.

Allow Pre-Planning and Mitigation
Alternatives that maximize the ability of cultural resource managers to anticipate, inventory, and mitigate impacts to cultural resources will be favored.

Reduce the Risk of Damage from High Severity Fire Events
Alternatives that reduce the risk of large-scale high severity fire events will be favored.

Impacts Common to All Alternatives

There are three major fire-related factors that can affect the level of impact to cultural resources: disturbance of the ground, the ability to pre-plan and avoid impacts, and the risk posed by high intensity fire events.

Surface disturbance would occur under all alternatives as a result of the need to construct fireline, fire camps, staging areas, and related facilities. Alternatives that minimize the need for surface disturbance would have less potential to affect cultural resources.

Pre-planning and mitigation minimize potential impacts from fire management actions by allowing consultation and oversight by cultural resource specialists. Alternatives that rely more heavily on pre-planned fire management actions (such as prescribed fire) allow advance identification and avoidance of cultural resources. Conversely alternatives that entail more unplanned or emergency fire events, with little opportunity for advanced planning and clearance for cultural resources, have more potential to impact cultural resources.

High intensity fires have the potential to drive heat pulses deep into the ground and to spall off rock surfaces. These mechanisms can negatively affect subsurface and lithic cultural resources. There are opportunities for high intensity fire events to occur under all alternatives, though the size and timing of such events vary by alternative. Those alternatives that proactively reduce heavy fuel accumulations through low intensity prescribed fire or through mechanical removal reduce the risk of damage to cultural resources from high intensity fire. Those alternatives that promote continued accumulation of fuels increase the risk to cultural resources from high intensity fire.

Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
This alternative uses a combination of mechanical fuel removal, suppression, and management of planned and unplanned ignitions to achieve modest accomplishments. Prescribed burns and mechanical treatments would be pre-planned allowing avoidance and mitigation of most cultural resource impacts. Protection of cultural resources would be considered when implementing fire use projects. With more conservative program goals than the other alternatives, line construction would be less than alternatives 2 and 4, but may be offset by more extensive line construction needed for more aggressive fire suppression actions.

Since this alternative does not treat all areas of the park with prescribed fire or mechanical fuel removal at a level sufficient to offset increasing accumulation of fuels, high intensity fire events leading to cultural resource damage would be expected on occasion.

Alternative 2 – Prescribed Fire
A focus on the use of pre-planned prescribed fire as the dominant management strategy in this alternative allows the best opportunity for advance clearance and avoidance of cultural resource impacts. Standard management strategies would be adopted to preclude or minimize impacts, e.g., scratching firelines around sites for their protection, reducing fuel loads by hand, and wrapping structures in fire shelters or similar protective material or covering them with fire retardant foam. However, since this alternative depends exclusively on the use of prescribed fire requiring extensive fireline construction throughout the park, it has a fairly high probability of disturbing currently unidentified cultural resources.

This alternative would treat heavy fuel accumulation parkwide, decreasing the risk of damage to cultural resources from intense fire events. Occasional emergency suppression actions needed to control unwanted fires may result in negative effects. With continued application of prescribed fire, fuels loads and resulting high

intensity events would diminish with time and reduce the potential for damage from that source.

Alternative 3 – Wildland Fire Use
This alternative optimizes the use of random fire ignitions and minimizes the use of pre-planned actions. As such, it provides the least opportunity for advance clearance and mitigation of fire effects on cultural resources. However, the early involvement of cultural resources specialists in planning the response to a given wildland fire would stand to minimize the likelihood of adversely affecting significant or potentially eligible cultural resources. Since much less fireline would be constructed under this alternative, concerns for sub-surface disturbance of cultural resources would be reduced. The lack of preplanning combined with the occasional large high intensity event would place above ground prehistoric and historic sites/structures/objects at highest risk. This alternative is the least amenable for overall protection of cultural resources given the current fuel loads.

Alternative 4 – Multi-Strategy (Preferred Alternative)
The adoption of a multi-strategy program may result in a variety of potential impacts to known cultural resources similar to the impacts outlined above for Alternative 1. However, the degree of these potential impacts would be greater given that more acres would be targeted for treatment per year.

With the use of prescribed fire and mechanical fuel reduction, the ability to pre-plan mitigation actions would reduce the potential impacts to cultural resources. Pro-active fuels management would also reduce the risk of catastrophic wildland fire and associated emergency responses. These planned treatments have the potential to increase surface disturbances through the construction of firelines that may result in adverse impacts to shallowly buried sites/structures/objects.

The use of wildland fire use and suppression would be closely coordinated with the parks' cultural resources specialist given the potential for ground disturbance and attendant site impacts (the emergency placement of fire camps, firelines, and staging areas).

Conclusions

Fire, managed or unmanaged, has the potential to impact cultural resources. Since these resources are located in a highly flammable environment, fire effects cannot be completely avoided under any alternative. However, impairment may be controlled with appropriate preplanning, avoidance, and mitigation. Alternative 2 allows the most opportunity to avoid or mitigate impacts to cultural resources due to extensive pre-planning, however it also entails the most risk to subsurface cultural resources from extensive fireline construction. Alternative 3 would entail less fireline construction than Alternative

2, though its reliance on random fire events to achieve fire management objectives significantly reduces the ability to preplan and mitigate impacts and exposes surface or above ground resources to more risk of high intensity fire. Alternative 1 uses a combination of management strategies, but generally allows some ability to pre-plan and avoid impacts from prescribed fire and mechanical treatments. However, with modest accomplishments across the parks and the continuing accumulation of fuels, its effectiveness in preventing damage to cultural resources from high intensity fire is limited to small areas. Impacts from Alternative 4 are similar to Alternative 1, though it results in a significant decrease in the risk from high intensity fire events over time as more acres are proactively treated and fewer aggressive emergency suppression actions – including fireline construction – may be needed.

Table 5-N1 – Comparison of Cultural/Historic Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Minimize Surface Disturbance	0	-	+	0
Allow Pre-Planning and Mitigation	0	++	--	0
Reduce the Risk of Damage from High Severity Fire Events	0	+	0	+

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 0 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)
- -- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

O. RISK OF CATASTROPHIC EVENTS

Catastrophic fire events are defined as those that cause significant loss of natural or cultural resource values, or the loss of human life. Risk is the probability of such an event occurring. Reducing the potential for large damaging fires is a significant concern to the public and to park managers. This section examines the factors that contribute to damaging fire events and evaluates each alternative's potential for success in reducing the occurrence of such events.

A number of risk factors are not manageable and are represented by natural random events such as drought, high winds, and lightning storms. Since park staff can exert no control over unmanageable risk factors, reducing the risk of catastrophic fire events entails

focusing on those factors within management control. The most significant manageable risk factor is the amount and arrangement of fuels that are available to burn once an ignition occurs. Other less significant risk factors also lend themselves to management control such as training people in the proper way to extinguish campfires thereby reducing ignition sources, and by constructing defensible space around structures and sensitive resources.

The greatest fuels management challenges in these parks are the enormous buildup of dead and down fuel that have accumulated over the past century of fire suppression, and the increasing density of trees, primarily smaller trees, in the forest understory. These combined conditions result in a high risk of catastrophic fire. Both elements have the potential to contribute to hotter, high intensity fires that are difficult and dangerous to suppress and that may cause unnaturally severe fire effects. Ignition sources for the forest fuels are plentiful, both from the 1.5 million visitors each year who roam far and wide, as well as from the occurrence of frequent lightning storms that ignite an average of 36 fires each year in the parks (Figure 5-O1).

There are a number of ways to reduce fuel load and tree density, with varying ecological outcomes and dollar costs. Mechanical fuel reduction provides a direct and relatively safe way of achieving specific fuel and forest stand conditions. It has relatively high costs and, in many areas of the parks, is problematic as a tool due to constraints of steep slopes, roadless areas, and wilderness designation. Ecological outcomes of mechanical treatments may not be the equivalent of fire treatments and result in negative effects. Data from nearly 15 years of fire effects monitoring show that the conservative use of prescribed fire appears to achieve desired fuel reduction and adjustment in small tree density in mixed conifer forests (Keifer 2000). Prescribed fires also cost significantly less than mechanical treatments. The management of unplanned ignitions within their natural range of fuel and forest conditions acts to reduce and maintain conditions that minimize the risk of catastrophic fire. They have low to moderate cost primarily depending on remoteness.

Factors Used to Assess Environmental Consequences

Minimize the risk of large-scale high severity fire
Alternatives that reduce the probability of large high severity events occurring will be favored.

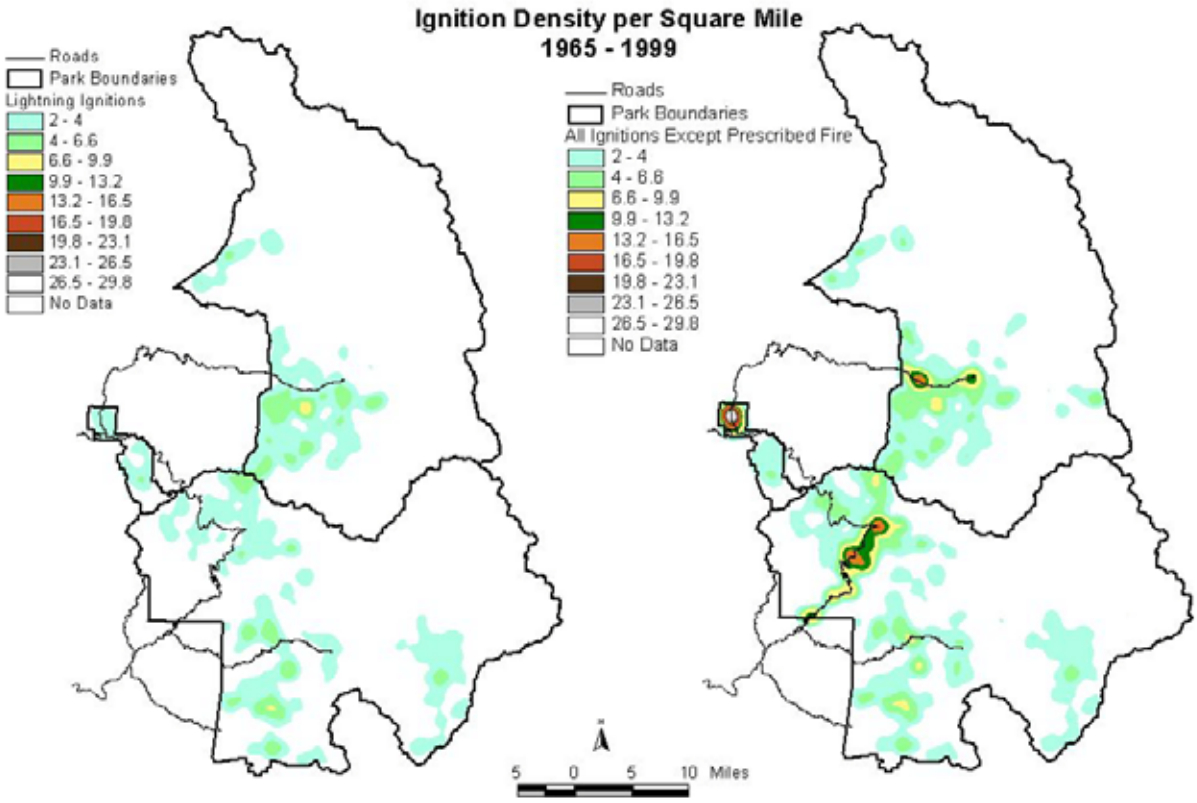
Impacts Common to all Alternatives

Protection of human life, including that of firefighters is the highest priority under all alternatives. All alternatives contain risk management actions such as fire prevention and fire education as a

strategy for reducing unwanted human ignitions. All alternatives contain provisions for reducing risk around developments, though the alternatives vary in their level of accomplishments and their attention to the protection of natural resources from catastrophic events.

The extent to which alternatives reduce the risk factors related to fuel loads and small tree density is one measure of their effect in preventing catastrophic fires. All the alternatives reduce fuels and tree density to some degree, though the alternatives vary in the extent of parklands affected. The alternatives also vary in the mix of techniques used to accomplish the needed fuel and density reduction – with some techniques (i.e. mechanical fuel reduction and prescribed fire) allowing more control and others (i.e. managing unplanned fires in heavy fuels) affording somewhat less control.

Figure 5-O1 – Density and location of unplanned fires
Map on left shows general density and location of lightning ignitions. Map on the right shows density and location of all unplanned fires.



Impacts Specific to Each Alternative

Alternative 1 – No Action (Current Program)
Continuation of the current program would provide a modest amount of protection from catastrophic fire in limited areas of the parks. High priority would be given to the protection of developments and boundary areas. Less emphasis would be placed on managing the risk of catastrophic fire for the benefit of natural or cultural resources. A full range of strategies would be used including mechanical fuel reduction, prescribed fire, wildland fire use, and wildland fire suppression.

Alternative 2 – Prescribed Fire
This alternative would reduce the threat of catastrophic fire across most of the susceptible parklands to a much greater degree than Alternative 1. The dominant use of prescribed fire along with some limited mechanical fuel reduction around developments optimizes the controllability of fuel reduction and forest density operations, and minimizes the opportunity for random natural variables (wind, lightning, etc.) to affect outcomes.

Alternative 3 – Wildland Fire Use
Managing unplanned fires without first reducing fuels or density through more conservative means (mechanical fuel reduction or prescribed fire) may result in an increased risk of catastrophic fire events. Under this alternative, developments would receive some mechanical treatment to minimize risk of catastrophic events, but natural and cultural resources outside of these developed areas would remain at risk.

Alternative 4 – Multi-Strategy (Preferred Alternative)
The effects of this alternative would be similar to Alternative 1, though a much larger portion of the susceptible areas in the parks would be treated, further reducing risk. The alternative uses a mix of alternatives including mechanical fuel reduction in and around developments and along boundaries, conservative prescribed fires to restore natural fuel loads and tree densities, and wildland fire use in restored areas or other areas under conditions that minimize the threat of catastrophic events.

Conclusions

All alternatives reduce the risk of catastrophic fire to some extent and therefore reduce the risk of impairing park resources. Alternative 1 provides the least protection given modest accomplishments, while Alternatives 2, 3, and 4 treat more acres and are therefore more effective. Alternative 3 relies heavily on random unplanned fire events in unrestored forests, and therefore would have the highest risk of catastrophic fire effects in those areas. Alternative 4 reduces the threat of catastrophic fire across a large portion of the parks, and includes the use of less predictable unplanned ignitions – though only in areas where such events where expected to have beneficial effects considering pre-existing conditions (i.e. already

restored or in maintenance). Alternative 2 treats a large amount of the parklands, and exercises the most control over fire events (reducing risk) while restoring fuel and tree density conditions.

Table 5-O2 – Comparison of "Risk of Catastrophic Events" Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Minimize the risk of large-scale high severity fire	0	++	-/+	+

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 0 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)
- -- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

P. ENVIRONMENTAL JUSTICE

Executive order 12898 requires federal agencies to assess whether their actions have a disproportionately high and adverse human health or environmental effect on minority and low-income populations.

Factors Used to Assess Environmental Consequences

Disproportionate Effect

Do the actions result in disproportionate effect on minority or low-income populations.

Conclusion

None of the actions proposed in any of the alternative would result in disproportionate effect on minority or low-income populations.

Table 5-P1 – Comparison of Environmental Justice Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Dis-proportionate Effect	0	0	0	0

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 0 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)
- -- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

Q. INDIAN TRUST RESOURCES

Secretarial Order 3175 and ECM 95-2 requires that agencies assess environmental impacts of proposed actions on Indian Trust Resources.

Factors Used to Assess Environmental Consequences

Would any actions proposed under the alternatives create impacts on Indian Trust Resources?

Conclusion

The parks do not contain Indian Trust Resources. Therefore proposed actions would not create impacts to such resources.

Table 5-Q1 – Comparison of Indian Trust Resource Effects

Assessment Factors	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)
Impacts to Indian Trust Resources	0	0	0	0

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

- ++ effects are **highly desirable** compared to Alternative 1 (No Action)
- + effects are **desirable** compared to the effects of Alternative 1 (No Action)
- 0 effects are **equal** to the effects of Alternative 1 (No Action)
- - effects are **undesirable** compared to the effects of Alternative 1 (No Action)
- -- effects are **highly undesirable** compared to the effects of Alternative 1 (No Action)

6 Summary of Environmental Consequences

SUMMARY OF ALL ALTERNATIVES

This chapter synthesizes the detailed information provided in Chapter 5 and provides summary information "at-a-glance." Table 6-1 rates the environmental consequences (or impacts) of each fire and fuels management alternative for each issue and assessment factor. Table 6-2 provides a narrative summary of each alternative.

Table 6-1 – Summary of environmental consequences of alternatives for each issue detailed in Chapter 5.

Issue and Assessment Factor	Alt. 1 No Action (Current Program)	Alt. 2 Prescribed Fire	Alt. 3 Wildland Fire Use	Alt. 4 Multi-Strategy (Preferred Alternative)
Vegetation				
· Maintenance of Natural Fire Regimes	0	+	+	++
· Acres Restored	0	++	+	++
· Risk of Catastrophic Loss	0	+	-	+
Wildlife				
· Maintenance of Natural Conditions and Habitat Diversity	0	+	+	++
· Acres Restored	0	+	+	+
· Risk of Catastrophic Habitat Loss	0	++	+	++
Special Status Species				
· Potential for Take of Individuals Protected as Threatened or Endangered	0	0	0	0
· Loss of Viable Protected Populations	0	0	0	0
· Loss of Critical Habitat Defined in Recovery Plans	0	0	0	0
· Amount of Habitat Restored or Maintained	0	+	+	+
· Reduced Risk of Catastrophic Loss	0	++	+	++
Prevent Spread of Non-Native/Invasive Species				
· Area Treated	0	0	0	0
· Area Exposed to High Severity Fire	0	0	0	0
Air				
· Conformity to Existing Law	0	0	0	0

Issue and Assessment Factor	Alt. 1 No Action (Current Program)	Alt. 2 Prescribed Fire	Alt. 3 Wildland Fire Use	Alt. 4 Multi-Strategy (Preferred Alternative)
· Conformity with Local and State Implementation Plans	0	0	0	0
· Extent to Which Alternatives Minimize Air Quality Effects while Achieving Park Goals	0	+	+	+
Water				
· Actions Conform to Intent of Clean Water Act	0	+	+	+
· Actions Conform to Executive Orders 11988 and 11990	0	0	0	0
· Alternatives Improve Resource Condition	0	+	+	+
Soil				
· Maintenance of Natural Processes	0	++	+	++
· Acres Pro-actively Managed	0	+	+	++
· Risk of Catastrophic Loss	0	++	+	+
Health/Safety				
· Minimize Direct Exposure to Hazardous Environment	0	++	0	+
· Minimize Exposure to Secondary Effects of Fire	0	++	-	+
Community Economics				
· Fire Management Payroll	$1 million	$1.2 million	$1.2 million	$1.5 million
· Program Support	$280 thousand	$300 thousand	$300 thousand	$320 thousand
· Tourism Impacts	0	- / 0	--	- / 0
Minimize Program Cost				
· Relative Cost of Alternatives for first 10 years	$2.5 million	$3.9 million	$7.3 million	$5.2 million
· Relative Cost of Alternatives for 25 years	$2.9 million	$3.1 million	$6.2 million	$5.1 million
· Achieve Management Objectives	0	0	0	++
Wilderness				
· Minimum Requirement	0	0	+	+
· Minimum Tool	0	0	0	0
· Wilderness Character	0	0	+	+
Wild and Scenic Rivers				
· Impact on Outstanding Resource Values	0	+	0	+
Recreation				

Issue and Assessment Factor	Alt. 1 No Action (Current Program)	Alt. 2 Prescribed Fire	Alt. 3 Wildland Fire Use	Alt. 4 Multi-Strategy (Preferred Alternative)
· Provide High Quality Visitor Experience · Minimize Interruption of Recreational Pursuits	0 0	- / + -	0 --	- / + 0
Cultural/Historic · Minimize Surface Disturbance · Allow Pre-Planning and Mitigation · Reduce the Risk of Damage from High Severity Fire Events	0 0 0	- ++ +	+ -- 0	0 0 +
Reduce Risk Of Catastrophic Events · Minimize the risk of large-scale high severity fire	0	++	- / +	+
Environmental Justice · Disproportionate Effect	0	0	0	0
Indian Trust Resources · Impacts to Indian Trust Resources	0	0	0	0

Alternatives 2, 3, and 4 are rated in relation to Alternative 1, which is the baseline for comparison and is always zero (0). The scale for Alternatives 2, 3, and 4 is:

++ effects are highly desirable compared to Alternative 1 (No Action)
+ effects are desirable compared to the effects of Alternative 1 (No Action)
0 effects are equal to the effects of Alternative 1 (No Action)
- effects are undesirable compared to the effects of Alternative 1 (No Action)
-- effects are highly undesirable compared to the effects of Alternative 1 (No Action)

Table 6-2 – Narrative Summary of environmental consequences of alternatives

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Summary of Consequences Continuation of the current program and its level of accomplishment would achieve localized resource and hazard fuel objectives but result in continued degradation of the natural resource overall. An analysis of past program accomplishments has shown that the actions taken to date have been significant at reducing	**Summary of Consequences** Most hazard fuel and some resource restoration objectives may be met with this strategy. Sequoia reproduction in some treated groves would increase. This alternative would intercept natural fire events, relying on well-planned management ignitions to simulate natural events and their	**Summary of Consequences** Many areas of the park currently in a natural state and having normal fuel loads would benefit from the natural fire events. Because of developments in various areas of the park that require protection from fire, and the random nature of natural fire events through space and time, this strategy may result in	**Summary of Consequences** This alternative would most fully achieve hazard fuel reduction and resource management objectives of restoring natural ecosystem process and function and provide for human safety. Giant sequoia reproduction throughout its range in the parks would increase to natural levels.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
hazard fuel conditions at the local level and to approximately 50% of giant sequoia grove acres. However, the current level of fire activity has not been adequate to effectively restore and maintain desired resource conditions throughout much of the park. Under this alternative many resource areas within the parks would continue to decline in condition due to the lack of fire and the subsequent increase in fuel loading. Sequoia reproduction in untreated groves would continue to decline.	effects. The strategy would allow the maximum amount of control over the timing and location of fire (and hence smoke) events by suppressing all random ignitions (lightning and human caused). Since this strategy would depend fully on management actions to simulate natural processes throughout the park, more scientific and monitoring information would be required to model and understand the timing, placement, and outcomes of the ignitions. Additional staff would be required to plan, implement, and monitor the increased number of planned ignitions. Loss of wilderness character may result from the intensive fire management activity needed to implement extensive prescribed fire projects. Replacing the natural fire regime with a simulated regime may result in unnatural ecological outcomes.	areas that would never be fully restored or managed for natural function within a conceivable time frame. Areas where unnaturally high fuel loads exist may experience more severe fire effects, including high tree mortality. Since unnatural fuels would not have been reduced through conservative prescribed burning or mechanical means, unwanted fire effects may be extensive should a natural fire event occur under severe weather or extremely dry fuel conditions.	An appropriate mix of natural fire, prescribed fire and mechanical fuel treatments would be used in concert with fire suppression to restore and maintain landscapes within the parks.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Vegetation Under the current program, the vegetation in some areas of the parks' would receive beneficial effects of fire treatment. At the current rate much of the parks' vegetation would burn too infrequently to mimic historic fire return intervals. The long-term consequences of this change in fire regime would further degrade the vegetation conditions throughout the parks. Adverse impacts would include an increase in fire-intolerant species, combined with a lack of regeneration of many fire-adapted species, resulting in further unnatural changes in vegetation structure, composition, and function. In addition to these changes, continued accumulation of fuels would lead to unwanted wildland fires with uncharacteristically severe fire effects, leading to increased mortality and inhibited postburn regeneration.	**Vegetation** A large increase in prescribed fire would beneficially affect the parks' fire-maintained vegetation by restoring fire-related ecological benefits. In areas where heavy fuel loads have resulted from fire exclusion, prescribed fire would be used to reduce fuel loads to more natural levels to help prevent severe effects of unwanted wildland fire. However, with increased use of prescribed fire, the natural ignition and spread pattern of fire on the landscape would be replaced by less random ignition patterns, creating a less natural pattern of fire effects compared with wildland fire use. The long-term consequences of less natural fire patterns are unknown.	**Vegetation** Due to the increase in acres treated with wildland fire use in this alternative, more of the parks' vegetation would burn with a more natural pattern of fire effects compared with Alternative 1. Fire effects would be beneficial to the structure and function of much of the parks' vegetation which has evolved with fire over time. In many areas between approximately 4000-8000 feet (1200-2400 meters) in elevation, where heavy fuel loads have resulted from fire exclusion and prescribed fire was not used to first restore fuel loads in the area, uncharacteristically severe fire effects could occur. In these cases, the adverse impacts on vegetation would include unnaturally high levels of mortality and disruption of plant succession, with slower postburn regeneration of species adapted to less severe fire effects.	**Vegetation** An increase in both prescribed fire and fire use would have a beneficial effect on the parks' vegetation by restoring the structure and function of historically fire-maintained vegetation over a larger area of the parks compared to Alternative 1. Fire-related ecological benefits would occur in a larger portion of the parks. More natural patterns of fire effects on vegetation would occur with an increase in wildland fire use. In vegetation types that have been greatly altered by fire exclusion, fire would be reintroduced initially with prescribed fire to first restore fuel and vegetation conditions to minimize adverse effects of severe fire. Wildland fire use would then be used to the extent possible to maximize the benefits of natural fire patterns.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Wildlife Under the current program, fire treatments would be less frequent than historic fire-return intervals. Without sufficient fire, the vegetation would continue to become more homogeneous resulting in wildlife habitat that is less varied. Wildlife would be adversely affected by the loss of some types of habitat that was maintained by historic fire regimes. In addition, the risk of uncharacteristically severe wildland fire would become greater over time, and would have the potential to threaten wildlife populations not adapted to more severe fire effects.	**Wildlife** The use of prescribed fire in a larger portion of the parks' would be restored than under Alternative 1. This would create more varied vegetation patterns across the landscape and a greater variety of wildlife habitat. More habitat conditions favorable to fire-adapted species would be created, but not necessarily in the same patterns associated with natural ignitions. The distribution of habitat would be determined by prescribed burn timing, locations, conditions, and pattern and could result in less natural habitat conditions compared to wildland fire use. The long-term consequences of less natural fire patterns and corresponding habitat conditions are unknown.	**Wildlife** With an increase in wildland fire use under this alternative a more natural distribution of habitat conditions would occur over a larger area than in Alternative 1. Many wildlife species would benefit. In areas where heavy fuel loads have resulted from fire exclusion, unnaturally severe fire effects could occur that might negatively impact wildlife species locally, but would increase the landscape heterogeneity, thereby improving wildlife biodiversity at the landscape scale.	**Wildlife** An increase in areas restored using fire in this alternative would maintain a more natural distribution of wildlife habitat than in Alternative 1. A greater use of wildland fire use in Alternative 4 would increase landscape heterogeneity and improve wildlife biodiversity at the landscape scale. In areas where heavy fuel loads have resulted from past fire exclusion, prescribed fire would first be used to reduce the risk of uncharacteristically severe fire and corresponding radical changes to the habitat.
Special Status Species Common to All: With the exception of the Valley elderberry longhorn beetle, no federally listed plant or animal species would be affected as a result of fire restoration.			

