Final
General Management Plan
and
Comprehensive River Management Plan / Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Sequoia and Kings Canyon
National Parks
Middle and South Forks of the
Kings River
and North Fork of the Kern River

Tulare and Fresno Counties
California

Volume 2:
The Affected Environment / Environmental Consequences / Appendixes / Glossary / Selected Bibliography Preparers and Consultants / Index

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SEQUOIA AND KINGS CANYON NATIONAL PARKS
and
MIDDLE AND SOUTH FORKS OF THE KINGS RIVER AND NORTH FORK OF THE KERN RIVER

Tulare and Fresno Counties • California

FINAL
GENERAL MANAGEMENT PLAN AND COMPREHENSIVE RIVER MANAGEMENT PLAN / ENVIRONMENTAL IMPACT STATEMENT

Volume 2: The Affected Environment / Environmental Consequences / Appendixes / Glossary / Selected Bibliography / Preparers and Consultants / Index

United States Department of the Interior • National Park Service

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THE AFFECTED ENVIRONMENT

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Abbreviations

The following abbreviations are used in the text or in bibliographic citations.

ADT	average daily traffic
BLM	Bureau of Land Management
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CE	California endangered species
CFR	*Code of Federal Regulations*
cfs	cubic feet per second
CO	carbon monoxide
CP	California protected species
CR	California rare species
CSC	California species of concern
CT	California threatened species
FE	federally endangered species
FERC	Federal Emergency Regulatory Commission
FSC	federal species of concern
FSS	Forest Service sensitive species
FT	federally threatened species
LOS	level of service
NAAQS	national ambient air quality standards
NO_x	nitrous oxides
NPS	National Park Service
O_3	ozone
PL	Public Law
PM_{10}	particulate matter less than 10 microns
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SO_2	sulfur dioxide
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compounds
VMT	vehicle miles traveled

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The Affected Environment

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Ecosystem Stressors

The Sierra Nevada Ecosystem Project (SNEP 1996) and decades of research in Sequoia and Kings Canyon National Parks have identified five important systemic stressors to park ecosystems:

- loss of pre-Euro-American fire regimes
- introduced species
- air pollution
- habitat fragmentation
- rapid anthropogenic climatic change

While these stressors all interact in complex ways, if projections are correct, climatic change could both exacerbate and dominate all other stressors in importance in the coming decades. The following description of stressors is from the *Natural and Cultural Resources Management Plan* (NPS 1999d).

Loss of Pre-Euro-American Fire Regimes

Between 1891 and 1967 all fires in Sequoia, General Grant, and Kings Canyon national parks were suppressed, with a fair degree of success. This lack of fire resulted in important ecosystem changes. A buildup of dense vegetation along foothill streams and in their upper catchments reduced annual streamflow in the foothills, probably to the detriment of aquatic communities.

The consequences of fire exclusion have been characterized best in the mixed-conifer zone. Both stream chemistry (Williams and Melack 1997) and stream flow (Ralph Moore, NPS, unpublished data) in the mixed-conifer zone were 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, effectively ceased, and reproduction of other shade-intolerant species was reduced (Harvey et al. 1980; Stephenson 1994). Today more area is dominated by dense intermediate-aged forest patches, and less by young patches (Bonnicksen and Stone 1978, 1982; Stephenson 1987). Perhaps most importantly, dead material has accumulated, causing an unprecedented buildup of surface fuels (Agee et al. 1978; van Wagtendonk 1985). 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-Euro-American times (Kilgore and Sando 1975; Stephens 1995, 1998).

Lack of fire also reduced habitat critical for certain wildlife species. The number and extent of forest openings was reduced without fire, causing a reduction of key herbaceous and shrub species, particularly nitrogen fixers such as *Ceanothus* (Bonnicksen and Stone 1982). Wildlife that depend on these plants, such as deer, now have less habitat available to them. Black-backed woodpeckers declined in the absence of fresh fire-created snags. Rodents are also less abundant in areas where fire has been excluded (Harold Werner, NPS, unpublished data), almost certainly leading to a reduction in the carnivore populations that depend on them.

In 1968 the parks began an aggressive prescribed fire program to reestablish fire in the parks' ecosystems. This program has made great strides in restoring giant sequoia groves and considerable progress in other mixed-conifer forest stands. However, after more than 30 years, the parks still are far from restoring natural fire regimes to the entire park landscape (Caprio and Graber 2000). The inability of the parks to maintain a natural fire regime continues to result in changes to the parks' vegetation, aquatic ecosystems, and wildlife populations.

Introduced Species

Hundreds of introduced species have become established within the parks, and invasions are ongoing. More than 120 nonnative vascular

plant species are known within park boundaries, and new ones are discovered yearly. Plant invasions have severely altered some park ecosystems. For example, about 99% of the herbaceous biomass in foothills grasslands is due to introduced species (Parsons and Stohlgren 1989), potentially affecting soil water dynamics, stressing native species, and perhaps increasing the probability of invasion by particularly noxious species, such as the star thistle (Gerlach, in review).

Blister rust, an exotic fungus that attacks white pines, is reducing the number of sugar pines in the parks and may effectively eliminate this species from the ecosystem over time. Sugar pine is one of the most important food sources for seed-eating animals in the mixed-conifer zone, and the potential consequences of its decline are largely unknown. Additionally, new and destructive exotic pathogens, such as pine pitch canker, have become established in California, and some seem likely to invade the parks in the future.

Even before the parks were created, humans moved fish into waters that were originally barren of fish and also introduced new species. As a result, most aquatic communities above 7,000 feet have been altered, some severely (Knapp 1996). Impacts have included a decline in both native invertebrate and vertebrate species, with the precipitous decline of the mountain yellow-legged frog being one of the most notable (Bradford 1989; Bradford et al. 1993; Knapp and Matthews 2000). (Other factors, such as airborne pesticides, are also likely contributors to the decline of the frog.) Additional damage has been caused by hybridization. For example, the Little Kern golden trout was almost lost due to hybridization with introduced rainbow trout, and the status of the Kern rainbow remains to be determined. Native rainbow trout genotypes were contaminated by genotypes from other geographic areas.

At lower elevations within the parks, domestic species (especially cats) and other nonnative wildlife periodically establish themselves. These animals compete with native wildlife for resources. Nonnative bullfrogs now occupy low-elevation streams, threatening the future of the western pond turtle (a California species of special concern) in the parks by preying on their young. Wild descendants of domestic pigs could become a major threat to native vegetation. Portions of Sequoia National Park have been severely grazed in the recent past by trespass cattle and now harbor numerous introduced plants. Human developments in the parks (especially residential areas and pack stations) have created conditions suitable for significant numbers of brown-headed cowbirds, which are nest parasites that attack rare native songbird species.

AIR POLLUTION

Sequoia and Kings Canyon National Parks periodically experience some of the worst air quality in the United States (Peterson and Arbaugh 1992; Cahill et al. 1996). Perhaps the most damaging pollutant is ozone. Ozone-sensitive individuals of ponderosa and Jeffrey pines show extensive foliar injury at present ozone levels (Peterson and Arbaugh 1992; Duriscoe and Stolte 1992; Stolte et al. 1992; Miller 1996). Compared to ozone-resistant individuals, ozone-sensitive pines have lower photosynthetic rates, lose their needles earlier, and have diminished annual ring growth (Miller 1996). In contrast to pines, mature giant sequoias seem to be relatively resistant to present ozone levels (Miller et al. 1994). However, newly emerged sequoia seedlings are more vulnerable to ozone injury (Miller et al. 1994; Miller 1996).

Research in southern California suggests that chronic ozone pollution can lead to shifts in forest structure and composition (Miller 1973). If ozone concentrations in the Sierra Nevada remain relatively constant into the future, they may affect the genetic composition of pine and sequoia seedling populations, and significantly contribute to increased death rates and decreased recruitment of ponderosa pine and Jeffrey pine (Miller 1996). Ponderosa/Jeffrey pines are important species ecologically in Sequoia and Kings Canyon. Increased damage due to ozone will cause a reduction in basal area, alter nutrient cycling patterns, change landscape stability, and

affect the fire susceptibility of forest ecosystems in the parks. The effects of chronic ozone pollution on other species are less well known.

High elevation lakes and streams in the parks are very dilute and potentially sensitive to human-induced acid deposition. While chronic acidification is not now a problem, episodic depression of acid-neutralizing capacity occurs during snowmelt (Melack and Sickman 1995; Melack et al. 1998), and episodic acidification occurs during rainstorms in summer and early fall (Stohlgren and Parsons 1987). If acid deposition increases in the future, episodic acidification will become more frequent, likely altering aquatic communities.

The deposition of atmospheric nitrogen in park watersheds has been increasing slowly (Lynch et al. 1995). However, there has been a decrease in dissolved nitrogen leaving watersheds (Melack et al. 1998). These changes parallel a shift in the phytoplankton community of the heavily studied Emerald Lake, from one dominated by phosphorus limitation to one dominated by nitrogen limitation. Mixed-conifer watersheds in Giant Forest have also shown net retention of nitrogen, with stream concentrations often below detection limits (Williams and Melack 1997). The consequences of increased nitrogen deposition and retention on terrestrial plant communities are unknown, but studies are underway.

Sequoia and Kings Canyon National Parks are downwind of one of the most productive agricultural areas in the world, the San Joaquin Valley, where tons of pesticides are applied to crops every year (Department of Pesticide Regulation 1999). Pesticides that become volatilized or suspended in the atmosphere as particulates drift into the parks on prevailing winds. Consequently, organophosphates have been found in precipitation as high as 6,300 feet (1,920 meters) (Zabik and Seiber 1993). Other synthetic chemicals (such as chlorinated hydrocarbons) drifting into the parks can have estrogenic or other effects as hormonal imitators. They can cause changes in wildlife reproductive capacity, longevity, intelligence, and behavior, or can lead to cancer or mutations.

While studies have not yet been conducted to establish cause-and-effect links between synthetic chemical drift into the parks and effects on park ecosystems, circumstantial evidence suggests that such effects may be occurring. For example, the parks' peregrine falcon aerie at Moro Rock has never produced offspring. Additionally, the foothill yellow-legged frog completely disappeared from these parks in the 1970s. The frog is much more common on the opposite side of the San Joaquin Valley (in the foothills of the Coast Range), upwind from pesticide drift. Synthetic chemical drift may also be playing a role in the ongoing decline in mountain yellow-legged frogs in these parks (Fellers, unpublished data), although other factors, such as fish introductions, are also contributing.

HABITAT FRAGMENTATION

Intensifying land use and population growth on lands adjacent to the national parks are turning the parks into biological islands, which will make the ecosystems significantly more difficult to preserve with their biodiversity intact. Several species have either already disappeared from this part of the Sierra Nevada or survive in very small numbers (e.g., black-tailed hare, foothill yellow-legged frog, California condor), most likely as a result of habitat loss on adjacent lands that leaves park habitat insufficient to support metapopulations over the long term (Graber 1996). There is a loss of stopover points and wintering grounds for migrating species. This problem is most serious for foothills species, including seasonal residents, because most adjacent lands are privately held and substantially altered through development, grazing, agriculture, hydrological diversions, exotic plants and animals (including pets and feral animals), and altered fire regimes.

The mostly public coniferous forested lands to the north and south of the parks have been altered by timber harvest, grazing, water diversions, introduced species, and loss of natural fire regimes, although to a much lesser extent than the foothills. The decline of forest wildlife populations in the region, including wolverine, fisher, and red fox, as well as some bat and owl species,

has been attributed to forest structural changes (DeSante 1995; Graber 1996). Fishers — which once occurred throughout the Sierra Nevada and whose populations were continuous with those in the Pacific Northwest — today are isolated from other populations, so opportunities for gene flow are now absent.

The loss of natural fire regimes and introduced plants and animals within as well as outside the parks' foothill zone may be exacerbating this regional problem. For example, eastern bullfrogs — which have benefited from water impoundments near the parks — may be an important predator on young western pond turtles, while European predatory brown trout and the overshading of foothills streams as a result of fire suppression may have led to the extirpation of the foothill yellow-legged frog (pesticides may also have played a role). Settlement outside the parks prevents the re-establishment of the extirpated grizzly bear (*Ursus arctos*) because a durable population requires more low-elevation habitat than can be provided by the national parks.

Domestic grazing on public lands east of the Sierra Nevada crest formerly threatened the reestablishment of healthy populations of Sierra Nevada bighorn sheep (*Ovis canadensis* ssp. *nova*) in and adjacent to the parks, leading to their endangerment. This is an example of functional habitat fragmentation. Bighorn are now recovering slowly.

Animals that routinely cross the park boundaries (e.g., deer, bear, and band-tailed pigeons) become legal game species once outside the boundaries. As a consequence, how these animals are managed outside the parks affects the age structure and abundance of populations within the parks. It is also likely that the unhunted park populations are a reservoir of source material for hunted and less dense populations outside these parks.

RAPID ANTHROPOGENIC CLIMATIC CHANGE

Average global temperature has been rising in this century, and the world is now warmer than at any point during the last several centuries (Mann et al. 1998). Internationally, climatologists and atmospheric scientists generally agree that at least part of this warming is due to human-caused increases in atmospheric greenhouse gases (Houghton et al. 1996). Global temperatures are projected to rise by another 1.0 to 3.5°C (2 to 6°F) over the next century (Houghton et al. 1996). Much uncertainty surrounds the details of how global climatic change will manifest itself locally in the Sierra Nevada.

The paleoecological record is one of the best tools for understanding the possible magnitude of biotic changes resulting from future climatic changes. About 10,000 to 4,500 years ago global summertime temperatures were perhaps up to 2°C higher than now, with prolonged summer drought in California. Both the species composition and fire regimes of Sierran forests were quite different from those of today (Anderson 1990, 1994; Anderson and Smith 1991, 1994, 1997). For example, forests growing on sites now occupied by sequoia groves were much more heavily dominated by pines, including lodgepole (which no longer occur in sequoia groves; R. Anderson 1994). Firs were less abundant than today, and sequoias were quite rare (R. Anderson 1994; Anderson and Smith 1994), probably existing only along creek and meadow edges where present groves exist. These and other paleoecological records clearly indicate that climatic changes smaller than or comparable to those projected for the next century may profoundly alter Sierran ecosystems.

Increasing temperature will probably result in higher snow lines, earlier snowmelt, and prolonged summer droughts (Vaux 1991). Without increased precipitation, perennial streams could dry out during the summer. In forested ecosystems, there could be a widespread and continuing failure in the reproduction of certain species, such as giant sequoia, whose seedlings are

highly vulnerable to drought (Harvey et al. 1980; Mutch 1994). Death rates would likely increase among adult trees as drought stress made them more vulnerable to insects, pathogens, and air pollution.

Global warming is also likely to increase the probability of destructive wildfires in the Sierra Nevada. Models predict that global warming will be accompanied by increased lightning strikes (Price and Rind 1991), and extreme weather conditions are likely to make individual fires burn more total area, be more severe, and escape containment more frequently (Torn and Fried 1992; Miller and Urban 1999).

Most Sierran habitats will likely shift to higher elevations. Organisms with limited mobility may become extinct locally. For example, subfossil records from the Pleistocene-Holocene transition in the Grand Canyon (spanning a global warming comparable in magnitude to that expected over the next century) indicate that rapid habitat displacement due to climatic change can lead to several millennia of depressed species diversity (Cole 1985). Finally, some habitats, such as high alpine habitats, are likely to disappear entirely, leading to the irreversible loss of some species.

Rapid anthropogenic climatic change has the potential to become the greatest stressor on the ecosystems of Sequoia and Kings Canyon National Parks. Climatic change undoubtedly will interact with other stressors, with unexpected consequences. While there is little that park managers can do to prevent global warming, they can take some steps to mitigate impacts on park ecosystems. For example, the resilience of forests to climatic change and consequent extreme wildfire behavior can be increased by restoring a more open structure to the forests, which would reduce both competition and fire intensity.

Air Pollution at Sequoia and Kings Canyon National Parks.

Natural Resources

Kings Canyon National Park encompasses the upper foothills and the subalpine and alpine region that forms the headwaters of the South and Middle Forks of the Kings River and the South Fork of the San Joaquin River. These rivers have extensive and spectacular glacial canyons. Both the Kings Canyon and Tehipite Valley are glacial "Yosemites" — deeply incised glacial gorges with relatively flat floors and towering granite cliffs thousands of feet high. To the east of the canyons are the high peaks of the Sierra Crest, with the 14,242-foot North Palisade being the highest point in Kings Canyon National Park. This is classic high Sierra country — barren alpine ridges and glacially scoured, lake-filled basins.

Sequoia National Park lies south of Kings Canyon. The park rises from the low western foothills to the crest of the Sierra at 14,495-foot-high Mount Whitney, the highest point in the lower 48 states. The Great Western Divide is a north-south ridge that runs through the middle of the park. Peaks in the vicinity of the divide rise as high as 13,802 feet. The eastern half of the park consists of the alpine headwaters of the North Fork of the Kern River, the glacial trench of Kern Canyon, and the Sierra Crest, which runs north-south and forms the eastern boundary of the park.

CAVES

Description

More than 200 caves and at least 75 active karst systems are known within Sequoia and Kings Canyon National Parks. Karst systems (subterranean stream systems), which have formed primarily along the five forks of the Kaweah River, are a major contributor to and potential groundwater storehouse for all five forks. The karst hydrology that creates caves feeds surface springs that have allowed extensive riparian areas to form.

The two parks contain some of the most extensive and least impacted caves in the western United States. Lilburn Cave is the most extensive cave in California, with over 17 miles of measured passages. A total of more than 30 miles of cave passages have been documented in the parks' caves. The caves contain many endemic invertebrates, several bat species, very unusual mineral deposits, and rare calcite speleothems (cave features such as helictites, stalactites, and curtains). Invertebrates that reside in the caves are largely cave-adapted and mostly endemic to a single valley, cave, or even room.

Many caves are in isolated areas and are not well known to the general public. Crystal Cave is the only cave now open to guided cave tours, and improvements have been made to facilitate visitation and resource protection (e.g., paved walkways, lighting, railings).

Stressors

Crystal Cave and Clough Cave (which was formerly commercialized) contain extensive areas of disturbance from trail construction and blasting, which have created unnatural habitats, altered microclimates, and broken fragile cave features. Other alterations in Crystal Cave include the effects of artificial lighting. Moss, algae, and even grasses are growing near lights along the cave tour route. The presence of this unnatural flora can alter habitats for cave-adapted animals. Anthropogenic lint and dust accumulations may be negative impacts in several park caves, including Crystal, Soldiers, and Clough. Local lints create acidic solutions that may alter habitat and damage cave surfaces. Lint is often deposited adjacent to trails, but may also be left behind by recreational cavers. Dust may be deposited dozens of feet away from an area of disturbance, altering the appearance of cave surfaces and surficial habitats. Restoration has begun on some caves, including Crystal, Clough, and Soldiers.

Recreational use of other park caves continues to grow slowly. Currently several hundred people per year visit park caves. Past damage from human use includes broken speleothems, trampled invertebrates, compacted soils, sediment transport on clothes, litter, deposits of toxic spent carbide, and the alteration of airflow and microclimates due to human modification of cave passages.