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Special Status Species Under Alternative 1, fire restoration would occur in limited areas of the parks and would have no effect or potentially beneficial effects to most special status species adapted to fire in treated areas. In other areas, fire treatments would occur less frequently than in the historic fire regime, leading to further degradation of conditions. These altered conditions would create a greater risk of uncharacteristically severe wildland fire that would have the potential to adversely affect special status species.	**Special Status Species** An increase in areas restored with fire in Alternative 2 compared to Alternative 1 would benefit those special status populations that are enhanced by fire effects on vegetative mosaics and habitats. Over time, the risk of adverse effects to sensitive species from uncharacteristically severe fire would decrease in treated areas. With the scheduled nature of increased prescribed fire activities under Alternative 2, a greater ability to locate and avoid the disturbance of fire-sensitive special status populations, if necessary, exists. Individual plants and animals may be affected or displaced by fire events. Restoration would have no effect or beneficial effect on overall populations of special status populations.	**Special Status Species** *An increase in areas treated with fire in Alternative 3 compared to Alternative 1 would benefit those special status populations that are enhanced by fire. In some areas, conditions altered by fire exclusion could lead to uncharacteristically severe wildland fire effects that might have an adverse effect on special status species not adapted to more severe fire. However, over time, the risk of adverse effects to sensitive species from uncharacteristically severe fire would decrease in treated areas. Due to the random nature of wildland fire use ignitions, sensitive populations might be impacted by fire before they could be located and protection efforts, if needed, would be more difficult. Species that are fire dependent would benefit from the occurrence of fire in a more ecologically-desirable natural pattern of wildland fire use leading to natural vegetation mosaics.* Individual plants and animals may be affected or displaced by fire events. Restoration would have no effect or beneficial effect on overall populations of special status populations.	**Special Status Species** An increase in areas treated with fire compared to Alternative 1 would benefit those populations that are enhanced by fire. The risk of adverse effects to special status species from uncharacteristically severe fire would decrease in treated areas. In areas where prescribed fire is used, species that are sensitive to fire could be located and protected if necessary. With increased wildland fire use in Alternative 4, and due to the random nature of these ignitions, sensitive populations might be impacted by fire before they could be located and protection efforts, if needed, would be more difficult to implement. More natural ignition and spread patterns would result from wildland fire use, benefiting species that are adapted to the creation of these vegetative mosaics. Individual plants and animals may be affected or displaced by fire events. Restoration would have no effect or beneficial effect on overall populations of special status populations.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Non-Native/Invasive Species With only some areas of the parks treated with fire under the current program, the potential for uncharacteristically severe wildland fire is greater, providing more opportunity for non-native/invasive species that respond positively to severe fire disturbance.	**Non-Native/Invasive Species** *An increase in areas restored with fire in this alternative compared to Alternative 1 would increase the potential for establishment and spread of non-native species promoted by fire disturbance, but limit the areas disturbed by severe wildland fire.*	**Non-Native/Invasive Species** *An increase in areas treated with fire under this alternative compared to Alternative 1 would increase the potential for establishment of non-native/invasive species that are enhanced by fire, but limit the areas disturbed by severe wildland fire.*	**Non-Native/Invasive Species** An increase in areas restored with fire in Alternative 4 compared to Alternative 1 would increase the potential for non-native/invasive populations that are enhanced by fire, but limit the areas disturbed by severe wildland fire.
Air Common to All: All individual wildland fire use and prescribed fire projects will be managed under the same conditions and constraints under all alternatives. Each project will be implemented only with the concurrence of the San Joaquin Valley Air Pollution Control District, and managed to maintain smoke emissions in communities below the legal thresholds as defined by the State of California and the Environmental Protection Agency.			
Air Under Alternative 1, PM-10 emissions would not significantly change in the short term. Modest levels of proactive fuels management with the opportunity to adjust timing would decrease smoke events in some areas of the parks over time. Occasional large unwanted fire events would continue to affect local communities and regional air quality several times each decade. Over the long-term fuels would accumulate in untreated areas of the parks resulting in larger, less predictable unwanted fire events.	**Air** A threefold increase in annual PM-10 emissions would occur compared to Alternative 1 in the first 10 years of implementation as the 100-year backlog of fuels was reduced. After 25 years of proactive fuels management, emissions would decrease compared to the 10-year average. Due to the exclusive use of prescribed fire in this alternative and the subsequent ability to select the timing and location of most fire events, the impacts of prescribed fire smoke events could be minimized. The duration and intensity of smoke from large unwanted fire events would decrease over time as heavy fuel concentrations were systematically reduced across the parks.	**Air** Annual PM-10 emissions would be 3.5 times the current program outputs (represented by Alternative 1) during the first 10 years of implementation. After 25 years of proactive fuels management, emissions would decrease compared to the 10-year average. Some large unwanted fire events would occur each decade, with declining duration and intensity of associated smoke events over time as fuels are proactively managed and fuel loads are reduced across the parks. Due to the exclusive use of random natural events under this alternative, less control over the timing and placement of fire events would result in less opportunity to manage smoke impacts compared to all other alternatives.	**Air** Annual PM-10 emissions would be 2.3 times the current program outputs compared to Alternative 1 during the first 10 years of implementation. After 25 years of proactive fuels management, emissions would rapidly decrease to near the current program levels. The use of natural fire in this alternative reduces the ability to manage smoke events in comparison to Alternative 2, but with the proactive management of prescribed fire, better control is effected over Alternative 3. Some large unwanted fire events would occur each decade, with declining duration and intensity of associated smoke events over time as fuels are proactively managed and fuel loads are reduced across the parks.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Water Temporary effects on water quality on a localized basis may occur. Only moderate increases in run-off yield due to the reduction of vegetation would result from prescribed burns because managers could control the location, timing, and severity of fire. There is a continuing backlog and accumulation of fuels with associated impacts of water resources and potential risk (moderate-to-high) of catastrophic fire events. Such events may be extreme with severe fire behavior over large areas, which would result in adverse impacts to various water properties. The risk does not decline significantly over time due to continuing fuel accumulations.	**Water** A moderate increase in run-off yield over alternative 1 would be expected under this alternative due to the reduction of vegetation produced by prescribed burns. This alternative provides for the maximum control of fire– season, size, severity, and location. Initially there would be some potential for adverse unplanned fire events in unnatural fuels, similar to Alternative 1, but the risk of such occurrences would decline over time. Significant long-term impacts on water could occur through such activities as extensive fireline construction necessary to control prescribed burns. Since these activities would be required in all portions of the parks under this alternative, there would be more widespread impacts. Because prescribed fires would be used, which would be ignited under specific prescriptions, there is the potential that the full range of natural processes that acted on water in the past would not be restored.	**Water** Outcomes of fire and its impact on park water resources would be less predictable under this alternative. The unpredictability may result in either desirable or undesirable impacts for water depending on location, size, and intensity of burns. The effects would be more positive to the extent that the unplanned fires occur under the normal range of fuel and fire behavior conditions. Fires outside this range could potentially result in detrimental impacts with unnatural impacts on water resources and sedimentation. Such fires would have the greatest chance of occurring where unnatural fuels and vegetation currently occur. The potential effects would probably be most pronounced in the Kings and Kaweah watersheds. Impacts related to line construction and similar activities would be minimized relative to the other alternatives.	**Water** The initial impacts of this alternative are similar to those for Alternative 2 due to the dominance of prescribed burning. As forest conditions and fuels are restored prescribed burning would decline and natural fire would play an increasingly important role. Impacts of natural fire would be minimal because they would generally be confined to areas where unnatural fuel levels have been restored by prescribed burning or to areas where forest conditions and fuels have remained within the range of pre-Euroamerican settlement conditions. Impacts from implementing prescribed burns (line construction etc.) would be greatest at the onset of this alternative and decline over time. The amount of park area where natural variation in fire effects on water resources could occur would increase over time.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Soil Because of the ability to control location, timing, and severity of some fires in this alternative, there would be moderate effects on soils. There is a continuing backlog and accumulation of fuels with associated impacts of soils and potential risk (moderate-to-high) of catastrophic fire events. Such events could be extreme, with severe fire behavior over large areas resulting in adverse impacts to various soil properties. These impacts may be most severe in chaparral vegetation. The risk does not decline significantly over time due to continuing fuel accumulations.	**Soil** Compared to all the alternatives, Alternative 2 provides for the maximum control of fire (season, size, severity, and location). Initially there would be potential for adverse fire events in unnatural fuels, similar to Alternative 1, but the risk of occurrence would decline over time as the amount of area restored is increased and fuel continuity is broken up. Significant long-term impacts on soils could occur through such activities as fireline construction necessary to control prescribed burns. Since these activities would be required in all portions of the parks under this alternative, the impacts would be widespread. Because prescribed fires would be used, which would be ignited under specific prescriptions, there is the potential that the full range of natural processes that acted on soils in the past would not be restored.	**Soil** Outcomes of fire and its impacts on park soil resources would be more unpredictable under this alternative. This alternative provides the least control over such factors as size, severity, season, and location of fires. The unpredictability or variation in fire events that result may have either desirable or undesirable impacts for soils, depending on location, size, and intensity of burns. Effects would be more positive to the extent that the unplanned fires occur under the normal range of fuel and fire behavior conditions. However, fires outside the range could result in detrimental impacts with unnatural rates of soil erosion and run-off. Such fires would have the greatest chance of occurring where unnatural fuels and vegetation currently occur. The potential effects would probably be most pronounced in the Kings and Kaweah watersheds. Impacts related to line construction and similar activities would be minimized relative to the other alternatives.	**Soil** The initial impacts of this alternative are similar to those for Alternative 2 due to the dominance of prescribed burning. As forest conditions and fuels are restored, prescribed burning would decline and unplanned fire would play an increasingly important role. Impacts of natural fire would be minimal because they would generally be confined to areas where unnatural fuel levels have been restored by prescribed burning or to areas where forest conditions and fuels have remained within the range of pre-Euroamerican settlement conditions. Impacts from carrying out prescribed burns (line construction etc.) would be greatest at the onset of this alternative and decline over time. Amount of area where natural variation in fire effects on soils occurred would increase over time.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Health/Safety Common to All: Implementation of the parks' *Smoke Management Plan* would minimize exposure of visitors, employees, and local communities to unhealthful exceedances of air quality standards. Some individuals exposed to smoke may be sensitive or susceptible to smoke impacts at levels below the legal limits. Under all alternatives, the parks will manage this potential impact through a system of identification of sensitive individuals in the affected communities, advance notification to help affected parties mitigate or avoid potential impacts, and any other actions deemed reasonable by the Air District.			
Health/Safety Public. There is no expected increase in fire caused injuries to visitors, employees, and the public. Under Alternative 1, fire operations would remain at current levels with intermittent visitor, employee, and general public exposure to ground level smoke. Fire Personnel. Since fire operations would remain at current levels, there would not be an immediate increase in the rate of exposure of fire personnel to hazardous conditions—both fire and smoke. Over time, as fuels continue to accumulate in untreated areas of the parks and the risk of catastrophic fire grows, fire personnel would be exposed to increasingly hazardous conditions.	**Health/Safety** Public. There is no expected increase in fire-caused injuries to visitors, employees, and the public. A significant increase in prescribed fire operations would occur which has the potential to increase the exposure of visitors, employees, and the public to ground level smoke particularly during late night and morning periods when smoke plumes collapse, descend and concentrate in low lying areas or canyon bottoms. Fire Personnel. There would be a significant increase in the number and extent of prescribed fire operations that would cause an increase in the rate of exposure of fire personnel to hazardous conditions—both fire and smoke. An increase in injuries may occur but it is not possible to predict with any certainty the increased rate of injury. The planned nature of prescribed fire events should allow for a lower rate of injuries than Alternative 3 given its unplanned nature.	**Health/Safety** Public. There is no expected increase in fire-caused injuries to visitors, employees, and the public. A significant increase in wildland fire use operations would occur which has the potential to increase the exposure of visitors, employees, and communities to ground level smoke particularly during late night and morning periods when smoke plumes collapse, descend and concentrate in low lying areas or canyon bottoms. Fire Personnel. There would be a significant increase in the number and extent of wildland fire use operations that would cause an increase in the rate of exposure of fire personnel to hazardous conditions—both fire and smoke. This exposure would be unplanned with the potential of a higher rate of injury than Alternative 2.	**Health/Safety** Public. There is no expected increase in fire-caused injuries to visitors, employees, and the public. A significant increase in prescribed fire and wildland fire use operations would occur which has the potential to increase the exposure of visitors, employees, and general public to ground level smoke particularly during late night and morning periods when smoke plumes collapse, descend, and concentrate in low lying areas or canyon bottoms. Fire Personnel. There would be a significant increase in the number and extent of prescribed fire and wildland fire use operations which would cause an increase in the rate of exposure of fire personnel to hazardous conditions—both fire and smoke.
Community Economics Common to All: The fire program provides a net benefit to local business through an infusion of funds from payroll and operations.			

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Community Economics Under Alternative 1, payroll costs for employees in the parks' fire management program under this alternative would be slightly over $1 million annually. Total additional dollars for program support and proactive fuels management would be $280 thousand annually. Offsetting the local economic benefits from fire payroll and support spending are expected periodic negative effects for the tourism industry as fire projects are implemented and fire suppression occurs resulting in road or facility closure. Impacts resulting from unplanned fires requiring suppression are expected to increase as suppression acres increase.	**Community Economics** Payroll size would increase through the addition of another operations crew. Payroll would increase to $1.2 million annually. Total support dollars available under the prescribed fire alternative would increase to about $300 thousand annually. Expected negative effects for the tourism industry would be greater initially than for Alternative 1, but decrease over time as fuels treatment leads to a reduction in fuels across the park. Negative effects could be partially mitigated through proper planning for prescribed fire events, reducing their randomness and subsequent impact upon the community.	**Community Economics** Payroll size would increase with the addition of one operations crew. Total payroll and total support dollars available would be the same as Alternative 2. A slightly higher level of negative impacts on tourism would be expected due to the random nature of the natural ignitions. Unplanned ignitions managed for resource benefit during the fire season without prior restoration of natural fuel loads could lead to more smoke production during the tourist season. Mitigation strategies would be more limited than with prescribed fire treatment (Alternative 2) or combined strategies (Alternatives 1 and 4).	**Community Economics** Payroll size would increase by roughly one-third with the addition of operations crews and support staff. Total payroll would increase to $1.5 million annually while total support dollars available would increase to $320 thousand. The budget for this program would be the highest of all alternatives, resulting in more economic benefit to local economies from that source. Anticipated negative effects on tourism would parallel the no action alternative. There would be a potential for an initial increase in impacts as treatment activity increased, but long-term effects from individual events would be reduced over time as fuels were restored to more natural levels.
Program Cost Park fire program costs would not change appreciably over current levels for implementation and monitoring. This alternative would have the lowest total cost and highest cost/acre of all alternatives.	**Program Cost** Annual operating costs for the park would increase to provide expanded staff to implement and monitor projects. This alternative would have the second lowest total cost and the lowest cost/acre of all alternatives.	**Program Cost** Annual operating costs for the park would increase to provide expanded staff to implement and monitor projects. This alternative would have the highest total cost and the second highest cost/acre of all alternatives.	**Program Cost** Park fire program costs would increase over past levels to provide proper management of the expanded efforts. This alternative would have the second highest total cost and the second lowest cost/acre of all alternatives.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Wilderness Under this alternative, the wilderness would appear natural to most visitors. However unnatural levels of fuels would continue to accumulate throughout much of the lower and mid-elevation wilderness. Tree density and species composition would continue to change away from natural conditions. Unnaturally intense fires may occur over larger portions of the wilderness as a result of increasing fuel and tree density. Some transient impacts would occur as a result of fire operations including helicopter use, fire camps, pack stock, motorized saws and pumps, and the presence of fire management personnel.	**Wilderness** This alternative would use prescribed fire to mimic natural process, and most unplanned ignitions would be suppressed. The result would be a reduction or elimination of unplanned fire events and their effects resulting in an environment primarily shaped by humans. Though the wilderness would appear “natural” or “wild” to most visitors, it would in fact be primarily a product of human intervention. More extensive use of firelines would be expected under this alternative than others, resulting in more visible and persistent evidence of human intervention. More activity related to management (necessary to simulate natural process) would result in increased levels of staff and equipment throughout the wilderness resulting in transient impacts.	**Wilderness** This alternative would allow the freest expression of natural processes in wilderness. However in areas that have been significantly altered by past suppression and have unnaturally high fuel loads and/or tree density, the effects of an unplanned fire may result in unnaturally intense or extensive fire. Most management activity would take the form of monitoring fire events by aircraft and on the ground. There would be an occasional need to initiate suppression actions to keep fires from directly impacting developments or other sensitive areas.	**Wilderness** This alternative would initially use extensive fireline construction to implement prescribed fire in areas where unnaturally high fuel loads and/or tree densities are present. In all other areas, the natural role of fire would be perpetuated and only constrained as required to protect structures, protect people, or conform to air quality regulations. Over time, impacts from fireline construction and suppression actions in wilderness would decrease.
Wild and Scenic Rivers This alternative would maintain or restore moderate amounts of wild and scenic river corridor, with emphasis on the segment flowing through the Cedar Grove developed area. Other areas of the wild and scenic river corridor not receiving treatment would be subject to greater unnatural change from high intensity wildfire events.	**Wild and Scenic Rivers** Most areas along the wild and scenic river corridors would receive proactive fuels management and would be protected from damaging large-scale high intensity fire events. Some degree of naturalness would be lost as a result of the deterministic implementation of prescribed fire projects throughout the river corridor.	**Wild and Scenic Rivers** Some areas along the wild and scenic river corridors would be protected from damaging large-scale high intensity fire events. Some risk from damaging large-scale high intensity fire events would remain as most areas would not receive conservative fuels reduction (either through mechanical treatment or prescribed fire) prior to burning in unplanned fire events.	**Wild and Scenic Rivers** Most areas along the wild and scenic river corridors would receive proactive fuels management and would be protected from damaging large-scale high intensity fire events. Areas would appear natural with minimal human intervention in wilderness areas.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Recreation Common to All: Depending on location and time of year, fire operations may cause temporary impacts to individual recreational experiences.			
Recreation Impacts include: 1) noise from aircraft and other power equipment such as chainsaws and portable pumps, and 2) temporary closures of roads, trails, or facilities to protect visitors from direct exposure to fire events. Smoke from fires may occasionally restrict visibility and impact viewsheds, or become heavy enough to become a nuisance. The health impacts to visitors would be slight due to the relatively short duration of the average visit and the ability to be both mobile and flexible enough in itinerary to avoid smoke exposure. Fire helps to shape and renew the vegetation and wildlife habitats that are integral parts of many recreational pursuits in the parks. Fire events may also create unique opportunities for visitor experiences and educational opportunities. The effects of some fires, such as facilitating the germination of giant sequoia seeds and stimulating wildflower displays, may provide positive experiences.	**Recreation** In the short term this alternative may result in slightly increased negative impacts to recreational use compared to Alternative 1 due to more aggressive implementation of a prescribed fire program. Impacts would take the form of occasional closures of roads or wilderness areas to implement fire operations. This alternative would have fewer negative impacts on recreational use than Alternative 3 due to more rigid control over timing and placement of ignitions. Over the long term, random and aggressive suppression actions would be reduced as more of parklands were restored to natural fuel loads and forest density, reducing the duration and number of closures and smoke events.	**Recreation** Many impacts are similar to Alternative 2. However this alternative may result in additional impacts to recreational use compared to other Alternatives due to the random nature of ignitions and lack of proactive fuels management.	**Recreation** Same as Alternative 2 except that there would be less evidence of fire management activities in wilderness and backcountry areas due to management of unplanned ignitions in place of more operations-intensive prescribed fire projects.

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Cultural/Historic This alternative uses a combination of mechanical fuel removal, suppression, and management of planned and unplanned ignitions to achieve modest accomplishments. Prescribed burns and mechanical treatments would be pre-planned allowing avoidance and mitigation of most cultural resource impacts. Protection of cultural resources would be considered when implementing fire use projects. Since this alternative does not treat all areas of the park with prescribed fire or mechanical fuel removal at a level sufficient to offset increasing accumulation of fuels, high intensity fire events leading to cultural resource damage would be expected on occasion.	**Cultural/Historic** A focus on the use of pre-planned prescribed fire as the dominant management strategy in this alternative allows the best opportunity for advance clearance and avoidance of cultural resource impacts. However, since this alternative depends exclusively on the use of prescribed fire requiring extensive fireline construction throughout the park, it has a fairly high probability of disturbing currently unidentified cultural resources. This alternative would treat heavy fuel accumulation parkwide, decreasing the risk of damage to cultural resources from intense fire events. Occasional emergency suppression actions needed to control unwanted fires may result in negative effects. With continued application of prescribed fire, fuels loads and resulting high intensity events would diminish with time and reduce the potential for damage.	**Cultural/Historic** This alternative optimizes the use of random fire ignitions and minimizes the use of pre-planned actions. As such, it provides the least opportunity for advance clearance and mitigation of fire effects on cultural resources. Since much less fireline would be constructed under this alternative, concerns for sub-surface disturbance of cultural resources would be reduced. However, the lack of preplanning combined with the occasional large high intensity event would place above ground prehistoric and historic sites/structures/objects at highest risk. This alternative is the least amenable for overall protection of cultural resources given the current fuel loads.	**Cultural/Historic** The adoption of a multi-strategy program may result in a variety of potential impacts to known cultural resources similar to the impacts outlined above for Alternative 1. However, the degree of these potential impacts would be greater given that more acres would be targeted for treatment per year. With the use of prescribed fire and mechanical fuel reduction, the ability to pre-plan mitigation actions would reduce the potential impacts to cultural resources. Pro-active fuels management would also reduce the risk of catastrophic wildland fire and associated emergency responses. These planned treatments have the potential to increase surface disturbances through the construction of firelines that may result in adverse impacts to shallowly buried sites/structures/objects. The use of wildland fire use and suppression would be closely coordinated with the parks' cultural resources specialist given the potential for ground disturbance and attendant site impacts (the emergency placement of fire camps, firelines, and staging areas).

Alternative 1 No Action (Current Program)	Alternative 2 Prescribed Fire	Alternative 3 Wildland Fire Use	Alternative 4 Multi-Strategy (Preferred Alternative)
Risk of Catastrophic Events Continuation of the current program would provide a modest amount of protection from catastrophic fire in limited areas of the parks. High priority would be given to the protection of developments and boundary areas. Less emphasis would be placed on managing the risk of catastrophic fire for the benefit of natural or cultural resources.	**Risk of Catastrophic Events** This alternative would reduce the threat of catastrophic fire across most of the susceptible parklands to a much greater degree than Alternative 1. The dominant use of prescribed fire along with some limited mechanical fuel reduction around developments optimizes the controllability of fuel reduction and forest density operations, and minimizes the opportunity for random natural variables (wind, lightning, etc.) to affect outcomes.	**Risk of Catastrophic Events** Managing unplanned fires without first reducing fuels or density through more conservative means (mechanical fuel reduction or prescribed fire) may result in an increased risk of catastrophic fire events. Under this alternative, developments would receive some mechanical treatment to minimize risk of catastrophic events, but natural and cultural resources outside of these developed areas would remain at risk.	**Risk of Catastrophic Events** The effects of this alternative would be similar to Alternative 1, though a much larger portion of the susceptible areas in the parks would be treated, further reducing risk.
Environmental Justice No effect.	**Environmental Justice** No effect.	**Environmental Justice** No effect.	**Environmental Justice** No effect.
Indian Trust Resources No effect.	**Indian Trust Resources** No effect.	**Indian Trust Resources** No effect.	**Indian Trust Resources** No effect.

MITIGATION

Following are the mitigation measures that would be implemented under the preferred alternative, Alternative 4 – Multi Strategy. These mitigation measures would prevent significant impact, impairment of park resources, violation of applicable laws and policies, and address public concerns. The issues and potential impacts are discussed at greater length in the related sections in Chapter 5.

Table 6-3 – Mitigation Matrix

Issue	Potential Impact	Mitigation Actions	Responsibility
Vegetation	Unnatural damage from high intensity fire events.	Use conservative prescriptions to reduce unnatural fuel loads and stem density in areas needing restoration. Monitor outcomes of planned fire and mechanical fuels projects.	Fire management office Fire effects program manager.
	Direct damage to trees and other vegetation while implementing fire management operations.	Apply minimum impact suppression techniques (MIST) to all fire management actions.	All fire operations.
Wildlife	Unnatural change in habitat induced by high intensity fire events.	Use conservative prescriptions to reduce unnatural fuel loads and stem density in areas needing restoration. Monitor outcomes on selected species.	Fire management office Fire effects program manager.
Special Status Species	Federally listed – Threatened valley elderberry longhorn beetle (*desmocerus californicus dimorphus)*	Restrict planned ignitions to between June 15 – February 28 in habitat below 3,000' elevation per USFWS recommendation of June 21, 1995 (Chapter 7).	Fire management office
	Other non-listed species of concern.	Monitor species recommended in Chapter 5.	Fire Effects program manager and park plant ecologist.
Prevent Spread of Non-Native Invasive Species	Introduction of aggressive non-native species.	Use MIST on all actions to minimize soil disturbance. Use appropriate burned area emergency rehabilitation (BAER) strategies and techniques to stabilize sites, monitor for invasives, and implement control measures as necessary following wildfire events. Monitor populations of known exotics of concern to determine trends.	All fire operations Fire Planner and BAER teams as appropriate. Fire effects program manager and exotic

Issue	Potential Impact	Mitigation Actions	Responsibility
		Support research into prevention and mitigation strategies to prevent introduction and spread of aggressive non-natives following fire.	plant program manager. Fire management and natural resource offices.
Air Quality	Smoke and particulate matter.	Consult with and obtain burn permits from the San Joaquin Valley Air Pollution Control District (SJVAPCD) when implementing any wildland fire use or prescribed burn project. Implement Best Available Control Measures (BACM) to conform with the SJVAPCD *Implementation Plan for PM-10*. Implement the *Smoke Management Plan* (SMP) contained in the *Fire and Fuels Management Plan*. The SMP implements BACM and contains detailed commitments for smoke modeling, monitoring, public notification, and regulatory oversight by the (SJVAPCD). As part of the *Smoke Management Plan*, monitor smoke in sensitive areas and adjust prescribed fire project accomplishments and progress as needed to maintain air quality within published health standards. Maximize the benefits of pre-planning and planned ignitions to the extent compatible with land management objectives to burn during the best possible dispersal periods. Work proactively with the SJVAPCD and other land managers to continue development of models, strategies, technologies, and best management practices to achieve further reductions in emissions.	Fire management officer, and fire monitoring/smoke management program manager. Fire management officer and all burn bosses. Fire management officer, burn bosses, fire monitors, smoke and weather technician, fire behavior specialist. Fire monitors, smoke and weather technician. Fire management office, fire behavior specialist, burn bosses. San Joaquin Valley Unified Air Pollution Control District staff.
Water	Contamination of waterways from firefighting retardant or foam.	Apply restrictions on the application of retardant and foams in or adjacent to waterways as contained in the *Fire and Aviation Management Operations Guide* (FAMOG).	Fire management office.

Issue	Potential Impact	Mitigation Actions	Responsibility
	Minimize unnatural levels of sedimentation in waterways.	Use conservative prescriptions to reduce unnatural fuel loads and stem density in areas needing restoration. Monitor outcomes of planned fire and mechanical fuels projects on water resources. Use appropriate burned area emergency rehabilitation (BAER) strategies and techniques to stabilize soils and implement control measures as necessary following unnaturally intense or extensive fire events. Use MIST strategies to rehabilitate firelines and other disturbances within the same season to the extent fire control objectives are not compromised, or no later than the next fire season.	Fire management office, all operations personnel. Fire effects program manager and aquatic ecologist. Fire planner and BAER team as appropriate. All fire operations.
Soil	Minimize unnatural rates of soil erosion	Use conservative prescriptions to reduce unnatural fuel loads and stem density in areas needing restoration. Individual project size would be within the range of natural variability. Use appropriate burned area emergency rehabilitation (BAER) strategies and techniques to stabilize soils and implement control measures as necessary following wildfire events. Use MIST strategies to rehabilitate firelines and other disturbances within the same season to the extent fire control is not compromised.	All fire operations. All fire operations. All fire operations.
Health/Safety	Visitor, community, and park resident health & safety.	Make firefighter and public safety the highest priority during all fire management actions. Implement local closures or restrictions as needed to prevent direct injury from fire. Implement road visibility standards contained in the FAMOG. Implement BACM for smoke management and monitoring as specified in the Smoke Management Plan.	Superintendent, Fire management office, all fire personnel. Fire management office in consultation with Supernatant. Burn boss. Burn boss, fire management office, fire monitors, smoke and weather technician.

Issue	Potential Impact	Mitigation Actions	Responsibility
	Firefighter health & safety.	Follow all guidelines regarding firefighter safety as specified by the National Wildland Coordinating Group, including mandatory safety training, consistent use of personal protective equipment, adherence to standard firefighting orders, and other guidance. Make firefighter and public safety the highest priority during all fire management actions.	All fire operations staff. All staff.
Community Economics	Potential loss of tourism and community revenue during suppression actions and related closures.	Encourage local purchase of lodging, supplies, and materials by suppression forces during emergency actions. Provide accurate public information regarding closures and impacts. Minimize the time and extent of closures and other restrictions consistent with firefighter and public safety.	Fire management office. Fire information officer. Fire management office.
Program Cost	Program cost.	Consistently assess program costs in relation to program objectives. Request routine fiscal audits by the National Interagency Fire Center. Apply recommendations from audits.	Fire management office, National Interagency Fire Center Fire management officer.
Wilderness	Use of minimum tool	As listed in the EA, certain mechanical, stock, and electronic devices would be considered as the minimum tool to achieve management, resource, and safety objectives. Timing, duration, and location of the use of various tools will take into account preservation of wilderness values.	All staff. Fire management office.
	Closures	Minimize the time and extent of trail and facility closures and other restrictions consistent with firefighter and public safety.	Fire management office.