WATER RESOURCES

Hydrology

Description

The four large river systems with headwaters within the parks are the North Fork of the Kern River, the five forks of the Kaweah River, the South and Middle Forks of the Kings River, and the South Fork of the San Joaquin River. Surface water occurs primarily as rivers and streams at lower elevations, with a greater occurrence of lakes and ponds at higher elevations. The quantity of surface flow follows an annual cycle, with the lowest flows typically occurring in August and the highest flows in May or June. Spring flows are primarily snowmelt from glaciers and snowpack at higher elevations; by late August, the source is primarily groundwater. The largest streams produce peak flows of about 82,000 liters per second (L/sec), which decrease to about 1,500 to 2,500 L/sec during August.

Groundwater is common in alluvial deposits in meadows and wherever decomposed or fractured granite is suitable to form an aquifer. Precipitation appears adequate to recharge the groundwater, but the actual quantity of stored water in aquifers is unpredictable. Rainfall and melting snow tend to rapidly infiltrate weathered and fractured rock. Even in areas of relatively solid rock, runoff tends to channel into the nearest fractures and crevices. These characteristics mean that much of the streamflow is a result of interflow, or shallow groundwater movement, rather than direct surface runoff. Groundwater supplies many meadows, seeps, springs, creeks, and perennial streams.

Stressors

Water withdrawals not only decrease waterflows downstream, but also reduce the variability of the system's hydrograph. This in turn can affect downstream riparian or meadow vegetation and sequoia groves (see related impact topics), as well as the habitat available to aquatic communities. Water is diverted to feed electrical generating systems and to supply water to support park development and use.

Kaweah hydroelectric plant no. 3, which began operations in 1907, is on the Middle Fork of the Kaweah River just outside Sequoia National Park. Water is drawn from the Middle and Marble Forks by means of a diversion dam on each fork and flumes, diverting up to 100 cubic feet per second (the average is 30 cfs) from the river. No minimum release requirements existed prior to 1964, sometimes resulting in diversion of 100% of river flow. In 1964 seasonal minimum release requirements were established for both forks combined. These requirements prevent diversions from occurring when the combined flows decrease below seasonal minimum levels. In 1974 seasonal minimum release requirements were further distributed into percentages for each fork. Today, the combined river flow at the driest point in the year is reduced to 11 cfs, which can be as little as 10% of the natural flow. In addition to the dams and flumes, there are four gaging stations, a siphon crossing the Middle Fork, and a cable crossing with concrete abutments. The Kaweah no. 1 generating facility (which dates from 1899), draws its water below the park, but uses four storage dams above Mineral King on Upper Monarch, Lower Crystal, Lower Franklin, and Eagle Lakes. These dams store a total of 500 acre-feet. The dams are designed to produce a more even flow in the East Fork of the Kaweah.

Most of the water consumed in the parks comes from surface sources such as streams and springs. There are a few shallow wells with good water, but one of the deeper foothills wells contains sulfur and arsenic and is not potable. The status of the water systems, water source production capacities, and water consumption throughout the parks are detailed in appendix E.

Facilities such as roads, culverts, and buildings also alter the local hydrology and drainages in scattered locations throughout the park's developed areas or road corridors.

Water Quality

Description

Surface waters in the parks contain concentrations of dissolved constituents that are so dilute that the electrical conductivities are very low. Alpine lakes and streams are generally below 20 microSiemens per centimeter (μs/cm), and sometimes approach 2 μs/cm, the conductivity of distilled water. One consequence of such pure water is that it is poorly buffered (limited ability to absorb water chemistry changes or additions), making the ecosystem sensitive to human disturbance and pollution. Ion concentrations do increase as elevation decreases. Conductivities may exceed 100 μs/cm when the rivers reach the park boundary. This is partially because marble, schist, and other metamorphic rocks add significant dissolved constituents, forming a band along much of the western portion of these parks and at several other scattered locations.

Surface water is also very clear, with turbidities generally well under 0.5 nephelometric turbidity unit (NTU), though meadow water may exceed 1.0 NTU. The waters are oligotrophic. Nutrients like phosphate or nitrate are generally less than 40 μg/L and ammonia is generally undetectable. Except for mineral springs, thermal springs, and some meadows, the water is normally saturated with oxygen (6.8–8.8 mg/L) and generally quite cold (8^{o}–16^{o}C). The pH is normally slightly acidic, but varies from about 5.5 to 8.5, and some sites exceed those extremes. Park surface waters contain some biota (e.g., *Giardia lamblia, Campylobacter, Cryptosporidium*) that can be harmful if consumed.

Stressors

The primary threats to water quality are air pollution, loss of natural fire, runoff from park facilities, and runoff from heavy visitor use areas in the backcountry. The single biggest threat is air pollution. Air pollution adds acidic deposition, nutrients, and other contaminants to park waters (Cory et al. 1970; Melack et al. 1985, 1995; Sickman and Melack 1989; Williams and Melack 1991; Zabik and Seiber 1993). Fire affects nutrients, buffering capacity, water temperature, sediment transport rates, and other water characteristics. Park facilities generate sewage effluent. Monitoring of the sprayfields at Red Fir and the former facility at Giant Forest detected elevated nutrients and conductivity in adjacent streams that extended as much as 1.3 kilometers downstream during low-flow conditions. In addition to sewage effluent, nonpoint pollution sources, such as recreational activities, roads, and parking lots, can contribute biological, physical, and chemical pollutants into aquatic systems.

Floodplains

Floodplains for most of the parks' watersheds have not been mapped. However, much of the parks encompass steep, upper watersheds that would limit the extent of floodplains. Of the parks' major developed areas, Lodgepole, Cedar Grove, and Mineral King are potentially subject to flooding from larger streams. Peak spring runoff, fed by melting snowpack, typically occurs in late spring through early summer. Winter flooding is associated with heavy warm rains falling on snowpack and is characterized by a large volume of runoff occurring in a relatively short time frame.

The Marble Fork runs through the Lodgepole area. From the developed area to its headwaters, the Marble Fork drains approximately 8,510 acres. The stream has a history of flooding in the Lodgepole area. Annual spring floods from snowmelt rise approximately 5 feet above the summertime stream level. Midwinter floods, which are the largest, have damaged campsites within 100 feet of the stream (NPS 1982). No buildings occur within the 100-year floodplain in the Lodgepole area. Campgrounds with sites in floodplain areas are being redesigned to remove those sites prone to flooding.

Cedar Grove is in a relatively broad portion of the lower valley of the South Fork of the Kings River. No buildings exist within the 100-year floodplain, although a portion of the Sentinel campground loop closest to the river is within the floodplain, as are sections of roads within the canyon.

The only NPS facility within the 100-year floodplain at Mineral King is a small segment of the Cold Spring campground, and a large segment is within the 500-year floodplain. Flood hazards are considered small due to low flows during the peak visitor use season. In addition, the probability of a large flash flood is low because of the size and nature of the drainage basin. Flows for the 100-year flood in the vicinity of the campground would be approximately 1,000 cfs and 6 feet above the river bottom.

SOILS AND VEGETATION

Description

Igneous rocks of Mesozoic origins (granite and its relatives) underlie the majority of the two parks, but extensive bands of Paleozoic metamorphic beds also occur. Within the latter, caves and beds of marble are common. Soils are derived from the two general igneous and metamorphic rock types, glacial debris, and alluvium. Sierran soils tend to be shallow and young, showing little development. They also tend to have high infiltration rates. Surface erosion is relatively low because infiltration rates are generally greater than rainfall or snowmelt rates, and water is absorbed into the soil.

Native plant communities within the parks are comprised of over 1,200 vascular plant species. Extreme topographic differences create a variety of habitat types and conditions that range from xeric low-elevation oak woodlands to high-elevation alpine communities. Within elevation and precipitation bands, an additional complex of species and communities exists that is affected by relatively static physical influences, such as aspect, slope position, soils, and the effects of past glacial action. Dynamic processes, such as variable moisture regimes and fire, also affect these species and communities.

Extensive tracts of Sierran mixed-conifer forest, generally at altitudes between 5,000 and 9,000 feet, cover much of the southern Sierra and consist primarily of fir (white and red), mixed conifer (fir and various pine), montane chaparral (green-leaf manzanita), and montane meadows. On surrounding lands the great majority of this forest zone has been managed for multiple use. As a result, Sequoia and Kings Canyon National Parks now contain the largest remaining old-growth forest in the southern Sierra. Below the conifer forest (in the western portions of the Sierra), various plant communities and environments constitute the foothill region. There is very little land within this natural zone in Kings Canyon; but the lower canyons of the forks of the Kaweah River include extensive foothill lands in Sequoia National Park. This environment, which is typified by deciduous woodland (blue and black oak, north slope), evergreen hardwoods (canyon and interior live oak), chaparral (mixed and chamise), and deciduous riparian forest (alder and sycamore), covers much of lowland central California outside the parks. Privately held lands cover much of the foothills, which have been altered by timber harvest, grazing, agriculture, mining, development, water diversions, loss of fire regime, and recreational use, as well as regional population growth and air pollution.

The remainder of Sequoia and Kings Canyon National Parks, most of which are above 9,000 feet in elevation, can be described as “high Sierra.” This environment covers nearly as much acreage as the two parks’ other environments combined. It is a spectacular land of rugged, ice-sculptured alpine ridges and sparsely wooded, lake-filled basins. Alpine and subalpine areas contain pine (foxtail, whitebark, and lodgepole), juniper, wet and dry meadows, alpine tundra, fell fields, and lichens.

Stressors

The use, maintenance, and management of park facilities affect only a small area and do not

contribute to widespread destruction of soils within the parks. Localized impacts such as compaction and erosion result from visitor use and development and are the major stressors. Inappropriately placed culverts, flume failures, social trails, and new construction all contribute to unnatural erosion.

Primary vegetation stressors include air pollution, historic loss of natural fire regime, possibly global warming, and invasion by exotic pathogens and plant species. Tropospheric ozone air pollution has been observed to have an effect on some sensitive species within the parks. Ponderosa and Jeffrey pine are particularly sensitive. Surveys and studies on these species have shown that a small percentage of the population of each is significantly affected in the most severely polluted areas of the parks, resulting in reduced vigor and increased susceptibility to other pathogens. Other less sensitive species include the emergent seedlings of giant sequoia, black oak, mugwort, and blue elderberry. Visible symptoms of ozone injury have been observed on these species within the parks, but no effect on their physiology has been shown. Successful fire suppression beginning in the late 1800s has significantly altered stand structure and species composition throughout many of the parks' vegetation communities. The exotic pathogen, white pine blister rust, has had a significant effect on native white pines, particularly sugar pine and western white pine within the parks. A recent survey has shown the disease to be widespread, and in localized areas it has resulted in the decline and mortality of a significant number of individual trees, especially saplings. The displacement of the native herbaceous component of the foothill vegetation communities by exotics has been virtually complete. Exotic species have recently been detected in other areas of the park through focused inventory efforts. Habitats most likely to harbor exotic species include riparian corridors, developed areas, roads and trails, pack stations, campgrounds, abandoned settlements, sewer sprayfields, and other disturbed areas.

While past human activity has altered and shaped the native vegetation resource at the landscape scale, visitor and administrative uses affect the vegetation on a local scale. Developments such as campgrounds and lodges require the local environment to be modified for safety and aesthetics. The maintenance and use of roads and trails have direct impacts and also provide corridors for the introduction of new exotic species. Direct compaction and trampling by visitors in high-use areas will modify local stand structure and composition over time. Grazing by pack and saddle stock in wilderness meadows creates localized impacts to the native vegetation, as well as provides a potential vector for the introduction of exotic plant species into new areas. Off-trail hiking can create informal social trails that lead to vegetation impacts. The infrastructure that supports park developments, such as the withdrawal of water and the discharge of wastewater, alter local to subwatershed hydrology, change local species composition, and affect nutrient availability.

Giant Sequoia Groves

Description

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 sequoias, the trees grow in about 75 separate groves; about 37 of these groves are within the two parks. The parks contain roughly a third of all the naturally occurring sequoias.

Most giant sequoia groves are managed as integral to the surrounding ecosystem, and natural processes are allowed to shape the communities. However, because of their long life and immense size, individual sequoia trees tend to generate strong emotional reactions and attachments from many visitors and admirers. A number of large specimen trees have been imbued with additional significance by being named (e.g., the General Grant tree which is also, by proclamation, the Nation's Christmas Tree) or by their particular attributes (e.g., the General Sherman tree, recognized as the largest living tree on earth). Due to the strong social connections to certain specimen trees (along with an assortment of sequoia snags, stumps, and logs), such

featured specimens are managed to perpetuate their condition and appearance as substantially unchanged through time.

Sequoia trees have enormous limbs, which when stressed, can drop as part of their natural biology. This can present some risk to humans as trees can fall without notice. In 1941 the superintendent's summer cabin in the Giant Forest / Round Meadow area was crushed by a falling tree. Overnight camping in the Giant Forest grove was removed in 1962, but in August 1969 a woman was killed by a falling tree at the Hazelwood picnic area. Popular overnight lodging in cabins and tent cabins have since been removed and the Giant Forest grove converted to day use.

Stressors

Prior to their inclusion in the parks, some groves (Atwell, Big Stump, Dillonwood, Squirrel Creek, and Redwood Mountain) were partially logged for commercial timber. Park developments at Grant Grove, Atwell Mill, and Giant Forest were constructed in and among the sequoia trees to provide direct visitor access to the prime resource. In the 1980s the process of removing overnight lodging and other commercial facilities from the Giant Forest Grove began. The project is substantially complete. Intensive commercial and administrative developments exist at Grant Grove, and a campground development remains in a second-growth portion of Atwell Grove. The 1,540-acre Dillonwood Grove, which was logged from the 1880s to the 1950s, contains both ancient, old-growth monarchs and extensive stands of second-growth forest.

The park has long identified the loss of the historic fire regime as a primary stressor and threat to the integrity of the giant sequoia groves. The Sierra Nevada Ecosystem Project (SNEP 1996) identified the loss of the natural fire regime as one of the dominant negative effects on the greater Sierran ecosystem. Frequent fire reduces competition for light and water and prepares an ideal set of conditions necessary for giant sequoia reproduction. A history of fire suppression over the past century has inhibited giant sequoia reproduction, increased hazardous fuel accumulation, and changed the forest structure within the parks. Since the advent of ecologically based management in the late 1960s, protection and management of natural grove conditions and fundamental natural processes have been emphasized over strict protection of individual specimen trees. Natural processes such as fire and native forest insect outbreaks have been reintroduced or managed to preserve the groves' ecological integrity. Threats from damage by unusually severe wildfire have been reduced, and giant sequoia reproduction has been stimulated.

Degradation of regional air quality has several potential effects on the giant sequoias. In fumigation chamber experiments, high ozone levels produced visible symptoms of damage in sequoia seedlings (Miller et al. 1994; Miller 1996), though no significant difference was found in short-term seedling survival. Long-term seedling mortality and differential genetic selection due to the observed effects of air pollution are unknown, but these are possible impact sources to sequoia groves (SNEP 1996). Ozone and other pollutants have been shown to be factors in the decline of several tree species that are part of the giant sequoia grove structure (ponderosa and Jeffrey pine) (SNEP 1996). Severe impacts to those species could result in significantly altered grove conditions over time.

White pine blister rust has had a significant effect on the native white pines, particularly sugar pine and western white pine within the parks. Sugar pine is a major component of the giant sequoia groves' forest structure, and the Redwood Mountain and Atwell Groves display some of the most severe blister rust infections. Active management of the sugar pine population may be necessary to maintain its historic importance in the composition of these mixed conifer forests.

Direct impacts of visitor use include trampling and soil compaction in high-use areas; these impacts are usually confined to specific sites. Indirect impacts, which occur as a result of the

development of visitor services and related support services, include the interception of natural fire ignitions by roads and trails throughout the giant sequoia groves. Indirect impacts are more widespread and difficult to detect and manage. Another indirect impact includes the withdrawal of surface and subsurface water. Both surface and groundwater conditions are important to the reproduction and maintenance of sequoias. High soil moisture availability in well-drained soils is the primary factor that determines the occurrence and extent of sequoia groves. Park developments and inholdings at Grant Grove and park developments at Atwell Mill use water from the grove hydrologic systems. A well supplies water at Atwell Mill. NPS and concession facilities at Grant Grove are supplied by water from four sources:

- The primary source is an artesian well in Round Meadow, which drains into Abbott Creek. This drainage is north of the General Grant Grove, and there is no known groundwater connection between Abbott Creek and the Mill Flat and Sequoia Creek drainage systems. If rock fractures that function as underground conduits exist, then water from the Round Meadow may affect groundwater in the sequoia groves in the Mill Flat and Sequoia Creek drainages.
- Rona and Merritt Springs supply water and are part of the Sequoia Creek drainage.
- The fourth source is a well in the Sequoia Creek drainage. Inholdings in Wilsonia also use wells located in this drainage.

Meadow / Riparian / Aquatic Communities

Description

Lakes, rivers, streams, and adjacent riparian areas are classified as wetlands. Wet meadows also fall into this category. The National Park Service defines wetlands as any area classified as wetland habitat according to the U.S. Fish and Wildlife Service's *Classification of Wetlands and Deepwater Habitats of the United States* (1979). According to this definition, a wetland has at least one of three attributes: undrained hydric soils, predominantly hydrophytic vegetation, or if the substrate is nonsoil, the area is saturated with water or covered with shallow water at some time during the growing season of each year. The primary types of wetlands and deepwater habitats within the parks are persistent palustrine emergent (wet meadows), deciduous broad-leaved palustrine scrub-shrub (primarily willow thickets), upper perennial riverine (permanent rivers and streams), lacustrine (lakes), open-water palustrine (ponds), and intermittent riverine (ephemeral streams). Many of the rivers and streams have riparian areas that are either forested palustrine (e.g., alder) or deciduous broad-leaved palustrine scrub-shrub (e.g., spice bush) along their banks. Park staff have determined that the Fish and Wildlife Service's wetland inventory is incomplete (Werner 2005). The staff use field survey data (Neuman 1990) and a recently completed vegetation map to identify additional wetland vegetation, particularly meadows.

Riparian areas, lakes, and meadows occur throughout the parks, although lakes and meadows are primarily found in the mid- to upper-elevations of the park. These communities provide important habitat for populations of a number of special status species, including amphibians, fish, and invertebrates (see the "Threatened, Endangered, and Sensitive Species" section). They affect the quality, quantity, and timing of streamflows. These ecosystems are also principal destinations for recreation within the parks.

Meadows are among the most attractive and important natural resources within the parks. Less than 2% of the land base supports meadow vegetation. Meadows are complex systems, varying widely in character and composition (Benedict and Major 1982; Ratliff 1982). Although meadow vegetation is generally highly productive and relatively resilient, meadow systems vary in their sensitivity to impacts and in their ability to recover. Meadows and their adjacent camp areas are frequently a principal destination for backcountry hikers and horseback riders. Many, if not most, of the grazed

meadows contain flora, soils, and hydrology associated with wetlands.