Issue	Potential Impact	Mitigation Actions	Responsibility
	Effect on natural appearance of wilderness areas.	Apply MIST firefighting techniques to all operations. Rehabilitate all firelines, camps, and other operational areas to natural appearance using MIST and BAER standards within the same season if consistent with fire control objectives, or as soon as practical in the subsequent season.	Burn boss and all fire operations. All fire operations staff.
	User conflicts	Timing of operations will fully consider opportunities to minimize noise, closures, placement of fire camps, and other temporary intrusions into the wilderness that may affect visitor use. Travel routes for helicopters and packstock used to support fire operations will be planned to minimize impacts on visitor use and enjoyment of the wilderness. Pack stock, where used, will conform to existing regulations regarding party size and grazing restrictions. Where opportunity exists, popular visitor destinations and forage areas will be avoided when grazing stock or establishing fire camps or other facilities.	Fire management office. Fire management office. Fire management office and stock use/meadow monitoring program manager.
Wild & Scenic Rivers	River character	No fire related permanent facilities or crossings will be built in any designated river corridors. Fire management objectives in these areas will be to restore and maintain natural conditions. See also “Water” above for related mitigations.	Fire management office.
Recreation	Closures	Minimize the time and extent of closures and other restrictions consistent with firefighter and public safety.	Fire management office.
	Aesthetic impacts	Minimize the effects of fire on featured giant sequoia trees, stumps, and logs of social importance (See *Fire and Fuels Management Plan*, Chapter 5 for listing of protected specimens and features and prescribed procedures).	Project burn boss.
Cultural/Historic Resources	Fire damage to resources.	Implement pro-active fuels management to minimize high intensity fire events. Incorporate cultural resources staff into pre-planning for	Fire management office. Fire management office, park archeologist.

Issue	Potential Impact	Mitigation Actions	Responsibility
		prescribed fire and mechanical fuel removal projects to identify, avoid, and protect significant resources.	
		For all non-emergency line construction, have cultural resources staff inspect and approve line corridor prior to any work. Avoid and/or protect significant resources in line construction area and within project area as directed by cultural resources staff.	Burn boss, fire management office, park archeologist.
		For emergency line construction, consult with cultural resources staff and avoid, protect, or otherwise mitigate potential damage consistent with firefighter and public safety.	Incident commander, fire management office, park archeologist.
		Monitor fire effects on known resources post-burn.	Park archeologist.
Reduce Risk of Catastrophic Events	Unnaturally intense and/or extensive fire events.	Implement pro-active fuels management to minimize high intensity extensive fire events.	Fire management office.
		Use conservative prescriptions to reduce unnatural fuel loads and stem density in areas needing restoration.	Fire management office.

7 Consultation and Coordination

INTERNAL AND PUBLIC SCOPING

A Scoping Notice was placed in the Federal Register on February 24, 1999 and press releases regarding the planning effort were sent to media outlets in the region at the outset of the planning process. Two internal scoping meetings were held for all park and concession employees, and five additional public scoping sessions were conducted throughout California. Several presentations were made to special interest groups at their request to solicit comments. These groups included the Mineral King Cabin Owners Association and Friends of the South Fork Kings River. A community-wide survey was conducted in the greater Three Rivers area to further assess issues of concern.

INTERAGENCY SCOPING

Adjacent land managers were consulted both through the public notification process and through a separate scoping session held in Fresno in May 1999. The U.S. Fish and Wildlife Service (USFWS) was contacted at the onset of the planning process to ensure proper Section 7 consultation. A list of species to consider was received from the USFWS and used to prepare this document. Prior consultation with USFWS on the effects of prescribed burns on the threatened valley elderberry longhorn beetle is incorporated in this plan (correspondence attached at end of this chapter). The San Joaquin Valley Unified Air Pollution Control District received a separate scoping presentation and a formal written request for comment was sent to the District. No comments were received from the District during the scoping process.

CULTURAL RESOURCES AND NATIVE AMERICAN CONSULTATION

The National Park Service conducted consultation meetings in July of 1999 with a variety of Native American (American Indian) tribal groups and individuals. These meetings were held on both sides of the Sierra Nevada in areas from which Native American groups historically accessed and used lands now subsumed by Sequoia and Kings Canyon National Parks. Information was received from eight separate groups regarding their past and present uses of the parks, with a total of 33 individuals being interviewed. In very general terms, the eastside meetings included Paiute and Eastern Mono groups of the Owens Valley while the westside meetings focused on Yokuts and Western Mono (Monache) groups that traditionally occupied portions of the Great

Central Valley and western foothills and slopes of the Sierran range (Van Horn and Burge).

Input was solicited on a number of ongoing park planning efforts, including *the General Management Plan*, the *Wilderness Plan*, and the *Fire and Fuels Management Plan*. Of direct interest here, several individuals shared concerns regarding aspects of the parks' fire program. Marie Dominguez Riley, as Tribal Chairperson for the Sierra Foothills Wuksachi Tribe, expressed clear interest in working closely with park planners in helping to identify park areas for possible access, use, and gathering activities relative to the role of fire and planning for fire suppression activities. She noted that her group's interest could include such things as protecting or encouraging the growth of sedges or acorns, the health of which are of traditional concern. A member of the Big Pine Paiute community (Richard Stewart) supported the use of prescribed fires as a management tool. He noted too that prescribed fires could be an avenue for assistance, employment, or interpretation opportunities for tribal members. Several members of the Tule River Indian Tribe voiced interest in pursuing opportunities with the National Park Service for creating training partnerships in a variety of areas, including fire management and fire suppression. Attendees from the North Fork Mono Rancheria also expressed similar interests, voicing a willingness to share tribal expertise with the park service (e.g., regarding plant health and use) and receiving advice on instituting a tribal prescribed fire program.

Overall, those groups that shared concerns or comments regarding the parks' fire program were interested in continuing to receive information and in being consulted regarding the planning and implementation of prescribed fires, in particular. A clear interest in recognizing the effects of fire on any number of natural resources was expressed, as these resources hold ongoing importance to tribal members.

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8 References

Agee, J. K., R. H. Wakimoto, and H. H. Biswell. 1978. Fire and Fuel Dynamics of Sierra Nevada Conifers. *Forest Ecology and Management* 1:255-265.

Bonnicksen, T.M. and E.C. Stone. 1982. Reconstruction of a Presettlement Giant Sequoia-Mixed Conifer Forest Community Using the Aggregation Approach. *Ecology* 63:1134-1148.

Bonnicksen, T.M. and E.C. Stone. 1978. An Analysis of Vegetation Management to Restore the Structure and Function of Pre-settlement Giant Sequoia-Mixed Conifer Forest Mosaics. Headquarters Library, Sequoia-Kings Canyon National Parks.

Caprio, A.C. and D.M. Graber. 2000. Returning Fire to the Mountains: Can We Successfully Restore the Ecological Role of Pre-Euroamerican Fire Regimes to the Sierra Nevada? In: Cole, David N.; McCool, Stephen F.; Borrie, William T.; O'Loughlin, Jennifer (comps). *Proceedings: Wilderness Science in a Time of Change--Vol. 5 Wilderness Ecosystems, Threats, and Management; 1999 May 23-27; Missoula, MT.* Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Proceedings RMRS-P-15-VOL-5. pp 233-241.

Caprio, A.C. 2000. Reconstructing attributes of pre-Euroamerican settlement fire at a watershed scale, Sequoia and Kings Canyon National Parks. Abstract and paper. 85th Ecol. Soc. Amer. Annual Meeting. p. 67.

Caprio, A.C. 1999. Temporal and Spatial Dynamics of Pre-Euroamerican Fire at a Watershed Scale, Sequoia and Kings Canyon National Parks. In: Proceedings *California Association for Fire Ecology 1999 Symposium on Fire Management and New Paradigms*, November 16-19, 1999. San Diego California

Caprio A.C., C. Conover, M. Keifer, and P. Lineback, 1997. Fire Management and GIS: a Framework for Identifying and Prioritizing Fire Planning Needs. In: *Proceedings of the Conference on Fire in California Ecosystems: Integrating Ecology, Prevention, and Management. Nov. 17-20, 1997, San Diego, CA.*

Chorover, J., P.M. Vitousek, D.A. Everson, A.E. Esperanza, and D. Turner. 1994. Solution chemistry profiles of mixed-conifer forests before and after fire. Biogeochemistry 26:115-144.

DeBano, L.F., D.G, Neary, and P.F. Ffolliott. 1998. *Fire's Effects on Ecosystems*. John Wiley & Sons, New York, 333 pp.

Haase S.M. and S.S. Sackett. 1998. Effects of Prescribed Fire in Giant Sequoia-Mixed Conifer Stands in Sequoia and Kings Canyon National Parks. pp 236-243. In: Leonard A. Brennan, and T.L. Pruden (eds.). *Fire in ecosystem management: shifting the paradigm from suppression to prescription. Proceedings of the Tall Timbers Fire Ecology Conference, No. 20*. Tall Timbers Research Station, Tallahassee, FL.

Harvey, H.T., H.S. Shellhammer, and R.E. Stecker. 1980. Giant Sequoia Ecology: Fire and Reproduction. Scientific Monograph Series, No. 12. USDI NPS, Washington, DC. 182 pp.

Hickman, J.C. ed. 1993. The Jepson Manual: Higher Plants of California. University of California Press. Berkeley, CA. 1400 p.

Keeley, J. 2000 (personal observations). United States Geological Survey, Three Rivers, CA.

Keifer, M., N.L. Stephenson and J. Manley. 2000. Prescribed Fire as the Minimum Tool for Wilderness Forest and Fire Regime Restoration: A Case Study from the Sierra Nevada, California. pp 266-269. In: Cole, David N.; McCool, Stephen F. 2000. *Proceedings: Wilderness Science in a Time of Change-- Vol. 5 Wilderness Ecosystems, Threats, and Management; 1999 May 23-27; Missoula, MT.* Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Proceedings RMRS-P-15-VOL-5.

Kilgore, B.M. and H.H. Biswell. 1971. Seedling Germination Following Fire in a Giant Sequoia Forest. *California Agriculture* 25:8-10.

Kilgore, B.M. and R.W. Sando. 1975. Crown-fire Potential in a Sequoia Forest after Prescribed Burning. Forest Science 21:83-87.

Lawrence, G.E. 1966. Ecology of vertebrate animals in relation to chaparral fire in the Sierra Nevada foothills. Ecology. 47(2): 276-291. [26766].

Longhurst, W.M. 1978. Responses of bird and mammal populations to fire in chaparral. California Agriculture. 32(10): 9-12. [7639].

Loomis, J., J. Elgin, and A. Gonzalez-Caban. 1999. Effects of Fire on the Economic Value of Forest Recreation in the Intermountain West: Preliminary Results. pp 199-208. In: *Proceedings of the symposium on fire economics, planning, and policy: bottom Lines.* USDA Forest Service General Technical Report PSW-GTR-173. Pacific Southwest Research Station, Forest Service, US Department of Agriculture, Albany, California. 332 p.

Lujan, Jr., M., D.R. Knowles, J. Turner, and others. 1992. Draft recovery plan for the northern spotted owl. keyw SPOTTED OWL, NORTHERN SPOTTED OWL, MGMT, [18985].

Moore, C. 2000. Annual Sequoia watershed report. pp. 124-132. In: A.C. Caprio (coord.). *1999 Annual Fire Report: Monitoring, Inventory, and Research*. Sequoia and Kings Canyon National Parks, California. 139 pp.

National Park Service. 2001. Directors Order-12: Conservation Planning, Environmental Analysis, and Decision Making. Section 2-14.

Newland, J.A. and T.H. DeLuca. 2000. Influence of fire on native nitrogen-fixing plants and soil nitrogen status in ponderosa pine - Douglas-fir forests in western Montana. Can. J. For. Res. 30:274-282.

Nichols, R. and J. Menke. 1984. Effects of chaparral shrubland fire on terrestrial wildlife. In: DeVries, Johannes J., ed. Shrublands in California: literature review and research needed for management. Contribution No. 191. Davis, CA: University of California, Water Resources Center: 74-97. [5706].

Norris, L. L. and D. A. Brennan. 1982. Sensitive plant species of Sequoia and Kings Canyon National Parks, Technical Report No. 8, Co-operative National Park Resources Studies Unit, U.C. Davis.

Norris, L.L. and D.A. Brennan. 1984. Sensitive Plant Species of Sequoia and Kings Canyon National Parks. Tech. Report No. 17. Update to Tech. Report No. 8. Cooperative National Park Resources Studies Unit, U.C. Davis.

Omi, P.N., D.B. Rideout, and S.J. Botti. 1999. An Analytical Approach for Assessing Cost-Effectiveness of Landscape Prescribed Fires. pp 237-241. In: *Proceedings of the symposium on fire economics, planning, and policy: bottom Lines.* USDA Forest Service General Technical Report PSW-GTR-173. Pacific Southwest Research Station, Forest Service, US Department of Agriculture, Albany, California. 332 p.

Parsons, D.J. and T.J. Stohlgren. 1989. Effects of Varying Fire Regimes on Annual Grasslands in the Sierra Nevada of California. *Madrono* 36:154-168.

Parsons, D. J. and S. H. DeBenedetti. 1979. Impact of fire suppression on a mixed-conifer forest. Forest Ecology and Manage. 2:21-31.

Paul Schissler and Associates. June 1999. A Public Opinion Survey Of The Residents Of Three Rivers, California. Management Report. Sequoia and Kings Canyon National Park

Quinn, Joyce A. 1987. Visitor Perception of NPS Fire Management in Sequoia and Kings Canyon National Parks: Results of a Survey Conducted Summer 1987. Technical Report #36.

Sequoia and Kings Canyon National Parks, *Fire and Aviation Management Operations Guide*, 1998.

Stephens, S.L., 1998. Effects of Fuels and Silvicultural Treatments on Potential Fire Behavior in Mixed Conifer Forests of the Sierra Nevada, CA. *Forest Ecology and Management* 105:21-34.

Stephens, S.L., 1998. *Sequoiadendron giganteum*-Mixed Conifer Forest Structure in 1900-1901 from the Southern Sierra Nevada, CA. *Madrono* 3:221-230.

Stephens, S. L. 1995. Effects of Prescribed and Simulated Fire and Forest History of Giant Sequoia (*Sequoiadendron giganteum* [Lindley Btichholz]) - Mixed Conifer Ecosystems of the Sierra Nevada, California. Ph.D. dissertation, University of California, Berkeley, California, USA.

Stephenson N.L., 1994. Long-Term Dynamics of Giant Sequoia Populations: Implications for Managing a Pioneer Species. Pages 56-63 In: P.S. Aune, technical coordinator. *Proceedings of the Symposium on Giant Sequoias: Their Place in the Ecosystem and Society* 1992 June 23-25, Visalia, CA, USDA For. Serv. Gen Tech. Rep. PSW-GTR-151

Stephenson, N. L. 1996. Ecology and management of giant sequoia groves. Pages 1431-1467 in Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and scientific basis for management options. Centers for Water and Wildland Resources, University of California, Davis.

Storie, R.E. and W.W. Weir. 1953. Generalized Soil Map II-3 of California. Univ. Calif. Agric. Exp. Stn. Manual No. 6.

Taylor, D.L. and W.J. Barmore, Jr. 1980. Post-fire succession of avifauna in coniferous forests of Yellowstone and Grand Teton National Parks, Wyoming. In: DeGraaf, Richard M., technical coordinator. Management of western forests and grasslands for nongame birds: Workshop proceedings; 1980 February 11-14; Salt Lake City, UT. Gen. Tech. Rep. INT-86. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station: 130-145. [17902].

Thomas, J.W., E.D. Forsman, J.B. Lint, and others. 1990. A conservation strategy for the northern spotted owl. Report ot the

Interagency Scientific Committee to address the conservation of the northern spotted owl. [18986].

U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. 2001. Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/ [access date: January 2001].

Van Horn, L.F. and T.L. Burge. Native American Consultations for The General Management Plan and Environmental Impact Statement for Sequoia and Kings Canyon National Parks, California (SEKI 2001-A167-409). On file at Sequoia and Kings Canyon National Parks, Three Rivers, California.

van Wagtendonk, J.W. 1985. Fire Suppression Effects on Fuels and Succession in Short-Fire Interval Wilderness Ecosystems. pp. 119-126. In: J.F. Lotan, B.M. Kilgore, W.C. Fischer, and R.F. Mutch (editors). *Proceedings Symposium and Workshop on Wilderness Fire. 15-18 November 1983, Missoula, Montana.* USDA Forest Service General Technical Report INT-182. 434 pp.

Werner, H., 1997 (personal communication). Sequoia and Kings Canyon National Parks, Three Rivers, California.

Werner, H., 1997. Wildlife Monitoring. Mineral King Risk Reduction Project, Annual Report for Research, Inventory and Monitoring 1997.

Williams, M.R. and J.M. Melack. 1997. Effects of prescribed burning and drought on the solute chemistry of mixed-conifer forest streams of the Sierra Nevada, California. Biogeochemstry 39:225-252.

Wirtz, W. O., II. 1982. Postfire community structure of birds and rodents in southern California chaparral. In: Conrad, C. Eugene; Oechel, Walter C., technical coordinators. Proceedings of the symposium on dynamics and management of Mediterranean-type ecosystems; 1981 June 22-26; San Diego, CA. Gen. Tech. Rep. PSW-58. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 241-246. [6025].

Wohlgemuth, P.M., J.L. Beyers, and S.G. Conard. 1999. Postfire Hillslope Erosion in Southern California Chaparral: A Case Study of Prescribed Fire as a Sediment Management Tool. pp. 269-276. In: *Proceedings of the symposium on fire economics, planning, and policy: bottom Lines.* USDA Forest Service General Technical Report PSW-GTR-173. Pacific Southwest Research Station, Forest Service, US Department of Agriculture, Albany, California. 332 p.

A - Alternatives Considered But Rejected

A preliminary analysis of alternatives resulted in the elimination of Alternative 5 – Wildland Fire Suppression Dominated, and Alternative 6 – Mechanical Fuel Reduction Dominated. These alternatives were described as follows:

Alternative 5 - Mechanical Fuel Reduction Dominated

This alternative would mechanically remove hazardous levels of fuels in non-wilderness areas and around developments. Up to 4% of the park (all non-wilderness) would be the primary focus of this alternative.

Legal and NPS policy restrictions prevent road construction and logging in designated and proposed wilderness, effectively restricting the application of this alternative to about 4% of the park. Mechanical work would occur primarily in the foothills zone and areas immediately adjacent to highway corridors and park developments, which constitutes the bulk of the parks non-wilderness acreage.

Prescribed fire would be used in conjunction with mechanical treatments to burn slash piles or similar fuels related activity. All unplanned ignitions would be suppressed consistent with firefighter safety.

Where mechanical treatments would be applied, they would be designed to reproduce natural plant community structure and function to the extent possible.

Alternative 6 – Wildland Fire Suppression Dominated

This alternative would return the park fire program to its function and purpose prior to 1968.

All unplanned ignitions would be suppressed. Prescribed burning would only occur in conjunction with mechanical treatments around developments. No prescribed fire projects would be implemented to restore or maintain natural systems, or to reduce hazardous levels of fuels outside developed areas.

The strategies and outcomes would be essentially the same as Alternative 5, except that mechanical fuel reduction would only be used immediately adjacent to developments to buffer these sites from unplanned fire events.

Factors in Eliminating Alternatives

The primary considerations that led to the elimination of these two alternatives were:

- An analysis of the maximum acres treatable under each of the two eliminated alternatives (Table A-1) showed that optimum accomplishments under those alternatives still fall well short of achieving even modest natural resource and fire management goals. Ecologically based desired future conditions for the resources have been developed, and the level of activity needed to move toward those conditions over time has been established through a comparison of existing conditions and desired conditions. See Chapter 4, Affected Environment, for additional details regarding that analysis.

- The designation of 96% of the park as proposed or designated wilderness is a primary constraint on mechanical fuel reduction, limiting its application to less than 4% of parklands (approximately 35,000 acres). Even within the 35,000 non-wilderness portion of the parks, many areas are in developed areas such as campgrounds or lodging, or are too steep or otherwise environmentally sensitive to apply mechanical treatments to any great degree (Figure A-2 and Table A-3). Many giant sequoia groves are located in wilderness areas. Selection of either of the alternatives would preclude proactive management of those groves, placing them at substantial risk.

- While some wildfires under the rejected alternatives would create local beneficial ecological effects at times, most areas of the park would be expected to suffer negative effects. Negative effects would come from areas accumulating unnaturally high fuel loads (which would eventually include much of the parklands under these alternatives) and making those acres subject to large-scale high-intensity catastrophic fire events that would be damaging to the natural resources including giant sequoia groves. These high intensity fire events would be hazardous and expensive to fight, compromise firefighter and public safety, and create long duration smoke events at random times. Aggressive suppression actions, including the creation of firelines, fire camps, and helispots, would have serious cumulative effects on park resources and wilderness conditions.

The interdisciplinary planning team forwarded the conclusions of the preliminary assessment to the parks’ Environmental Management Committee for review and advice. The Committee ultimately recommended that Alternatives 5 and 6 be removed from further analysis since they could not be implemented in any fashion that would result in significant resolution of issues, nor would they fulfill fundamental fire management and natural resource objectives. The Superintendent concurred with this determination in a memo dated April 19, 2000.

Table A-1 – Summary of expected annual program achievement in acres by alternative at year 25.

Treatment Acres per year	Alt 1 No Action (Current Program)	Alt 2 Prescribed Fire	Alt 3 Wildland Fire Use	Alt 4 Multi-Strategy (Preferred Alternative)	Alt 5 Mechanical Fuel Reduction	Alt 6 Wildland Fire Suppression
Mechanical Fuel Reduction	10	16	30	16	467	30
Wildland Fire Suppression	886	726	2245	986	3055	3105
Prescribed Fire	1478	14490	164	2225	25	34
Wildland Fire Use	1293	0	11349	12055	0	0
Grand Totals	3667	15232	13788	15282	3547	3547

Notes:
This table represents the average program achievements projected at 25 years from implementation to assess the ability of each alternative to achieve resource management goals.
A conservative ecological analysis indicates that approximately 15,000 acres per year is the *minimum* average that would have burned under completely natural circumstances. Most years would have seen much higher numbers. (Caprio 1999). All alternatives were developed to attempt to meet minimum ecological needs.
Mechanical acres under Alternative 5 represent the maximum area that could be reasonably treated on a sustained basis given constraints of roadless and wilderness areas. Many development areas are currently treated by mechanical means under the parks tree hazard management program (e.g. campgrounds). Acres treated under this program are not included in these figures.
Mechanical acres increased slightly under Alternative 6 over most other alternatives as a tool to create larger reduced fuel buffers directly around developments to offset generally more intense fire events expected under this alternative.
Suppression acreage increased somewhat under Alternative 3 due to the random placement and timing of unplanned ignitions. Additional acres of suppression will be needed due to the lack of other preventative or proactive measures (e.g. prescribed fire) along boundaries and adjacent to developments that would otherwise buffer and allow freer management of unplanned ignitions.
Wildland fire use acres are slightly less under Alternative 3 than Alternative 4 due to the need to suppress or constrain more fire use projects due to the lack of proactive fuels management in adjacent areas. The number of acres for Alternative 4 represents a more liberal management of wildland fire use ignitions due to proactive fuels management in buffer areas, areas of special concerns (e.g. in giant sequoia groves), and around developments.

Figure A-2 – Non-wilderness areas in park minimally suitable for mechanical treatment.

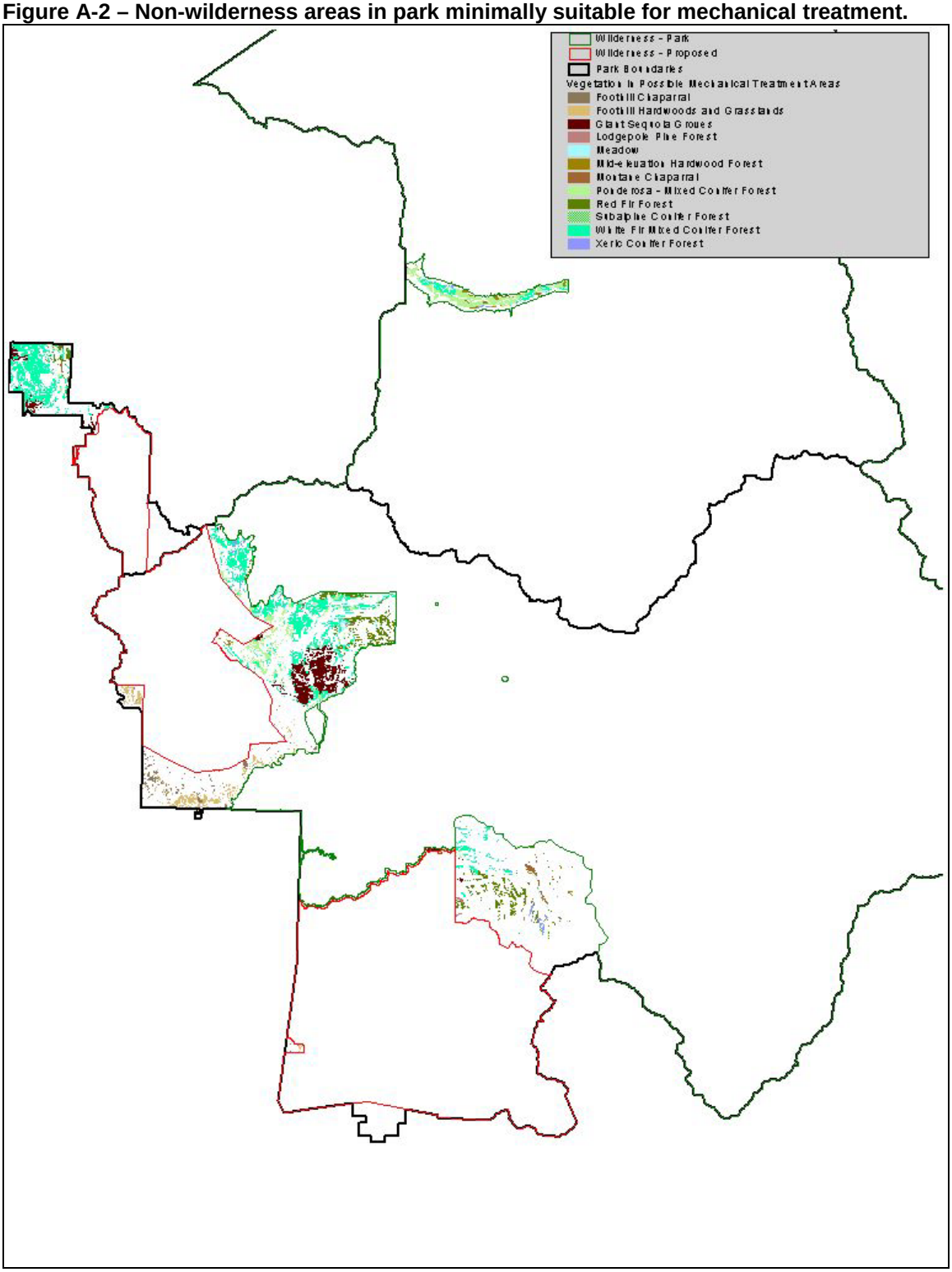

Table A-3 – Acres by vegetation type of non-wilderness areas in park minimally suitable for mechanical treatment.

Vegetation Type	Acres
Foothill Chaparral	388
Foothill Hardwoods and Grasslands	873
Giant Sequoia Groves	1,781
Lodgepole Pine Forest	46
Meadow	163
Mid-elevation Hardwood Forest	179
Montane Chaparral	166
Ponderosa - Mixed Conifer Forest	1,950
Red Fir Forest	1,495
Subalpine Conifer Forest	16
White Fir Mixed Conifer Forest	5,273
Xeric Conifer Forest	253
No (or missing) Data	311
TOTAL ACRES	**12,894**

Criteria for inclusion as minimally suitable were acres:
- Outside of designated or proposed wilderness, and
- Greater that 100' from streams, lakes or wetlands, and
- Less than 100 % slope, and
- Within 3 miles of a roadway to accommodate potential helicopter logging operations.

B - Plant and Wildlife Species Removed From Further Analysis

The U.S. Fish and Wildlife Service provided the parks with the list of "Endangered and Threatened Species that may occur or be Affected by Projects in the USFWS 7 1/2 Minute Quads, Reference File No. 03-SP-1295." Table B-1 identifies the plant species on this list that are not known to occur within the boundaries Sequoia and Kings Canyon National Parks, nor were they historically found in the parks. Table B-2 identifies the wildlife species on this list that are not known to occur within the boundaries Sequoia and Kings Canyon National Parks, nor were they historically found in the parks. The National Park Service has determined, therefore, that the plants and wildlife included below would not be affected by the fire and fuels management program. Therefore, there is no effect on these species from any of the alternatives, nor are they potentially indirectly or cumulatively affected by any of the alternatives. These species will not be evaluated further in this environmental assessment. If any of these species are identified within SEKI boundaries in the future, the parks would initiate consultation with the U.S. Fish and Wildlife Service and determine assessment or analysis needs.

Table B-1 – Federal and State listed plant species in Fresno and Tulare counties not known to occur within Sequoia and Kings Canyon National Parks (endangered, threatened, candidate, state-listed, species of concern, and species of local concern).

Federal Endangered Species:

California jewelflower	*Caulanthus californicus*
palmate-bracted bird's beak	*Cordylanthus palmatus*
San Joaquin woolly-threads	*Monolopia congdonii (= Lembertia congdonii)*
Hartweg's golden sunburst	*Pseudobahia bahiifolia*
Keck's checker-mallow	*Sidalcea keckii*
Green's tuctoria	*Tuctoria greenei*

Federal Threatened Species:

Mariposa pussy-paws	*Calyptridium pulchellum*
San Benito evening-primrose	*Camissonia benitensis*
succulent owl's clover	*Castilleja campestris ssp. succulenta*
Hoover's spurge	*Chamaesyce hooveri*
Springville Clarkia	*Clarkia springvillensis*
Hoover's eriastrum	*Eriastrum hooveri*
Orcuttia inaequalis	*Orcuttia inaequalis*
San Joaquin adobe sunburst	*Pseudobahia peirsonii*

Candidate Species:

Ramshaw Meadows abronia	*Abronia alpina*
slender moonwort	*Botrychium lineare*

California State-Listed Species:

Kaweah brodiaea	*Brodiaea insignis*
carpenteria	*Carpenteria californica*
striped adobe-lily	*Fritillaria striata*
Boggs Lake hedge-hyssop	*Gratiola heterosepala*

Species of concern:

obovate-leaved thornmint	*Acanthomintha obovata ssp. obovata*
heartscale	*Atriplex cordulata*
brittlescale	*Atriplex depressa*
San Joaquin spearscale	*Atriplex joaquiniana*
lesser saltscale	*Atriplex minuscula*
vernal pool saltbush	*Atriplex persistens*
Lost Hills saltbush	*Atriplex vallicola*
Scalloped moonwort	*Botrychium crenulatum*
scalloped moonwort	*Botrychium crenulatum*
Inyo County star-tulip	*Calochortus excavatus*
alkali mariposa lily	*Calochortus striatus*
Shirley Meadows star-tulip	*Calochortus westonii*
Mono Hot Springs evening-primrose	*Camissonia sierrae ssp. alticola*
San Benito spineflower	*Chorizanthe biloba var. immemora*
Fresno County bird's-beak	*Cordylanthus tenuis ssp. barbatus*
Piute cypress	*Cupressus nevadensis*
Hall's tarplant	*Deinandra halliana*
Ewan's larkspur	*Delphinium hansenii ssp. ewanianum*
recurved larkspur	*Delphinium recurvatum*
Pierpoint Springs liveforever	*Dudleya cymosa ssp. costafolia*
Twisselmann's buckwheat	*Eriogonum twisselmannii*
spiny-sepaled coyote-thistle	*Eryngium spinosepalum*
delta tule-pea	*Lathyrus jepsonii var. jepsonii*
rayless layia	*Layia discoidea*
pale-yellow layia	*Layia heterotricha*
Munz's tidy-tips	*Layia munzii*
Panoche peppergrass	*Lepidium jaredii var. album*
Yosemite lewisia	*Lewisia disepala*
long-petaled lewisia	*Lewisia longipetala*
orange lupine	*Lupinus citrinus var. citrinus*
Father Crowley's lupine	*Lupinus padre-crowleyi (=L. dedeckerae)*
showy madia	*Madia radiata*
calico monkeyflower	*Mimulus pictus*
flax-like monardella	*Monardella linoides ssp. oblonga*
little mousetail	*Myosurus minimus ssp. apus*
Pine Mountains navarretia	*Navarretia setiloba*
Twisselmann's nemacladus	*Nemacladus twisselmannii*
Charlotte's phacelia	*Phacelia nashiana*
Nine Mile Canyon phacelia	*Phacelia novenmillensis*
valley sagittaria	*Sagittaria sanfordii*
Bolander's clover	*Trifolium bolanderi*

Species of Local Concern:

forked fiddleneck	*Amsinckia vernicosa var. furcata*
Kern Plateau milk-vetch	*Astragalus lentiginosus var. kernensis*
Earlimart orache	*Atriplex erecticaulis*
sublte orache	*Atriplex subtilis*
South Coast Range morning-glory	*Calystegia collina ssp. venusta*
Lemmon's jewelflower	*Caulanthus coulteri var. lemmonii*
cottony buckwheat	*Eriogonum gossypinum*

Kings river buckwheat	*Eriogonum nudum var. regirivum*
stinkbells	*Fritillaria agrestis*
serpentine bedstraw	*Galium andrewsii ssp. gatense*
Monarch gilia	*Gilia yorkii*
Tulare horkelia	*Horkelia tularensis*
Madera linanthus	*Linanthus serrulatus*
Indian Valley bush mallow	*Malacothamnus aboriginum*
slender-stalked monkeyflower	*Mimulus gracilipes*
no common name	*Schizymenium shevockii*

Table B-2 – Federal and State-listed wildlife species in Fresno and Tulare counties not known to occur within Sequoia and Kings Canyon National Parks (listed species and species of concern).

Listed Species:

San Joaquin kit fox	*Vulpes macrotis mutica*
riparian woodrat	*Neotoma fuscipes riparia*
giant kangaroo rat/critical habitat	*Dipodomys ingens*
Fresno kangaroo rat	*Dipodomys nitratoides exilis*
Tipton kangaroo rat	*Dipodomys nitratoides nitratoides*
San Joaquin antelope squirrel (CA only)	*Ammospermophilus nelsoni*
least Bell's vireo	*Vireo bellii pusillus*
greater sandhill crane (CA only)	*Grus canadensis tabida*
bank swallow (CA only)	*Riparia riparia*
California condor critical habitat	*Gymnogyps californianus*
western yellow-billed cuckoo (Candidate)	*Coccyzus americanus occidentalis*
mountain plover (Proposed)	*Charadrius montanus*
blunt-nosed leopard lizard	*Gambelia sila*
giant garter snake	*Thaamnophis gigas*
California red-legged frog	*Rana aurora draytonii*
California tiger salamander	*Ambystoma californiense*
Sacramento splittail	*Pogonichthys macrolepidotus*
delta smelt	*Hypomesus transpacificus*
Lahonton cutthroat trout	*Oncorhynchus clarki henshawi*
Paiute cutthroat trout	*Oncorhynchus clarki seleniris*
Central Valley steelhead	*Oncorhynchus mykiss*
Green sturgeon (Candidate)	*Acipenser medirostris*
vernal pool tadpole shrimp	*Lepidurus packardi*
vernal pool fairy shrimp	*Branchinecta lynchi*
vernal pool invertebrate critical habitat(Proposed)	NA

Species of concern:

Short-nosed kangaroo rat	*Dipodomys nitraatoides brevinasus*
Tulare grasshopper mouse	*Onychomys torridus tularensis*
southern grasshopper mouse	*Onychomys torridus ramona*
San Joaquin pocket mouse	*Perognathus inornatus*
Mt. Lyell shrew	*Sorex lyelli*
Pacific western big-eared bat	*Corynorhinus townsendii pallescens*
long-billed curlew	*Numenius americanus*
western burrowing owl	*Athene cunicularia hypugaea*
Costa's hummingbird	*Calypte costae*
Aleutian Canada goose	*Branta canadensis leucopareia*
American bittern	*Botaurus lentiginosus*
white-faced ibis	*Plegadis chihi*
San Joaquin LeConte's thrasher	*Toxostoma lecontei macmillanorum*
San Joaquin coachwhip	*Masticophis flagellum ruddocki*

western spadefoot	*Spea hammondii*
yellow-blotched ensatina	*Ensatina eschscholtzii croceator*
longfin smelt	*Spirinchus thaleichthys*
Kern brook lamprey	*Lampetra hubbsi*
Pacific lamprey	*Lampetra tridentata*
river lamprey	*Lampetra ayresi*
Cierro aegialian scarab beetle	*Aegialia concinna*
midvalley fairy shrimp	*Branchinecta mesovallensis*
San Joaquin dune beetle	*Coelus gracilis*
wooly hydroporus diving beetle	*Hydroporus hirsutus*
California linderiella fairy shrimp	*Linderiella occidentalis*
Hopping's blister beetle	*Lytta hoppingi*
molestan blister beetle	*Lytta molesta*
moestan blister beetle	*Lytta moesta*
Morrison's blister beetle	*Lytta morrisoni*
Dry Creek cliff strider bug	*Oravelia pege*
Bohart's blue butterfly	*Philotiella speciosa bohartorum*
San Emigdio blue butterfly	*Plebulina emigdionis*
Sierra pygmy grasshopper	*Tetrix sierrana*
San Joaquin tiger beetle	*Cicindella tranquebarica*
Kings Canyon cryptochian caddisfly	*Cryptochia excella*

C - Scoping Issues and Responses

The following table includes all comments received during the internal and public scoping period. The comments (and tables) are grouped by fifteen major themes. Similar comments have been edited or merged where thoughts were duplicated. Every effort was made to retain the original intent and tone of all comments. Park responses briefly address how those comments were considered or incorporated in the planning process. Responses often refer to more detailed information in the main text of this document (EA) or the companion *Fire and Fuels Management Plan* (FFMP).

Table C-1 – Desired Future Conditions: Scoping Issues and Responses

Comment	Response
Goal is to get as much of park as possible to pre-Euroamerican fire regime… until then, have core "natural" fire areas and other "appropriate" fire areas. Designate core areas in every major vegetation type where, come hell or high water, we maintain pre-Euroamerican fire regime.	The park has established target resource conditions to fulfill resource stewardship requirements required by law and policy. The targets are based on the best available science and technology. Ongoing studies and research are conducted to continuously refine the ecological models used. The effects of current management actions on resources are monitored annually to provide feedback on program accomplishments. Program
The parks need a measurable 5-year long-term goal(s) for fire in the ecosystem that would be broken down to annual measurable goals.	
All natural starts, no matter location or burning conditions, should be allowed to burn unimpeded.	
I have always been a strong proponent of fire histories. They give us the best perspective of where we should be.	
Fire is an issue only because it is a natural force that was unfortunate to be weak enough for people to influence but strong enough to not be controlled. If fire was treated like rain, wind, and other natural forces, we would not have a problem.	
The parks have always done compliance on fires, but fire is the natural condition. It is for our failure to burn or our failure to allow natural fires to burn that we should be required to do compliance.	
Why is pre-Euroamerican desired? We can't go back. The climate is different, the air is different, the ecosystem is different, because it's limited.	

Table C-2 – Aesthetics: Scoping Issues and Responses

Comment	Response
Appearance near developed areas – use caution. Be careful of over-removal of “green space” – all vegetation types. “Green space” is important for a park landscape. By accelerating burning to “catch-up” we remove too much green space	Social science research shows most visitors accept fire effects (including fire scars on sequoia trees) as part of the natural environment (see EA Chapter 5, part I). However, some featured giant sequoia trees, logs, and snags would be protected from direct scorch or impact from fire if they are of particular individual significance (see FFMP Chapter 5, part C). In other parts of the park the rate and intensity of burning would be managed to create natural conditions based on the best available models of ecosystem process and structure.
The human idea of aesthetics is ever changing, and thus less important. Long-term aesthetics are truly served with fire. It’s natural and healthy. Let it be! I think the way fire changes things is beautiful. Anything that is natural to this park is aesthetic.	
Blackened trees, more sunlight penetrating to the forest floor, and a carpet of wildflowers all sound aesthetically more pleasing than a dog-hair thicket of puny gray barked white fir trees.	
Aesthetics should be the lowest priority! The health of the ecosystem as a whole (not primarily human interest) should be most important.	

Table C-3 – Cost: Scoping Issues and Responses

Comment	Response
The parks can regulate the cost a lot easier if they use management burns.	A cost comparison of the different strategies is included in Chapter 5. Unwanted wildland fires are the most expensive to control, and bring a greater risk of loss than either prescribed fire or wildland fire use. Mechanical fuel removal is also an expensive strategy, but may be cost effective in focused areas adjacent to high value developments and along park boundaries.
As we learn more about all aspects of fire management, I hope we can be more aggressive in burning the forest. I don't know the numbers, but, in general, a proactive response is more economical than a reactionary one.	
Give us an example of how much it costs to do a prescribed burn vs. put out a wildfire.	
It seems to be most cost-effective to focus on managing prescribed fires as a preventive measure.	
The cheapest option is important, but it should also be the safest. Doesn't prescribed fire fit the bill for both?	
Prescribed burns cost approximately $40-$100 per acre. Wildfires cost approximately $400-$500 per acre.	
The parks need to continue to seek special funding for prescribed fire to reduce fuels and to reintroduce fire into the Sierran forests. The extreme buildup of fuels threatens the ecosystem, endangered and threatened species, the sequoia trees themselves, and remnants of prehistoric and historic human activities.	
Managing for fire/fuel load – once you've got structures endangered you've got to put your dollars there.	
Sure appears to be costly.	

Table C-4 – Air Quality: Scoping Issues and Responses

Comment	Response
Air Quality is a difficult issue. The park needs to continue to work with the state of California to assure that prescribed fires are carried out. The park needs to understand that prescribed fire is a better (air quality-related) alternative than wildfires, both from the standpoint of ignition pattern/timing and from the use of weather parameters to reduce emissions. They may not understand that most acreage WILL burn; it’s just a matter of time.	Through a proactive fire management program and the adoption of a comprehensive *Smoke Management Plan* (Appendix J of the companion *Fire and Fuels Management Plan*) the parks will minimize the potential for air quality impacts from unwanted wildland fires, while accomplishing important public land management objectives.

Comment	Response
Know our airsheds – when and where we can burn. Can this be quantified? Timing is most important.	The *Smoke Management Plan* describes the best management practices that will be used for reducing emissions. These practices include mandatory training, smoke monitoring, public information, and strict adherence to permitting requirements of the San Joaquin Valley Unified Air Pollution Control District.
BIG valley concern. Shouldn't stop or slow burning.	
I am confused as to why Air Quality Standards supercede all other resource-based objectives.	
A lot of smoke during a short period of time is more bearable than a lot of fire and loss of property.	
What about all the other air pollution sources which can be of greater health concern and are on-going as opposed to prescribed fires? It seems the major issue is the other pollution caused by human activities. Fire is just a larger, more visible source.	
If air quality is a major concern that would potentially deter us from encouraging natural fire cycles, maybe we should make a more serious commitment towards reducing emissions we are responsible for by car-pooling.	
Trying to choose the timing of smoke events seems difficult. When lightning strikes, the fire that may result should be allowed to follow its natural course if it is safe.	
Fire is a necessary agent and smoke is an unavoidable occurrence. By "scheduling" smoke events, people with health concerns or small children can make arrangements to temporarily relocate (rather than evacuate) if conditions are unhealthy.	
The inevitable smoke from this burning will have to be seen as both a natural part of the ecosystem and as an essential part of the visitor experience by all of us who recreate in or reside in or near the park. I regularly spend 3-4 weeks per year in Sequoia (at our family cabin in Silver City) and I am willing to put up with whatever smoke comes our way in order to assure that the ecosystem functions properly.	
Assess health effects/compared to everyday input.	

Table C-5 – Logging: Scoping Issues and Responses

Comment	Response
It may be necessary to physically remove some fuels by logging them out or by using burn piles in order to reduce these fuels. I have no problem with using logging trucks to remove some of the built-up fuels on a one-time basis in any given area. I would not want to see this logging continue in any given area. Fire should be used after the initial buildup has been removed by logging.	An assessment was conducted to determine acceptable portions of the park where mechanical removal of fuels could be used. Due to the steepness of terrain and other constraints such as wilderness designation, many areas of the parks are unsuitable for extensive mechanical removal. In other limited areas, primarily around developments, mechanical fuel removal is proposed as both an effective and acceptable means of reducing hazard fuels.

Table C-6 – Information / Education: Scoping Issues and Responses

Comment	Response
It would be great if somehow, a national education campaign could be started to coincide with the new fire management plans. Fire has been ingrained in the public's head as BAD for so long, that the public support is not there for the new policy.	As a result of public input gathered in the preparation of this document, the park has increased support for fire information efforts including the addition of a full time Fire Information Officer. These efforts have been formally incorporated into the fire management program.
Critical to success of the program.	
You're doing a great job! I appreciate the dialogue.	
Any thought of positioning a public information officer booth in Three Rivers during nearby burns? The parks could also staff booths in other locales, ie Lodgepole, Grant Grove, Cedar Grove, etc.	

Comment	Response
Provide local media postings in area of park.	

Table C-7 – Fire Effects: Scoping Issues and Responses

Comment	Response
Set broad structural objectives in addition to process objs.	The park has, and will continue, an extensive program to monitor the outcomes of fire management actions on park resources, including cultural resources (FFMP Appendix C). If unexpected effects are detected, additional studies will be conducted on ways to mitigate or avoid undesired effects.
If fire is part of the natural process, harm to individual plants and animals would be negligible. Help restore processes… use prescribed fires!	
Without fire, individual plants and animals may undergo stress. When an ecosystem is impaired, every part of it can be impaired, keep things natural and let nature decide what lives and dies.	
As long as fires are set and monitored with safety in mind, I see nothing wrong with this also with the health effects to those living in the area.	
Fire is natural. Protect cultural resources, but don't limit burning.	
Sacrifices must be made.	
Burn! It's a natural process!	

Table C-8 – Hazard: Scoping Issues and Responses

Comment	Response
Careful prescribed burning should go along with studies on the effects to human health.	The Environmental Protection Agency, the state of California, and other agencies and public institutions conduct extensive research on the health effects of various pollutants. The park relies on the expertise of those agencies and the ongoing studies to assess health effects rather than conduct redundant research. The park, in conjunction with the San Joaquin Valley Air pollution control district, use the results of studies to design best management practices, smoke monitoring strategies, and to establish public health thresholds. The use of mechanical means to reduce hazard fuels in the parks is assessed under all alternatives and applied in some areas under the preferred alternative.
Include pros and cons for mechanical (cutting) or other fuel reduction options. Educate public about the pros and cons.	
It seems that the only way to stay within the limit of the laws that the park must obey is through burning fuel in as natural a way as possible.	
Firewood sales, salvage logging (in non-wilderness), biomass harvesting, cutting, piling, burning and prescribed burns should all be used.	
It would seem that trying to help keep nature in sync with its natural ongoing cycles would be the best policy, therefore – BURN BABY BURN!	
Prescribed burning seems less polluting or damaging to human health than the emissions that would result from making roads and using trucks to haul fuel away. Who wants the sound of chainsaws in the park?	
Can you do light burning?	
Trees that come down after the burn. Erosion problem? Responsibility? Response should be?	

Table C-9 – Human-Caused Fires: Scoping Issues and Responses

Comment	Response
If it is in a zone marked for prescribed burns, we may want to consider letting it burn.	By current national policy and direction fires begun by humans (other than management ignited prescribed burns) will be suppressed. Suppression strategies will consider firefighter safety and collateral damage to resources as a result of suppression actions when planning a response to a human caused ignition.
I think human-caused fires should be managed just like any other fires that start. Each fire should be analyzed for benefits and risks for the given area.	
I think if a human-caused fire occurs in an area that needs it, it can be safely monitored. It should not be suppressed.	
If a human-caused fire occurs in an area in need of burning why suppress it?	

Comment	Response
Suppressing all human-caused fires is not always necessary and can be more costly than managing the anthropogenic ignition as a natural occurrence.	
Permit to burn if they achieve resource objectives.	
Human-caused fires should also be considered “most appropriate response”. Backcountry campfire escapes or late-season fires that would be extinguished by snow anyway should at least have an opportunity to be looked at in a different management response.	
Some should be managed based on location, time of year.	
Humans are part of nature. Some human-caused fires should be left to burn. Thank goodness for the boys who burnt Point Reyes, or the community would never have done it. We should encourage it!	

Table C-10 – Lightning Fires: Scoping Issues and Responses

Comment	Response
Let them burn except where human safety is of concern.	Lightning ignited fires may be allowed to burn in some areas of the park if they provide resource benefit, do not threaten other resources or humans, and if the San Joaquin Unified Air Pollution District concurs with the management of those fires from an air quality standpoint. Other lightning fires that do no meet management objectives or that pose a significant risk to resources or air quality may be suppressed.
I think this is zone dependent.	
It seems that lightning fires are natural and should not be suppressed unless there's a risk to humans.	
Only fires that threaten life, irreplaceable resources, or property should be suppressed.	
The parks and lots of other land managing agencies, need to adjust their prescriptions for (what used to be called) prescribed natural fires to give lightning caused fires a chance to play their role in reducing fuels and modifying the vegetative cover. Particularly once fuels are reduced at the lower elevations and along boundaries, lightning should be the PRIMARY method of ignition that should burn the majority of the acreage each year.	

Table C-11 – Planning: Scoping Issues and Responses

Comment	Response
Must be well thought out. The parks need to accept political implications – place energies where there are no road blocks.	The park is applying planning models that incorporate both ecological need for fire along with areas at significant risk from unwanted fires. Significant constraints on the program will continue to be the need to balance other social and public health considerations with ecological and hazard reduction objectives. Each year specific prescribed burn projects will be proposed by the park and receive concurrence from the San Joaquin Valley Air Pollution Control District prior to implementation.
Bring burning back to natural levels.	
We wish to emphasize that although the NPS should be receptive to public input, the NPS should show leadership in upholding its mandate to protect the natural resources of Sequoia and Kings Canyon National Parks. The plan should employ clear, specific language to prevent ambiguity or misinterpretation of its proposals. We believe that appropriate reintroduction of fire to national park units will greatly improve resource health and reduce the threat of catastrophic fires to human safety and property.	

Table C-12 – Public Health: Scoping Issues and Responses

Comment	Response
Important, but let's not allow fire programs to be curtailed for exceeding standards over a short-term time table.	The park is compelled by both law and as a good steward to consider the effects of its actions on public health. Each prescribed fire and wildland fire use action will be evaluated by the San Joaquin Valley Air Pollution Control District to assure that they are conducted in ways that protect public health. Projects that do not meet the requirements of the District will not be implemented and will be suppressed (in the case of natural ignitions) or postponed to a more appropriate time (in the case of prescribed fire).
Although harsh, if you live next to a national park, you should expect to live with natural conditions/processes happening in the park – such as smoke.	
Particulate impacts – effects on residents in parks – effects on local communities.	

Table C-13 – Safety: Scoping Issues and Responses

Comment	Response
We have to have well trained managers along with accountability of supervisors for the training.	Public and firefighter safety will be foremost in implementing any fire management action. Safety is promoted through a proactive rather than reactive fire management program. Elements of a proactive program include safety training, physical fitness, presuppression planning, preparedness, and reduction of hazard fuels.
The Interpretation staff on fires need safety and survival training…to be on lines or in fire.	
Need to retain prescribed fire's "place" in dividing the smoke allowed pie.	
I think this is the most important premise with regards to fire management. Safe fire management practices are paramount for all decisions.	
Proactive management decreases the need for future suppression.	
Which is riskier, suppressing fire or managing it? Emphasis should be on the safest strategy. Need local education on fire safety, defensible space.	

Table C-14 – Prescribed Fire: Scoping Issues and Responses

Comment	Response
It took 130 years of suppression to mess up our fuels. We should plan on another 130 years to get back to something natural. We are not going to restore the system overnight, but we are not going to be successful until we overcome attitudes toward fire.	Current planning for exact prescribed fire locations is based on our best available knowledge of past fire regimes and current resource conditions. Initial prescribed burns tend to be smaller to both provide for control and to allow better management of smoke emissions. As fuel loads are reduced, larger areas may be burned at the same time with less risk, and with significantly less smoke. Due to the numerous variables of wind, weather, terrain, and human error, a small percentage of prescribed fires escape control. The risk of occasional escape from a prescribed fire must be balanced against the risks posed by ever increasing hazard fuel loads on parklands. These increasing loads, if not proactively treated, create increased risk to both park resources and human health and safety. Under procedures instituted by the NPS in 2001, contingency resources to manage potential escapes will be fully considered and available prior to implementing any prescribed burn. These procedures are intended to further reduce the risk of escape, and provide for timely and cost efficient response should one occur.
Increase the mean size of burns. The larger the burn, the lower the cost per acre. We should be thinking of doing entire drainages at a time, with provisions for assuring escape routes for mobile wildlife.	
The park should get more creative in using climatic and fuel moisture regimes as natural controls of prescribed fires and wildfires. Expected winter snows, major rain events, high moisture levels in 100 hr and 1000 hr fuels, cool temperatures during the occasional dry winters, night-time mass ignitions of large areas under cool temperatures and high humidities – these are all methods to increase the amount of acreage burned and to reduce costs per acre.	
Burns in developed areas – is it worth it? Burn where there are the least political implications.	
Somehow minimize the role of politics on our decision-making process. Decisions ideally should be resource based.	
Make strong distinction between restoration fires, (prescribed fire is often the tool of choice) and maintenance fires (both prescribed fire and lightning).	
With the increase in prescribed burning, I think information should be given to the public through TV and radio to explain the purpose, effects, and goals. Park neighbors and the public will have a better understanding of the situation. As a Three Rivers, resident I think more information as to what is going on to justify the smoke would settle some of the questions and grousing about the burning.	
I really dislike fire lines for several reasons. a) They look ugly and scar the park. b) They remove one more level of naturalness from the fire program – stochastic events controlling the fire perimeter. I realize that some areas must be tightly controlled. But sometimes it should be OK to plan a target burning and be able to allow consumption of whatever adjacent areas into which the fire moves.	
Park fire crews igniting prescribed fires have much less impact than bulldozers carving control lines around wildfires.	
Can be useful, but low intensity might not do what you want them to.	
Follow-up prescribed fires are questionable, especially when the end results of the initial fire burned with greater intensity then anticipated.	
I don't believe that humans automatically have an inherent right to "take" what we think we need at any cost and have no price to repay. I am referring to the question about local residents and others suffering the temporary discomfort of tolerating smoke. I believe that those who are so privileged as to be able to reside in proximity to such a national treasure have the duty to save it from exploitation, misuse, and neglect.	
Millions of dollars in salaries to manage fires. You have many more people on salary because of prescribed burns. They frequently go out of control and many of us have been adversely affected by smoke. Please stop burning!	
The Park Service's policy is designed to let nature take care of itself, because it has proved it can do better than humans. We expect other residents of Tulare County will agree. The best advice would be to let nature do its thing and stay out of the way.	

Table C-15 – Science: Scoping Issues and Responses

Comment	Response
Science is the only way to gain a platform of knowledge for deciding what to let burn or what to burn. Gives managers support for their decisions. It may help keep the lawyers at bay, when Mother Nature doesn't cooperate with management plans.	The Sequoia and Kings Canyon fire management program is based on over 30 years of research and monitoring. Both the monitoring and research plans (FFMP Appendices C and D) describe the continuing commitment of the park to assuring that the fire management program will operate using the best available information.
It would seem that science will lead us to err in the direction of long-term health goals instead of seemingly good short-sighted, short-term goals.	
Monitoring should be conducted on all wildfires and prescribed burns. The funding should be sought from fire funds to gather these data and a serious effort made to know what the role and function of fire truly is under the wide variety of conditions in the park. All fires are different.	
What else should fire management be based on? Science is the only impartial choice. You do need to take the human factor into consideration at the same time…	
GIS is an important element in monitoring. Actively use this system.	
Yes, we should be monitoring our environment and the impacts that cause changes.	
Do more science	

D - National Register Listing

Eighteen (18) of the recorded sites, structures, or features within the parks are formally listed in the National Register of Historic Places (NRHP). The Giant Forest Lodge and Giant Forest Village/Camp Kaweah historic districts are not included in this listing below, given their recent (1998-99) removal on the ground. The impacts of this on-the-ground removal were mitigated as part of the Giant Forest Restoration Project.