Stressors

Meadow, riparian, and aquatic communities can all be directly affected by visitor impacts. Visitor-caused impacts on wetlands include social trails around the edges of lakes that often cut through the wetland meadows adjacent to many lakes and ponds. In heavy use locations, upland areas adjacent to rivers are also impacted. Trampled streambanks are often associated with swimming areas. How swimming and wading affect benthic communities is unknown. Because streams undergo constant natural disturbance, they are unlikely to be damaged by visitor use. However, waders sometimes leave conspicuous scars on lake bottoms. Whether these effects are biological or just aesthetic is not known.

Park regulations prohibit backcountry camping in meadows. Since the 1980s a program has been undertaken to relocate trails outside sensitive meadows, further reducing direct hiker impacts on meadow vegetation.

In some wilderness meadows a limited amount of grazing by administrative and visitor pack and saddle stock is allowed. This creates localized impacts to native vegetation and wildlife, soils, and water quality, and provides a potential vector for the introduction of exotic plant species. Some park meadows are permanently closed to stock because of heavy backpacker camping use, their small size, research purposes, or relative sensitivity to grazing impacts. Stock animals are permitted in other areas, but feed must be packed in. All park meadows open to grazing are subject to seasonal opening dates, which are determined according to soil moisture conditions as predicted by May snowpack. In most park meadows, reduced levels of use and increased minimum impact awareness among stock users has led to a general improvement in site conditions since the 1970s and 1980s.

Residual biomass monitoring is a central component of wilderness meadow management at Sequoia and Kings Canyon National Parks. (Residual biomass refers to the amount of aboveground plant material present in a meadow after grazing. In systems dominated by herbaceous plants, adequate residue must be present to protect soil surfaces and plants, to replenish the soil mulch and organic layers, and to trap and hold moisture [Neuman 1991].) Residual biomass (production) and groundcover data are collected at the end of the growing season from approximately two dozen wilderness meadows that consistently receive moderate to heavy use. These data provide NPS staff with short-term information on site conditions and allow for the development of minimum residual biomass standards for grazed meadows in the long term. These standards will then be used to establish appropriate use levels that are directly tied to site conditions. Seven years of preliminary residual biomass data are currently being analyzed to develop minimum standards that will allow managers to set limits on the amount of use allowed during a given season. These standards will ensure that adequate residual matter remains on a site each year.

Wetlands are also impacted by trespass cattle. Cattle not only trample and defecate on the edges of riparian wetlands, they heavily graze riparian sedges and other vegetation. Trespass cattle have been seen grazing in the middle of the North Fork of the Kaweah.

In a few areas, exotic wetland flora (*Elodea* sp.) have apparently displaced the native benthic flora (*Isoetes* sp.) that normally dominate the parks' lake bottoms. Today, these sites are structurally and floristically very different from what should be there (e.g., Rae Lakes).

Fire has an important influence on wetlands. During severe fire conditions, fires will push through riparian areas, completely altering the structure and function of the vegetation and temporarily influencing the composition of future species. During drought conditions, fires sometimes burn the organic soils, causing long-term changes to the wetland community structure and species composition. In moist conditions, wetlands serve as barriers to the spread of

fire, but fire influences the wetlands by liberating nutrients, altering sediment loads, and changing hydrologic yield.

WILDLIFE

Description

Sequoia and Kings Canyon National Parks are known to include 264 native vertebrate terrestrial species, and an additional 25 species may be present. Of the native vertebrates, five species have been extirpated, and 126 are rare or uncommon. The 264 terrestrial vertebrates include 5 species of amphibians, 21 species of reptiles, 168 species of birds, and 70 species of mammals.

Few studies of terrestrial invertebrates have been conducted. The most extensive work is the ongoing collection at the end of the flume on the Middle Fork of the Kaweah River. Many of the parks' caves are known to contain invertebrates. While the taxonomic work on cave fauna is incomplete, the available information shows high levels of endemism, with some species being restricted to a single cave.

For purposes of distinguishing aquatic fauna from terrestrial fauna, aquatic wildlife species are defined as those that depend on occupying either lentic or lotic environments for all or portions of their lives. These species may be either fully aquatic or amphibious. Aquatic wildlife does not include species that frequent wetlands or deepwater habitats but that are not dependent on those environments (e.g., *Microtus longicaudus*). Of the vertebrates, Sequoia and Kings Canyon National Parks are known to have 45 native species that fit this definition, and an additional 16 species may be present. Of the 45 native vertebrates, one species (*Rana boylii*) is extirpated, and 15 are rare or uncommon. The 45 vertebrate species include 5 fish, 7 amphibians, 1 reptile, 30 birds, and 2 mammals. While some studies of aquatic invertebrates have been conducted (Abel 1977, 1984; Kubly 1983; Bradford et al. 1998; Kratz et al. 1994; Stoddard 1987; Taylor and Erman 1980; Knapp and Matthews 2000), known invertebrates have not been compiled into a master list. The broad taxonomic groups studied include both benthic invertebrates (primarily aquatic insects) and zooplankton.

Stressors

Terrestrial wildlife are affected by landscape level stressors, including

- ecological impacts from exotic species
- changes in the species composition and abundance due to the altered fire regime
- bioaccumulation of contaminants
- isolation and fragmentation of some species due to differences in land-use practices on adjacent lands

Other effects to wildlife occur from conflicts with visitor use, changes to the natural distribution and abundance of native species due to park developments, and anthropogenic mortality (both accidental and by poaching).

The primary threats to native aquatic wildlife include competition and genetic introgression from exotic species, and predation. Thirteen vertebrate species have been introduced to the parks' aquatic environments, and at least nine have become established. At least one aquatic invertebrate and several plants have been introduced into park waters. There is also a serious concern about the introduction of contaminants, especially biocides and pollutants from internal-combustion engines. Some native aquatic species are declining. There has been some anthropogenic alteration of aquatic habitats and harvest of fish.

THREATENED, ENDANGERED, OR SENSITIVE SPECIES

Description

The U.S. Fish and Wildlife Service lists 2 wildlife species in Sequoia and Kings Canyon as threatened, 5 as endangered, and 39 as species of concern (see Table 1). California lists 3 species as threatened, 5 as endangered, and 36 as

protected, sensitive, or of concern. Three species are listed as sensitive by the U.S. Forest Service.

Of over 1,400 species of vascular plants in the parks, no species are listed as federally threatened or endangered, and only one, Tompkins' sedge *(Carex tompkinsii)*, is listed by the state as rare. Little is known about the status and habitat requirements of this species within the two parks. What is known is primarily derived from a single systematic survey conducted during the early 1980s (Norris and Brennan 1982), and more localized surveys carried out in conjunction with major construction projects.

TABLE 1: THREATENED, ENDANGERED, OR SENSITIVE SPECIES

Common Name	Status	Occurrence in the Parks
Vertebrate Animals		
Mammals		
Bat, big-eared bat	FSC, CSC	Uncommon foothill resident.
Bat, greater western mastiff	FSC, CSC	Uncommon in the Sierra Nevada.
Bat, spotted	FSC, CSC	Uncommon to rare resident at mid elevations.
Bear, grizzly	FT	Extirpated from the Sierra Nevada.
Beaver, mountain	FSC, CSC	Uncommon resident of montane riparian areas; at its southern extent of range in the Sierra Nevada.
Fisher, Pacific	FSC, CSC	Uncommon to rare resident in foothill hardwood and mixed conifer zones.
Fox, Sierra Nevada red	CT, FSC	Very rare resident to subalpine and alpine. May be extirpated.
Hare, white-tailed	CSC	Uncommon resident of upper montane and subalpine areas.
Marten	FSS	Same as above.
Myotis, fringed	FSC	Widely distributed in the Sierra Nevada.
Myotis, long-eared	FSC	Occurs in mid to high elevations.
Myotis, long-legged	FSC	Ranges length of the Sierra Nevada in woodland, montane, and subalpine areas.
Myotis, small-footed	FSC	Parks fall within range but no records exist.
Myotis, Yuma	FSC, CSC	Common in lower elevations in the parks and throughout the Sierra Nevada.
Pallid	CSC	Status unknown in the parks — surveys in progress for this and following bat species. Uncommon foothill resident.
Sheep, bighorn	FE, CE	Rare resident of alpine areas.
Wolverine, California	CT, FSC	Rare resident of upper montane to alpine areas.
Birds		
Condor, California	FE, CE	Extirpated from the parks.
Eagle, bald	FT, CE	Species rarely uses the parks, which are outside of this species preferred habitat. No known nesting or communal roosting in the parks.
Eagle, golden	CP, CSC	Moderately common at all elevations.
Falcon, peregrine	CSC	Rare breeding resident of montane zones.
Falcon, prairie	CSC	Uncommon migrant and rare resident of alpine and subalpine areas.
Flycatcher, willow	CE, FSS	Rare in the parks in montane.
Goshawk, northern	FSC, CSC	Uncommon in montane to subalpine.
Gull, California	CSC	Uncommon migrants through alpine/subalpine areas.
Harrier, northern	CSC	Uncommon in the parks. Uses open, burnt, chaparral habitat.
Hawk, Cooper's	CSC	Uncommon to rare in foothills to montane.
Hawk, sharp-shinned	CSC	Uncommon in foothills to montane.
Hawk, Swainson's	CT	Rare resident/accidental visitor in the parks, which are outside usual range / preferred habitat.
Kite, white-tailed	CP	Same as above.
Lark, horned	CSC	Same as above.
Martin, purple	CSC	Same as above.
Merlin	CS	Sporadic use of open terrain in the parks.
Osprey	CSC	Rare resident/accidental visitor in the parks, which are outside usual range / preferred habitat.
Owl, great gray	CE, FSS	Parks are apparently south of normal range in Sierra Nevada. Rare/limited occurrence in the parks.
Owl, long-eared	CSC	Very rare in montane areas.
Owl, short-eared	CSC	Very rare visitor.

Common Name	Status	Occurrence in the Parks
Owl, spotted	FSC, CSC	Uncommon resident of montane forests.
Shrike, loggerhead	FSC, CSC	Rare resident / accidental visitor in the parks, which are outside usual range / preferred habitat.
Swift, Vaux's	CSC	Uncommon resident of oak and fir forests.
Reptiles		
Lizard, California legless	FSC, CSC	Status unknown. Found in foothill chaparral and oak woodland/savanna areas.
Lizard, coast horned	FSC, CP, CSC	No modern records for parks. Either extirpated or never established in the parks.
Amphibians		
Frog, foothill yellow-legged	FSC, CP, CSC	Extirpated from the parks.
Frog, mountain yellow-legged	FSC, CP, CSC	Occurs in upper montane and subalpine/lower alpine areas.
Toad, Yosemite	FSC, CP, CSC	Occurs in subalpine/lower alpine areas.
Turtle, Western pond	FSC, CP, CSC	Locally common in some foothill rivers and streams.
Salamander, Mount Lyell	FSC, CP, CSC	Habitat includes alpine/subalpine areas.
Fish		
Roach, California	CSC	Found in the lower reaches of the Middle Fork of the Kaweah River.
Trout, California golden	FSC, CSC	Does not occur within the park as a native species. This species is native immediately south of the park and occurs within the park as an introduced species.
Trout, Kern River rainbow	FSC, CSC	Native to the Kern River.
Trout, Little Kern golden	FT	Native to the Soda Springs Creek drainage — a small area within the parks.
Invertebrate Animals		
Insects		
Beetle, Ciervo aegialian	FSC	Status unknown in the parks. No records for the park.
Beetle, Hopping's blister	FSC	Species occupy treeless habitats. Not present in the parks.
Beetle, moestan blister	FSC	Same as above.
Beetle, molestan blister	FSC	Same as above.
Beetle, Morrison's blister	FSC	Same as above.
Beetle, San Joaquin dune	FSC	Species found on the west side in the Central Valley and the Sacramento-San Joaquin delta. Not present in the parks.
Beetle, San Joaquin tiger	FSC	Same as above.
Beetle, valley elderberry longhorn	FT	All specimens collected are from the Kaweah drainage and have been identified as the unlisted and common coastal subspecies. This species occurs below 3,000 feet elsewhere.
Beetle, wooly hydroporous diving	FSC	Status unknown in the parks. No records for the parks.
Bug, Dry Creek cliff strider	FSC	Same as above.
Butterfly, Bohart's blue	FSC	Same as above.
Butterfly, San Emigdio blue	FSC	Same as above.
Caddisfly, Denning's cryptic	FSC	Occurs in freshwater habitat in the parks.
Caddisfly, Kings Canyon cryptochian	FSC	Same as above.
California linderiella	FSC	Status unknown in the parks. No records for the parks.
Grasshopper, Sierra pygmy	FSC	Same as above.
Crustaceans		
Vernal pool fairy shrimp	FT	Status unknown in the parks. No records in the park.
Plants		
Tompkins' sedge	CR	Foothills and lower montane forests.

FE = federally endangered
FT = federally threatened
FSC = federal species of concern
CP = California protected
CE = California endangered
CT = California threatened
CSC = California species of concern
CR = California rare
FSS = Forest Service sensitive

Stressors

Stressors to sensitive species include those mentioned under previous resource topics. Landscape level stressors include invasion by exotic species, altered fire regime, bioaccumulation of contaminants, isolation or fragmentation of populations, and anthropogenic climate change. Other effects are associated with visitor use and developments within the parks.

AIR QUALITY

Sequoia and Kings Canyon National Parks have been designated as class I areas under the federal Clean Air Act, as amended in 1977. As such, the parks are afforded the greatest degree of air quality protection under the Clean Air Act, and the National Park Service is required to do all it can to ensure that air quality related values are not adversely affected by air pollutants. This includes participation in the review of permits of those sources whose emissions will potentially affect the park as defined in the Prevention of Significant Deterioration (PSD) program, which was established in the 1977 amendments to the Clean Air Act (Title I, Part C).

Regional Air Quality

The San Joaquin Valley to the west of the parks is a trap for air pollutants originating in the valley as well as pollutants from cities along the central California coast that are carried in on prevailing winds. Southerly wind patterns carry these pollutants through the valley until they reach the mountains at the southern end of the basin, causing an eddy to form in the vicinity of Visalia and Fresno. Frequent inversions over the valley place a lid over the valley air at night. Rising daytime air currents then carry these trapped pollutants up into the parks, giving the parks some of the worst air quality of any national park in the country. This movement of polluted air into the Sierra occurs daily during the summer months.

Vehicular traffic is one of the major sources of pollutants in the San Joaquin Valley, contributing much of the particulates, carbon monoxide, nitrogen oxides, and hydrocarbons annually emitted. In the presence of sunlight, the latter two constituents interact to form ozone. Ozone levels in the parks approach and often exceed state and federal health and welfare standards during the summer (based on the newer 8-hour ozone average). Other sources of pollution include power generation, petroleum production, and agricultural practices.

Not only does pollution pose a human health risk, it also impairs visibility and injures plant and animal life. The once vast panoramas from vista points in the parks looking westward are highly obscured by regional haze. Plant species differ in their sensitivity to pollutants. Studies have shown that Jeffrey and ponderosa pines are especially susceptible to ozone. Sequoia seedlings suffer needle damage at current ozone levels and reduced growth when exposed to elevated levels. Acid deposition has been found to affect the chemical composition of lakes and streams within the parks, which can harm aquatic life.

Air pollution is one of the most serious external threats to Sequoia and Kings Canyon National Parks. Most of the air pollution originates outside park boundaries, and the National Park Service has virtually no control over the air quality within the San Joaquin Valley Air Pollution Control District (see Figure 1). Therefore, park staff participate in local and state air quality planning efforts to improve air quality and protect park resources. Park monitoring stations have been established to measure ozone, carbon monoxide, particulates, acid deposition, and visibility in order to define the extent of the problem and pollutants' effects on park resources.

FIGURE 1: SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT

Air Emissions in the Parks

Typical air emissions found with the boundaries of Sequoia and Kings Canyon National Parks include stationary, area, and mobile sources. Stationary sources can include water-heating equipment, generators, and fuel storage tanks. Area sources include prescribed burning, campfires, highway maintenance, and wastewater treatment plants. Mobile sources include vehicles operated by the public, cooperators, and NPS and concession employees. On-road mobile sources are greatest in the summer, when visitation is at its highest. During the winter most in-park emissions are from wood used for heating.

In 1999 a survey of emissions was conducted using 1998 data. This was done to help park managers determine which emissions are associated with what park activities. The knowledge of what is generated within park boundaries allows managers to better understand the contribution of outside sources to air pollution levels found in the park. (See *Final Air Emissions Inventory: Sequoia and Kings Canyon National Parks, California*, EA Engineering, Science, and Technology 2000.)

Almost a century of fire suppression has led to major changes in the structure and composition of forested ecosystems. Before Euro-American settlement, fires were frequent and of variable intensity and size. Now with high fuel loads, there is a greater risk of large fires. Since 1968 the parks have been actively restoring fire as a natural process, and both management-ignited fires and natural ignitions are used to achieve fire management objectives. Because of conflicts over the effects of smoke and the need to restore an altered fire regime, ways are being explored to improve the management of smoke from prescribed fires. The parks work closely with the San Joaquin Valley Unified Air Pollution Control District in conducting prescribed fires under favorable air quality conditions.

TABLE 2: NATIONAL AND CALIFORNIA AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	Federal Primary Standard	California Standard
Carbon Monoxide (CO)	8-hour	9 ppm (10 $\mu g/m^3$)	9.0 ppm (10 $\mu g/m^3$)
	1-hour	35 ppm (40 $\mu g/m^3$)	20 ppm (23 $\mu g/m^3$)
Hydrogen Sulfide	1-hour	–	0.03 ppm (42 $\mu g/m^3$)
Lead (Pb)	Calendar Quarter	1.5 $\mu g/m^3$	–
	30-day average	–	1.5 $\mu g/m^3$
Nitrogen Dioxide (NO_2)	Annual	100 $\mu g/m^3$ (0.053 ppm)	–
	1-hour	–	470 $\mu g/m^3$ (0.25 ppm)
Ozone (O_3)	8-hour	0.08 ppm	–
	1-hour	0.12 ppm (235 $\mu g/m^3$)	0.09 ppm (180 $\mu g/m^3$)
Particulate Matter (PM_{10})	Annual Arithmetic Mean	50 $\mu g/m^3$	20 $\mu g/m^3$
	Annual Geometric Mean	–	30 $\mu g/m^3$
	24-hour	150 $\mu g/m^3$	50 $\mu g/m^3$
	1-hour	–	–
Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	15 $\mu g/m^3$	12 $\mu g/m^3$
	Annual Geometric Mean	–	–
	24-hour	65 $\mu g/m^3$	–
	1-hour	–	–
Sulfates	24-hour	–	25 $\mu g/m^3$
Sulfur Dioxide (SO_2)	Annual	80 $\mu g/m^3$ (0.03 ppm)	–
	24-hour	365 $\mu g/m^3$ (0.14 ppm)	105 $\mu g/m^3$ (0.04 ppm)
	1-hour	–	655 $\mu g/m^3$ (0.25 ppm)
Vinyl Chloride (chloroethene)	24-hour	–	0.010 ppm (26 $\mu g/m^3$)

NOTE: Federal primary standards are designed to protect human health. Federal secondary standards are designed to protect human welfare, including economic impacts such as damage to crops, vegetation, and materials.