The remaining sites/structures/features currently listed on the NRHP are:

1) Pear Lake Ski Hut
2) Barton-Lackey Cabin
3) Ash Mountain Entrance Sign
4) Cabin Creek Ranger Residence and Dormitory
5) Cattle Cabin
6) Knapp Cabin
7) Hocket Meadow Ranger Station
8) Moro Rock Stairway
9) Quinn Ranger Station
10) Redwood Meadow Ranger Station
11) Gamlin Cabin
12) Generals Highway Stone Bridges
13) Groenfeldt Site (Native American)
14) Tharp’s Log
15) Shorty Lovelace Historic District (includes multiple structures)
16) Smithsonian Institution Shelter
17) Squatter’s Cabin
18) Hospital Rock (Native American)

Additionally, a handful of sites or features have been formally determined “eligible” for listing in the NRHP. By regulation, they are to be managed as if they were formally listed on the register. These structures and features include:

1) Generals Highway
2) Atwell’s Mill
3) Atwell Mill Ranger Station and Garage
4) Lost Grove Comfort Station
5) Redwood Mountain Residence
6) Warehouse at Grant Grove (Old Maintenance)
7) Mineral King Road Cultural Landscape District (listing pending)
8) General Grant National Park Historic District

E - Air Quality Analysis Methodology

Step 1. Determine quantity of fuels consumed under each alternative

Background

The alternatives in this environmental assessment were structured around primary fire management tools (wildland fire suppression, prescribed fire, wildland fire use, and mechanical fuel reduction). The acres proposed to be treated under each alternative were initially categorized under those headings. Those figures, however, do not automatically translate into volumes of fuel consumed each year by alternative – information critical to comparing the relative amount of particulate released into the air under each alternative.

To make the conversion from acres by tool to acres by fuel load, each vegetation type in the parks was assigned one or more standard fuel model to describe its current state. Fuel models describe the type and amounts of fuels, among other characteristics of interest to fire managers.

The fuel models do not remain static over time. As the forests change with time, so do the related fuel models. For example, changes in forest conditions may occur as a result of fire suppression and subsequent buildup of dead fuels and increases in live fuel density. Fuel complexes may also change as a result of a fire event. Since fuels are reduced and the forest canopy becomes more open. Areas within a particular vegetation type that have been prescribed burned or otherwise received fire in recent years generally have less fuel load and are consequently assigned a fuel model that represents that load. Areas of the park that have not been treated with fire generally have higher fuel loads and are assigned fuel models that represent those loads. The estimates that follow were generated at two time steps, 10 and 25 years, to evaluate long term changes that occur as fuels are altered by the management actions proposed under the alternatives.

The parks used the following process to convert acres proposed for annual treatment by primary tool under each alternative into fuels information usable by the software package that produced the emissions estimates. The software package is called First Order Fire Effects Model version 4.0 (FOFEM). The resulting emissions estimates were then used to compare air quality effects between alternatives.

Process to determine fuels consumed each year by each alternative

1 - Establish the number of current acres in good ecological/low hazard fuel condition (maintenance mode) for each vegetation type using the Fire Return Interval Departure (FRID) analysis.

1a - assign a representative fuel model for each vegetation type in maintenance mode (FRID class 0-1)

2 - Establish the number of acres needing restoration/fuel reduction for each vegetation type using the FRID analysis.

2a - assign a representative fuel model for each vegetation type needing restoration (FRID class 2+)

Model Assumption: The FRID analysis adequately represents differences in forest structure and fuel loads. Areas that have missed a significant number of fire return intervals as a result of past fire suppression will have a significantly different fuel load, and need to be represented by a different fuel model than those areas that have been previously restored or maintained, or that have naturally long return intervals.

3 - Establish a maximum natural return interval for each vegetation type that, if achieved, would maintain fuels within a safe range and keep ecosystem function intact.

Model Assumption: Maintaining vegetation within the natural fire return interval will reduce hazard while maintaining adequate ecosystem function. While the natural fire return interval for each vegetation type is more accurately expressed as a range of years (e.g. "between 5 and 15 years"), the model assumes that acceptable conditions will be sustained by using a reasonable maximum interval (e.g. "15 years"). This is, however, an untested ecological assumption.

4 - For each alternative, model the number of acres treated per year that could be restored in each vegetation type given the strategies to be applied under the alternative.

Model Assumption: The backlog of acres needing restoration should restored slowly over time and not all at once to minimize smoke events. Different alternatives allow more or less management control over where and when acres burn. To restore the backlog of fuels over time, the following rules were applied:

-In short fire return interval vegetation types (less than 25 years), attempt to eliminate the backlog over 25 years

-In long fire return interval vegetation types (over 25 years), attempt to eliminate the backlog within one fire return interval.

5 - For each alternative, model the number of acres that would be maintained for each vegetation type given the strategies to be applied under the alternative.

Model Assumption: To the extent possible, prevent acres in good condition (FRID class 0-1) from reverting to unacceptable condition (FRID class 2+).

- Include in the model, acres already in acceptable condition, plus those restored each year

- Acres in maintenance are divided by the maximum return interval to arrive at annual targets

6 - Total the modeled acres burned per year (maintenance + restoration) by fuel type for each alternative.

7 - Run steps 4-6 using 10-year average accomplishments and conditions and repeat the analysis at 25 years to reflect changes in the fuel

load as backlogs of heavy fuels are reduced (or increased) and areas are converted to fuel models with more (or less) fuel load.

Assumptions used to determine the categorization of vegetation types into fuel models include:

Alternative 1

- Acres for each vegetation type were based on estimates from initial analysis spreadsheets used to develop environmental assessment alternatives.
- Acres determined to be suppression are considered restoration fuel model.
- Acres for wildland fire use are considered maintenance fuel model.
- Prescribed fire acres include some restoration and some maintenance fuel models proportional to the amount of acres in those classes as determined through the FRID analysis.

Alternative 2

- Acres for each vegetation type were based on estimates from initial analysis spreadsheets used to develop environmental assessment alternatives.
- The proportion of acres within each vegetation type assigned restoration or maintenance fuel model was accomplished by using proportion derived from the FRID analysis.
- An assumption was that a program constrained to prescribed fire would mimic prescribed fire and wildland fire use accomplishments to extent possible.

Alternative 3

- Additional suppression acres would occur as a result of less proactive fuels management.
- Suppression acres were all considered restoration fuel model since there would be little proactive fuels management.
- Many acres managed with wildland fire use would not have been previously restored under this alternative, so those acres are split between restoration and maintenance fuel model proportional to the acres indicated by the FRID model. The exceptions are the lodgepole and subalpine types which have naturally long fire return intervals and have been little affected by fire suppression to date.
- Foothills Chaparral and Foothills Hardwood vegetation acres were split proportionally between restoration and maintenance fuel model based on Alternative 4’s GIS/FRID analysis of their current condition.

Alternative 4

- All wildland fire use acres are considered maintenance fuel model.
- Prescribed fire acres were split between restoration and maintenance fuel models per proportions from the GIS/FRID extended analysis.

- All suppression acres in this alternative were considered restoration fuel model.
- Lodgepole and subalpine wildland fire use and prescribed fire acres were all considered as maintenance fuel model due to long fire return intervals and little disturbance to date.

Alternative 5

- All acres were considered restoration fuel model to account for the effects of fuel removal, pile burning, and follow-up underburn. The exceptions were lodgepole and subalpine acres which were all considered as maintenance fuel model due to long fire return intervals and little disturbance to date.

Alternative 6

- All acres were considered restoration fuel model. The exceptions were lodgepole and subalpine acres which were all considered as maintenance fuel model due to long fire return intervals and little disturbance to date.

Different assumptions between alternatives lead to different amounts of fuel being consumed. An example of how the basic assumptions affect fuel loads by alternative is shown below.

EXAMPLE: White Fir/Mixed Conifer Vegetation Type

Assumptions common to both alternatives in the example:

- Total treatment acres were derived from alternative development sessions and are similar between Alternatives 2 and 4.
- Suppression acres (not included below) were also derived from alternative development sessions and are considered restoration fuel model, but are the similar for both Alternative 1 & 2 at both time steps.
- The change in percent between the two time steps came from analysis conducted within each vegetation type, and represents conversion from restoration (fuel model 10) to maintenance (fuel model 8) over time.
- The example calculations are based on 100 acres for simplicity.

Alternative 2 – Prescribed Fire - Assumptions:

- Percentages from FRID analysis based on vegetation type acres needing restoration (FRID Class 2+) and acres needing maintenance (FRID class 0-1).
- Change in percent between 10 and 25 years represents change from FM-10 to FM-8.

	10yr	25yr

Prescribed fire acres 100 acres 52%	Maintenance (27ac)	27%	48% (48ac)
	Restoration (73ac)	73%	(52ac)
	Total Acres = 100		100

Alternative 4 – Multi-Strategy - Assumptions:

- Prescribed fire acres assume some maintenance and some restoration, the percent of each based on the FRID assessment and subsequent conversion of FM-10 to FM-8 between year 10 and 25.
- Wildland fire use acres assumed to be all maintenance fuel model (FM-8).

		10yr	25yr
Prescribed fire acres (yr 10=50 acres) (yr 25=7 acres)	Maintenance (13.5ac)	27%	48% (3.4ac)
	Restoration (36.5ac)	73%	52% (3.6ac)
Wildland Fire Use acres (yr 10=50 acres) (yr 25=93 acres)	Maintenance (50ac)	100%	100% (93ac)
	Maintenance Acres =	63.5	96.4
	Restoration Acres =	36.5	3.6
	Total Acres =	100	100

Step 2. Update fuel model information and run emissions analysis for each alternative

To best represent fuel loads, information used in the model was based on park wide fire effects plots and fuels inventory plots data, where such information was available. Fuel consumption estimates were made based on data from park fire effects plots collected on prescribed burn projects over the past 18 years. Where no local data was available, standard fuel model descriptors were applied.

In order to produce smoke emission estimates based on fuel loading and consumption data the First Order Fire Effects Model version 4.0 (FOFEM) was used. In its present configuration FOFEM does not exactly duplicate the consumption measured in the field by fire effects plots. However, the model does have the benefit of using algorithms that approximate the relationship between fuels that are burned in the flaming and smoldering phases. Modeling consumption using the two phases is important because significantly more smoke is produced in the smoldering phase than in the flaming phase given the same quantity of fuel burned.

Estimated smoke emission outputs for each fuel model from FOFEM were then used as a multiplier for the acres of fuel model that are estimated to be burned each year under the various environmental alternatives. The results show estimated emissions of PM-10 for each alternative per year.

Example of the methodology used:

- Park wide heavy timber litter forest stands (fuel model 10) have an average total fuel loading of 101 tons-per-acre of burnable, dead and down vegetation.
- The park wide average overall fuels reduction that occurs in fuel model 10 is 76%.
- Using the data based on the above examples, the FOFEM runs show that for each acre of fuel model 10 that is burned in the parks an average of 1,650 pounds of PM-10 is produced.

Under Alternative 4 - 3,421 acres comprised of fuel model 10 would burn each year at 10 years which would produce about (1,650 pounds/acre x 3,421 acres) = 5,644,650 pounds of PM-10 per year parkwide.

F - Data From First Order Fire Effects Model

TITLE: ANNUAL GRASS (1) - model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***
SMOKE SUMMARY TABLE - FUEL CONSUMPTION CALCULATIONS

REGION: Pacific West
COVER TYPE: Mountain Grasslands (FRES 36)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR
WOOD (10 HR) MOISTURE (%): .0

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number
Litter	.0	.0	.0	.0	39
Wood (0-1 inch)	.0	.0	.0	.0	21
Wood (1-3 inch)	.0	.0	.0	.0	25
Wood (3+ inch)	.0	.0	.0	.0	32
Duff	.0	.0	.0	.0	1
Herbaceous	.7	.7	.0	100.0	22
Shrubs	.0	.0	.0	.0	23
Tree regeneration	.0	.0	.0	.0	24
Crown branchwood	.0	.0	.0	.0	38
Crown foliage	.0	.0	.0	.0	37
Total Fuels	.7	.7	.0	100.0	

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Mountain Grasslands (FRES 36)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY TABLE - SMOKE EMISSIONS CALCULATIONS

Forest Floor Emission Component	Ave Combust Efficiency	PM10 Emission (lbs/acre)	PM2.5 Emission (lbs/acre)	CO (lbs/acre)
Litter	.00	.0	.0	.0
Wood (0-1 inch)	.00	.0	.0	.0
Wood (1-3 inch)	.00	.0	.0	.0

Wood (3+ inch)	.00	.0	.0	.0
Duff	.00	.0	.0	.0
Herbaceous	.85	18.6	15.8	184.4
Shrubs	.00	.0	.0	.0
Tree regeneration	.00	.0	.0	.0
Crown branchwood	.00	.0	.0	.0
Crown foliage	.00	.0	.0	.0
Total Fuels	.85	18.6	15.8	184.4

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Mountain Grasslands (FRES 36)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY -- FLAMING AND SMOLDERING SUMMARY

Fuel Component Name	Prefire loading ton/acre	Moist Content (%)	------- Consumption ------- Flaming (t/ac)	Smoldering (t/ac)	Total (t/ac)	PM2.5 Emissions (%)
Litter	.0	--	.0	.0	.0	.0
Wood (0-1 inch)	.0	--	.0	.0	.0	.0
Wood (1-3 inch)	.0	--	.0	.0	.0	.0
Wood (3+ inch)	.0	20.0	.0	.0	.0	.0
Duff	.0	20.0	.0	.0	.0	.0
Herbaceous	.7	--	.7	.0	.7	100.0
Shrubs	.0	--	.0	.0	.0	.0
Tree regeneration	.0	--	.0	.0	.0	.0
Crown branchwood	.0	--	.0	.0	.0	.0
Crown foliage	.0	--	.0	.0	.0	.0
Total Fuels	.7	--	.7	.0	.7	100.0

TITLE:High Elev Shrt Ndle, Vry Slw Sprd (18) model execution on date: 1/31/01

*** FIRE EFFECTS CALCULATOR ***

SMOKE SUMMARY TABLE - FUEL CONSUMPTION CALCULATIONS

REGION: Pacific West
COVER TYPE: Red Fir (SAF 207)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 24.0 - Entire
WOOD (3+ IN) MOISTURE (%): 1.0 - Actual
WOOD (10 HR) MOISTURE (%): 15.0

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number
Litter	4.8	4.8	.0	100.0	39
Wood (0-1 inch)	2.7	2.4	.3	90.0	21
Wood (1-3 inch)	2.6	1.7	.9	65.0	25
Wood (3+ inch)	31.6	28.0	3.6	88.5	31
Duff	28.0	20.6	7.4	73.5	2
Herbaceous	.0	.0	.0	.0	22
Shrubs	.0	.0	.0	.0	23
Tree regeneration	.0	.0	.0	.0	24
Crown branchwood	.0	.0	.0	.0	38
Crown foliage	.0	.0	.0	.0	37
Total Fuels	69.7	57.5	12.2	82.5	

TITLE: Results of FOFEM model execution on date: 1/31/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Red Fir (SAF 207)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 24.0 - Entire
WOOD (3+ IN) MOISTURE (%): 1.0 - Actual

SMOKE SUMMARY TABLE - SMOKE EMISSIONS CALCULATIONS

Forest Floor Emission Component	Ave Combust Efficiency	PM10 Emission (lbs/acre)	PM2.5 Emission (lbs/acre)	CO (lbs/acre)
Litter	.95	44.6	37.9	251.5
Wood (0-1 inch)	.95	22.6	19.2	127.3
Wood (1-3 inch)	.92	23.7	20.1	188.3

Wood (3+ inch)	.89	534.4	453.3	4879.8
Duff	.82	625.4	530.8	6503.2
Herbaceous	.00	.0	.0	.0
Shrubs	.00	.0	.0	.0
Tree regeneration	.00	.0	.0	.0
Crown branchwood	.00	.0	.0	.0
Crown foliage	.00	.0	.0	.0
Total Fuels	.87	1250.8	1061.3	11950.1

TITLE: Results of FOFEM model execution on date: 1/31/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Red Fir (SAF 207)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 24.0 - Entire
WOOD (3+ IN) MOISTURE (%): 1.0 - Actual

SMOKE SUMMARY -- FLAMING AND SMOLDERING SUMMARY

Fuel Component Name	Prefire loading ton/acre	Moist Content (%)	------- Consumption ------- Flaming (t/ac)	Smoldering (t/ac)	Total (t/ac)	PM2.5 Emissions (%)
Litter	4.8	--	4.8	.0	4.8	3.6
Wood (0-1 inch)	2.7	--	2.4	.0	2.4	1.8
Wood (1-3 inch)	2.6	--	1.7	.0	1.7	1.9
Wood (3+ inch)	31.6	1.0	22.4	5.6	28.0	42.7
Duff	28.0	24.0	8.2	12.3	20.6	50.0
Herbaceous	.0	--	.0	.0	.0	.0
Shrubs	.0	--	.0	.0	.0	.0
Tree regeneration	.0	--	.0	.0	.0	.0
Crown branchwood	.0	--	.0	.0	.0	.0
Crown foliage	.0	--	.0	.0	.0	.0
Total Fuels	69.7	--	39.5	17.9	57.5	100.0

TITLE: Clsed Tmbr, Shrt Ndl, Slw Sprd (8) - model execution on date: 1/31/01

*** FIRE EFFECTS CALCULATOR ***

SMOKE SUMMARY TABLE - FUEL CONSUMPTION CALCULATIONS

REGION: Pacific West
COVER TYPE: White Fir (SAF 211)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 27.4 - Entire
WOOD (3+ IN) MOISTURE (%): 42.0 - Actual
WOOD (10 HR) MOISTURE (%): 15.0

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number
Litter	1.6	1.6	.0	100.0	39
Wood (0-1 inch)	2.5	2.3	.3	90.0	21
Wood (1-3 inch)	2.5	1.6	.9	65.0	25
Wood (3+ inch)	7.0	5.0	2.0	72.0	31
Duff	4.7	3.4	1.3	72.0	2
Herbaceous	.0	.0	.0	.0	22
Shrubs	.0	.0	.0	.0	23
Tree regeneration	.0	.0	.0	.0	24
Crown branchwood	.0	.0	.0	.0	38
Crown foliage	.0	.0	.0	.0	37
Total Fuels	18.3	13.9	4.4	76.0	

TITLE: Results of FOFEM model execution on date: 1/31/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: White Fir (SAF 211)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 27.4 - Entire
WOOD (3+ IN) MOISTURE (%): 42.0 - Actual

SMOKE SUMMARY TABLE - SMOKE EMISSIONS CALCULATIONS

Forest Floor Emission Component	Ave Combust Efficiency	PM10 Emission (lbs/acre)	PM2.5 Emission (lbs/acre)	CO Emission (lbs/acre)
Litter	.95	14.9	12.6	83.8
Wood (0-1 inch)	.95	20.9	17.8	117.9
Wood (1-3 inch)	.92	22.8	19.3	181.0
Wood (3+ inch)	.89	96.2	81.6	878.7

Duff	.82	102.9	87.3	1070.1
Herbaceous	.00	.0	.0	.0
Shrubs	.00	.0	.0	.0
Tree regeneration	.00	.0	.0	.0
Crown branchwood	.00	.0	.0	.0
Crown foliage	.00	.0	.0	.0
Total Fuels	.89	257.7	218.7	2331.6

TITLE: Results of FOFEM model execution on date: 1/31/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: White Fir (SAF 211)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 27.4 - Entire
WOOD (3+ IN) MOISTURE (%): 42.0 - Actual

SMOKE SUMMARY -- FLAMING AND SMOLDERING SUMMARY

Fuel Component Name	Prefire loading ton/acre	Moist Content (%)	------- Consumption ------- Flaming (t/ac)	Smoldering (t/ac)	Total (t/ac)	PM2.5 Emissions (%)
Litter	1.6	--	1.6	.0	1.6	5.8
Wood (0-1 inch)	2.5	--	2.3	.0	2.3	8.1
Wood (1-3 inch)	2.5	--	1.6	.0	1.6	8.8
Wood (3+ inch)	7.0	42.0	4.0	1.0	5.0	37.3
Duff	4.7	27.4	1.4	2.0	3.4	39.9
Herbaceous	.0	--	.0	.0	.0	.0
Shrubs	.0	--	.0	.0	.0	.0
Tree regeneration	.0	--	.0	.0	.0	.0
Crown branchwood	.0	--	.0	.0	.0	.0
Crown foliage	.0	--	.0	.0	.0	.0
Total Fuels	18.3	--	10.9	3.0	13.9	100.0

TITLE: Grass w/overstory (2) FOFEM model execution on date: 2/ 1/01

*** FIRE EFFECTS CALCULATOR ***

SMOKE SUMMARY TABLE - FUEL CONSUMPTION CALCULATIONS

REGION: Pacific West
COVER TYPE: Mountain Grasslands (FRES 36)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR
WOOD (10 HR) MOISTURE (%): .0

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number
Litter	.0	.0	.0	.0	39
Wood (0-1 inch)	3.0	2.7	.3	90.0	21
Wood (1-3 inch)	.5	.3	.2	65.0	25
Wood (3+ inch)	.0	.0	.0	.0	32
Duff	.0	.0	.0	.0	1
Herbaceous	.5	.5	.0	100.0	22
Shrubs	.0	.0	.0	.0	23
Tree regeneration	.0	.0	.0	.0	24
Crown branchwood	.0	.0	.0	.0	38
Crown foliage	.0	.0	.0	.0	37
Total Fuels	4.0	3.5	.5	88.1	

TITLE: Results of FOFEM model execution on date: 2/ 1/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Mountain Grasslands (FRES 36)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY TABLE - SMOKE EMISSIONS CALCULATIONS

Forest Floor Component	Ave Combust Efficiency	PM10 Emission (lbs/acre)	PM2.5 Emission (lbs/acre)	CO Emission (lbs/acre)
Litter	.00	.0	.0	.0
Wood (0-1 inch)	.95	25.1	21.3	141.5
Wood (1-3 inch)	.92	4.5	3.9	36.2
Wood (3+ inch)	.00	.0	.0	.0

Duff	.00	.0	.0	.0
Herbaceous	.85	12.6	10.6	124.6
Shrubs	.00	.0	.0	.0
Tree regeneration	.00	.0	.0	.0
Crown branchwood	.00	.0	.0	.0
Crown foliage	.00	.0	.0	.0
Total Fuels	.93	42.2	35.8	302.3

TITLE: Results of FOFEM model execution on date: 2/ 1/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Mountain Grasslands (FRES 36)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY -- FLAMING AND SMOLDERING SUMMARY

Fuel Component Name	Prefire loading ton/acre	Moist Content (%)	------- Consumption ------- Flaming (t/ac)	Smoldering (t/ac)	Total (t/ac)	PM2.5 Emissions (%)
Litter	.0	--	.0	.0	.0	.0
Wood (0-1 inch)	3.0	--	2.7	.0	2.7	59.5
Wood (1-3 inch)	.5	--	.3	.0	.3	10.8
Wood (3+ inch)	.0	20.0	.0	.0	.0	.0
Duff	.0	20.0	.0	.0	.0	.0
Herbaceous	.5	--	.5	.0	.5	29.7
Shrubs	.0	--	.0	.0	.0	.0
Tree regeneration	.0	--	.0	.0	.0	.0
Crown branchwood	.0	--	.0	.0	.0	.0
Crown foliage	.0	--	.0	.0	.0	.0
Total Fuels	4.0	--	3.5	.0	3.5	100.0

TITLE: TALL GRASS (3) - model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***
SMOKE SUMMARY TABLE - FUEL CONSUMPTION CALCULATIONS

REGION: Pacific West
COVER TYPE: Mountain Grasslands (FRES 36)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR
WOOD (10 HR) MOISTURE (%): .0

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number
Litter	.0	.0	.0	.0	39
Wood (0-1 inch)	.0	.0	.0	.0	21
Wood (1-3 inch)	.0	.0	.0	.0	25
Wood (3+ inch)	.0	.0	.0	.0	32
Duff	.0	.0	.0	.0	1
Herbaceous	3.0	3.0	.0	100.0	22
Shrubs	.0	.0	.0	.0	23
Tree regeneration	.0	.0	.0	.0	24
Crown branchwood	.0	.0	.0	.0	38
Crown foliage	.0	.0	.0	.0	37
Total Fuels	3.0	3.0	.0	100.0	

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Mountain Grasslands (FRES 36)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY TABLE - SMOKE EMISSIONS CALCULATIONS

Forest Floor Component	Ave Combust Efficiency	PM10 Emission (lbs/acre)	PM2.5 Emission (lbs/acre)	CO Emission (lbs/acre)
Litter	.00	.0	.0	.0
Wood (0-1 inch)	.00	.0	.0	.0
Wood (1-3 inch)	.00	.0	.0	.0
Wood (3+ inch)	.00	.0	.0	.0

Duff	.00	.0	.0	.0
Herbaceous	.85	75.6	64.1	750.1
Shrubs	.00	.0	.0	.0
Tree regeneration	.00	.0	.0	.0
Crown branchwood	.00	.0	.0	.0
Crown foliage	.00	.0	.0	.0
Total Fuels	.85	75.6	64.1	750.1

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Mountain Grasslands (FRES 36)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY -- FLAMING AND SMOLDERING SUMMARY

Fuel Component Name	Prefire loading ton/acre	Moist Content (%)	------- Consumption ------- Flaming (t/ac)	Smoldering (t/ac)	Total (t/ac)	PM2.5 Emissions (%)
Litter	.0	--	.0	.0	.0	.0
Wood (0-1 inch)	.0	--	.0	.0	.0	.0
Wood (1-3 inch)	.0	--	.0	.0	.0	.0
Wood (3+ inch)	.0	20.0	.0	.0	.0	.0
Duff	.0	20.0	.0	.0	.0	.0
Herbaceous	3.0	--	3.0	.0	3.0	100.0
Shrubs	.0	--	.0	.0	.0	.0
Tree regeneration	.0	--	.0	.0	.0	.0
Crown branchwood	.0	--	.0	.0	.0	.0
Crown foliage	.0	--	.0	.0	.0	.0
Total Fuels	3.0	--	6.6	.0	3.0	100.0

TITLE: TALL BRUSH (4) - model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

SMOKE SUMMARY TABLE - FUEL CONSUMPTION CALCULATIONS

REGION: Pacific West
COVER TYPE: Chaparral - high shrub cover (FRES 34)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR
WOOD (10 HR) MOISTURE (%): .0

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number
Litter	.0	.0	.0	.0	39
Wood (0-1 inch)	.0	.0	.0	.0	21
Wood (1-3 inch)	.0	.0	.0	.0	25
Wood (3+ inch)	.0	.0	.0	.0	32
Duff	.0	.0	.0	.0	1
Herbaceous	.0	.0	.0	.0	22
Shrubs	16.0	12.8	3.2	80.0	231
Tree regeneration	.0	.0	.0	.0	24
Crown branchwood	.0	.0	.0	.0	38
Crown foliage	.0	.0	.0	.0	37
Total Fuels	16.0	12.8	3.2	80.0	

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Chaparral - high shrub cover (FRES 34)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY TABLE - SMOKE EMISSIONS CALCULATIONS

Forest Floor Component	Ave Combust Efficiency	PM10 Emission (lbs/acre)	PM2.5 Emission (lbs/acre)	CO Emission (lbs/acre)
Litter	.00	.0	.0	.0
Wood (0-1 inch)	.00	.0	.0	.0
Wood (1-3 inch)	.00	.0	.0	.0
Wood (3+ inch)	.00	.0	.0	.0

Duff	.00	.0	.0	.0
Herbaceous	.00	.0	.0	.0
Shrubs	.85	321.9	273.2	3195.7
Tree regeneration	.00	.0	.0	.0
Crown branchwood	.00	.0	.0	.0
Crown foliage	.00	.0	.0	.0
Total Fuels	.85	321.9	273.2	3195.7

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Chaparral - high shrub cover (FRES 34)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY -- FLAMING AND SMOLDERING SUMMARY

Fuel Component Name	Prefire loading ton/acre	Moist Content (%)	------- Consumption ------- Flaming (t/ac)	Smoldering (t/ac)	Total (t/ac)	PM2.5 Emissions (%)
Litter	.0	--	.0	.0	.0	.0
Wood (0-1 inch)	.0	--	.0	.0	.0	.0
Wood (1-3 inch)	.0	--	.0	.0	.0	.0
Wood (3+ inch)	.0	20.0	.0	.0	.0	.0
Duff	.0	20.0	.0	.0	.0	.0
Herbaceous	.0	--	.0	.0	.0	.0
Shrubs	16.0	--	12.8	.0	12.8	100.0
Tree regeneration	.0	--	.0	.0	.0	.0
Crown branchwood	.0	--	.0	.0	.0	.0
Crown foliage	.0	--	.0	.0	.0	.0
Total Fuels	16.0	--	12.8	.0	12.8	100.0