ABBREVIATIONS: $\mu g/m^3$ — micrograms per cubic meter
ppm — parts per million
– — no standard exists for this pollutant and/or averaging time.

National and State Ambient Air Quality Standards

Sequoia National Park is located in the mountainous portion of Tulare County in the southern Sierra Nevada, and Kings Canyon National Park is located in Fresno and Tulare counties, which are part of the eight-county San Joaquin Valley air basin. The San Joaquin Valley Unified Air Pollution Control District is the governing authority that has primary responsibility for controlling air pollution from stationary sources.

The U.S. Environmental Protection Agency (USEPA) has established national ambient air quality standards (NAAQS) for each of six "criteria" pollutants to protect the public from the health hazards associated with air pollution. These six criteria pollutants are carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns in diameter (PM_{10}), and lead (Pb). The state of California has adopted additional air quality standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility-reducing particulates. Table 2 lists the national and California standards for these pollutants.

Geographic areas (including counties, air basins, or portions thereof) that exceed a particular national or state pollutant standard are considered "non-attainment" areas for that pollutant. The attainment status of the San Joaquin Valley Air District, which includes Fresno and Tulare counties, is shown in Table 3.

TABLE 3: SAN JOAQUIN VALLEY AIR DISTRICT ATTAINMENT STATUS

	Designation / Classification	
Pollutant	Federal	State
Ozone (1 hour)	N/Extreme	N/Severe
Ozone (8 hours)	N/Serious	No state standard
Carbon monoxide	U/A	A
PM_{10}	N/Serious	N
$PM_{2.5}$	N	No state standard
Nitrogen dioxide	U/A	A
Sulfur dioxide	U	A
Lead	No designation	A

SOURCE: San Joaquin Valley Air Pollution Control District 2005.
A = attainment. N = non-attainment. U = unclassified.

The San Joaquin Valley Air District is designated as a serious non-attainment area for PM_{10}, an extreme non-attainment area for 1-hour ozone, and a serious non-attainment area for 8-hour ozone. The San Joaquin Valley Unified Air Pollution Control District is empowered to adopt rules and regulations to protect the public health and prevent the violation of ambient air quality standards. The air district requires all federal agencies to comply with appropriate general conformity requirements and emission budgets within non-attainment areas.

As a non-attainment area, the San Joaquin Valley Unified Air Pollution Control District is required to develop three attainment plans — a rate of progress plan, a post rate of progress plan, and an attainment demonstration plan.

Stationary Sources

Existing stationary air pollution sources within the park were determined in a *1998 Air Emissions Inventory* (EA Engineering, Science, and Technology 2000). The inventory shows that the largest park air pollution sources are smoke from managed wildland fires and vehicle emissions. Stationary sources within the parks are minor and include generators, boilers, and furnaces; emissions from these sources are between 8.1 and 16.6 tons per year for all pollutants (EA Engineering, Science, and Technology 2000).

The California Air Resources Board (CARB) estimates average annual emissions from California counties. Table 4 summarizes estimates for criteria emissions from stationary sources in California, Fresno and Tulare counties, and the San Joaquin Valley air basin, and it compares them to emissions from stationary sources in Sequoia and Kings Canyon National Parks. The CARB data indicate that the majority of volatile organic compound (VOC) emissions, which are a precursor for ozone formation, are generated by landfills in Fresno County. NO_X and VOC emissions from stationary sources in Sequoia and Kings Canyon National Parks are relatively minor compared to totals in the two counties.

TABLE 4: ESTIMATED ANNUAL EMISSIONS FROM STATIONARY SOURCES

Area	PM_{10} (tons/yr)	SO_x (tons/yr)	NO_X (tons/yr)	CO (tons/yr)	VOC (tons/yr)
California*	130.4	134.4	507.4	405.6	507.3
Fresno County*	4.0	8.0	19.2	9.4	17.5
Tulare County*	3.5	0.6	4.3	2.1	4.4
San Joaquin Valley Air Basin*	23.6	21.0	138.9	53.7	86.7
Sequoia and Kings Canyon National Parks**	1.1	0.1	1.2	7.9	3.3

* California Air Resources Board Almanac Emission Projection Data (2004).
**EA Engineering, Science, and Technology 2000.

Smoke Emissions

The parks' fire management and natural resources staff work closely with staff of the San Joaquin Valley Unified Air Pollution Control District. Projected smoke emissions from prescribed fire in the parks are included in the "San Joaquin Valley Smoke Management Plan." This plan is part of the State Implementation Plan for the San Joaquin Valley. A memorandum of understanding between the San Joaquin Valley Unified Air Pollution Control District and land management and fire protection agencies establishes a formal working relationship to develop and implement methods of reducing air quality impacts from prescribed burn practices.

Prior to igniting a prescribed fire, park staff must obtain permission from the San Joaquin Valley Unified Air Pollution Control District, which has the responsibility to adopt, implement, and enforce air quality rules and regulations for prescribed burns, in accordance with the smoke management program and the State Implementation Plan (Title 17, California Code of Regulations, Rule 4106). As an additional measure to mitigate the potential cumulative impacts of prescribed fires, park fire management staff are members of a Sierra-wide interagency group, which addresses smoke impacts and plays a role on the Interagency Air and Smoke Council. The goal of these groups is to ensure that planned ignitions on federal and state lands in the Sierra do not adversely impact smoke sensitive areas in and around the burn area. Both groups meet on a regular basis to discuss policy updates, data needs, and current technology.

A smoke communication strategy and a smoke management plan have been included as appendixes in the latest park *Fire Management Plan and Environmental Assessment* (NPS 2000b). These documents provide guidance for managing future smoke events from prescribed fires, fire use projects, suppression actions, and fires occurring outside the parks. Messages and information on health issues and concerns are posted for visitors, employees, and residents in affected smoke-sensitive areas. The parks also have the ability to monitor particulate levels in the parks during smoke events on an hourly basis. These levels are used to compute a 24-hour average, which correlates with the national ambient air quality standards for particulates.

Transportation Sources

Since the proposed transportation system improvements are within national parks, and the air basin is designated as non-attainment for PM_{10} and O_3, the general conformity rule will apply to any project construction. Conformity with the air quality standards is presumed if the project will emit less than the general conformity *de minimis* thresholds. In serious ozone non-attainment areas, the *de minimis* thresholds for VOC and NO_x are 50 tons per year. In serious PM_{10} non-attainment areas, the *de minimis* threshold for PM_{10} emissions is 70 tons per year. If emissions from a project could exceed the *de minimis* threshold of any criteria pollutant in one year, a more rigorous determination of conformity will be required.

A regional transportation model was developed by the San Joaquin Valley Association of Governments. The model is used to generate information about existing and future traffic volumes, patterns, and congestion for the San Joaquin Valley. It takes into consideration all planned

land developments, and it estimates the most likely amount and type of future development for the region. Traffic volumes for 1998 were used to reflect existing conditions, and 2010 was used for the planning year horizon analysis. The San Joaquin Valley Unified Air Pollution Control District uses the regional transportation plan to demonstrate attainment of the federal Clean Air Act pollutant standards and also conformity.

The park vehicle fleet increasingly uses alternative fuels, such as compressed natural gas, to reduce transportation-related emissions.

Human Health and Enjoyment

Sequoia and Kings Canyon National Parks use air quality data to issue periodic warnings to staff and visitors about limiting activity in times of lower air quality. Wayside signs describe regional air quality conditions and point out reduced visibility from historical conditions.

Air Quality Monitoring and Research

Air monitoring efforts in Sequoia and Kings Canyon National Parks began in the early 1980s and have grown over the years to include more sites and types of monitoring equipment. Three air quality monitoring stations operate year-round, measuring a combination of ambient ozone concentrations, meteorological data, visibility, particulate matter, UV, and wet/dry deposition chemistry. The stations are at the Ash Mountain headquarters area, at Lookout Point near the Mineral King road entrance station, and at the Lower Kaweah site in Giant Forest (see Table 5 and Figure 2).

TABLE 5: AIR MONITORING STATIONS

Site	Type	Network*
Ash Mountain	Meteorology	NPS – ARD
	Ozone	NPS – ARD
	Particulate Matter	SEKI Fire
	PM 2.5 and 10	IMPROVE
Lookout Point	Meteorology	NPS – ARD
	Ozone	NPS – ARD
	Dry deposition	CASTNet
Lower Kaweah	Meteorology	NPS – ARD
	Ozone	NPS – ARD
	Wet deposition	NADP/NTN
	Mercury	MDN
	Webcam	NPS – ARD

* CASTNet — Clean Air Status and Trends Network
IMPROVE — Interagency Monitoring of Protected Visual Environments
MDN — Mercury Deposition Network
NADP/NTN — National Atmospheric Deposition Program / National Trends Network
NPS-ARD — National Park Service – Air Resources Division

The national parks are part of several national networks, including the following:

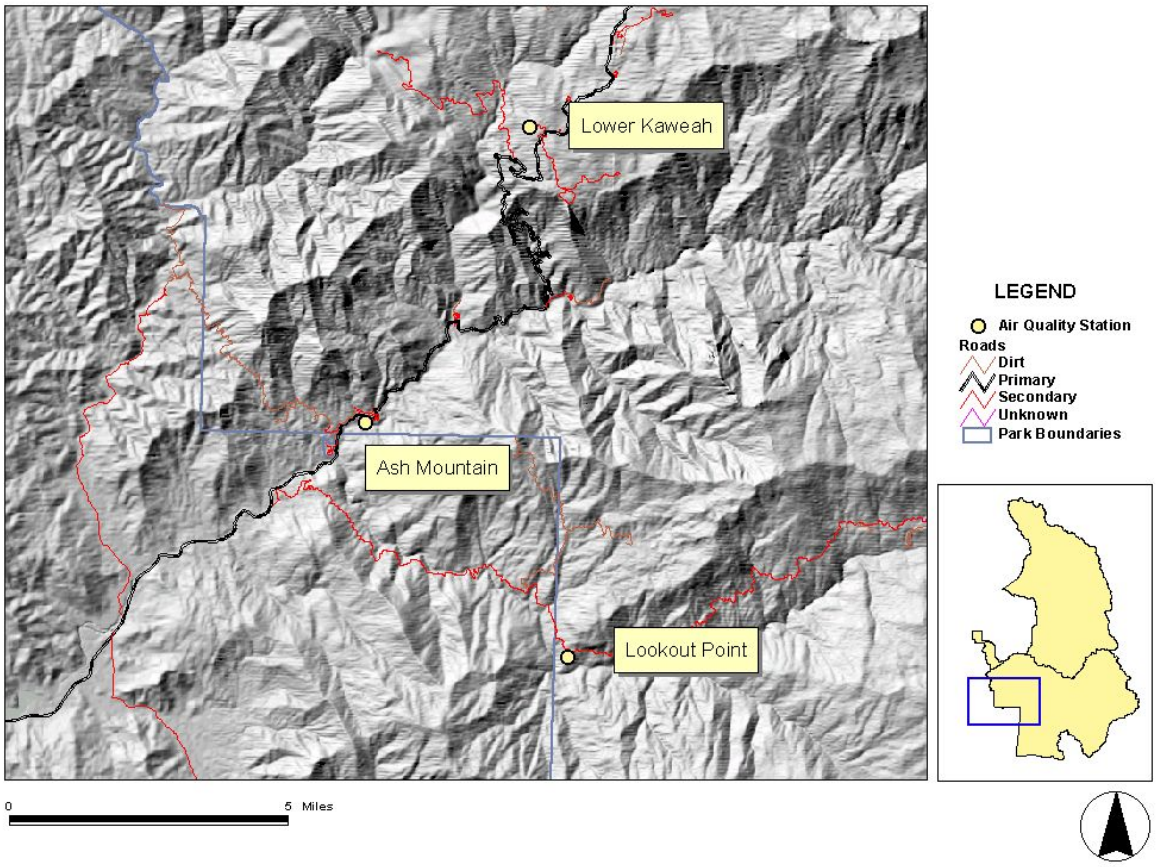
- National Atmospheric Deposition Program / National Trends Network (<http://nadp.sws.uiuc.edu/nadpoverview.asp>)
- Clean Air Status and Trends Network (<http://www.epa.gov/castnet>)
- Interagency Monitoring of Protected Visual Environments (http://vista.cira.colostate.edu/improve/>)
- National Park Service / Air Resources Division monitoring data (<http://www2.nrintra.nps.gov/air/monitoring/network.htm>)
- Mercury Deposition Network (http://nadp.sws.uiuc/edu/mdn/>)
- Park Research and Intensive Monitoring of Ecosystems Network

Ambient concentrations of PM_{10} are only monitored at the air monitoring site at Ash Mountain. During summer months portable monitors and passive samplers are installed throughout the park to measure particulate matter and ozone.

In 1999 the parks implemented a parkwide air advisory program from about May to October. Air quality designations are based on ozone values from the parks' monitoring station. Health standards were exceeded every year through 2002.

Since the late 1970s air-related research has helped determine the effects of air pollutants on park resources and air quality related values, as required in a designated class I park. (Air quality monitoring data can be obtained from the NPS Air Resources Division Website at <www2. nature.nps.gov/air>. Information on air quality related values for Sequoia and Kings Canyon National Parks can be found at <http://www2.nature.nps.gov/air/Permits/ARIS/seki/index.htm>.)

FIGURE 2: AIR QUALITY STATIONS IN SEQUOIA-KINGS CANYON NATIONAL PARKS



Air Quality Conformity

In 1993 the Environmental Protection Agency adopted regulations implementing section 176 of the Clean Air Act, which requires that federal actions conform to State Implementation Plans (SIP) for achieving and maintaining national air quality standards. Federal actions must not cause or contribute to new violations of any standard, increase the frequency or severity of any current violation, interfere with timely attainment or maintenance of any standard, delay emission reduction milestones, or contradict requirements in the State Implementation Plan.

The conformity rule has two parts — general conformity and transportation conformity. General conformity deals with stationary sources such as boilers or generators, and area sources, such as smoke from prescribed fire. Transportation conformity deals with mobile air pollution sources, such as cars and buses. The conformity rule applies only in federally designated non-attainment areas, or those areas that currently exceed federal standards. Conformity applies to park activities because Fresno and Tulare counties exceed federal ozone and particulate matter standards.

To determine if the park emissions conform, the National Park Service must prove that total direct or indirect emissions are in compliance with all State Implementation Plan requirements. Park emissions have either been identified and accounted for in the state plan, or based on air quality modeling, do not cause or contribute to any new violations or increase the severity or frequency of existing violation. The two main sources of air pollution in the park are smoke from managed wildland fire and mobile source emissions from visitor vehicles and concessioners.

Wild and Scenic Rivers

Description of Designated River Segments

The Middle and South Forks of the Kings River and the North Fork of the Kern River, which have been designated as wild and scenic rivers, are described below. The outstandingly remarkable values of each river segment are listed in volume 1 in the alternatives table.

Middle Fork and South Fork of the Kings River

The Kings River is the largest free-flowing river in the Sierra Nevada. Approximately 88.8 river miles* of the Middle Fork, South Fork, and main stem of the Kings River were added to the national wild and scenic rivers system on November 3, 1987 (PL 100-150). The designated reaches include:

- the Middle Fork from its headwaters at Lake Helen between Muir Pass and Black Giant Mountain to its confluence with the main stem (29.5 miles)
- the South Fork from its headwaters at Lake 11599 to its confluence with the main stem (31.7 miles)
- the main stem of the Kings River from the confluence of the Middle Fork and the South Fork to the point at elevation 1,595 feet above mean sea level (this portion is outside the park and is managed by the U.S. Forest Service)

These reaches encompass the entire Middle and South Forks, which are largely in Kings Canyon National Park. The National Park Service manages the 61.2 miles of the Middle and South Forks within Kings Canyon National Park and the U.S. Forest Service the remaining 27.6 miles (USFS 1991a).

The portions of the Middle and South Forks managed by the National Park Service begin in glacial lakes above timberline and flow through deep, steep-sided canyons, over falls and cataracts, and eventually become an outstanding whitewater rafting river in Sequoia National Forest (USFS 1991a). Both the Middle and South Forks flow through extensive and spectacular glacial canyons. All of the Middle Fork is within designated wilderness, as is the upper portion (24.1 miles) of the South Fork. The lower 7.6-mile portion of the South Fork canyon is known as the Kings Canyon, giving the park its name.

The Kings Canyon, including the Cedar Grove developed area, is the only segment of the Kings River accessible by motor vehicle.

North Fork of the Kern River

The North Fork of the Kern River was added to the national wild and scenic rivers system on November 24, 1987 (PL 100-174). This 78.5-mile segment extends from its headwaters at the 12,000-foot contour just south of Harrison Pass Lake below the Kings-Kern Divide and off the west slopes of Mount Whitney in Sequoia National Park to the Tulare-Kern county line. The National Park Service manages the upper 28.9 miles of the North Fork within Sequoia National Park, and the U.S. Forest Service manages the remainder of the river, which flows almost entirely through national forest land, including the Golden Trout Wilderness.

The upper river portion is free flowing for over 61 miles, the longest stretch of free-flowing river in the Sierra Nevada, and it is classified as wild. The lower 17.5-mile stretch managed by the U.S. Forest Service is classified as recreational due to road accessibility and minor impoundments (USFS 1994).

* Stated mileages are from the 2002 GIS-based calculations; some of these mileages differ slightly from those given in the Wild and Scenic Rivers Act, as amended in 1987.

The 28.9-mile segment of the North Fork managed by the National Park Service includes the headwaters and the spectacular reaches of the Kern Canyon within the park, all of which is within designated wilderness.

RIVERS BEING STUDIED FOR INCLUSION IN THE SYSTEM

Description

The South Fork of the San Joaquin River and five forks of the Kaweah River (North, Marble, Middle, East, and South) were studied for their suitability and eligibility for inclusion in the national wild and scenic rivers system. The following descriptions are inventories of all features that were analyzed to determine the outstandingly remarkable values for these rivers. The outstandingly remarkable values of the eligible segments are listed in volume 1 in the alternatives table. Only the North Fork of the Kaweah within the park boundary was determined to be ineligible because no outstandingly remarkable values were identified.

South Fork of the San Joaquin River

The South Fork of the San Joaquin River originates at Martha Lake, a scenic alpine basin at 11,000 feet on the west slope of Mount Goddard (13,568 feet). From Martha Lake the stream descends to the northwest into a rough rocky gorge of increasing depth. At an elevation of 8,800 feet the South Fork joins Evolution Creek, a major eastern tributary. Five miles downstream, at an elevation of 7,900 feet, the South Fork leaves Kings Canyon National Park.