TITLE: MEDIUM BRUSH (6) - Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***
SMOKE SUMMARY TABLE - FUEL CONSUMPTION CALCULATIONS

REGION: Pacific West
COVER TYPE: Chaparral - moderate shrub cover (FRES 34)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR
WOOD (10 HR) MOISTURE (%): .0

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number
Litter	.0	.0	.0	.0	39
Wood (0-1 inch)	.0	.0	.0	.0	21
Wood (1-3 inch)	.0	.0	.0	.0	25
Wood (3+ inch)	.0	.0	.0	.0	32
Duff	.0	.0	.0	.0	1
Herbaceous	.0	.0	.0	.0	22
Shrubs	6.0	4.8	1.2	80.0	231
Tree regeneration	.0	.0	.0	.0	24
Crown branchwood	.0	.0	.0	.0	38
Crown foliage	.0	.0	.0	.0	37
Total Fuels	6.0	4.8	1.2	80.0	

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Chaparral - moderate shrub cover (FRES 34)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY TABLE - SMOKE EMISSIONS CALCULATIONS

Forest Floor Component	Ave Combust Efficiency	PM10 Emission (lbs/acre)	PM2.5 Emission (lbs/acre)	CO Emission (lbs/acre)
Litter	.00	.0	.0	.0
Wood (0-1 inch)	.00	.0	.0	.0
Wood (1-3 inch)	.00	.0	.0	.0
Wood (3+ inch)	.00	.0	.0	.0

Duff	.00	.0	.0	.0
Herbaceous	.00	.0	.0	.0
Shrubs	.85	120.5	102.2	1196.2
Tree regeneration	.00	.0	.0	.0
Crown branchwood	.00	.0	.0	.0
Crown foliage	.00	.0	.0	.0
Total Fuels	.85	120.5	102.2	1196.2

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: Chaparral - moderate shrub cover (FRES 34)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 20.0 - Lower
WOOD (3+ IN) MOISTURE (%): 20.0 - Adjusted NFDR

SMOKE SUMMARY -- FLAMING AND SMOLDERING SUMMARY

Fuel Component Name	Prefire loading ton/acre	Moist Content (%)	------- Consumption ------- Flaming (t/ac)	Smoldering (t/ac)	Total (t/ac)	PM2.5 Emissions (%)
Litter	.0	--	.0	.0	.0	.0
Wood (0-1 inch)	.0	--	.0	.0	.0	.0
Wood (1-3 inch)	.0	--	.0	.0	.0	.0
Wood (3+ inch)	.0	20.0	.0	.0	.0	.0
Duff	.0	20.0	.0	.0	.0	.0
Herbaceous	.0	--	.0	.0	.0	.0
Shrubs	6.0	--	4.8	.0	4.8	100.0
Tree regeneration	.0	--	.0	.0	.0	.0
Crown branchwood	.0	--	.0	.0	.0	.0
Crown foliage	.0	--	.0	.0	.0	.0
Total Fuels	6.0	--	7.6	.0	4.8	100.0

TITLE: HEAVY TIMBER LITTER (10) - model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

SMOKE SUMMARY TABLE - FUEL CONSUMPTION CALCULATIONS

REGION: Pacific West
COVER TYPE: White Fir (SAF 211)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 1.0 - Entire
WOOD (3+ IN) MOISTURE (%): 70.0 - Actual
WOOD (10 HR) MOISTURE (%): 80.0

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number
Litter	13.6	13.6	.0	100.0	39
Wood (0-1 inch)	5.0	4.5	.5	90.0	21
Wood (1-3 inch)	5.0	3.3	1.8	65.0	25
Wood (3+ inch)	32.4	18.3	14.1	56.5	31
Duff	42.7	35.7	7.0	83.7	2
Herbaceous	.0	.0	.0	.0	22
Shrubs	.0	.0	.0	.0	23
Tree regeneration	.0	.0	.0	.0	24
Crown branchwood	.0	.0	.0	.0	38
Crown foliage	.0	.0	.0	.0	37
Total Fuels	98.7	75.4	23.3	76.4	

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: White Fir (SAF 211)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 1.0 - Entire
WOOD (3+ IN) MOISTURE (%): 70.0 - Actual

SMOKE SUMMARY TABLE - SMOKE EMISSIONS CALCULATIONS

Forest Floor Component	Ave Combust Efficiency	PM10 Emission (lbs/acre)	PM2.5 Emission (lbs/acre)	CO Emission (lbs/acre)
Litter	.95	126.5	107.4	712.6
Wood (0-1 inch)	.95	41.9	35.6	236.3
Wood (1-3 inch)	.92	45.6	38.8	362.8
Wood (3+ inch)	.89	349.5	296.4	3191.4

Duff	.82	1086.5	922.1	11297.4
Herbaceous	.00	.0	.0	.0
Shrubs	.00	.0	.0	.0
Tree regeneration	.00	.0	.0	.0
Crown branchwood	.00	.0	.0	.0
Crown foliage	.00	.0	.0	.0
Total Fuels	.87	1650.0	1400.3	15800.4

TITLE: Results of FOFEM model execution on date: 1/30/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: White Fir (SAF 211)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 1.0 - Entire
WOOD (3+ IN) MOISTURE (%): 70.0 - Actual

SMOKE SUMMARY -- FLAMING AND SMOLDERING SUMMARY

Fuel Component Name	Prefire loading ton/acre	Moist Content (%)	------- Consumption ------- Flaming (t/ac)	Smoldering (t/ac)	Total (t/ac)	PM2.5 Emissions (%)
Litter	13.6	--	13.6	.0	13.6	7.7
Wood (0-1 inch)	5.0	--	4.5	.0	4.5	2.5
Wood (1-3 inch)	5.0	--	3.3	.0	3.3	2.8
Wood (3+ inch)	32.4	70.0	14.6	3.7	18.3	21.2
Duff	42.7	1.0	14.3	21.4	35.7	65.8
Herbaceous	.0	--	.0	.0	.0	.0
Shrubs	.0	--	.0	.0	.0	.0
Tree regeneration	.0	--	.0	.0	.0	.0
Crown branchwood	.0	--	.0	.0	.0	.0
Crown foliage	.0	--	.0	.0	.0	.0
Total Fuels	98.7	--	50.3	25.1	75.4	100.0

TITLE: Low Elev. Shrt Ndle Conifer (14) - model execution on date: 1/31/01

*** FIRE EFFECTS CALCULATOR ***

SMOKE SUMMARY TABLE - FUEL CONSUMPTION CALCULATIONS

REGION: Pacific West
COVER TYPE: White Fir (SAF 211)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 1.0 - Entire
WOOD (3+ IN) MOISTURE (%): 55.0 - Actual
WOOD (10 HR) MOISTURE (%): 35.0

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number
Litter	6.7	6.7	.0	100.0	39
Wood (0-1 inch)	2.9	2.6	.3	90.0	21
Wood (1-3 inch)	2.9	1.9	1.0	65.0	25
Wood (3+ inch)	40.3	26.3	14.0	65.2	31
Duff	27.9	23.2	4.7	83.3	2
Herbaceous	.0	.0	.0	.0	22
Shrubs	.0	.0	.0	.0	23
Tree regeneration	.0	.0	.0	.0	24
Crown branchwood	.0	.0	.0	.0	38
Crown foliage	.0	.0	.0	.0	37
Total Fuels	80.7	60.7	20.0	75.2	

TITLE: Results of FOFEM model execution on date: 1/31/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: White Fir (SAF 211)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 1.0 - Entire
WOOD (3+ IN) MOISTURE (%): 55.0 - Actual

SMOKE SUMMARY TABLE - SMOKE EMISSIONS CALCULATIONS

Forest Floor Emission Component (lbs/acre)	Ave Combust Efficiency	PM10 Emission (lbs/acre)	PM2.5 Emission (lbs/acre)	CO Emission (lbs/acre)
Litter	.95	62.3	52.9	351.1
Wood (0-1 inch)	.95	24.3	20.6	136.8
Wood (1-3 inch)	.92	26.4	22.4	210.0
Wood (3+ inch)	.89	501.9	425.7	4582.9

Duff	.82	706.3	599.4	7344.1
Herbaceous	.00	.0	.0	.0
Shrubs	.00	.0	.0	.0
Tree regeneration	.00	.0	.0	.0
Crown branchwood	.00	.0	.0	.0
Crown foliage	.00	.0	.0	.0
Total Fuels	.87	1321.2	1121.1	12624.8

TITLE: Results of FOFEM model execution on date: 1/31/01

*** FIRE EFFECTS CALCULATOR ***

REGION: Pacific West
COVER TYPE: White Fir (SAF 211)
FUEL TYPE: Natural
FUEL ADJ FACTOR: Typical
DUFF MOISTURE (%): 1.0 - Entire
WOOD (3+ IN) MOISTURE (%): 55.0 - Actual

SMOKE SUMMARY -- FLAMING AND SMOLDERING SUMMARY

Fuel Component	Prefire loading	Moist Content	------- Consumption ------- Flaming	Smoldering	Total	PM2.5 Emissions
Name	ton/acre	(%)	(t/ac)	(t/ac)	(t/ac)	(%)
Litter	6.7	--	6.7	.0	6.7	4.7
Wood (0-1 inch)	2.9	--	2.6	.0	2.6	1.8
Wood (1-3 inch)	2.9	--	1.9	.0	1.9	2.0
Wood (3+ inch)	40.3	55.0	21.0	5.3	26.3	38.0
Duff	27.9	1.0	9.3	13.9	23.2	53.5
Herbaceous	.0	--	.0	.0	.0	.0
Shrubs	.0	--	.0	.0	.0	.0
Tree regeneration	.0	--	.0	.0	.0	.0
Crown branchwood	.0	--	.0	.0	.0	.0
Crown foliage	.0	--	.0	.0	.0	.0
Total Fuels	80.7	--	41.5	19.2	60.7	100.0

G - Fire Management Zones and Units

The parks are divided into three **Fire Management Zones** - the Kings, Kern, and Kaweah. The Zones represent, for the most part, major park watersheds resulting in an ecologically based planning framework for fire management activities. Each Zone has characteristics that allow unified fire and fuels management concepts to be applied within the Zone.

Zones may be subdivided into smaller **Fire Management Units (FMUs)**. FMUs are generally sub-watersheds having locally unique values, hazards, and/or risks that affect the specific mix of fuels treatments and fire management activities to be used. Because the FMUs are based on sub-watersheds, ecological integrity and landscape level goals and achievements can be evaluated with some confidence. (Maps of the Zones and FMUs are found in the companion *Fire and Fuels Management Plan*.)

FMUs may be further subdivided into **Segments**. Segments are comprised of a portion of a FMU that will receive uniform treatment. Segments are usually defined by natural or human created boundaries that allow for ease of management. Each segment will have a separate action plan developed (burn plan and/or fuels treatment plan). In some cases, segments may be further divided into **Sub-segments** under the same burn plan or fuels treatment plan to allow greater control and flexibility in managing the duration of the project, smoke impacts, or for other purposes.

Table G-1 – Fire Management Zones, Units, Segments, and Sub-Segments

Planning Unit	Subset of:	Geographic Extent	Designation	
Fire Management Zone	Parks	Major watershed(s)	Kings Kern	Kaweah
Fire Management Unit (FMU)	Fire Management Zone	Sub-watershed	<u>Kings Zone</u> Sierra Crest Cedar Grove <u>Kern Zone</u> Kern	<u>Kaweah Zone</u> Grant Grove North Fork Marble Fork Middle Fork East Fork South Fork
Segment	FMU	Manageable portion of a sub-watershed receiving common treatment under a single burn plan or fuels treatment plan.	Boundaries determined through annual planning process.	
Sub-Segment	Segment	Portion of a segment. Individual project to be treated along with other segments (though perhaps at different times) under a single	Boundaries determined through annual planning process and on-the-ground reconnaissance.	

		burn plan or fuels treatment plan.	

H - Minimum Requirement/Tool Definitions

NATIONAL PARK SERVICE
SEQUOIA AND KINGS CANYON NATIONAL PARKS

RECORD OF DECISION
MINIMUM REQUIREMENT/MINIMUM TOOL DEFINITIONS
FOR MANAGEMENT OF THE
SEQUOIA-KINGS CANYON WILDERNESS
AND SPECIFIED ASSOCIATED AREAS

APRIL 2003

INTRODUCTION

In order to establish and maintain wilderness character in designated wilderness areas, the Wilderness Act of 1964 establishes the following standard:

> *…except as necessary to meet the minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area) there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.*
>
> *-The Wilderness Act: Section 4 (c)*

The Service's Management Policies further define this process:

> *All management decisions affecting wilderness must be consistent with a minimum requirement concept…. When determining minimum requirement, the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resource or character is unavoidable, only those actions that preserve wilderness character and/or have localized short-term adverse impacts will be acceptable.*
> *-NPS Management Policies: 6.3.5 Minimum Requirement*

Director's Order 41, *Wilderness Preservation and Management,* provides additional guidance on this concept:

> Wilderness managers may authorize (using a documented process) the generally prohibited activities or uses listed in Section

> 4(c) of the Wilderness Act if they are deemed necessary to meet the minimum requirements for the administration of the area as wilderness and where those methods are determined to be the 'minimum tool' for the project. The use of motorized equipment and the establishment of management facilities are specifically prohibited when other reasonable alternatives are available.

The purpose of this document is to define, as specified above, the Minimum Requirement for managing the Sequoia-Kings Canyon Wilderness in Sequoia and Kings Canyon National Parks, California, and to identify and analyze those specific actions that represent the "minimum tool" approach to implementing the programs so defined. The Minimum Requirement herein defined also applies to certain additional areas, termed here "associated areas" and specifically defined as other portions of Sequoia and Kings Canyon National Parks that are proposed or recommended for wilderness designation or are being studied for wilderness suitability.

Proposed actions that fall completely within the definitions contained herein therefore fall within the scope of Minimum Requirements for the Management of the Sequoia-Kings Canyon Wilderness. Proposed actions not conforming to the following must be the subject of additional specific minimum requirement analysis before they can be implemented.

MANAGEMENT GOALS

Section 2 of the Wilderness Act states that a designated wilderness is an area that:

(c)(2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation.

This statement makes it clear that recreation is one of the purposes of designated wilderness.

Section 2(a) of the Wilderness Act states that wilderness areas:

> *shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness.*

This section clearly identifies the responsibility of agencies to manage wilderness areas. As implied by the legislation, this management should provide for:

- The safety of visitors, which enhances enjoyment;

- The protection of the wilderness resource through educational efforts and repair of impacted areas; and
- "Gathering and dissemination" of information on wilderness use patterns and activities, which is utilized in planning processes for long and short term wilderness preservation.

These outcomes are achieved through trail patrols, public contact activities, rehabilitation of damaged areas, emergency medical actions, search and rescue actions and the preparation of reports detailing wilderness conditions and public use patterns.

Section 4(a) of the Wilderness Act stipulates that wilderness areas in national parks remain subject to national park legislation:

> *(3) Nothing in this Act shall modify the statutory authority under which units of the national park system are created. Further, the designation of any area of any park, monument, or other unit of the national park system as a wilderness area pursuant to this Act shall in no manner lower the standards evolved for the use and preservation of such park, monument, or other unit of the national park system in accordance with the Act of August 25, 1916, the statutory authority under which the area was created, or any other Act of Congress which might pertain to or affect such area….*

Section 4(b) of the Wilderness Act reinforces this concept by stating:

> *Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use.*

Together, these statements confirm that the Sequoia-Kings Canyon Wilderness should continue to be managed under the Acts of 1890, 1926, and 1940 that created and enlarged Sequoia and Kings Canyon National Parks and the Act of 1916 that created the National Park Service. These acts address the responsibility of national parks to protect and understand natural and cultural resources.

The <u>Management Goals of the Sequoia-Kings Canyon Wilderness</u> follow from the above:

1. To provide opportunities for primitive and unconfined wilderness recreation and visitor enjoyment in a manner that is compatible with the Wilderness Act and the legislation creating Sequoia and Kings Canyon National Parks;
2. To provide for visitor management and resource protection in such a way and by such means as to enhance enjoyment of the wilderness resource while preserving wilderness character; and
3. To protect, restore, and understand natural and cultural resources in wilderness.

These three goals generate a suite of management programs, which, taken together, constitute the Minimum Requirement for Management of the Sequoia-Kings Canyon Wilderness.

MINIMUM REQUIREMENT FOR MANAGEMENT

1. Program for Visitor Recreation and Enjoyment

Goal: To provide opportunities for primitive and unconfined wilderness recreation and visitor enjoyment in a manner which is compatible with the Wilderness Act and the legislation creating Sequoia and Kings Canyon National Parks.

To provide for visitor enjoyment in the Sequoia-Kings Canyon Wilderness (723,000 acres) and associated areas, the National Park Service maintains a trail system of approximately 800 miles of foot and horse routes. Trails in the Sequoia-Kings Canyon Wilderness are constructed of materials available on site including earth, rock, gravel, and logs. No trails are hard surfaced. Causeways of timber or rock and earth may be constructed in wet areas. Trails generally are 2-3 feet wide, but may be wider in areas of heavy use or rugged terrain, where additional space is required for safety.

To support recreational use of this trail system and to manage human impacts associated with use, the Service also maintains the following trail-associated items of human manufacture:

- Signing (directional, safety, and regulatory)
- Bridges and Footlogs
- Drift Fences
- Trailside Camps

Analysis and Justification

The use of a system of defined trails to facilitate recreation in the high Sierra of California is a long recognized attribute of Sierra Nevada wilderness recreation. All of the major trail routes in the Sequoia-Kings Canyon Wilderness predate the establishment of the wilderness in 1984. Many of the routes date back to the 19th century, and a number follow Native American routes that predate documented history.

The Sequoia-Kings Canyon Wilderness is one of the most rugged in the 48 contiguous states. Altitudes vary from barely 3,000 feet to over 14,000 feet above sea level. Huge canyons (several rivaling the Grand Canyon of Arizona) cut through the range. High ridges separate the various watersheds, with a dozen passes exceeding 12,000 feet and two more than 13,000 feet above the sea. Thick vegetation clothes the middle altitude country and thickets can impede travel up to 10,000 feet. Above about 9,000 feet, where Pleistocene glaciers scoured the ground across the landscape as recently as 12,000 years ago, the

terrain is rocky and sometimes unstable. No roads cross the southern Sierra, and much of the Sequoia-Kings Canyon Wilderness is accessible only by several days of foot or stock travel.

For all these reasons, trail construction began early in the Sierra, and the existing system was essentially complete by 1940. Little has changed over the years, and trails remain the primary means of access. Almost all Sequoia-Kings Canyon Wilderness users rely on them for access. Even experienced hikers who enjoy cross-country (off-trail) travel in the high country usually approach their destinations on maintained trail routes.

Associated with the parks' trail system are a number of supporting improvements, all of which are necessary to meet the goal of wilderness recreation.

Trailside signing is limited to that necessary to provide visitors with required orientation (trail junctions, for example), that required to help visitors avoid the most serious safety hazards (such as lightning on the summit of Mt. Whitney) and that required to enforce necessary resource protection regulations (e.g. no fires, campsite closed, closed to grazing).

Several major rivers are born in the Sequoia-Kings Canyon Wilderness, and crossing them can be dangerous, particularly during the first half of the summer when the snowmelt is still underway. To facilitate access, a small number of bridges and footlogs are maintained over major streams where crossings are particularly dangerous or difficult. The great majority of stream crossings remain without bridges.

Stock use (mainly horses and mules) remains significant in the Sequoia-Kings Canyon Wilderness, and stock is traditionally turned out to graze in many areas within the Wilderness. In some of these areas, drift fences are maintained where free-grazing is an appropriate use and to protect sensitive resources near camps from which stock tends by historical experience to drift away. Drift fences thus facilitate stock camping and travel, which is recognized as a traditional wilderness use in the Sierra and protect resources.

In pursuit of the goal of "a primitive and unconfined type of recreation," camping is allowed over nearly the entire extent of the Sequoia-Kings Canyon Wilderness. Nature, however, in the form of providing level terrain near water and adjacent the trails, has the effect of concentrating camping in desirable locations. Many of these sites have been in use since the trails themselves came into being long ago. As a result, these desirable locations tend to be heavily used.

To mitigate these impacts while preserving opportunities for primitive and unconfined recreation, the Service has found it necessary over the years to provide, selectively, limited camp improvements including constructed fire pits (where fires are legal), food storage boxes

(where bears are common and raid camps, hitching posts (where tethered stock would otherwise damage vegetation), and toilets (where the natural systems are too fragile to handle waste without them).

Without this trail system and associated trailside improvements, it would be impossible to sustain wilderness recreation in the Sequoia-Kings Canyon Wilderness in the manner that has developed over more than a century in the High Sierra of California. Since this form of recreation is, quite literally, one of the forms of wilderness use that helped inspire the Wilderness Act, it is clear that the wilderness should be managed to sustain these uses in a manner that, as the Act of 1916 requires, "provides for their enjoyment by future generations…."

The Minimum Requirement for recreation in the Sequoia-Kings Canyon Wilderness thus consists of a trail system supported by trailside signs, bridges and footlogs, drift fences, and campsites with (when necessary) fire pits, food storage boxes or toilets.

2. Program for Visitor Management and Resource Protection

Goal: To provide for visitor management and resource protection in such a way and by such means as to enhance enjoyment of the wilderness resource while preserving wilderness character.

In order to assure the safety and well being of wilderness users and to protect the wilderness resource from unacceptable impacts, Sequoia and Kings Canyon National Parks maintains a system of backcountry rangers. In order to provide adequate support for the actions of the rangers, certain facilities are permitted to exist and to be maintained. These include:

- The existence and maintenance of backcountry ranger stations
- The existence and maintenance of toilet facilities
- The existence and maintenance of small-scale utility systems
- The existence and maintenance of communication systems

Analysis and Justification

It has been determined that, due to the size of the Sequoia-Kings Canyon Wilderness, and owing also to the large numbers of wilderness users, rangers must reside temporarily within the wilderness. This means that backcountry ranger stations are necessary. Options that do not provide for stations do not allow adequate patrol coverage of the vast area. In order to enhance enjoyment and protect the wilderness resource, the presence of rangers deep within the wilderness is required.

Owing to the requirement of stationed rangers, certain facilities and actions are necessary for proper and efficient conduct of wilderness ranger duties. Largest of the facilities are ranger stations. These provide a point from which rangers can work. They are utilized for shelter, storage of supplies and normal day to day living activities. They also serve as a place for visitors in need to seek out and obtain assistance.

The ranger stations and some high use camping areas have toilet facilities. Most of these are of the “privy” type, that is, pit toilets. These are required in areas of concentrated ranger and visitor use and assure that human waste is not scattered throughout an area thereby preventing unsanitary and unhealthy conditions. At Emerald and Pear Lakes there are two larger scale composting toilets. These structures are necessary due to the solid bedrock of this high use area. The digging of pit toilets is not feasible.

Ranger stations also contain some small-scale utilities, primarily solar generated electricity. This is necessary in order to provide power to recharge radio batteries as a part of communication systems.

The system of wilderness rangers requires effective radio communication systems to provide support responses for emergency services and to provide updated information to the frontcountry about trail and other wilderness conditions. In order to adequately cover the large size of the SEKI wilderness, radio repeaters exist in strategic locations and need to be maintained.

In order for the rangers to sustain themselves and to provide visitor management and assistance, it is necessary to supply the rangers and their stations. Food, clothing, tools, communication devices, and emergency medical and search and rescue supplies must be maintained at the stations. There are times when it is necessary to bring these supplies and occasionally insert or remove rangers from their stations via helicopters. This is generally when stock access is precluded, such as when passes are snowed in, supplies are too heavy or large, when time-sensitive materials are being transported, or there are no stock available.

Without the actions of the backcountry rangers and the support these stations provide, enjoyment of the wilderness by the visiting public and protection of the wilderness resource would be compromised. The quality of the wilderness experience and the quality of the wilderness resource would be impaired.

The Minimum Requirement for managing visitor use and enhancing wilderness enjoyment and resource protection in the Sequoia-Kings Canyon Wilderness and associated areas thus consists of a system of backcountry rangers and stations supported by specific facilities and actions as defined above.

3. Program for Resource Management and Research

Goal: Protect, restore, and understand natural and cultural resources in wilderness

To provide for scientific, educational, conservation, and historical use of the Sequoia-Kings Canyon Wilderness and associated areas, the National Park Service conducts a broad resource management and research program designed to:

- Sustain cultural resources in wilderness through understanding, inventory, monitoring, protection, restoration, and maintenance;
- Sustain natural resources in wilderness through understanding, inventory, monitoring, protection, restoration, and maintenance. Such actions include establishing plots, monitoring devices, and collection of biologic and other samples, removal of trash and other manmade materials, removal of non-native plants and animals, removal or relocation of hazardous plants and animals;
- Sustain natural fire regimes in wilderness through understanding, monitoring, restoration, and maintenance. Such actions include prescribed fires, management of natural fire, hazard fuel removal, fire suppression and control. In order to foster natural fire regimes in wilderness, it is necessary to protect certain structures, installations, and natural and cultural resources from fire;
- Provide barriers to protect natural and cultural resources from incompatible uses. Such barriers include cave exclusion gates, boundary fences, fences to protect structures and installations from wildlife depredation, food storage lockers, fireline construction and rehabilitation, containment and diversions to protect resources from hazardous wastes and other unnatural flows, stock confinement structures such as hitching rails and drift fences, and signs for resource protection and visitor safety.

Analysis and Justification

Managing for scientific, educational, conservation, and historical use is a long recognized attribute of the Sequoia-Kings Canyon Wilderness. Such management long predates the establishment of the wilderness in 1984, and is based on the legislation which established both the National Park Service and Sequoia and Kings Canyon National Parks. These acts give the Park Service a clear mandate to manage cultural and natural resources.

Implementation of the resource management and research program involves crews entering the Sequoia-Kings Canyon Wilderness to conduct field activities. Associated with this field work are a number of supporting improvements, all of which are necessary to meet the goal of scientific, educational, conservation, and historical use. Infrastructure is limited to that necessary to support field crews, mitigate safety hazards, and minimize impacts in the wilderness.

To mitigate the impacts of field crew camps, the parks have found it necessary over the years to selectively provide constructed fire pits (where fires are legal), food storage boxes (where bears are common and raid camps) and pit toilets (where the natural systems are too fragile to handle waste without them). Field-crew camp infrastructure is provided to the minimum extent necessary and is rehabilitated as appropriate when no longer required.

Stock (mainly horses and mules) are sometimes used to support field crews in the Sequoia-Kings Canyon Wilderness. Stock is traditionally turned out to graze in many areas within the wilderness. In some of these areas, drift fences are maintained near camps to prevent animals from drifting into sensitive habitats. Stock-related infrastructure is provided to the minimum extent necessary and is rehabilitated as appropriate when no longer required.

Stock are generally the preferred method of supporting field crews in the Sequoia-Kings Canyon Wilderness. Helicopter support is used to (1) transport equipment that is too fragile for other methods, (2) to transport samples and other cargo which are time-dependent, require stable conditions, or are of large volume or weight, or (3) where stock are not allowed or would be unduly damaging to the resource.

Without the parks' resource management and research program and associated improvements, it would not be possible to manage for scientific, educational, conservation, and historical use in the Sequoia-Kings Canyon Wilderness in the manner necessary to sustain the quality and integrity of the wilderness resource.

The actions, activities, and services of the resource management and research program ensure that the Sequoia-Kings Canyon Wilderness will allow for appropriate resource protection and visitor management. These actions, activities, and services are thus categorically defined as minimum requirement on the basis of past management experience and are carried out with the purpose of appropriate and necessary administration of the area as wilderness and do not pose a significant impact to wilderness resources and character.

The minimum requirement for scientific, educational, conservation, and historical use in the Sequoia-Kings Canyon Wilderness thus consists of the above described resource management and research program.

MINIMUM TOOL

In order to carry out those actions that are defined above as the Minimum Requirement for Management of the Sequoia-Kings Canyon Wilderness and associated areas, it is required that managers "identify the management method (tool) that causes the least amount of

impact to the physical resources and experiential qualities (character) of wilderness." This is defined as the "Minimum Tool."