The South Fork canyon is glaciated throughout its length within the park and has numerous interesting glacial features. The Mount Goddard roof pendant, a geological formation at the headwaters of the South Fork, contains metamorphic formations of scientific and scenic interest, including meta-volcanic marine rocks (largely metamorphosed rhyolite).

The South Fork canyon is designated wilderness and provides for a variety of outdoor recreational opportunities. The entire canyon, with the exception of the uppermost 2 miles, is accessible via a maintained trail that parallels the river. All points within the canyon are more than a day's travel from the nearest roads. In addition to wilderness camping, the area is used for climbing and photography.

The South Fork is a cold water trout fishery, with rainbow trout being dominant (these are possibly from native stock, though genotypes are likely altered). No stocking is done, the river being self-sufficient. The river's cold water provides for a high level of dissolved oxygen that in turn provides good habitat for aquatic invertebrates, such as stoneflies (restricted to highly oxygenated water). While the area contains typical California alpine wildlife, the drainage contains major clusters of fishless waters (west of Mount Goddard) that provide good habitat for populations of the mountain yellow-legged frog and the Yosemite toad, which are both declining across their range. This rocky area is sparsely wooded. The most common trees include lodgepole and whitebark pine, with some scattered populations of mountain hemlock, mountain juniper, aspen, and cottonwood. While vegetation is sparse, it plays a role in determining the character of this area.

Human use of this drainage is not well documented. A handful of sparse lithic scatters in the upper end of the drainage attest to some prehistoric use; a systematic survey would likely find additional evidence. Various Western Mono (Monache) groups would have known about the drainage and its tributaries, and it can be inferred that they would have used the area for hunting, travel, and probably trade and interaction with Paiute groups to the east. During historic times this remote, high alpine country was seldom visited, and there was little interest from sheep grazers and miners.

Water quality is excellent.

North Fork of the Kaweah River

The North Fork of the Kaweah River rises in several headwater streams along the Kings-

Kaweah Divide and flows out of the Jennie Lakes Wilderness. It becomes the North Fork at the confluence of Stony Creek (from the north) and Dorst Creek (from the east), at an elevation of approximately 5,400 feet. At this point it forms the boundary between Sequoia National Park and Kings Canyon National Park. The river flows southwest then turns to the south, serving as the western boundary of Sequoia National Park, leaving the park at approximately 1,700 feet elevation. The full extent of the river passes through numerous areas of metamorphic rocks and also forms deep, steep gorges in granitic rocks in its upper reaches. The North Fork provides examples of an incised river canyon and gorge with a moderate, stepped gradient of descent. In its lower reaches the river eases its rate of descent, creating long gentle stretches of calm water with extensive riparian development and deep pools. Examples of karst topography in the watershed include Lilburn Cave, Hurricane Crawl, and Crystal Cave.

Redwood Creek, a primary tributary, flows for approximately 5 miles through the lower reaches of Redwood Canyon. This drainage contains the Redwood Mountain Grove and several other sequoia groves. The lower reaches support stands of foothill riparian forest vegetation, which is dominated by an overstory of alder and sycamore with tangles of blackberry and wild grape in the understory.

The river supports a self-sustaining population of naturalized trout. Rainbow are native (though genotypes are likely altered), with several other species, including the golden, brown, and brook trout, having been introduced. The native western sucker is also present. There is a self-sustaining population of the western pond turtle in the river. Peregrine falcons regularly nest in the Chimney Rock area above the North Fork. The water and riparian vegetation create oasis-like habitats for various species during the hot summer months.

The North Fork is accessible only with difficulty in its middle reaches, as essentially there are no roads (remnants of historic roads still exist), and the popular North Fork trail is generally high above the river corridor.

Native American use of the North Fork is indicated by a handful of mid-elevation and foothill sites, including bedrock mortars, grinding slicks, and scatters of obsidian tools and debris. Ethnographically, the river and its upland tributaries were most often frequented by Western Mono (Monache) groups, especially the Wuksachi. Historically, the lower stretches of the river witnessed activity by the settlers of the Kaweah Colony, and features are associated with the sites of Kaweah, Advance, and Camp Flagstaff, as well as Colony Mill Road. The Grunigen homestead is found along the lower elevations of Yucca Creek, with a CCC camp having been located at the confluence of Yucca Creek and the North Fork; this junction marks the western boundary of Sequoia National Park.

Most of the lands west of the river are managed by the Bureau of Land Management, and there are grazing allotments. Some private land and USFS land lies to the west. (Note: The Forest Service did not address its portion of the North Fork in regards to wild and scenic river status in the 1988 *Sequoia National Forest Land and Resource Management Plan — Forest Plan*. The USFS parcel adjoining the North Fork was zoned as "semi-private motorized.")

Water quality is generally good to fair, with some limited agricultural and air pollutant deposition.

Marble Fork of the Kaweah River

The Marble Fork is one of the most spectacular watercourses in California, dropping 8,000 feet in approximately 15 miles; it is the only major watercourse wholly contained within Sequoia National Park. The Marble Fork originates above timberline at Lake 10,559, and the upper reach (4.1 river miles) flows from the area known as the Tableland. At Tokopah Falls the river drops 1,500 feet over a massive granite bluff to the floor of a spectacular, glacially carved canyon known as the Tokopah Valley. Below Lodgepole the river plunges through a

steep-walled canyon that is essentially inaccessible, except for the Crystal Cave Road bridge. In its middle reaches the river flows through Marble Falls and Wild Child Caves; at low flow, the entire river flows through these caves. At the multistepped Marble Falls the river drops more than 1,000 feet. Below the falls, the steep canyon again does not allow access until just above the Potwisha campground, where an impoundment dam for hydroelectric generation alters the river's flow. The river then flows through Potwisha campground and under the Generals Highway before joining the larger Middle Fork of the Kaweah River.

The Tableland is a wilderness recreation area accessed by the Lakes Trail and used primarily by backpackers and climbers, with some limited stock use. In the Tokopah Valley the river is paralleled by a popular frontcountry trail from the Lodgepole campground to the falls.

The lower reaches of the Marble Fork support outstanding examples of foothill riparian forest vegetation, with towering sycamores providing welcome shade to park visitors near Potwisha. Marble outcrops provide habitat for yucca and other plants with calcicole (marble) affinities. Stands of big-leaf maple and alder line the river in the reaches below the Crystal Cave bridge, along with mixed coniferous vegetation from the adjacent forested slopes.

There are numerous prehistoric and historic sites along the Marble Fork and its tributaries. The Potwisha had village sites at the mouth of the Marble Fork. A variety of bedrock mortar sites, grinding slicks, large bedrock basins, pictographs, midden soils, caves, and lithic scatters have been recorded within the drainage. Yokuts (e.g., Wukchumni) and Western Mono (e.g., Potwisha and Wuksachi) peoples were present throughout the area in protohistoric and early historic times. Military patrol camps, CCC camps, ranger stations, and even a remote trapper's cabin site mark historic era activities.

At the turn of the 20th century the Mount Whitney Power Company constructed a complex of power generation facilities on the Kaweah, including the impoundment about 0.5 mile above the Potwisha campground. The impoundment (which is still used under a park permit) consists of a small concrete dam with a concrete diversion flume that feeds into a siphon, passes under the Middle Fork, and then joins the Middle Fork flume. The total length of the flume and siphon is about 1.25 miles. In accordance with the park permit, the amount of water released from the diversion into the natural stream course is either the natural streamflow or the following, whichever is less: January and February, 6 cfs; March through June, 9 cfs; July through August, 6 cfs; September through December, 1.5 cfs.

Water quality of the Marble Fork is very good.

Middle Fork of the Kaweah River

The Middle Fork of the Kaweah River begins in a glacial U-shaped head-valley several thousand feet deep, at the confluence of Lone Pine and Hamilton (Deer) creeks, and flows 17.6 miles to the park boundary. The river lunges through a spectacular, very rugged, V-shaped canyon, among the deepest in the Sierra Nevada. Much of its course is cut through solid granite in the form of a slickrock gorge, which is very difficult to access. Below the river's confluence with Moro Creek, a road winds through the river canyon, usually 100–200 yards from the river's banks, so the character of the river is not changed. In its lower stretches the river has a riparian oasis-like character owing to the very dry nature of the surrounding landscape.

The Middle Fork canyon is a popular wilderness and non-wilderness recreation area for hikers and stock users, especially in spring, fall, and winter when its foothill trails are snow free. The Middle Fork trail in the upper 10 miles or so of the canyon parallels the river on the north side. Several giant sequoia groves are in the watershed, and the Redwood Meadow Grove is immediately adjacent to the river. Patches of alder, sycamore, and live oak line the river corridor near the Buckeye Flat campground and along the lower reaches. There is a naturalized and self-sustaining fishery, with surviving native roach, western sucker, and rainbow trout; brown,

golden, brook, and hatchery rainbow trout have been introduced, some in tributaries only. The foothills habitat also serves as home to wildlife such as bear, deer, mountain lions, and a variety of birds. There are notable bat colonies at Walk Softly Cave near Ash Mountain.

The Middle Fork area is a popular summer recreation area, with the river providing a welcome respite from the high ambient summer temperatures. The Buckeye Flat campground and the Ash Mountain administrative headquarters are located on and near the Middle Fork.

The Middle Fork Canyon supports a high density of prehistoric and historic sites, especially along its mid-slope and foothill elevations. Lithic scatters, bedrock mortar sites, granite basins, rock art panels, and midden soils are recorded. The village site of Potwisha marks the confluence with the Marble Fork, and the village site of Hospital Rock occurs a few miles farther upstream and is traversed by the historic Generals Highway. Other historic sites include the remains of a fish hatchery, a CCC camp, hydroelectric facilities, and the Ash Mountain headquarters complex.

The lower reach of the Middle Fork contains an impoundment/diversion that is part of the Kaweah power generation complex constructed by the Mount Whitney Power Company at the turn of the 20th century. The impoundment is about 1 mile above the confluence with the Marble Fork and consists of a small concrete dam with a concrete and wooden diversion flume running along the south side of the Middle Fork canyon for about 4 miles inside the park. According to the park permit, the amount of water released from the diversion into the natural stream course is either the natural streamflow or the following, whichever is less: January and February, 14 cfs; March through June, 21 cfs; July through August, 14 cfs; September through December, 9.5 cfs.

Water quality of the Middle Fork is very good.

East Fork of the Kaweah River

The East Fork of the Kaweah River begins on the slopes of spectacular granitic peaks of the Great Western Divide. Tributary streams flow through Mesozoic metamorphic rocks in the vicinity of the U-shaped, glaciated Mineral King Valley. Evidence of glaciation extends to an elevation of 7,000 feet, below which is a deep granitic canyon extending to and below the park boundary. The upper river canyon (Mineral King Valley) is a rare glaciated metamorphic landscape in the Sierra Nevada. This area has a variety of geologic features, including tufa deposits and soda springs, which are the result of groundwater systems super-charged with carbon dioxide; these features are unusual in the region. Karst features are extensive and notable due to their alpine location. The river then rapidly descends into a steep and deeply incised granite V-shaped canyon, which is essentially inaccessible due to its ruggedness. The area's dominant scenic features are the dramatic subalpine valley, several giant sequoia groves, and the deep river-cut canyon.

Stands of quaking aspen, uncommon in this part of the Sierra, line the river in its upper reaches as it flows through the Mineral King Valley. Thickets of willow and stands of cottonwood provide habitat along the river corridor below the valley and adjacent to the Cold Springs campground.

There is abundant wildlife in the East Fork drainage, including deer, bear, and marmots. In the lower reaches deep pools provide valuable habitat for resident and migratory species.

Less well documented for cultural resources, especially along its lower reaches, the East Fork parallels the Mineral King Road Cultural Landscape District, which has been listed on the National Register of Historic Places. The area contains the remains of a homestead, NPS ranger stations, CCC-era structures, water troughs, and subalpine special use permit cabin communities, along with the historic road corridor.

Also within the upper reaches of the drainage are abandoned mines, remnants of a sawmill, former sequoia logging sites, and old military

campsites. Prehistoric and protohistoric sites are not well documented, though clearly Native American use is evidenced by bedrock mortars, granite basins, and lithic scatters. The Mineral King Valley was the focus of a landmark environmental battle in the 1970s over its long-term future.

The diverse mountain environment provides excellent recreational opportunities for activities such as hiking and photography.

There are two private inholdings along the river, one in the Mineral King Valley and one at Kaweah Han, just downstream from the valley. The park's current *Land Protection Plan* for this area (NPS 1984) recommends that the Mineral King Valley inholding (5 acres, owned by the Disney Corporation) be acquired in fee for visitor use and minor facility development. The Kaweah Han inholding (60 acres) is expected to continue in private use (the existing historic Kaweah Han building complex is south of Silver City). So long as existing use continues, private ownership of Kaweah Han is compatible with park purposes. If uses changed, this position would need to be reassessed. One option would be to purchase an easement, which would safeguard park purposes and provide land protection while recognizing the rights of the private owners.

Four dams are used in the upper reaches of the East Fork drainage above Mineral King Valley at Monarch, Crystal, Franklin, and Eagle lakes. Constructed as part of the Kaweah complex of power generation facilities in 1903–5 by the Mount Whitney Power Company, they consist of concrete and native stone with check gates to regulate flow for downstream (out of park) diversion and power generation.

Water quality is generally good. Runoff in Mineral King Valley from some permittee cabins does not meet the California standards and may contribute to localized degradation.

South Fork of the Kaweah River

The South Fork of the Kaweah River originates on the granitic Hockett Plateau (near 10,000 feet) west of the Great Western Divide. It flows through a steep granite canyon to areas with Mesozoic metamorphic marine rocks near the park boundary. Prominent depositional terraces line the river in its lower reaches. It flows past one of these terraces (near the South Fork campground) before leaving the park at approximately 3,400 feet elevation. The South Fork canyon has been cut by glaciation and river erosion. It may be an example of a "captured stream," i.e. its pre-glacial course was notably altered by glaciation. The upper reaches are on a large glaciated plateau, and the lower reaches are a deeply incised river canyon. There are several examples of karst topography, among them Clough and Soldiers Caves. There is evidence of a massive landslide from the 19th century, which temporarily blocked the flow of the river. Large meadows line the upper reaches of the river as it cuts through the lodgepole and red fir forest, which characterize the Hockett Plateau. Several populations of purple mountain parsley, a sensitive plant species, can be found in the decomposed granites near the river and adjacent to Hockett, Mitchell, and Tuohy meadows. Nearby giant sequoia groves include the Garfield and South Fork groves. In the lower elevations, big-leaf maple, alder, and an occasional California nutmeg line the river corridor.

In the South Fork drainage, Homer's Nose is a regular nesting area for peregrine falcons. The karst features are known to provide nesting areas to notable populations of several species of bats near the river.

The headwaters of the South Fork suggest mid-elevation to higher elevation use by Native Americans, as evidenced by campsites, bedrock mortar sites, and lithic scatters. A few historic cabins and ranger stations are also found along the drainage. Hockett Meadow supports a well-preserved CCC-era ranger cabin and storage building. Evidence of the previous South Fork ranger station is found on the river floodplain near where the river leaves the park.

The South Fork canyon was utilized by Euro-Americans as the first Trans-Sierra trail, ca. 1863–64 and was known as the Hockett Trail.

The area is very popular with backpackers and stock users. Clough Cave is a popular recreational cave (use requires a permit).

Water quality is very good.

Status of Hydroelectric Facilities in Relation to Wild and Scenic Rivers

The Mount Whitney Power Company constructed the Kaweah complex of hydroelectric power generation facilities roughly between 1902 and 1913. The complex encompasses facilities both inside and outside Sequoia National Park. These facilities have been in continuous operation since their construction. In 1920 the Mount Whitney Power Company was dissolved and became a part of its parent company, Southern California Edison.

The operation of these facilities, and their permitting and licensing, is currently mandated by congressional legislation. In 2005 Congress authorized the secretary of the interior to permit the operation of impoundments and diversions on the Marble and Middle Forks of the Kaweah River until 2026.

In 1978, pursuant to PL 95-625, the Mineral King area (including four Southern California Edison dams on tributaries of the East Fork of the Kaweah River) was transferred from the U.S. Forest Service to the National Park Service. PL 95-625 amended PL 93-522 to incorporate studies of hydroelectric facilities contained within the Mineral King addition.

In 1984 a report on the impacts of hydroelectric facilities on park resources (Jordan/Avent 1984) found that the impacts were not sufficiently significant to compel the secretary to remove or cease operation at that time, hence both the permit and license were subsequently renewed.

In 1992 the Federal Energy Regulatory Commission renewed Southern California Edison's license for the Kaweah complex facilities outside Sequoia National Park (Project 298-000-California). The commission specifically excluded from its licensing those portions of the complex in the national park. The current FERC license runs through December 31, 2021.

The impoundments and diversions for hydropower generation on the Marble and Middle Forks, and from impoundments on the tributaries of the East Fork, have an adverse impact on the free-flowing condition and ecological functions of these rivers. However, it has been determined that the magnitude of impacts resulting from these relatively small-scale facilities does not preclude the inclusion of these river segments in the wild and scenic rivers system, since even with these facilities the waterways remain "generally natural and riverine in appearance" (*Federal Register* 47, no. 173: 39458). The desired future condition for these rivers is to provide for the removal of the impoundment and diversion infrastructure, which would allow the rivers to be restored to naturally functioning and free-flowing condition.

Backcountry / Wilderness

Backcountry is a term used by the National Park Service to refer to primitive, undeveloped, and roadless portions of parks. Backcountry includes areas designated or managed as wilderness. In Sequoia and Kings Canyon National Parks backcountry includes steep inaccessible areas, as well as areas reached by an extensive trail system. Most backcountry areas, which comprise about 96% of the parks, are managed as wilderness.

The NPS *Management Policies 2001* (sec. 8.2.2.4) state the following for backcountry use:

> The number and type of facilities to support visitor use, including sanitary facilities, will be limited to the minimum necessary.
>
> Public use levels will be managed . . . in accordance with the natural system's ability to absorb human waste.
>
> All refuse must be carried out.

Background material related to congressional wilderness designation has been presented in the context for the plan. This section describes wilderness status and related issues for Sequoia and Kings Canyon National Parks.

Designated Wilderness

On September 28, 1984, the Sequoia–Kings Canyon Wilderness was established as federally designated wilderness, including approximately 723,000 acres, or about 83.5% of the parks. Immediately adjacent wilderness areas managed by the U.S. Forest Service include the following:

- the John Muir Wilderness within Sierra and Inyo national forests, 580,293 acres, established in 1964
- the Golden Trout Wilderness in Inyo and Sequoia national forests, 303,287 acres, established in 1978
- the Jennie Lakes Wilderness in Sequoia National Forest, 10,289 acres, established in 1984
- the Monarch Wilderness in Sequoia and Sierra national forests, 44,896 acres, established in 1984

Other nearby wilderness areas include Dinkey Lakes, Ansel Adams, Hoover, and Kaiser. As a result of the 1984 designation, the parks became the core of the second largest wilderness in the lower 48 states, totaling 1,661,785 acres.

Potential Wilderness and Other Areas

The following areas are potential wilderness, meaning that when and if the facilities were removed, they would become wilderness.

- The Bearpaw Meadow high Sierra camp is a 32-acre roadless area surrounded by wilderness. The area is at 7,800′ elevation and is east of Giant Forest. It contains a popular concessioner-run tent hotel and backcountry campground.
- Pear Lake is a 5-acre area surrounded by wilderness. The area includes a ranger station.
- Two utility corridors for powerlines total 34 acres.

Oriole Lake and adjacent park lands are designated wilderness, including a primitive road that provides access to 12 acres of private inholdings. Surrounded by wilderness, the current private uses, including five cabins, are inconsistent with wilderness. A private airstrip has been removed.

Backcountry Areas Managed to Preserve Wilderness Characteristics

In 1984 three other areas of Sequoia and Kings Canyon National Parks were included in the wilderness recommendation but were not formally designated as wilderness. At that time Congress stated that this was done "without

prejudice." The parks have continued to manage these areas to preserve wilderness characteristics per NPS policy. These areas include:

- Redwood Canyon in Kings Canyon and the North Fork of the Kaweah River in Sequoia National Park, which have a combined total of 35,321 acres

  Redwood Canyon, which is separated from the core of Kings Canyon National Park and lies to the southwest, includes the largest sequoia grove in the parks — the Redwood Mountain Grove. There are over 10 miles of hiking trails and extensive karst features (including Lilburn Cave, one of the largest caves in California). Adjacent to the area that was originally recommended as wilderness is a rough, unpaved road less than two lanes wide that provides access to a trailhead. Some of the area was logged and contains second-growth sequoias, as well as a historic ranger station and an experimental sequoia management station. The area is used by hikers and stock parties.

- The North Fork of the Kaweah River is south of the Redwood Canyon area, in the northwestern section of Sequoia National Park. It contains rugged terrain and ranges from low foothill country to coniferous forests, including several giant sequoia groves. The area also contains the historic Colony Mill Road, now a trail, which was a wagon road built to access timber from giant sequoia groves in the late 19th century. Light use by hikers, stock parties, and anglers occurs mostly in spring and fall.

- Hockett Plateau in the watershed of the East Fork of the Kaweah River contains around 56,315 acres. Lying in the southwestern corner of Sequoia National Park, the area contains a variety of natural resources, including extensive tracts of giant sequoia groves. Part of Hockett Plateau was included in the original legislation for Sequoia National Park in 1890. At an elevation of 8,500′, the Hockett Plateau receives considerable stock and backpacker use. A historic ranger station is staffed seasonally. The southeast portion of the Hockett Plateau area is adjacent to Dillonwood and the Golden Trout Wilderness, and the northeast portion is adjacent to the Mineral King area.

WILDERNESS STUDIES

At the direction of Congress or in accordance with NPS *Management Policies 2001*, wilderness studies are to be conducted for the following areas:

- The 1,756-acre Chimney Rock area in Kings Canyon National Park is a rocky, rugged, and little-used area that is accessed by way of Forest Service roads. It has been determined to have characteristics that make it eligible for wilderness.

- The 15,600-acre Mineral King area is accessed by a road; trails leading out of the scenic Mineral King Valley provide access to high-altitude alpine areas. A stock pack station is near the valley trailhead. The area has been determined to have characteristics that make it eligible for wilderness except for the immediate road corridor and existing developments.

Wilderness studies for these areas by the parks could lead to wilderness recommendations that Congress could act on.

The Dillonwood area on the southern boundary of the park totals approximately 1,518 acres, 1,180 of which contain a sequoia grove. Access is provided by a dirt road from the Springville area. The area has been determined not to be eligible for wilderness.

Cultural Resources

HISTORICAL OVERVIEW OF THE PARKS

American Indians

When the present-day Sequoia and Kings Canyon National Parks were first inhabited is unclear. However, the possibility of Paleo-Indians' presence is postulated based on projectile point evidence dating from 12,000 B.C. to 9,000 B.C. By 1,000 B.C. human occupation in the parks is better documented, indicating more intensive use that continued into the historic period. European contact is dated to A.D. 1858 when Giant Forest was first visited by Hale Tharp, the first Euro-American to view the giant sequoia trees of this area.

Archeological evidence includes projectile points and tools of different cultural complexes and periods, pictographs and petroglyphs, small encampments and larger village sites, trade rendezvous places, granite bedrock mortars used to prepare acorns and other seeds, rock shelters associated with habitation sites, and so-called workshops where projectile points were manufactured from materials such as obsidian. In the historic period the Western Mono or Monache and the Eastern Mono or Owens Valley Paiute were known to occupy and frequent the park areas, as well as the Yokuts and Tubatulabal peoples. The Western Mono, who are linguistically related to the Eastern Mono, may have crossed the Sierra Nevada from east to west about A.D. 1500. Prehistorically and historically indigenous peoples used areas at higher elevations in the summer and lower elevations the rest of the year.

Euro-Americans

Euro-Americans first entered the southern Sierra Nevada during the late 1850s and early 1860s, building trails, grazing sheep and cattle, searching for gold and silver, and felling timber. Hale Tharp, who had begun raising cattle in the present-day Three Rivers vicinity, entered the Giant Forest area in September 1858 — perhaps the first Euro-American to do so and guided by two young Potwishas. By 1861 Tharp had begun using Log Meadow as summer range for horses and later built a trail to the south end of the meadow to be used by his growing cattle herd.

The first record of a Euro-American entering the Kings Canyon area is from 1862, when John Hardin Thomas "discovered" what would later be known as the General Grant Tree. The influx of Euro-American settlers, prospectors, and loggers forced Native Americans to leave the Sequoia and Kings Canyon area by the mid-1860s. In 1870 settlers occupied the Fallen Monarch, a huge hollow log in what would become known as Grant Grove, operating a saloon within its confines.

Sheepherders made the first commercial use of the Kings / Kaweah / Kern watersheds during the 1860s and 1870s, but prospectors also participated in the exploration and utilization of the watersheds. After years of futile efforts by prospectors to find valuable minerals, silver was discovered in 1873, touching off a rush to the Mineral King Valley. Prospectors eagerly filed mining claims, and the New England Tunnel and Smelting Company promoted development. Thomas Fowler, a prominent Californian, completed a toll road into the valley in 1879 and built a stamp mill and a tramway to the Empire Mine, but these ventures proved unprofitable. The toll road (the precursor of the present-day Mineral King Road) became public, but only a few summer tourists, attracted by the cool mountain air, continued to visit the valley.

Logging began soon after the first settlers arrived in the San Joaquin Valley; by the 1860s several small mills operated on the most accessible fringes of the coniferous forest. At first the mills served only local communities, but the completion of the Southern Pacific Railroad line in the mid-1870s opened more distant markets. Although pine and fir trees provided most of the lumber, many giant sequoias were cut to provide

shakes, fence posts, and grape stakes. In 1885 colonists associated with the utopian Kaweah Colony, under the leadership of Charles Keller, filed claims to lands in the Giant Forest vicinity and built the Colony Mill Road to provide access for sequoia logging operations. In 1889 log flumes were introduced, opening previously inaccessible timberlands to loggers. In 1890 the Kings River Lumber Company (later reorganized as the Sanger Lumber Company) began to ship timber via a long flume to Sanger, more than 50 miles away. During its operation this one company felled nearly every tree in the Converse Basin, once the finest stand of giant sequoias in existence.

John Muir first traveled into the southern Sierra Nevada in 1873. Two years later he traced the belt of giant sequoias south from the Mariposa Grove, crossing the North and Marble Forks of the Kaweah River and climbing into a "noble forest," which he named the Giant Forest.

Establishment and Development of the National Parks

Shortly after John Muir's visit, efforts to save the magnificent sequoias began. In 1880 four sections of the Grant Grove area were suspended from entry, temporarily prohibiting anyone from claiming the land under existing land laws. Sequoia National Park, the nation's second national park, and General Grant National Park, the nation's fourth national park, were established by Congress on September 25 and October 1, 1890, respectively. On the latter date, Sequoia National Park was tripled in size. On February 14, 1893, President Benjamin Harrison signed a proclamation establishing the Sierra Forest Reservation, an area of more than 4 million acres stretching from Yosemite National Park in the north to a point well south of Sequoia National Park.

Administration of the new national parks was assigned to the military. On June 7, 1891, Captain J. H. Dorst, Fourth United States Cavalry, established a camp outside the parks at Mineral King and became their first acting superintendent. In 1914 Walter Fry was appointed as the first civilian superintendent of the two national parks.

During the early 20th century efforts were started to improve access to the national parks and to develop their recreational potential. In 1902 a contract was awarded to John Broder and Ralph Hopping, two local ranchers, to operate the first commercial transportation and camping facilities in Sequoia National Park. That same year a road was constructed to the "Big Trees" in Grant Grove; later this road would be rebuilt with alignment changes to form the Sequoia Lake Road. In 1903 the Colony Mill Road was improved and extended to Round Meadow and Moro Rock in Giant Forest under the direction of Captain Charles Young, the only African-American then holding a regular commission in the U.S. Army, and on May 24, 1904, the first automobile entered Giant Forest. In 1913 the first well-graded approach road to General Grant National Park was constructed, reaching the park from the south.

During the 1910s a simple commercial village developed near Round Meadow in the Giant Forest vicinity. Campgrounds were established at Giant Forest in 1920, and the first winter accommodations, as well as informal winter sports activities, were initiated here in 1922. By the end of the 1920s, a new Giant Forest village had taken shape around the Sentinel Tree, featuring a gasoline station, a lunch room that also served as a winter lodge, a market, and a new photography studio.

In 1926 Sequoia National Park was enlarged to include the Kern Canyon / Mount Whitney area, increasing the park's area from 252 to 604 square miles. Samuel Pierpont Langley had conducted research on solar heat on the summit of Mount Whitney as early as 1881, and in 1909 the Smithsonian Institution had constructed a stone building on the peak's summit to conduct solar heat observations.

The 1926 legislation also designated 25 square miles in the Mineral King area as the Sequoia National Game Refuge to protect the area's wildlife that moved freely in and out of the

surrounding national park lands. The refuge was administered by the U.S. Forest Service.

Road construction during the 1920s and early 1930s made the national parks more accessible to automobile touring. In 1921 construction of Generals Highway began, and it took five years to build 18 miles from Ash Mountain (the site of the new park headquarters at the southern edge of Sequoia National Park) to Giant Forest. In 1932 the General Grant National Park section of the Generals Highway was completed, and in 1934 the picturesque inter-park highway was opened for automobile travel from Grant Grove to Ash Mountain. In 1929 construction started on a state highway from Grant Grove to Kings River Canyon.

In 1933 five Civilian Conservation Corps (CCC) camps were established in Sequoia National Park; later two more were added. Enrollees constructed campgrounds, trails, ranger stations, and other administrative facilities; landscaped roadsides; cut firewood; and controlled forest fires. Some of the notable CCC improvements included structures and trails in Giant Forest and Grant Grove villages, the rock work along Generals Highway, and the stone stairway on Moro Rock. An ice-skating rink at Lodgepole and a ski area at Wolverton were opened in 1934. In 1940 Crystal Cave, discovered by park employees in 1918, was opened to the public after the CCC constructed a trail and lighting system.

After a 50-year struggle Kings Canyon National Park was finally established on March 4, 1940. Its purpose was to protect some 710 square miles of scenic mountain and rugged canyon wilderness on the west slope of the Sierra Nevada, including the former General Grant National Park. Several months later the Redwood Mountain area north of Sequoia National Park was added to Kings Canyon. In 1943 the administration of Sequoia and Kings Canyon National Parks was unified as a wartime economy measure, an arrangement that continues to the present day. In 1965 the Cedar Grove area of the Kings Canyon, described by John Muir as a "rival to Yosemite," and Tehipite Valley were added to Kings Canyon National Park to protect their valley floors from proposed water development projects for the expanding Los Angeles metropolitan area.

In 1976 Sequoia and Kings Canyon National Parks were among the first American national parks to be designated as international biosphere reserves under the Man and Biosphere Program of the United Nations Educational, Scientific, and Cultural Organization. Each biosphere reserve represents a specific ecosystem; a place for research, monitoring, and education; and a place where government policy makers, scientists, and local persons cooperate to manage land and water resources to meet human needs while conserving natural resources.

In 1978 Congress added the Mineral King area to Sequoia National Park, bringing an end to a 12-year fight. In 1966 the U.S. Forest Service, responding to greater demands for outdoor recreation, had granted Walt Disney Productions a preliminary planning permit for a year-round resort in the Mineral King Valley, which would include a Swiss-style village, ski-lifts to serve 20,000 skiers daily, and parking for 3,600 vehicles. However, the Sierra Club argued that Mineral King's value as wilderness made the valley worthy of national park status, and that development would cause irreversible damage. As a result of litigation that reached the U.S. Supreme Court, the California legislature's refusal to fund improvements of the Mineral King Road, and growing national public opposition to the plans, Disney dropped the resort plans, leading to the legislation adding the area to the park.

Nearly 70 years after John White (park superintendent 1920–1939 and 1941–1947) raised the issue that development was damaging the very sequoias that the parks had been established to protect, all overnight visitor facilities, including many locally significant historic structures, were removed from the Giant Forest area. Replacement facilities and lodging accommodations are being provided at Wuksachi, and the grove's natural setting is being rehabilitated.

On April 15, 2000, President William J. Clinton signed a proclamation creating the Giant Sequoia National Monument, consisting of two parcels of Sequoia National Forest. The northern parcel is bordered by the Kings Wild and Scenic River (authorized on November 3, 1987); the southern parcel by the North Fork of the Kern Wild and Scenic River (authorized on November 24, 1987).

ARCHEOLOGICAL RESOURCES

There are some 260 archeological sites known in the parks. About 4% of the parks' acreage (approximately 35,000 acres out of 864,000) has been surveyed for cultural resources. Most of the survey work has been in the parks' frontcountry, which is more easily accessible and where developments or projects are most often proposed (e.g., roads, campgrounds, overnight accommodations, and prescribed fires). Comparatively fewer backcountry projects have been carried out (excluding historic structure evaluations, trail surveys, and topic-specific research).

Both prehistoric and historic archeological sites can be found in the parks. Twenty-six archeological sites have been recorded that show obsidian fragments. Obsidian tools were highly prized for their sharpness and suggest trade since mineral analysis of the obsidian shows that some of it came from sources far away (Roper Wickstrom 1992). Sites in east-west passes like Taboose Pass in Kings Canyon National Park suggest trade routes, as well as the presence of women with children, because grinding stones have been found as evidence of food preparation. Also, stone structures thought to have served as hunting blinds as well as temporary shelters have been found. At least one site suggests evidence of use over many years because of the range of artifacts, from prehistoric stone tools to 19th century trade beads (1200 B.C. to A.D. 1850).

Human remains have been found in Crystal Cave, which were repatriated according to Native American consultation procedures in accordance with the Native American Graves and Repatriation Act. A newly published book provides evidence of Yokuts traditional ethnographic interest in Crystal Cave (Despain 2003), which will be pursued as a topic of the parks' ongoing Native American consultations. Archeologically, one prehistoric bedrock mortar site for grinding seeds is located outside the entrance to Crystal Cave. Inside the cave, a charcoal hearth has been found that came "from a tree that died between [A.D] 1600 and 1820 . . . [and the hearth was located] near the largest entrance to Crystal Cave, in an area natural light has its farthest reach into the cave . . . [marking] the best place to start a fire to illuminate the next dark and to light torches for further exploration" (Despain 2003). Other than the historic remnants of CCC stone work at the Crystal Cave's entrance, there are no other known cultural resources associated with caves in the parks.

Two archeological sites are listed on the National Register of Historic Places:

- *Groenfeldt Site* — Listed March 30, 1978. This is a rock shelter of late prehistoric times with considerable human habitation. While the site is between Grant Grove and Giant Forest, it is in such remote and relatively steep terrain that visitors would probably find it only by accident.
- *Hospital Rock* — Listed August 29, 1977. Hospital Rock is a late prehistoric village site with pictographs, pottery, and evidence of human burials. Its historic components continue up to the time of European contact in the mid-19th century. However, any links between the prehistoric and the historic Indians who lived here are not well defined. Located at the point where Generals Highway begins its ascent to Giant Forest, this is a popular spot for visitors to picnic, use the comfort station, and take in the interpretive wayside exhibits.

HISTORIC STRUCTURES, DISTRICTS, AND CULTURAL LANDSCAPES

The wide range of cultural resources in Sequoia and Kings Canyon National Parks reflects the evolution of land use philosophy, from prehistoric human use of natural resources; through

Euro-American settlement, control, and extraction of resources; to the conservation and preservation movements of the late 19th and 20th centuries. According to the NPS thematic framework of American history and prehistory for studying and interpreting historic sites, four of the primary NPS history themes can be related to Sequoia and Kings Canyon National Parks:

I. *Peopling Places* — human population movement and change through prehistoric and historic times, as well as the evolution and development of communities according to cultural norms, historical circumstances, and environmental contingencies

III. *Expressing Cultural Values* — expressions of culture — people's beliefs about themselves and the world they inhabit, as well as the ways that people communicate their moral and aesthetic values

V. *Developing the American Economy* — ways Americans have worked and the ways they have materially sustained themselves by the processes of extraction, agriculture, production, distribution, and consumption of goods and services

VII. *Transforming the Environment* — the variable and changing relationships between people and their environment

Historic sites, structures, and landscapes in Sequoia and Kings Canyon National Parks date from the late 19th century and extend to the post-World War II era. Site types include cabins, ranger stations, cattle and sheep camps, ranching sites, logging areas, mines, bridges, hydroelectric dams and flumes, trails, wagon roads, and early automobile roads and highways. Numerous structures relate to the development of the national parks under the direction of the National Park Service.

Historic Properties Listed on the National Register of Historic Places

Authorized by the National Historic Preservation Act of 1966, the National Register of Historic Places is the nation's official list of districts, sites, buildings, structures, and objects in both public and private ownership that are significant in American history, architecture, archeology, engineering, and culture. The following 20 historic structures and districts in Sequoia and Kings Canyon National Parks are listed on the national register, along with the date each was listed:

- Ash Mountain entrance sign — April 27, 1978
- Barton-Lackey cabin — March 30, 1978
- Cabin Creek ranger residence and dormitory — April 27, 1978
- Cattle cabin — September 15, 1977
- Gamlin cabin — March 8, 1977
- Generals Highway stone bridges (Clover Creek bridge, Marble Fork bridge) — September 13, 1978
- Giant Forest Lodge Historic District — May 5, 1978. During 1998–99, all structures in this historic district were removed.
- Giant Forest Village / Camp Kaweah Historic District — May 22, 1978. During 1998–99, the majority of the structures in this historic district, with the exception of the district ranger's residence, the comfort station, and the market, were removed.
- Hockett Meadow ranger station (also includes a barn) — April 27, 1978
- Knapp's cabin (also known as Artist's Cabin) — December 20, 1978
- Mineral King Road Cultural Landscape District — October 24, 2003. Includes 52 buildings, 2 sites, and 4 structures that contribute to the district's significance, along with 19 buildings and 1 structure that do not contribute to its significance. (Preliminary determination of eligibility studies identified mining, resource preservation [logging and early NPS history], recreation, and the modern environmental movement as themes contributing to the significance of the cultural landscape district.)
- Moro Rock stairway — December 29, 1978

- Pear Lake ski hut (also known as Pear Lake ranger station) — May 5, 1978
- Quinn ranger station — April 13, 1977
- Redwood Meadow ranger station (also includes barn) — April 13, 1978
- Shorty Lovelace Historic District — January 31, 1978. Includes Cloud Canyon, Vidette Meadow, Gardiner Creek, Woods Creek, and Granite Pass cabins.
- Smithsonian Institution shelter (also known as Mount Whitney summit shelter, Mount Whitney shelter) — March 8, 1977
- Squatter's cabin — March 8, 1977
- Tharp's Log — March 8, 1977
- Wilsonia Historic District — March 14, 1996. An inholding in the Grant Grove vicinity within Kings Canyon National Park, the historic district is composed of 139 buildings that contribute to the district's significance, as well as 73 non-contributing buildings.