According to Director's Order 41, "Minimum Tool means a use or activity, determined to be necessary to accomplish an essential task, which makes use of the least intrusive tool, equipment, device, force, regulation, or practice that will achieve the wilderness management objective. This is not necessarily the same as the term "primitive tool," which refers to the actual equipment or methods that make use of the simplest available technology (i.e., hand tools)."

Attachment "A" defines Minimum Tool as practiced within the Sequoia-Kings Canyon Wilderness. For the purposes of analysis, three alternative approaches to Minimum Tool application are presented for each major element of the three management program elements that constitute the Minimum Requirement. In all cases, Alternative "B" is the approved Minimum Tool approach. This Record of Decision incorporates Alternative "B" as the approved Minimum Tool program for the Sequoia-Kings Canyon Wilderness and associated areas.

The Minimum Tool Analysis does not address roads or motorized ground transport since these activities are prohibited entirely within the Sequoia-Kings Canyon Wilderness.

PROHIBITED ACTIVITIES

The following management actions are prohibited within the Sequoia-Kings Canyon Wilderness:

- THE CONSTRUCTION, MAINTENANCE, OR USE OF ANY TEMPORARY ROAD IN WILDERNESS.
- The use of any motor vehicle in wilderness, other than approved helicopter use as described above.
- The use of any motorized equipment or motorboats in wilderness, other than described above.
- The landing of any aircraft in wilderness, other than described above.
- The use of any mechanical transport in wilderness.
- The maintenance, placement, or construction of any structure or installation or related facility in wilderness, other than described above.
- Any management action or activity not described above.

SCOPE AND DURATION

The Minimum Requirement defined by this Record of Decision and attached Minimum Tool Analysis applies specifically to the Sequoia-Kings Canyon Wilderness and also to other portions of Sequoia and

Kings Canyon National Parks that are proposed or recommended for wilderness designation or are being studied for wilderness suitability. These additional areas that are not current designated wilderness are referred to above as “associated areas.”

The decisions herein documented are valid for one year from the date of approval of this document unless revoked sooner by the Superintendent of Sequoia and Kings Canyon National Parks.

IMPLEMENTATION

In order to insure that the decisions documented herein are implemented in a consistent and compliant fashion, each of the operating divisions of Sequoia and Kings Canyon National Parks that intends to carry out management activities in the Sequoia/Kings Canyon Wilderness under the authority of this decision will develop and maintain a “Minimum Requirement/Minimum Tool Compliance Agreement.” These agreements, which will be reviewed by the parks’ Environmental Management Committee and approved by the Superintendent, will provide detailed examples and guidance to supervisors and employees to assure that the parks’ Minimum Requirement/Minimum Tool policies and standards are consistently followed. Enforcement of the parks’ Minimum Requirement/Minimum Tool policies will be the responsibility of the parks’ Environmental Management Committee.

/S/
Richard H. Martin
Superintendent

Attachment: Minimum Tool Analysis

Table H-1 – Minimum Tool Analysis

Table: Maintain a wilderness trail system
Requirement: Tasks involved include trail tread maintenance, clearing of logs and debris, drainage improvements, retaining wall construction or reconstruction, causeway construction or reconstruction, trail relocation for resource protection reasons, and abandoned trail restoration to natural conditions. Trail crew camps are occupied for significant periods at sites that are often returned to annually. Crew campsites require limited improvements to function effectively. Storage containers are needed to protect food from bears and other wildlife. Hitching posts and portable, temporary electric fences facilitate stock use and protect resources at selected, regularly used camps. Fenced pastures are constructed at a few of these camps to facilitate stock support of the crews.

	Alternative A: Primitive Tools	**Alternative B: Selective Mix of Tools**	**Alternative C: Modern Tools**
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	No motorized equipment used. All work done by hand.	Motorized equipment used limited to chainsaws, rock drills, generators, and power hand tools. Use of motorized tools limited to between 8:30 am and 4:30 pm. Most work done by hand.	Motorized equipment used includes, but not limited to, bobcats, cement mixers, motorized wheelbarrows, chainsaws, rock drills, generators, and power hand tools. Little work is done by hand.
	Analysis		
	Work required to sustain trails is not fully accomplished unless substantial increases are made to trail crew budgets, which would result in the presence of larger crews and crew camps in the wilderness. Wilderness travelers do not encounter motorized equipment. Trail system likely to deteriorate. Wilderness character preserved, but minimum requirement not fully met.	Work required to sustain trails is done with moderate efficiency. Presence of motorized tools is limited to certain machines and to specified working hours only. Most work is done by hand. Wilderness travelers encounter only very limited motorized equipment. Trail system sustained. Wilderness character essentially preserved. Minimum requirement met.	Work required to sustain trails is done efficiently, but conflicts significantly with wilderness character. Wilderness travelers frequently encounter motorized equipment. Minimum requirement met, but wilderness character impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	No supply of trail work by helicopter. Trail crews access work sites by ground travel only. Trail crews receive construction supplies by non-motorized ground transport only.	Limited supply of trail work by helicopter. Trail crews access work sites by air only when ground travel is not feasible due to trail conditions, weather conditions, or non-availability of stock. Crews receive camp supplies under same limitations. Supplies delivered by air to work sites when above conditions apply or when required items are too large or too fragile for ground transport.	Unlimited supply of trail crews by helicopter. Trail crews routinely access work sites by helicopter. Crews routinely receive construction and camp supplies by helicopter.
	Analysis		

	Crew access and supply is accomplished only with difficulty. Large or fragile items cannot be delivered to sites. Travelers never encounter helicopters supporting trail crews. Stock impacts increase. Wilderness character preserved, but minimum requirement not fully met.	Crew access and supply is done with moderate efficiency but in a manner that essentially preserves wilderness character. Helicopters have a limited presence. Travelers seldom encounter helicopters supporting trail crews. Wilderness character essentially preserved and minimum requirement met.	Crew access and supply is efficient, but conflict with wilderness character is significant. Travelers encounter helicopters supporting trail crews with some regularity. Wilderness character significantly impaired, but minimum requirement met.
Structures and Installations	**Allowable Structures and Installations**		
	Only fully portable (by stock or person) food storage or equipment storage containers present at camp and work sites. Hitching racks and portable, temporary electric fences are not erected at trail crew campsites. Fenced pastures are not constructed or maintained at trail crew campsites.	Larger, temporary (not attached to ground) food storage and equipment storage containers present at camp and work sites. Hitching racks and portable, temporary electric fences are erected at some trail crew campsites. Fenced pastures are developed at a tightly limited number of regularly used camps where stock is based.	Large, semi-permanent (attached to ground) food storage and equipment storage containers present at camp and work sites. Hitching racks and electric fences are constructed at most sites where crews camp. Fenced pastures are developed at numerous locations to control stock and facilitate trail crew operations.
	Analysis		
	Small containers make it difficult to insure that all food is kept securely out of reach of wildlife. Tools and valuable private property in trail crew camps are generally not kept secure when crews are not in camp. Containers are portable and can be easily removed when no longer needed at site. Problems with wildlife and security may result. Not having hitching posts or electric fences makes stock use difficult, and natural resources suffer. Lack of fenced pastures make stock control difficult. Crew efficiency suffers. Wilderness travelers see no structures, but overall productivity of trail crews is low and trail system deteriorates. Wilderness character preserved but minimum requirement not fully met.	Larger containers insure that all food is kept securely out of reach of wildlife and that tools and valuable private property in trail crew camps are kept secure when crews are not present. Containers are temporary and are removed when no longer needed at site. Problems with wildlife and security area essentially prevented. Hitching posts and portable, temporary electric fences are uncommon but present. Fenced pastures at a few carefully selected locations increase crew efficiency but are seldom detected by visitors. Wilderness travelers encounter a limited number of structures. Wilderness character essentially preserved and minimum requirement met.	Larger containers insure that all food is kept securely out of reach of wildlife and that tools and valuable private property in trail crew camps are kept secure when crews are not in camp. Containers are semi-permanent and remain onsite for indefinite periods. Problems with wildlife and security essentially prevented. Hitching posts and electric fences are commonly present, and fenced pastures are encountered. Wilderness travelers encounter a significant number of structures. Wilderness character impaired but minimum requirement met.

Table: Provide necessary signs.
Requirement: Trailside signing is limited to that necessary to provide visitors with required orientation (trail junctions, for example), that required to help visitors avoid the most serious safety hazards (such as lightning on the summit of Mt. Whitney) and that required to enforce necessary resource protection regulations (no fires, campsite closed, closed to grazing, etc.). Signing work within the wilderness is related to delivery and installation of the signs. Signs are manufactured outside the designated wilderness. Also required to support this requirement, but addressed elsewhere, is maintaining a wilderness trail system.

	Alternative A: Primitive Tools	Alternative B: Selective Mix of Tools	Alternative C: Modern Tools
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	No motorized equipment used to install signs. Installation by hand tools only.	Selective and limited used of motorized equipment is made. Signs posts are placed in ground by hand unless soil conditions (bedrock) require drilling of a hole for the post.	Regular use of motorized equipment is made to install signs. Power tools are used to excavate post holes where signs are erected.
	Analysis		
	All work is done by hand. No impacts on wilderness character. Work is accomplished except that signs could not be erected securely in those few sites where bedrock is only surface medium. Minimum requirement not fully met.	Almost all work is done by hand. Impacts on wilderness character are negligible. Work is accomplished and Minimum requirement met.	Significant presence of motorized equipment. Wilderness character impaired. Work accomplished and minimum requirement met.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	No motorized equipment used to deliver signs. Delivery is accomplished by pack stock only.	Signs are delivered to work sites under provisions identified in “Trails” table for delivery of supplies to trail crews.	Signs are brought into wilderness primarily by helicopter.
	Analysis		
	Supply is accomplished only with difficulty. Crew efficiency is low and sustaining of sign systems may not be possible. Sign system may deteriorate. Wilderness character not impaired, but minimum requirement not fully met.	Supply is accomplished with moderate efficiency but in a manner that essentially preserves wilderness character. Helicopters have a limited presence. Work sites supplied with some difficulty but minimum requirement met.	Work sites supplied without difficulty. Supply is efficient, but conflict with wilderness character is significant. Helicopters have a strong presence. Minimum requirement met, but wilderness character significantly impaired.
Structures and Installations	**Allowable Structures and Installations**		
	Signs are largely not present in the backcountry. Directional information not usually found at trail junctions. Hazards such as lightning risk on Mt. Whitney not identified to travelers on site. Regulatory signs not present.	Signs are placed in wilderness as called for in SEKI Backcountry Management Plan. Signs are limited to directional signs at junctions, safety warning signs where there is a clear and present danger, and regulatory signs where ranger patrol staff recommend their presence.	In addition to signs called for in Alternative B, additional signing is installed to identify creeks, geographic features, points, of interest, etc.

	Analysis		
	Travelers do not encounter signs that may intrude in their wilderness experience. Signs are not present to provide critical information to wilderness users. Directional information at trail junctions not present. Highest level safety messages not made available to all travelers on the site. Information necessary to protect resources where problems occur not present. Additional management problems occur resulting from lost visitors, safety incidents, and resource damage. Wilderness character preserved. Minimum requirement not met.	Travelers encounter a limited number of signs that may intrude on their wilderness experience. Signs are present to provide critical information to wilderness users. Directional signs at trail junctions define routes for travelers. Highest level safety messages are made available to all travelers on the site. Regulatory signs provide information necessary to protect resources where problems occur. Critical information communicated to wilderness travelers. Wilderness character is not impaired, and the minimum requirement met.	Travelers encounter numerous signs that may intrude on their wilderness experience. Signs are present to provide critical information to wilderness users. Directional signs at trail junctions define routes for travelers. Highest level safety messages are made available to all travelers on the site. Regulatory signs provide information necessary to protect resources where problems occur. Basic and supplemental messages are communicated. Wilderness character impaired, but minimum requirement met.

Table: Trail bridges and footlogs
Requirement: Trail bridges or placed footlogs are provided at selected critical locations where crossings are particularly dangerous or difficult. The great majority of stream crossings remain without bridges. Bridge and footlog work is related to constructing, maintaining, and reconstructing bridge structures and their footings. These actions require imported supplies and materials that must be worked on site. Native materials are also sometimes used. Also required to support this requirement, but addressed elsewhere, is maintaining a wilderness trail system.

	Alternative A: Primitive Tools	Alternative B: Selective Mix of Tools	Alternative C: Modern Tools
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	No motorized equipment used to construct, maintain, or reconstruct bridges and footlogs. All work done by hand tools only	Selective and limited used of motorized equipment is made. Motorized equipment used limited to chainsaws, rock drills, generators, welders and power hand tools. Use of motorized tools limited to between 8:30 am and 4:30 pm. Much work is still done by hand.	Full use of motorized equipment is made to do bridge and footlog work. Motorized equipment used includes, but not limited to, bobcats, cement mixers, motorized wheelbarrows, chainsaws, rock drills, generators, and power hand tools. Little work is done by hand.
	Analysis		
	Crew efficiency is low. Work required to sustain bridges and footlogs is not fully accomplished unless substantial increases are made to trail crew budgets. Systems of bridges and footlogs may deteriorate. Wilderness character preserved but minimum requirement not met.	Work required to sustain bridges and footlogs is done with moderate efficiency. Presence of motorized tools is limited to certain machines and to specified working hours only. Wilderness character essentially preserved. Minimum requirement met.	Work required to sustain bridges and footlogs is done efficiently, but conflict with wilderness character is significant. Motorized tools have a strong presence. Minimum requirement met.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	No supply of bridge projects by helicopter. Bridge projects receive construction supplies by non-motorized ground transport only.	Limited supply of bridge projects by helicopter. Trail crews access work sites by air only when ground travel is not feasible due to trail conditions, weather conditions, or non-availability of stock. Supplies delivered by air to work sites when above conditions apply or when required items are too large or too fragile for ground transport.	Unlimited supply of bridge projects by helicopter. Projects routinely receive construction supplies by helicopter.
	Analysis		

	Project supply is accomplished only with difficulty. Large or fragile items cannot be delivered to sites. Bridges and footlogs deteriorate, and stock impacts increase. Travelers never encounter helicopters supporting bridge work. Wilderness character preserved, but minimum requirement not fully met.	Project supply is done with moderate efficiency but in a manner that essentially preserves wilderness character. Travelers seldom encounter helicopters supporting bridge work. Wilderness character essentially preserved, and minimum requirement met.	Project supply is efficient, but conflict with wilderness character is significant. Travelers may encounter helicopters supporting bridge work with some frequency during project periods. Minimum requirement met, but wilderness character significantly impaired.
Structures and Installations	**Allowable Structures and Installations**		
	Bridges and footlogs are not constructed or maintained along any park trails. Existing structures are removed.	Bridges are constructed or maintained or footlogs placed at selected sites on primary through routes where major safety problems exist for a significant part of the summer use season. The great majority of water crossings remain without bridges.	Bridges are constructed or maintained at numerous locations on both primary and less important routes where the public faces a challenge in crossing streams. Significant portions of the trail system's stream crossings have bridges or placed footlogs.
	Analysis		
	No stream crossing by visitors is assisted, even in the most dangerous situations. This presents hazards to public safety. Wilderness character preserved but minimum requirement not met.	Safe passage is provided across a small number of the most dangerous selected stream crossings. Wilderness character is preserved essentially intact and the minimum requirement met.	Safe and easy passage is provided across many park streams. Increased presence of work crews reduces opportunities for solitude. Wilderness character impaired, but minimum requirement met.

Table: Provide drift fences
Requirement: Provide drift fences at selected locations along major wilderness trails. Drift fences limit wandering by free-grazing stock in areas appropriate for stock camping, protecting sensitive resources from pack stock impacts. Drift fence work involves constructing, reconstructing, or maintaining trail gates and fences. These actions require imported supplies and materials, for on-site construction. Materials native to the site may also be used. Also required to support this requirement, but addressed elsewhere, is maintaining a wilderness trail system.

	Alternative A: Primitive Tools	Alternative B: Selective Mix of Tools	Alternative C: Modern Tools
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	All work is done by hand. Drift fences and gates are constructed, reconstructed, or maintained entirely by crews using non-motorized hand tools.	Most work is done by hand. Selective and limited use of motorized equipment is made. Fences are placed in ground by hand unless soil conditions (bedrock) require drilling of a hole. Use of motorized tools limited to between 8:30 am and 4:30 pm. Gates are constructed mostly by hand with limited use of power saws.	Much work is done with motorized equipment. Regular use of motorized equipment is made to install fences. Power tools are used to excavate post holes where fences are erected. Power tools are used to facilitate construction of gates.
	Analysis		
	Work is accomplished with some loss in efficiency. Ability to maintain fence system is reduced, and fence system may deteriorate. Travelers never encounter motorized equipment in use to support fence work. Wilderness character preserved but minimum requirement not fully met.	Work is accomplished. Travelers seldom encounter motorized equipment being used to support fence work. Wilderness character is preserved and minimum requirement met.	Significant presence of motorized equipment facilitates efficient work. During periods of fence work, travelers are likely to encounter motorized tools being used. Minimum requirement met, but wilderness character significantly impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	No supply of fence projects by helicopter. Projects receive construction supplies by non-motorized ground transport only.	Limited supply of fence projects by helicopter. Trail crews access work sites by air only when ground travel is not feasible due to trail conditions, weather conditions, or non-availability of stock. Supplies delivered by air to work sites when above conditions apply or when required items are too large or too fragile for ground transport.	Unlimited supply of fence projects by helicopter. Projects routinely receive construction supplies by helicopter.
	Analysis		

	Project supply is accomplished only with some difficulty. System of fences may deteriorate, and stock impacts increase. Travelers do not encounter helicopters supporting fence work. Wilderness character preserved, but minimum requirement not fully met.	Project supply is done with moderate efficiency but in a manner that essentially preserves wilderness character. Travelers seldom encounter helicopters supporting fence work. Wilderness character preserved and minimum requirement met.	Project supply is efficient, but conflict with wilderness character is significant. Travelers are likely to encounter helicopters supporting fence work during project periods. Wilderness character significantly impaired, but minimum requirement met.
Structures and Installations	**Allowable Structures and Installations**		
	Drift fences are not constructed or maintained along any park trails. Existing structures are removed.	Drift fences are constructed or maintained at selected sites only on primary through-routes where free-grazing is an appropriate use, stock camping is a regular activity, and to protect sensitive resources where stock historically wander from camp. The great majority of camp areas do not have drift fences.	Drift fences are constructed or maintained at numerous locations on both primary and less important routes where the public faces a challenge in maintaining easy control over free grazing stock. A significant portion of the parks' wilderness campsites have drift fences nearby.
	Analysis		
	There is no control of free-grazing stock. No fences intrude. Sensitive resources are impacted by free-grazing stock. Stock camping is significantly more difficult. Wilderness character preserved, but minimum requirement not fully met.	Control of free-grazing stock is achieved in the vicinity of a limited number of regularly used stock camps. Meadow and streams are protected from impairment. Fences are a rare wilderness feature. Wilderness character is preserved essentially intact and the minimum requirement met.	Control of free-grazing stock is achieved at numerous locations on both primary and less important routes. Fences are a common wilderness feature. Minimum requirement met, but wilderness character impaired significantly.

Table: Trailside camps
Requirement: Provide opportunities for camping in a “primitive and unconfined” manner along wilderness trails by constructing the following improvements:

- Construct fire pits to limit size and impact of user-constructed fire rings in areas were fires are allowed and use is heavy
- Install food storage boxes at sites where bears are common and raid camps
- Construct toilets structures where natural systems are not sufficiently robust to handle the volume of human waste being generated
- Construct hitching posts at campsites that are commonly used by stock parties and where resource damage can be thus reduced

Tasks involved focus on the installation and maintenance of these improvements. Also required to support this requirement, but addressed elsewhere, is maintaining a wilderness trail system.

	Alternative A: Primitive Tools	Alternative B: Selective Mix of Tools	Alternative C: Modern Tools
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	All work done by hand. No motorized equipment used.	Most work done by hand. Motorized equipment used limited to chainsaws, rock drills, generators, and power hand tools. Use of motorized tools limited to between 8:30 am and 4:30 pm.	Little work is done by hand. Motorized equipment used includes, but not limited to, bobcats, cement mixers, motorized wheelbarrows, chainsaws, rock drills, generators, and power hand tools.
	Analysis		
	Travelers will not encounter motorized equipment being used to support campsite work. Tasks required to sustain camp improvements will not be fully accomplished unless substantial increases are made to park trail crew budgets. Camp improvements likely to deteriorate. Wilderness character preserved but minimum requirement not met.	Travelers will seldom encounter motorized equipment being used to support campsite work. Tasks required to sustain camp improvements will be done with moderate efficiency. Presence of motorized tools is limited to certain machines and to specified working hours only. Camp improvements sustained. Wilderness character essentially preserved and minimum requirement met.	Travelers likely to encounter motorized equipment being used to support campsite work during project periods. Tasks required to sustain campsite improvements done efficiently. Motorized tools have a strong presence. Minimum requirement met, but wilderness character impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	No supply of camp improvement work by helicopter. Trail crews access work sites by ground travel only. Trail crews receive construction supplies by non-motorized ground transport only.	Limited supply of camp improvement work by helicopter. Crews access work sites by air only when ground travel is not feasible due to trail conditions, weather conditions, or non-availability of stock. Supplies delivered by air to work sites when above conditions apply or when required items are too large or too fragile for ground transport.	Unlimited supply of crews by helicopter. Trail crews routinely access work sites by helicopter. Crews routinely receive construction and supplies by helicopter.
	Analysis		

	Travelers do not encounter helicopters being used to support campsite work. Crew access and supply is accomplished only with difficulty. Large or fragile items cannot be delivered to sites. Stock impacts increase with increased use. Wilderness character preserved, but minimum requirement not fully met.	Travelers seldom encounter helicopters being used to support campsite work. Crew access and supply is done with moderate efficiency but in a manner that essentially preserves wilderness character. Helicopters have a limited presence. Wilderness character essentially preserved and minimum requirement met.	Travelers likely to encounter helicopters being used to support campsite work during project periods. Crew access and supply is efficient, but conflict with wilderness character is significant. Helicopters have a strong presence. Wilderness character significantly impaired, but minimum requirement met.
Structures and Installations	**Allowable Structures and Installations**		
	No camp improvements constructed.	Limited camp improvements constructed as follows: Fire pits where fires are allowed and use is heavy Food storage boxes at sites where bears are common and raid camps Toilets structures where natural systems are not sufficiently robust to handle the volume of human waste being generated Hitching posts at campsites that are commonly used by stock parties and where resource damage can be thus reduced	Camp improvements constructed as follows: Fire pits wherever fires are allowed and fires are built regularly Food storage boxes at sites where wilderness travelers desire them Toilets structures where travelers request them for convenience Hitching posts at campsites that are commonly used by stock parties
	Analysis		
	Wilderness travelers do not encounter structures and installations associated with trailside campsites. At popular sites, the following issues intensify: problems with unmanaged fire pits; camp raiding by bears and other wildlife; human waste; damage to trees and other natural resources from the tethering of stock; and trampling and overgrazing of adjacent meadows. Wilderness character preserved, but minimum requirement not fully met.	Wilderness travelers encounter a limited number of structures and installations associated with trailside campsites. Campsites with specific problems receive improvements that limit impacts but most sites are left undeveloped. Wilderness character essentially preserved and minimum requirement met.	Wilderness travelers frequently encounter structures and installations associated with trailside campsites. Many campsites, including some with no resource problems, receive improvements. Wilderness character significantly impaired, but minimum requirement met.

Table: The existence and maintenance of backcountry ranger stations
Requirement: Maintain a system, or network, of backcountry rangers and appropriate support mechanisms in order to provide for public safety, enhanced wilderness enjoyment, and protection of the wilderness resource. Rangers also provide for education and the gathering and dissemination of information which leads to wilderness preservation through informed planning and operational decisions.

	Alternative A: Primitive Tools	Alternative B: Selective Mix of Tools	Alternative C: Modern Tools
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	Prohibit all use of motorized equipment to maintain or support wilderness Ranger Stations.	Motorized equipment used limited to drills, saws and power hand tools. Use of motorized tools limited to between 8:30 am and 4:30 pm.	Regular and frequent use of motorized equipment.
	Analysis		
	Ability to maintain stations with only hand tools leads to deterioration over time. Aesthetic condition of stations compromised. Structures are more primitive and require more frequent replacement. Wilderness character preserved, but minimum requirement not fully met.	Structures are maintained in good condition leading to a positive aesthetic. Structures are kept in condition to maximize efficient operation. Wilderness character essentially preserved and minimum requirement met.	Structures are kept in condition to maximize efficient operation. Minimum requirement met, but wilderness character impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	Aircraft is never used to maintain or support wilderness Ranger Stations.	Limited use of aircraft to maintain and support.	Regular and frequent use of aircraft.
	Analysis		
	All material to maintain and support stations brought in by stock or on foot, limiting types of materials and support equipment, and impacting associated functions (e.g. EMS/SAR). Additional stock use would lead to more trail and meadow impacts. Wilderness character preserved, but minimum requirement not fully met.	Material to adequately support structure and associated functions would be available. Impacts of stock use is kept at manageable levels. Wilderness character essentially preserved and minimum requirement met.	All supplies are readily available. Impacts of stock use are significantly reduced or eliminated. Minimum requirement met, but wilderness character impaired.
Structures and Installations	**Allowable Structures and Installations**		
	No ranger stations would be maintained; existing structures would be removed.	Maintain and/or improve existing ranger stations.	Improve existing ranger stations and construct stations in new locations.
	Analysis		

	No structures would severely limit the time rangers can spend in wilderness which would reduce visitor enjoyment by not having available associated functions (e.g. EMS/SAR and educational opportunities). Also, resource damage in remote wilderness areas would not be mitigated in most cases. If no structures, wilderness character (i.e. aesthetic) would be improved. Removal of existing structures requires large numbers of stock, and or aircraft use for removal and cleanup efforts. Wilderness character preserved, but minimum requirement not fully met.	System of stations provides support for wilderness administration activities (e.g. EMS/SAR, education, resource protection) enhancing visitor enjoyment and preservation. Wilderness character essentially preserved and minimum requirement met.	System of support for administration of wilderness would increase, providing more services to the public and more resource protection. Construction of new facilities would lead to more materials being transported (via stock or helicopter). Minimum requirement met, but wilderness character impaired.

Table: The existence and maintenance of toilet facilities
Requirement: Maintain primitive toilet facilities at ranger stations and in wilderness areas of high use. Tasks involve maintenance of above ground structures, removal of waste in some cases, and relocation of pits. Also required to support this requirement, but addressed elsewhere, is maintaining trailside camps.

	Alternative A: Primitive Tools	Alternative B: Selective Mix of Tools	Alternative C: Modern Tools
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	Prohibit all use of motorized equipment to maintain or support wilderness toilets.	Limited utilization of motorized equipment to maintain and support. Use of motorized tools limited to between 8:30 am and 4:30 pm.	Regular and frequent use of motorized equipment.
	Analysis		
	Ability to maintain with only hand tools leads to deterioration over time. Aesthetic condition of toilets less than optimal. Structures more primitive and require more frequent replacement. Sanitation is compromised. Wilderness character preserved, but minimum requirement not fully met.	Structures maintained in good condition leading to good aesthetics. Structures kept in condition to maximize efficient operation. Sanitation would be maintained. Wilderness character essentially preserved and minimum requirement met.	Structures kept in condition to maximize efficient and sanitary operation. Minimum requirement met, but wilderness character impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	Aircraft is never used to maintain or support wilderness toilets.	Limited use of aircraft to maintain and support.	Regular and frequent use of aircraft.
	Analysis		
	All material to maintain would be brought in or removed by stock or on foot. Waste would need to be dealt with on site or hauled out by stock or on foot, creating problems of safe handling. Additional stock use would lead to more trail and meadow impacts. Wilderness character preserved, but minimum requirement not fully met.	Material to adequately support structure is available. Waste is removed for disposal outside wilderness and handled in safe manner. Impacts of stock use is kept at manageable levels. Wilderness character essentially preserved and minimum requirement met.	All supplies are readily available. Waste is removed and handled safely. Impacts of stock use are significantly reduced or eliminated. Minimum requirement met, but wilderness character impaired.
Structures and Installations	**Allowable Structures and Installations**		
	No toilets would be maintained; existing structures would be removed.	Maintain existing toilets.	Maintain or modernize existing toilets and construct new toilets in more locations.
	Analysis		

	No toilets severely impacts resource protection and visitor enjoyment. High use areas have high potential of encountering human waste on the landscape. Water quality also impacted. Higher probability of visitors contracting illnesses. Removal of existing structures requires increased stock use, and or aircraft use for removal and cleanup efforts. Wilderness character preserved, but minimum requirement not fully met.	Toilets provide a safe way to concentrate human waste, enhancing visitor enjoyment, preservation, and health and safety. Wilderness character essentially preserved and minimum requirement met.	Number of structures increases, providing more sanitary conditions for the public and more resource protection. Improvement of old and construction of new facilities leads to more materials being transported (via stock or helicopter). Minimum requirement met, but wilderness character impaired.