Historic Properties Determined Eligible for Listing on the National Register of Historic Places

Seven historic structures, features, and districts in Sequoia and Kings Canyon National Parks (along with their dates of determination) have been determined eligible for listing on the National Register of Historic Places by the California state historic preservation officer:

- Atwell Mill ranger station and garage — December 8, 1997
- Atwell mill site — 1976
- General Grant National Park Historic District — December 29, 1998. Includes 71 eligible buildings/structures (3 structures not eligible).
- Generals Highway (including Hospital Rock automobile watering stations and stone water fountain, and Tunnel Rock) — June 1992
- Lost Grove comfort station — December 8, 1997
- Redwood Mountain residence — December 8, 1997
- Kaweah hydroelectric plant no. 3 — March 21, 1990. Located near Three Rivers, this historic property includes three contributing structures (the powerhouse, the Marble Fork conduit, and the Marble Fork siphon and diversion dam).

Potential National Register Listings

Four historic districts in the parks are under consideration by the National Park Service for evaluation and potential nomination to the National Register of Historic Places. Formal evaluations are yet to be undertaken:

Ash Mountain Historic District — The National Park Service considers 17 buildings or structures as contributing to the significance of the potential historic district, and 38 buildings or structures do not contribute.

Lodgepole Historic District — The National Park Service considers four buildings or structures as contributing to the significance of the potential historic district and two buildings or structures as not.

Sycamore Civilian Conservation Corps Camp Historic District — The National Park Service considers four buildings or structures as contributing to the significance of the potential historic district. Trailers in this area do not contribute to the significance of the area.

Mission '66 Structures — While most historic sites, structures, and landscapes in the parks date from the late 19th century and extend through the 1940s, current studies are examining potentially eligible structures from the NPS Mission '66 construction program in the Ash Mountain, Lodgepole, and Grant Grove areas.

Structures Determined Ineligible for the National Register

Three historic structures in Sequoia and Kings Canyon National Parks have been determined to be ineligible for listing on the National Register of Historic Places by the California state historic preservation officer. These properties, and the dates of their determinations, are:

- Muir hut (also known as Muir Pass shelter cabin) — September 15, 1976
- Beetle Rock assembly hall — August 5, 1994
- Sycamore Village shoeing shed — December 8, 1997

Historic Districts to be Removed from the National Register

In 1994 the California state historic preservation officer determined that additional resources in the Giant Forest area were eligible for listing on the National Register of Historic Places, including the Pinewood Shelter Camp Historic District, Lower Camp Kaweah Historic District, and various structures in the NPS Highland housing area. However, the National Park Service, the California state historic preservation officer, and the Advisory Council on Historic Preservation had executed a memorandum of agreement on August 21, 1978, providing for the removal of overnight facilities from Giant Forest that adversely affected the internationally significant natural values for which Sequoia National Park had been established to preserve. As previously mentioned, during 1998–99 all buildings (all of which had been determined to have local historical significance) were removed from the Giant Forest area, with the exception of the ranger's residence, the comfort station, the market, and the Beetle Rock assembly hall. This action was taken pursuant to the memorandum of agreement between the National Park Service and the California state historic preservation officer, and it was accepted by the Advisory Council on Historic Preservation on September 25, 1995. The 1995 agreement was undertaken to provide for the restoration/rehabilitation of the natural conditions of the Giant Forest area and the preservation of the internationally significant sequoias. The National Park Service intends to initiate actions to remove the Giant Forest Lodge and Giant Forest Village / Camp Kaweah Historic Districts from listing on the National Register of Historic Places.

The Beetle Rock assembly hall is to be retained for use as a center for public education and/or group events.

List of Classified Structures

Currently, 98 structures in the parks are on the parks' List of Classified Structures (see appendix C). This list is an inventory of all structures with historical, architectural, or engineering significance and in which the National Park Service has or plans to acquire a legal interest. Structures may individually meet the criteria of the national register or may be contributing resources to sites and districts that meet national register criteria. Also included are other structures that have been moved or reconstructed, commemorative structures, and structures achieving significance within the last 50 years. These structures are to be managed as cultural resources because of management decisions made pursuant to the planning process.

CULTURAL LANDSCAPES

To date, one cultural landscape in Sequoia and Kings Canyon National Parks has been listed on the National Register of Historic Places. The Mineral King Road Cultural Landscape District is a historic vernacular landscape, and it was listed on October 24, 2003.

In 1998 the Cultural Landscapes Automated Inventory Management System database indicated that 10 parent landscapes and 13 component landscapes have been identified in the parks at the park reconnaissance survey stage. Studies are underway to identify and inventory additional cultural landscapes. Currently identified landscapes include:

- Ash Mountain Historic District
- Generals Highway

  - Hospital Rock automobile watering stations
- Giant Forest
  - Giant Forest Lodge Historic District
  - Giant Forest Village / Camp Kaweah Historic District
  - Lodgepole
- Kern Ranger Station / Lewis Camp Area
  - Kern River Trail
- Mineral King Historic District
  - Early Trails
  - Empire Mine
  - Mineral King cabin community
  - Mineral King Road
  - New England Tunnel and Smelting Company
  - White Chief Mine
- Pear Lake
  - Pear Lake ski hut and ranger station
- Quinn ranger station
- Sycamore Village
- Wilsonia
- Cabin Creek ranger residence and dormitory

The May 2003 "National Park Service Cultural Landscapes Inventory" for Sequoia and Kings Canyon National Parks (NPS 2003c) made the following preliminary determinations about park landscapes:

- Landscapes that have lost their integrity:

  Lodgepole
  Hospital Rock
  General Sherman Tree area
  Giant Forest
  Sycamore CCC camp

- Landscapes that have retained their integrity:

  Generals Highway
  Ash Mountain
  Grant Grove
  Crystal Cave

- Landscapes that may be found significant under the current Mission '66 study:

  Potwisha campground
  Buckeye Flat campground
  Buckeye housing area

Because the evaluation process has not been completed, this environmental impact statement has evaluated impacts on all of these cultural landscapes as if they were eligible for listing on the National Register of Historic Places.

ETHNOGRAPHIC RESOURCES AND LANDSCAPES

An ethnographic resource is defined as "a site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it" (NPS 1997). Certain plants continue to be gathered and used by American Indian tribes near the parks, such as the Wuksachi Tribe; specific gathering spots have not been identified to date. Sites or areas with continuing importance to contemporary Native American groups and individuals include the rock art at the Hospital Rock picnic area and the Potwisha campground. (Federally recognized tribes are listed in appendix D.)

At the time of Spanish and American exploration and settlement in the early and middle 1800s, known Yokuts groups included the Chunut and the Tachi of the Tulare Lake region; the Chukaimina of the Squaw Valley area; the Wukchumni of the upper Kaweah River area, including Lemoncove and Three Rivers; and the Choinimi, Dumna, Kechayi, and Chukchansi of the northern foothills. On the west side of the Sierra were Paiute-related groups, the Western Mono or Monache. They are believed to have migrated over the mountains 400 to 500 years ago. The Monache groups included the Michahai, Wuksachi, Wobonuch, Entimbich, and Potwisha.

The Yokuts as well as Monache groups are known to have seasonally used general areas within the parks, and a newly published book provides evidence of the Yokuts' traditional ethnographic interest in Crystal Cave. Historic

era contact and intermarriage among Yokuts and Monache groups occurred with some regularity, making the ethnographic picture more complex. Descendants of these groups can be found today on the Tule River Reservation, within the various Paiute reservations and communities of the Owens Valley, and interspersed within the larger communities of the foothills and central valley towns and cities on the west side of the parks. A handful of key ethnographic studies exist for Native American groups (Gayton 1929, 1930, 1948; Latta 1949; and Steward 1933, 1935), but a formal parks-specific ethnographic overview has not been conducted to date.

Ethnographic landscapes generally are larger in area and broader in scope than the vernacular or designed historic landscapes that are often considered under the category of cultural landscapes. No ethnographic landscapes have been identified thus far through consultations with American Indians and other neighbors of the parks.

To date no ethnographic resources have been identified as potentially eligible for listing on the National Register of Historic Places as traditional cultural properties. Ethnographic resources eligible for or listed on the national register are called traditional cultural properties. Such resources may be listed or eligible for listing because of their association with a living community's cultural practices or beliefs that are rooted in that community's heritage and history and because they are important to the continuity of the community's identity.

Consultations with American Indians and other neighbors of the parks will continue to identify possible ethnographic resources and landscapes for further learning and consideration. One such topic for ongoing Native American consultations is indigenous fire management. Possible indigenous fire-management areas could be considered as traditional cultural properties eligible for the national register and could be a topic of mutual interest for both a tribe and the National Park Service to share information about how such areas might best be managed.

The parks have completed their compliance with the provisions of the Native American Graves Protection and Repatriation Act.

MUSEUM COLLECTIONS AND ARCHIVES

Sequoia and Kings Canyon National Parks have maintained museum collections since the earliest days of the National Park Service. The collections support cultural and natural resource management and provide material for research by park staff and outside scholars. At present, the parks' museum collections and archives total approximately 340,000 items. A relatively small number of museum objects (about 200) are on exhibit to the public in the parks' various visitor centers.

Collections

The parks' museum collections document the archeology, biology (including wildlife biology and botany), geology, paleontology, ethnography, and history of the region.

- The archeology collection (some 22,000 artifacts) consists primarily of obsidian tools and debris, and also pottery (relatively rare on the western slope of the Sierra Nevada).
- The largest and most heavily used part of the biology collection (with 10,000 zoological or botanical specimens) is the herbarium, with examples of 1,200 of the 1,400 known plant species. Other collections preserve bird, insect, and mammal specimens. As these collections grow with ongoing inventory and monitoring efforts, they will help establish a baseline for species and their geographic distribution within the parks.
- The geology collection (300 specimens) consists primarily of minerals and formations from area caves.
- The paleontology collection (20 specimens) consists entirely of fossilized sequoia wood. The 17 sequoia fossils are from different parts of the world, such as Norway, Alaska,

and Washington State. The geologic conditions of the parks do not facilitate preservation of fossils.

- The ethnographic collection (30 artifacts) consists of a small but important group of historic, locally produced American Indian baskets.
- The history collection includes nearly 300,000 manuscripts and records associated with Euro-American exploration and settlement, local history, and park history. Other items include period uniforms, photographic albums, maps, and a miner's cache. A collection of 11,000 historic photographs documents both the natural and cultural environment of the parks.

Library

Museum staff maintain the parks' five branch libraries, which make available various scientific, regional, and park-specific works on natural and cultural resources. The libraries provide an opportunity for research and the preparation of visitor-education materials and programs.

Storage Conditions

Today, most of the parks' museum collections are housed in the headquarters at Ash Mountain. This is essentially a research and storage facility, not an exhibit space.

The museum collections storage area is approximately 600 square feet, which is inadequate and limited for the present collections. While temperature and humidity are regularly monitored and recorded, these are controlled by the thermostat for the building-wide heating and cooling system. Temperature and humidity levels have proven to be fairly constant, and within NPS standards, perhaps, because this end of the building is partially built into an earthen bank.

Security and Fire Suppression Arrangements

The Ash Mountain facility is secure and well protected with keyed entry and an independent alarm system.

A fire suppression system is in place, and the collections and archives environment is closely monitored. This is especially important given that the Sequoia and Kings Canyon ecosystems are thoroughly co-adapted to fire. The primary collections storage area is equipped with an automated fire detection and suppression system employing a halon-substitute (ozone-depletion problems preclude the use of halon). Individual fire extinguishers are kept at other museum storage facilities. No original, irreplaceable objects from the collections are exhibited or stored under conditions not in full compliance with NPS fire-safety standards.

Future Needs

The primary concern for the continued well-being of museum collections is space. Both storage and workspace are at premium in the collections storage area, despite the installation of compressed shelving on movable tracks. The collections are certain to grow, especially with regard to collections linked to ongoing projects (e.g., the herbarium and the records of prescribed burns and wild fires); this will further exacerbate the space shortage. There is also a shortage of adequate workspace for researchers and for the curation of objects.

Transportation and Circulation

ROADWAY NETWORK IN AND AROUND THE PARKS

In 1988 a total of 83 roadways in Sequoia and Kings Canyon National Parks (including some roads to parking areas) were classified and numbered (NPS 1988). The discussion below describes important regional and park roadways.

Two regional highways provide access to Sequoia and Kings Canyon National Parks:

- California Highway 198 provides access from Visalia to the Foothills visitor center at Ash Mountain in Sequoia National Park. At Ash Mountain California 198 becomes Generals Highway, which provides most of the road access to Sequoia's main visitor interest areas. Generals Highway terminates at Kings Canyon Highway about 1 mile south of Grant Grove and east of the Big Stump entrance station.
- California 180 provides access from Fresno to the Big Stump entrance station in Kings Canyon National Park. At Big Stump California 180 continues into the park as the Kings Canyon Highway, leading through Grant Grove to the Cedar Grove area of Kings Canyon.

Kings Canyon Highway and Generals Highway are paved two-lane roads, characterized by 22-foot traveled ways. Shoulder widths vary, but are generally very narrow and unpaved. Both highways also have a fair number of vehicle turnouts at scenic viewpoints. Free-flow speeds on both highways vary from about 20 miles per hour (mph) on steep, winding sections to 35–40 mph on newer, flatter sections. Generals Highway provides access to private inholdings along the Big Meadow road and to USFS special use permit cabins at Hart Meadows. There is a large year-round resort at Montecito-Sequoia, and seasonal lodging and food service at Stony Creek that are accessed directly from Generals Highway. As previously stated, the Generals Highway has been determined eligible for the National Register of Historic Places.

Mineral King Road intersects California 198 just south of the Ash Mountain entrance station and provides access to the Mineral King trailheads, camping areas, and several private inholdings. The first section of the road is outside the park and is under the jurisdiction of Tulare County; the remainder of the road is within Sequoia National Park. Mineral King Road is paved for 17 miles; the remaining 8 miles are a mix of paved sections around development and unpaved sections away from cabins and campgrounds. All of the unpaved sections are within the park. At higher elevations and within the park, the road is predominantly one lane and unpaved, with a speed limit of 10–20 mph. As previously stated, the Mineral King Road Cultural Landscape District has been listed on the National Register of Historic Places.

Two other roads follow the North and South Forks of the Kaweah River into the western side of Sequoia National Park. Both are two-lane paved roads that provide access to homes and other lands in the Three Rivers area. As the roads near the park, they become one-lane unpaved roads. Both roads terminate inside the park boundary, with a campground at the end of the South Fork road.

Other paved two-lane roads of substantial length within the park connect attractions, including Crystal Cave, Crescent Meadow / Moro Rock, Wolverton, Lodgepole, and Panoramic Point. Of these roads, Crescent Meadow / Moro Rock, Crystal Cave, and Panoramic Point are two-way but are not wide enough to allow a center stripe to demarcate two lanes. Wolverton Road has full 11-foot lanes in both directions and center striping. Other shorter roads to campgrounds, trailheads, viewpoints, and natural features throughout the parks are typically narrow and unpaved, with no shoulders. The Panoramic Point Road and Kings Canyon Highway, as well as portions of Mineral King Road, were paved in 2001. The

Wye, near Grant Grove, was replaced with a T intersection. Some roads were also improved in park developed areas.

The Moro Rock trail and Colony Mill Road (now a trail) have been determined eligible for the National Register of Historic Places. Other roads and trails will be identified, inventoried, and evaluated for listing eligibility.

VISITOR CIRCULATION IN THE PARKS

A comprehensive visitor survey was conducted for the parks in the winter and spring of 1998 and is documented in the "Transportation and Visitor Use Data Summary for Winter / Spring 1998 and Transportation Condition Assessment" (BRW, Inc., and Lee Engineering 1999).* According to this survey, the distribution of visitors between the two primary entry routes was fairly even. About 60% of visitors left via the same gate they entered.

Data on areas visited showed that over 66% of visitors went to only one major activity area; no single activity area was a clear favorite. In fact, 10% of survey respondents had not visited any major activity areas during their stay. Surveys in the summer of 1997 showed slightly longer stays, as well as visits to more major activity areas per stay, than the winter / spring 1998 surveys. This finding is not unexpected, since families with school-age children probably limit their visits to weekends during non-summer months, and many activity areas are not accessible in the winter.

Visitors primarily travel to Sequoia and Kings Canyon National Parks by private vehicle; tour bus use has increased in recent years, but is still limited. Vehicular access is predominantly along the Generals Highway and the Kings Canyon Highway. The Mineral King Road and the North Fork and South Fork roads also provide access to other park areas. All of these roads wind through foothills and mountainous forest areas and may provide challenging driving experiences for visitors. Vehicle length restrictions and advisories are intended to provide more pleasant experiences for all motorists and safer ones for those with larger vehicles. Roads may be closed due to weather conditions; the Mineral King and Cedar Grove areas are closed from winter through late spring.

TRANSPORTATION SERVICE QUALITY OF PARK ROADS

Road Use and Congestion

Traffic congestion and road use data are expressed here in four ways: length and classification of vehicles in the traffic stream, average daily traffic (ADT) on key road segments, peak-hour volumes and level of service (LOS) on key road segments, and peak-hour volumes and level of service at intersections.

Vehicle Length and Classification

Data on vehicle length and type were collected in 1997 for the "Visitor Use Survey" at the following locations:

1. Big Stump entrance on Kings Canyon Highway, inbound — length and classification
2. Generals Highway at the Giant Forest museum, northbound — length and classification
3. Mineral King entrance, inbound — classification only

Single vehicles on Generals Highway are restricted to a maximum length of 40 feet, and vehicles with trailers may not exceed 35 feet. The Park Service recommends that large vehicles use the Big Stump entrance because the horizontal and vertical curves along the northern portion of Generals Highway are not as sharp as those along the southern portion. Vehicles longer than 22 feet are discouraged from using Generals Highway between the Potwisha

* Visitors were randomly sampled upon exiting the parks about their entry point, visit duration, and use of various roads and major activity areas, such as Giant Forest, Kings Canyon, or Mineral King. More than 1,400 surveys were collected over five days (three days in March and three days in May).

campground and the Giant Forest museum because of the numerous switchbacks. Table 6 summarizes vehicle lengths and Table 7 vehicle classifications.