Table: Existence and maintenance of small-scale utility systems.
Requirement: Maintain small-scale utility systems, both electrical (consisting of solar panels, inverters, and batteries), and in some cases water, at ranger stations in wilderness. Tasks involve installation and maintenance of systems to support rangers through enabling the recharging of radio batteries and production of indoor water. Ranger presence and ability to provide visitor services leads to wilderness enjoyment, protection of the wilderness resource and public safety. Also required to support this requirement, but addressed elsewhere, is maintaining a system of backcountry rangers and adequate support for them to accomplish their duties of enhancing visitor enjoyment, public safety, and resource protection.

	Alternative A: Primitive Tools	Alternative B: Selective Mix of Tools	Alternative C: Modern Tools
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	Prohibit all use of motorized equipment to maintain or support wilderness utility systems.	Limited utilization of motorized equipment to maintain and support. Use of motorized tools limited to between 8:30 am and 4:30 pm. Most work done by hand.	Regular and frequent use of motorized equipment to maintain and support.
	Analysis		
	Ability to maintain with only hand tools leads to deterioration over time. Aesthetic condition of systems less than optimal. Systems require more frequent replacement. Wilderness character preserved, but minimum requirement not met.	Systems are maintained in good condition leading to good aesthetics. Systems are kept in condition to maximize efficient operation. Sanitation of structures is maintained. Wilderness character essentially preserved. Minimum requirement met.	Systems are kept in condition to maximize efficient operation. Minimum requirement met, but wilderness character impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	Aircraft is never used to maintain or support wilderness utility systems.	Limited use of aircraft to maintain and support. Supplies delivered by air to stations when ground travel is not feasible due to trail conditions, items are too large or fragile for stock, or stock is not available.	Regular and frequent use of aircraft.
	Analysis		
	All material to maintain is brought in or removed by stock or on foot. Broken/obsolete equipment is dealt with on site or hauled out by stock or on foot, creating problems of safe handling. Additional stock use leads to more trail and meadow impacts. Wilderness character preserved, but minimum requirement not met.	Material to adequately support systems is available. Broken/obsolete equipment is removed for disposal outside wilderness and handled in a safe manner. Impacts of stock use are kept at manageable levels. Wilderness character essentially preserved. Minimum requirement met.	All supplies are readily available. Failed equipment is removed and handled safely. Impacts of stock use are significantly reduced or eliminated. Minimum requirement met, but wilderness character impaired.
Structures and	**Allowable Structures and Installations**		

Installations	No utility systems would be maintained; existing systems would be removed.	Maintain existing small-scale systems consisting of solar panels, inverters, and batteries. In limited instances, waterheads with pipes to stations are permitted.	Maintain or modernize existing systems.
	Analysis		
	No utility systems impairs rangers' ability to carry out the full scope of their duties leading to compromised resource protection and visitor enjoyment. No systems regularly leads to lack of communication that compromises visitor safety and enjoyment. Removal of existing structures requires increased stock use, and or aircraft use for removal efforts. Wilderness character preserved, but minimum requirement not met.	Systems provide efficient, low-impact way to support communication of rangers, enhancing visitor enjoyment, preservation, and health and safety. Wilderness character essentially preserved. Minimum requirement met.	Size and obtrusiveness of systems increases, providing increased public safety and resource protection. Improvement of old and construction of new facilities leads to more materials being transported (via stock or helicopter) further compromising wilderness character. Minimum requirement met, but wilderness character impaired.

Table: Existence and maintenance of a communications network
Requirement: Tasks involved include installing and maintaining a network of radio relays sites in order to provide emergency and operations communications capacity for government personnel working within the wilderness. Radio relay sites are mostly located on peaks and ridges well away from trails or areas of general use. Also required to support this requirement, but addressed elsewhere, are the trail system, trail bridges, trailside camps, backcountry ranger stations, toilet facilities, and small scale utility systems.

	Alternative A: Primitive Tools	Alternative B: Selective Mix of Tools	Alternative C: Modern Tools
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	All work done by hand. No motorized equipment used.	Site work involving rock or vegetation done mostly by hand. Motorized equipment used for site work limited to chainsaws, welders and rock drills. Generators and motorized hand tools used on structures. Use of motorized tools limited to between 8:30 am and 4:30 pm. Work on electronic components done with battery- or generator-powered equipment.	Little work is done by hand. Motorized equipment used without limitations on site work, structures, and electronic components.
	Analysis		
	Travelers will not encounter motorized equipment being used to support the communications network. Crew efficiency is very low and work on electronic components may be impossible in some cases. Communications systems will not be fully sustained. Wilderness character preserved but minimum requirement not met.	Travelers almost never encounter motorized equipment being used to support communications network because sites are remote. Crew efficiency will be moderate, but work can be accomplished. Wilderness character essentially preserved and minimum requirement met.	Travelers may occasionally encounter motorized equipment being used to support communications network. Crew efficiency will be high but with increased potential for negative impact on wilderness character. Minimum requirement met, but wilderness character impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	No supply of communications network improvement work by helicopter. Crews access work sites by ground travel only. Communications crews receive construction and maintenance supplies by non-motorized ground transport only.	Limited supply of work sites by helicopter. Crews access work sites by air when ground travel is not feasible due to remoteness (lack of trail access), poor trail conditions, weather conditions, or non-availability of stock. Supplies delivered by air to work sites when above conditions apply or when required items are too large or too fragile for ground transport. Repair work at sites will continue as required to maintain operations but major construction or reconstruction is scheduled in the shoulder season whenever possible.	Unlimited supply of crews by helicopter. Crews always access work sites by helicopter. Crews always receive construction and maintenance supplies by helicopter. Work at sites occurs throughout the summer season as required.

	Analysis		
	Travelers do not encounter helicopters being used to support communications network. Crew access and supply is accomplished only with difficulty. Large or fragile items cannot be delivered to sites. Maintenance of installations is difficult and expensive. Installation of new facilities is almost impossible. Network cannot be maintained and deteriorates. Wilderness character preserved, but minimum requirement not met.	Because most communication sites are located on sites that are remote from the trail system, helicopters will commonly be used to support work at these sites. When the conditions listed above can be met, ground access will be used but this will not happen frequently. Travelers encounter helicopters being used to support communications network, but most trips occur in spring or fall when use is light. Crew access and supply is done with moderate efficiency. Wilderness character essentially preserved and minimum requirement met.	Travelers likely to encounter helicopters being used to support communications work during project periods. Crew access and supply is efficient, but conflict with wilderness character is significant. Helicopters have a strong presence. Wilderness character impaired, but minimum requirement met.
Structures and Installations	**Allowable Structures and Installations**		
	Existing communications system is removed; no new improvements constructed.	Electronic equipment shelters and antennas installed as required to sustain network. Structures are designed to blend in whenever possible.	Electronic equipment shelters and antennas installed as required to sustain network.
	Analysis		
	Wilderness travelers never encounter structures and installations associated with communications network because network does not exist. Removal and clean up of existing system requires extensive use of helicopter and/or stock with resultant impacts. Wilderness character preserved, but minimum requirement not fully met.	Wilderness travelers encounter a limited number of structures and installations associated with the communications network. Sites are remote and seldom visited. Installations are designed to minimize visibility from a distance. Wilderness character essentially preserved and minimum requirement met.	Wilderness travelers encounter a limited number of structures and installations associated with the communications network. Sites are remote and seldom visited. Installations are often visible from some distance. Wilderness character impaired but minimum requirement met.

Table: Sustain cultural resources in wilderness through understanding, inventory, monitoring, protection, restoration, and maintenance.
Requirement: Conduct cultural resource management and research actions including inventory, monitoring, evaluating resource impacts or conditions, restoration and maintenance of resources (historic cabins, etc.), collection of samples, removal of debris and intrusive materials, establishing and marking plots. Some of the above actions involve transporting items (e.g., quick response required by law) that are time-critical. Some of the above actions involve transporting equipment (e.g., artifacts) that is too fragile or hazardous for ground transport. Some of the above actions involve transporting material (e.g., secure storage lockers) that is too large for ground transport. Also required to support this requirement, but addressed elsewhere, are minimum necessary signs for resource protection, visitor safety, and trail orientation, stock confinement facilities including hitching rails and regular and electric drift fences, communication systems, and temporary field crew camps and work sites which may include toilets and temporary food storage lockers and other secure storage.

	Alternative A: Primitive Tools	**Alternative B: Selective Mix of Tools**	**Alternative C: Modern Tools**
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	No motorized equipment used.	Motorized equipment limited to chainsaws, generators, computers, and other hand-held motorized tools such as drills. Use of motorized tools limited to between 8:30 am and 4:30 pm. When operating motorized equipment, reasonable efforts will be made to limit disturbance of nearby wilderness users.	Work is accomplished with motorized equipment whenever that method is deemed most efficient. Motorized equipment includes, but is not limited to, motorized wheelbarrows, chainsaws, generators, computers, and other hand-held motorized tools such as drills.
	Analysis		
	No motorized equipment used. Wilderness character preserved, but minimum requirement not fully met.	Motorized equipment limited to chainsaws, generators, and hand-held motorized tools. Use of motorized tools limited to between 8:30 am and 4:30 pm. When operating motorized equipment, reasonable efforts will be made to limit disturbance of nearby wilderness users. Wilderness character essentially preserved and minimum requirement met.	Work is accomplished with motorized equipment whenever that method is deemed most efficient. Motorized equipment includes, but is not limited to, bobcats, motorized wheelbarrows, chainsaws, generators, and hand-held motorized tools. Minimum requirement met, but wilderness character impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	No support of cultural resource work by helicopter. Field crews, supplies, and materials that cannot be transported by ground will not be transported.	Limited support of cultural resource work by helicopter. Field crews, supplies, and materials transported by ground except when infeasible due to trail conditions, weather conditions, or unavailability of stock or when moving large, fragile, or time-sensitive items that cannot be practically transported otherwise.	Substantial support of cultural resource work by helicopter. Field crews, supplies, and materials frequently transported by helicopter whenever convenient.
	Analysis		

	Crew access and supply is accomplished only with severely impaired efficiency but in a manner that preserves wilderness character. Large, fragile, and time-sensitive items cannot be delivered or removed from sites. No helicopters touch down except in emergencies. Number of stock required on trails to support field crew camps significantly increases over Alternative C with resultant impacts. Field crew camps adequately supplied. Cultural resources remain uninventoried or deteriorate and minimum requirements are not met.	Helicopters have a limited presence, limited to transporting large, fragile, or time-sensitive items that cannot be practically transported otherwise. Much transport that could most efficiently be accomplished by helicopter is instead done with stock or backpack. Number of stock required on trails to support field crew camps slightly increases over Alternative C with resultant impacts. Field crew camps adequately supplied. Crew access and supply is accomplished with moderate efficiency. Cultural resources are inventoried and sustained, wilderness character essentially preserved and minimum requirements are met.	Helicopters are commonly employed for efficiency. Number of stock required on trails to support field crew camps is similar to present conditions. Field crew camps well supplied. Crew access and supply is accomplished with maximum efficiency. Cultural resources are inventoried and sustained and minimum requirements are met, but wilderness character is significantly impaired.
Structures and Installations	**Allowable Structures and Installations**		
	Cultural resource structures are not actively removed, but they are treated with benign neglect. No installations are permitted in support of cultural resources.	Significant cultural resource sites and structures are maintained consistent with NPS policies, but the rest are treated with benign neglect. Limited installations are used in support of cultural resources. Installations are limited to survey markers (e.g. pin flags) and monitoring devices.	Cultural resource structures are maintained and protected consistent with NPS policies. Installations are used in support of cultural resources whenever that method is deemed most efficient. Installations include, but are not limited to, survey markers and monitoring devices.
	Analysis		
	Due to benign neglect, NPS policies are not met, cultural resources deteriorate, and minimum requirements are not met. Wilderness character is preserved.	Cultural resources are sustained at an acceptable level and minimum requirements are met. Wilderness character is preserved.	Cultural resources are sustained at an acceptable level and minimum requirements are met. Wilderness character is impaired.

Table: Sustain natural resources in wilderness through understanding, inventory, monitoring, protection, restoration, and maintenance. Such actions include establishing plots, placing monitoring devices, and collection of biologic and other samples, removal of trash and other manmade materials intruding on the wilderness, removal of non-native plants and animals, and removal or relocation of hazardous plants and animals.
Requirement: Conduct natural resource management and research actions including inventory, monitoring (including but not limited to meteorological stations, air quality sampling stations, water quality gauging and sampling stations, sound recording equipment, remote cameras, data loggers, and wildlife traps), evaluating resource impacts or conditions, restoration and maintenance of resources, control and removal of non-native plants and animals, tree hazard mitigation, collection of samples, removal of debris and intrusive materials, establishing and marking plots. Some of the above actions involve transporting items that are time-critical. Some of the above actions involve transporting equipment that is too fragile, hazardous, or too large for ground transport. Also required to support this requirement, but addressed elsewhere, are minimum necessary signs for resource protection, visitor safety, and trail orientation, stock confinement facilities including hitching rails and drift fences, communication systems, and temporary field crew camps and work sites which may include toilets and temporary food storage lockers and other secure storage.

	Alternative A: Primitive Tools	**Alternative B: Selective Mix of Tools**	**Alternative C: Modern Tools**
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	No motorized equipment used.	Motorized equipment limited to chainsaws, rock drills, generators, computers, electroshocking devices, and other hand-held motorized tools such as drills. Use of motorized tools limited to between 8:30 am and 4:30 pm. When operating motorized equipment, reasonable efforts will be made to limit disturbance of nearby wilderness users.	Work is accomplished with motorized equipment whenever that method is deemed most efficient. Motorized equipment includes, but is not limited to, bobcats, motorized wheelbarrows, chainsaws, rock drills, generators, computers, electroshocking devices, and other hand-held motorized tools such as drills.
	Analysis		
	Work required to sustain natural resources is accomplished with severely impaired efficiency. No motorized tools are used except in emergencies. Wilderness character is preserved, but natural resources deteriorate and minimum requirements are not met.	Work required to sustain natural resources is accomplished with moderate efficiency. Presence of motorized tools is limited to smaller machines and to working hours only. Much work that could most efficiently be accomplished by modern tools is instead done with nonmotorized tools. Wilderness character is essentially preserved, natural resources are sustained and minimum requirements are met.	Work required to sustain natural resources is accomplished with maximum efficiency. Motorized tools are commonly employed for efficiency without restriction to working hours. Natural resources are sustained and minimum requirements are met, but wilderness character is significantly impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		

	No support of natural resource work by helicopter. Field crews, supplies, and materials that cannot be transported by ground will not be transported.	Limited support of natural resource work by helicopter. Field crews, supplies, and materials transported by ground except when infeasible due to trail conditions, weather conditions, or unavailability of stock or when moving large, fragile, or time-sensitive items that cannot be practically transported otherwise.	Substantial support of natural resource work by helicopter. Field crews, supplies, and materials transported by helicopter whenever that mode is deemed most efficient.
	Analysis		
	Crew access and supply is accomplished only with severely impaired efficiency. Large, fragile, and time-sensitive items cannot be delivered or removed from sites. No helicopters touch down except in emergencies. Number of stock required on trails to support field crew camps significantly increases over Alternative C with resultant impacts. Field crews are not adequately supplied. Wilderness character is preserved, but natural resources deteriorate and minimum requirements are not met.	Crew access and supply is accomplished with moderate efficiency. Helicopters have a limited presence, limited to transporting large, fragile, or and time-sensitive items that cannot be practically transported otherwise. Much transport that could most efficiently be accomplished by helicopter is instead done with stock or backpack. Number of stock required on trails to support field crew camps slightly increases over Alternative C with resultant impacts. Field crew camps adequately supplied. Wilderness character is essentially preserved, natural resources are sustained and minimum requirements are met.	Crew access and supply is accomplished with maximum efficiency and convenience. Helicopters are commonly employed for efficiency. Number of stock required on trails to support field crew camps is similar to present conditions. Field crew camps well supplied. Natural resources are sustained and minimum requirements are met, but wilderness character is significantly impaired.
Structures and Installations	**Allowable Structures and Installations**		
	No structures or installations used in support of natural resources.	Limited temporary structures and installations are used in support of natural resource protection and are removed when no longer required. Structures and installations are limited to survey and plot markers, monitoring devices (meteorological stations and monitoring devices, air quality sampling stations, water quality gauging and sampling stations, cave monitoring stations, sound recording equipment, remote cameras, data loggers and similar recording devices, wildlife traps, snares, track plates, gill nets, mist nets etc.).	Temporary structures and installations are used in support of natural resources whenever that method is deemed most efficient or convenient and remain onsite for indefinite periods. Structures and installations include, but are not limited to, survey and plot markers, monitoring devices (meteorological stations and monitoring devices, air quality sampling stations, water quality gauging and sampling stations, cave monitoring stations, sound recording equipment, remote cameras, data loggers and similar recording devices, wildlife traps, snares, track plates, gill nets, mist nets etc.).
	Analysis		

	Work required to sustain natural resources is accomplished with severely impaired efficiency. No structures or installations are used except in emergencies. Much work that could most efficiently be accomplished with the support of structures and installations is instead left undone, accomplished with reduced accuracy, or done with labor intensive methods. Wilderness character is preserved, but natural resources deteriorate and minimum requirements are not met.	Work required to sustain natural resources is accomplished with moderate efficiency. Presence of structures and installations is limited. Some work that could most efficiently be accomplished with the support of structures and installations is instead left undone, accomplished with reduced accuracy, or done with labor intensive methods. Wilderness character is essentially preserved, natural resources are sustained and minimum requirements are met.	Work required to sustain natural resources is accomplished with maximum efficiency and convenience. Structures and installations are commonly employed for efficiency. Natural resources are sustained and minimum requirements are met, but wilderness character is significantly impaired.

Table: Sustain natural fire regimes in wilderness through understanding, inventory, monitoring, restoration, and maintenance. Such actions include prescribed fires, management of natural fire, hazard fuel removal, fire suppression and control. In order to foster natural fire regimes in wilderness, it is necessary to protect certain structures, installations, and natural and cultural resources from fire.
Requirement: Conduct fire management actions including inventory, monitoring, evaluating resource impacts or conditions, restoration and maintenance of natural fire regimes, collection of samples, removal of debris and intrusive materials, establishing and marking plots, hazard fuel removal, fire suppression and control, and actions to protect structures and installations from fire. Some of the above actions involve transporting items (e.g., fire pumps) that are time-critical. Some of the above actions involve transporting material (e.g., secure storage lockers) that is too large for ground transport. Also required to support this requirement, but addressed elsewhere, are minimum necessary signs for resource protection, visitor safety, trail orientation, communication systems, and temporary field crew camps and work sites which may include toilets and temporary food storage lockers and other secure storage.

	Alternative A: Primitive Tools	**Alternative B: Selective Mix of Tools**	**Alternative C: Modern Tools**
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	No motorized equipment used.	Motorized equipment limited to chainsaws, fire pumps, generators, and other hand-held motorized tools such as drills. When operating motorized equipment, reasonable efforts will be made to limit disturbance of nearby wilderness users.	Work is accomplished with motorized equipment whenever that method is deemed most efficient or convenient. Motorized equipment includes, but is not limited to, motorized wheelbarrows, chainsaws, fire pumps, generators, and other hand-held motorized tools such as drills.
	Analysis		
	Work required to sustain natural fire regimes is accomplished with severely impaired efficiency but in a manner that preserves wilderness character. No motorized tools are used except in emergencies such as fire suppression. Wilderness character is preserved, but natural fire regimes deteriorate and minimum requirements are not met.	Work required to sustain natural fire regimes is accomplished with moderate efficiency. Presence of motorized tools is limited to smaller machines. Much work that could most efficiently be accomplished by modern tools is instead done with nonmotorized tools. Wilderness character is largely preserved, natural fire regimes are sustained and minimum requirements are met.	Work required to sustain natural fire regimes is accomplished with maximum efficiency. Motorized tools are commonly employed for efficiency and convenience. Natural fire regimes are sustained and minimum requirements are met, but wilderness character is significantly impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		
	No support of natural fire regime work by helicopter. Field crews, supplies, and materials that cannot be transported by ground will not be transported.	Limited support of natural fire regime work by helicopter. Field crews, supplies, and materials transported by ground except when infeasible due to trail conditions, weather conditions, or unavailability of stock or when moving large, fragile, or time-sensitive items that cannot be practically transported otherwise.	Substantial support of natural fire regime work by helicopter. Field crews, supplies, and materials transported by helicopter whenever that mode is deemed most efficient and or convenient.

	Analysis		
	Crew access and supply is accomplished only with severely impaired efficiency. Large, fragile, and time-sensitive items cannot be delivered or removed from sites. No helicopters touch down except in emergencies. Number of stock required on trails to support field crew camps significantly increases over Alternative C with resultant impacts. Field crew camps are not adequately supplied. Wilderness character is preserved, natural fire regimes deteriorate and minimum requirements are not met.	Crew access and supply is accomplished with moderate efficiency. Helicopters have a limited presence, limited to transporting large, fragile, or and time-sensitive items that cannot be practically transported otherwise. Much transport that could most efficiently be accomplished by helicopter is instead done with stock or backpack. Number of stock required on trails to support field crew camps slightly increases over Alternative C with resultant impacts. Field crew camps are adequately supplied. Wilderness character is essentially preserved, natural fire regimes are sustained and minimum requirements are met.	Crew access and supply is accomplished with maximum efficiency and convenience. Helicopters are commonly employed for efficiency. Number of stock required on trails to support field crew camps is similar to present conditions. Field crew camps are well supplied. Natural fire regimes are sustained and minimum requirements are met, but wilderness character is significantly impaired.
Structures and Installations	**Allowable Structures and Installations**		
	No structures or installations used in support of natural fire regimes.	Limited temporary structures and installations are used or erected in support of natural fire regimes and are removed when no longer required. Structures and installations are limited to such things as survey markers and monitoring devices.	Temporary structures and installations are used and erected in support of natural fire regimes whenever that method is deemed most efficient or convenient and remain onsite for indefinite periods. Structures and installations include, but are not limited to, survey markers and monitoring devices.
	Analysis		
	Work required to sustain natural fire regimes is accomplished with severely impaired efficiency. No structures or installations are used or erected except in emergencies. Much work that could most efficiently be accomplished with the support of structures and installations is instead left undone, accomplished with reduced accuracy, or done with labor intensive methods. Wilderness character is preserved, but natural fire regimes deteriorate and minimum requirements are not met.	Work required to sustain natural fire regimes is accomplished with moderate efficiency. Presence of structures and installations is limited. Some work that could most efficiently be accomplished with the support of structures and installations is instead left undone, accomplished with reduced accuracy, or done with labor intensive methods. Wilderness character is essentially preserved, natural fire regimes are sustained and minimum requirements are met.	Work required to sustain natural fire regimes is accomplished with maximum efficiency. Structures and installations are commonly employed for efficiency and convenience. Natural fire regimes are sustained and minimum requirements are met, but wilderness character is significantly impaired.

Table: Provide barriers to protect natural and cultural resources. Such barriers include cave exclusion gates, boundary fences, fences to protect structures and installations from wildlife depredation, food storage lockers, fireline construction and rehabilitation, containment and diversions in response to hazardous wastes and other unnatural flows, stock confinement structures such as hitching rails and drift fences, and signs for resource protection and visitor safety.
Requirement: Fences (boundary fences, cave exclusion gates, research exclosures, regular and electric fences for protecting structures and installations from wildlife depredation), fireline, and dams and diversions for resource protection. Also required to support this requirement, but addressed elsewhere, are minimum necessary signs for resource protection, visitor safety, and trail orientation, stock confinement facilities including hitching rails and regular and electric drift fences, communication systems, and temporary field crew camps and work sites which may include toilets and temporary food storage lockers and other secure storage.

	Alternative A: Primitive Tools	**Alternative B: Selective Mix of Tools**	**Alternative C: Modern Tools**
Use of Motorized Equipment	**Allowable Motorized Equipment**		
	No motorized equipment used.	Motorized equipment limited to chainsaws, rock drills, generators, computers, and other hand-held motorized tools such as drills. Use of motorized tools limited to between 8:30 am and 4:30 pm. When operating motorized equipment, reasonable efforts will be made to limit disturbance of nearby wilderness users.	Work is accomplished with motorized equipment whenever that method is deemed most efficient and convenient. Motorized equipment includes, but is not limited to, bobcats, motorized wheelbarrows, chainsaws, rock drills, generators, computers, and other hand-held motorized tools such as drills.
	Analysis		
	Work required to provide barriers is accomplished with severely impaired efficiency. No motorized tools are used except in emergencies. Wilderness character is preserved, but barriers deteriorate or are foregone and minimum requirements are not met.	Work required to provide barriers is accomplished with moderate efficiency. Presence of motorized tools is limited to smaller machines and to working hours only. Much work that could most efficiently be accomplished by modern tools is instead done with nonmotorized tools. Wilderness character is essentially preserved, necessary barriers are provided and minimum requirements are met.	Work required to provide barriers is accomplished with maximum efficiency. Motorized tools are commonly employed for efficiency and convenience without restriction to working hours. Necessary barriers are provided and minimum requirements are met, but wilderness character is significantly impaired.
Landing of Aircraft	**Allowable Landing of Aircraft**		

	No support of barrier work by helicopter. Field crews, supplies, and materials that cannot be transported by ground will not be transported.	Limited support of barrier work by helicopter. Field crews, supplies, and materials transported by ground except when infeasible due to trail conditions, weather conditions, or unavailability of stock or when moving large, fragile, or time-sensitive items that cannot be practically transported otherwise.	Substantial support of barrier work by helicopter. Field crews, supplies, and materials transported by helicopter whenever that mode is deemed most efficient or convenient.
	Analysis		
	Crew access and supply is accomplished only with severely impaired efficiency. Large, fragile, and time-sensitive items cannot be delivered or removed from sites. No helicopters touch down except in emergencies. Number of stock required on trails to support field crew camps significantly increases over Alternative C with resultant impacts. Field crew camps are not adequately supplied. Wilderness character is preserved, but barriers deteriorate and minimum requirements are not met.	Crew access and supply is accomplished with moderate efficiency. Helicopters have a limited presence, limited to transporting large, fragile, and or time-sensitive items that cannot be practically transported otherwise. Much transport that could most efficiently be accomplished by helicopter is instead done with stock or backpack. Number of stock required on trails to support field crew camps slightly increases over Alternative C with resultant impacts. Field crew camps are adequately supplied. Wilderness character is essentially preserved, necessary barriers are provided and minimum requirements are met.	Crew access and supply is accomplished with maximum efficiency. Helicopters are commonly employed for efficiency and convenience. Number of stock required on trails to support field crew camps is similar to present conditions. Field crew camps are well supplied. Necessary barriers are provided and minimum requirements are met, but wilderness character is significantly impaired.
Structures and Installations	**Allowable Structures and Installations**		
	No barriers or other structures or installations used in support of natural or cultural resources.	Limited temporary structures and installations are used in support of natural and cultural resources and are removed when no longer required. Structures and installations are limited to barriers (electric and regular fences, gates, fireline, dams and diversions for resource protection, etc.) and such support items as survey markers and monitoring devices.	Temporary structures and installations are erected and used in support of natural and cultural resources and are removed when no longer required. Structures and installations include, but are not limited to barriers (electric and regular fences, gates, fireline, dams and diversions for resource protection, etc.) and such things as survey markers and monitoring devices.
	Analysis		

	Barriers are not provided except in emergencies. Existing structures and installations are removed via stock with resultant impacts. Wilderness character is preserved, but barriers deteriorate or are foregone and minimum requirements are not met.	Work required to provide and maintain barriers is accomplished with moderate efficiency. Presence of structures and installations is limited. Wilderness character is essentially preserved, necessary barriers are provided and minimum requirements are met.	Work required to provide barriers is accomplished with maximum efficiency. Structures and installations are commonly employed for efficiency or convenience. Necessary barriers are provided and minimum requirements are met, but wilderness character is significantly impaired.

I - Addendum

Fire and Aviation Management Operations Guide (FAMOG), Sequoia and Kings Canyon National Parks, 2002.