Average Daily Traffic

Daily traffic volume counts were taken at 19 locations in and near the parks in the summer of 1997 and the winter and spring of 1998, but not all locations were counted in all three seasons. Data represent the daily average for a three-day count period at each location (see Figure 3). The California Department of Transportation (Caltrans) has also published 1997 ADT information for California Highways 180 and 198 showing annual average daily traffic for these highways. On California 180, just west of Kings Canyon National Park, the Caltrans ADT count was 1,400 in 1997, somewhat lower than the average three-day weekend volume reported in the NPS study. On California 198, just south of Mineral King Road, the Caltrans ADT count was 3,450, considerably higher than the count reported for the NPS study. The higher count could include local traffic in the Three Rivers community.

Peak-Hour Roadway Level of Service

Transportation service quality for recreational roads is commonly based on definitions in the Transportation Research Board's *Highway Capacity Manual*. Uniform standards are used to define and measure the operational performance of different types of roads by using the level of service (LOS) concept, as defined below:

- *LOS A* — free-flow traffic. Individual users are virtually unaffected by other vehicles on the road. Nearly all drivers are free to select their desired speeds and to maneuver within the traffic stream. The general levels of comfort and convenience for motorists, passengers, and pedestrians are excellent.
- *LOS B* — high-quality, stable traffic flow. The presence of other users begins to be noticeable to individual drivers. The freedom to select desired speeds is relatively high, but the freedom to maneuver within the traffic stream declines slightly from LOS A. The levels of comfort and convenience for individual travelers are somewhat less than at LOS A because the presence of others in the traffic stream begins to affect individual behavior. On a road operating at LOS B, slow-moving vehicles would delay a few drivers, especially on steep grades.
- *LOS C* — the beginning of traffic flow in which individual travelers are substantially affected by other vehicles in the traffic stream. The selection of speed by most users is affected by the presence of other vehicles. Maneuvering within the traffic stream requires substantial vigilance on the part of the driver. At LOS C slow-moving vehicles delay some drivers. The general

TABLE 6: VEHICLE LENGTHS

	Sample Size	Primary Vehicles			Primary Vehicles with a Trailer			
	(veh)	<22′	22–30′	>30′	<22′	22–30′	30–40′	>40′
Big Stump Entrance	792	92%	3%	1%	1%	1%	1%	1%
Generals Highway at Moro Rock	649	96%	2%	0%	2%	0%	0%	0%

SOURCE: BRW Inc. and Lee Engineering 1999. Data collected by Traffic Analysis and Research, Inc.

TABLE 7: VEHICLE CLASSIFICATIONS

	Sample Size (veh)	Passenger Cars	Motorcycles	Pickups (w/ Camper), Vans (<22′)	RVs (<22′)	Commercial Buses	Single Unit Trucks	Semi-Trailers
Big Stump Entrance	792	92%	1%	2%	2%	1%	1%	1%
Generals Highway at Moro Rock	649	96%	0%	4%	0%	0%	0%	0%
Mineral King Entrance	49	98%	0%	2%	0%	0%	0%	0%

SOURCE: BRW Inc. and Lee Engineering 1999. Data collected by Traffic Analysis and Research, Inc.

level of comfort and convenience at this level is noticeably worse than at LOS B, and some park visitors may begin to consider their visitor experience compromised.

- *LOS D* — the upper end of traffic volumes that can be accommodated while maintaining stable traffic flow. Vehicle speeds and the freedom to maneuver are severely restricted for nearly all users. Drivers and pedestrians experience a poor level of comfort and convenience. Other vehicles delay most drivers, and some visitors perceive conditions as crowded.
- *LOS E* — operating conditions at or near the capacity of the roadway. All speeds are reduced to a low but relatively uniform level. There is virtually no freedom to maneuver within the traffic stream; traffic entering the stream usually requires that drivers already on the road voluntarily "give way." Comfort and convenience levels are extremely poor, and driver frustration is high. Operations at this level are usually unstable, in that small increases in flow or minor disruptions within the traffic stream cause all traffic to stop. Delays and slow speeds create a noticeable negative visitor experience for most visitors.
- *LOS F* — forced flow. LOS F occurs when more traffic attempts to use a road segment than can be accommodated. Flow is extremely unstable. Long queues form in the traffic stream, and operations are characterized by stop-and-go waves, with vehicles perhaps progressing at reasonable speeds for several hundred feet, then stopping in cyclic fashion. At this level the experience is so compromised that many visitors may reconsider their route or destination and make comments about traffic problems to acquaintances or park officials.

The methods, measures, and empirical relationships developed for two-lane rural roads are the most applicable to the roads in Sequoia and Kings Canyon National Parks.

Driving in a park environment (especially where attractive natural scenery is visible from the car) differs considerably from driving on a typical roadway. Driving in a park can be part of the visitor experience, and traffic often moves at speeds well below the legal limit. As such, the LOS results may understate traffic congestion, because the effects of drivers slowing or stopping in the roadway to look at scenery or read signs are not taken into account. The peak-hour level of service was evaluated for the morning and evening peak hours at all locations and seasons for which data were collected and are shown in Figure 4.

Intersection Level of Service

Level of service for intersections relates to the delays drivers encounter while waiting for an acceptable gap in opposing traffic. LOS estimates are based on information about specific turning movements at each intersection, and the level of service is determined from the total estimated delay for unsignalized intersections.

Four intersections along Generals Highway were analyzed — the Wye on Kings Canyon Highway, Lodgepole road, Wolverton Road, and Crescent Meadow / Moro Rock road. Vehicles were counted at each location in summer 1997 during the morning, midday, and evening peak hours (9–11 A.M., 12 noon–2 P.M., and 3–5 P.M.), and the volumes in the highest hour (four consecutive 15-minute periods) were chosen for analysis. All four intersections operated at LOS A or B (very low delays) in each peak hour.

Traffic Accidents

Traffic accident statistics on NPS roads are compiled in the Systemwide Traffic Accident Reporting System (STARS). The system assists in the compilation and analysis of high-accident locations. The most recent comprehensive study of road accidents was completed in 1995 and covered 1990 through 1993. The study reviewed the progress of the NPS traffic safety program and compared accident records with those from 1982 through 1984. The study identified 20 high-accident locations (18 road segments and 2 intersections) and made detailed recommendations to improve the two intersections. Table 8

shows the 1990–93 accident statistics for roadway segments and Table 9 for intersections.

When Generals Highway was designed and constructed in the 1920s and early 1930s, vehicles were fewer and smaller, so the road width and hairpin turns from Ash Mountain (milepost 1) to the Wolverton Road junction (milepost 19) were not as hazardous for drivers as they are today. Now larger vehicles often need to use part of the oncoming traffic lane to negotiate a turn, creating a safety risk.

Many accidents occurred at or near roadside pullouts and could be attributed to the pullout design and use. Most pullouts are on the fill side of the road, but traffic volumes and use patterns indicate a need for more pullouts on the cut side of some roads. Poor design or marking creates a potential hazard in terms of sight distance, as well as for bicyclists and pedestrians.

Approximately 225 paved roadside turnout areas are used as slow-vehicle refuge areas, resting places, viewpoints for scenic resources, and winter chain-up areas; 165 of the turnouts are on Generals Highway. Most turnouts are 105–158 feet long and 10–20 feet wide, but some are as short as 52 feet, and less than 10 feet wide. Many more informal pullouts are unpaved shoulder areas created by years of continued use. Recent roadway construction projects have closed some pullouts and "formalized" others.

TABLE 8: HIGH-ACCIDENT ROADWAY SEGMENTS, 1/1/1990 TO 12/31/1993

High-Accident Roadway Segments	Milepost	Length (miles)	Accidents	Density (acc/mile)	Severity Index	Accident Rate (acc/mvmt)*
Generals Highway (Tunnel Rock)**	2.60–2.65	0.05	6	12.0	1.06	97.00
Generals Highway**	3.00–3.50	0.50	3	6.0	1.33	4.85
Generals Highway**	4.15–4.25	0.10	3	30.0	1.38	24.25
Generals Highway**	4.85–5.05	0.20	3	15.0	1.00	12.12
Generals Highway**	6.30–6.40	0.10	5	50.0	1.23	40.41
Generals Highway**	6.55–6.60	0.05	2	40.0	1.13	32.33
Generals Highway**	6.80–7.40	0.60	9	15.0	1.33	12.12
Generals Highway (Commissary Curve)	14.50–14.70	0.20	10	50.0	1.00	6.32
Generals Highway	14.85–15.08	0.20	3	15.0	1.44	10.85
Generals Highway (Buena Vista Point)	15.20–15.30	0.10	5	50.0	1.00	36.15
Generals Highway	15.60–16.40	0.80	6	7.5	1.06	5.42
Generals Highway	16.45–16.60	0.15	8	53.3	1.00	38.56
Generals Highway (Giant Forest)	16.80–17.50	0.70	22	31.4	1.25	21.10
Generals Highway (General Sherman Tree)	18.50–19.30	0.80	9	11.3	1.00	7.55
Generals Highway	24.10–24.90	0.80	2	2.5	1.00	2.38
Generals Highway	29.10–29.60	0.50	3	6.0	1.61	5.72
Generals Highway	45.25–45.40	0.15	2	13.3	1.00	11.51
Grant Tree Road	0.45–0.60	0.15	2	13.3	1.00	29.51

SOURCE: "Traffic Safety Program Review for Sequoia and Kings Canyon National Parks."
* Road segment accident rates are expressed in terms of accidents per million vehicle-miles traveled.
** Because Generals Highway has been reconstructed from the Ash Mountain entrance to about milepost 11, the conditions at the first seven high-accident locations are no longer the same as during the 1990–93 study period.

TABLE 9: HIGH-ACCIDENT INTERSECTIONS

High Accident Intersections	Accidents	Average Daily Traffic	Accident Rate (acc/mve)*
Generals Highway at Lodgepole Campground	7	1,830	2.90
Generals Highway at Grant Grove Road (the Wye)**	9	1,590	4.30

SOURCE: "Traffic Safety Program Review for Sequoia and Kings Canyon National Parks."
* Intersection accident rates are expressed in terms of accidents per million vehicles entering.
** The Wye intersection was reconstructed in summer 2002 to a new design, so a lower accident rate than observed in the 1990–93 study can be expected.

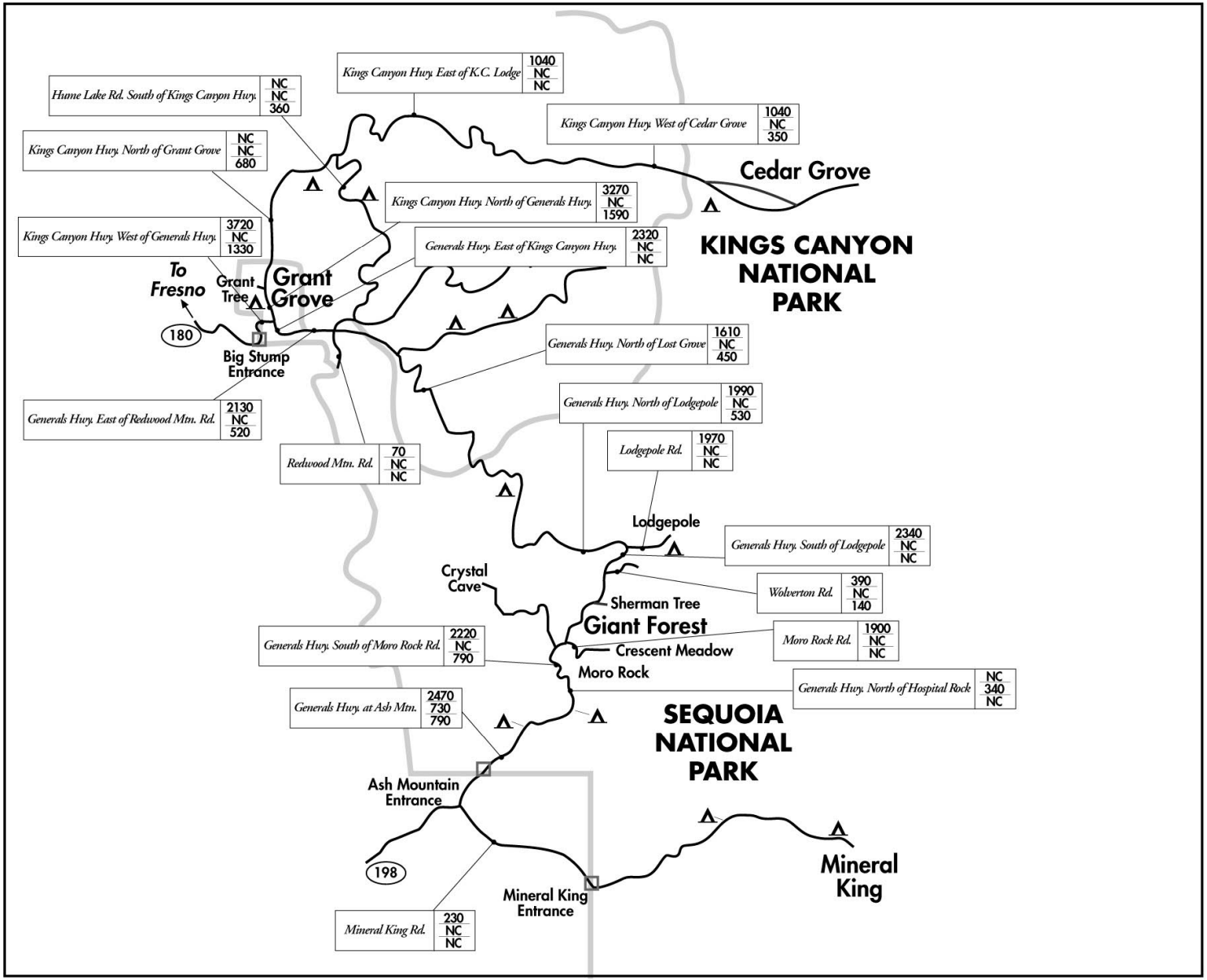


FIGURE 3: AVERAGE SEASONAL DAILY TRAFFIC (FRIDAY–SUNDAY)

XXX Summer 1997 ADT
XXX Winter 1998 ADT
XXX Spring 1998 ADT
NC Data Not Collected

LEGEND

- PARK BOUNDARY
- ROADS
- CAMPGROUNDS
- ENTRANCE STATIONS

Source: Lee Engineering and Traffic Research and Analysis

N

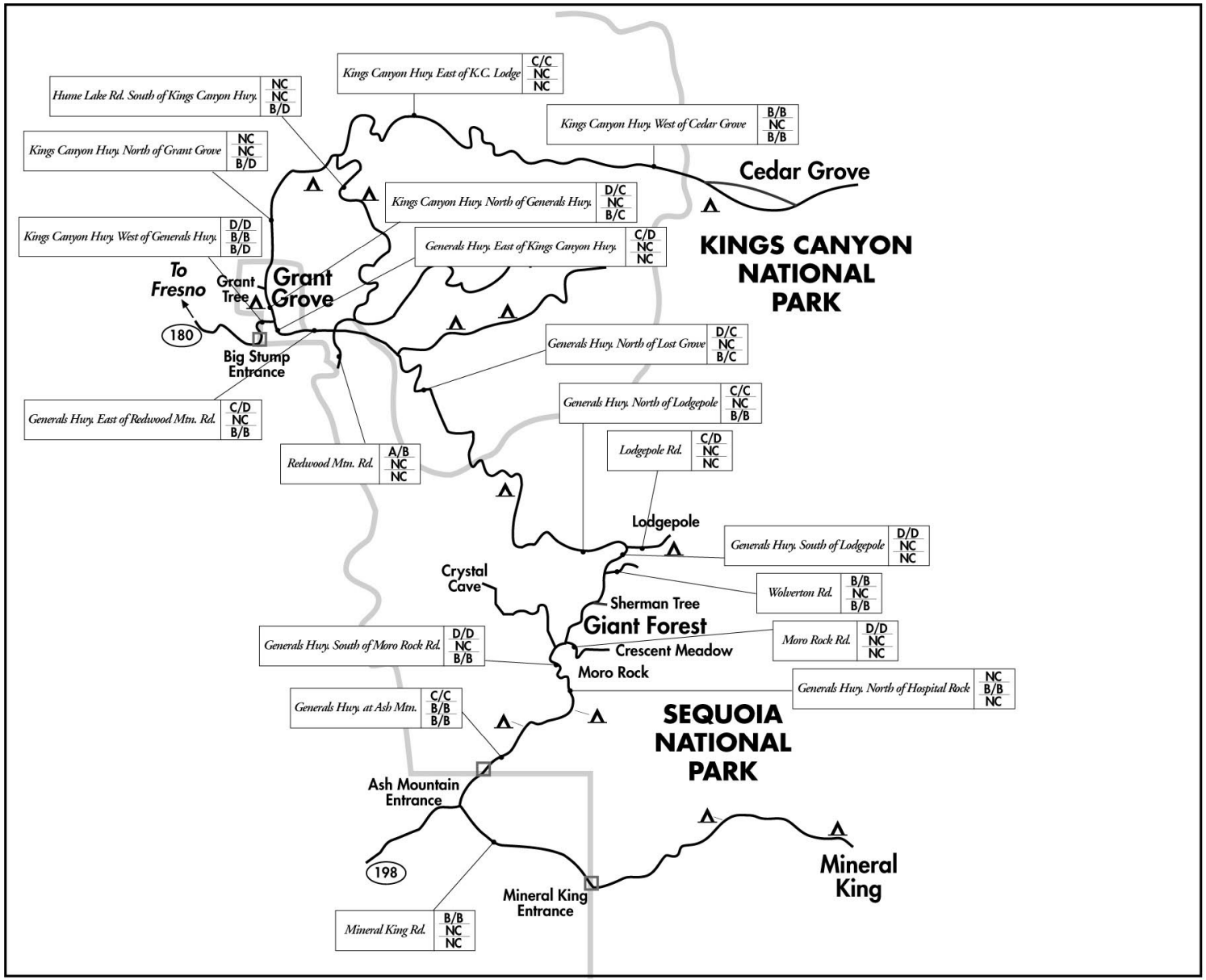


FIGURE 4: PEAK-HOUR LEVEL OF SERVICE

C/C — AM/PM Peak Hour LOS (Summer 1997)

B/B — AM/PM Peak Hour LOS (Winter 1998)

B/B — AM/PM Peak Hour LOS (Spring 1998)

NC — Data Not Collected

LEGEND

- PARK BOUNDARY
- ROADS
- CAMPGROUNDS
- ENTRANCE STATIONS

Source: Lee Engineering and Traffic Research and Analysis

N

Planned and Ongoing Transportation Improvements

Reconstruction of Generals Highway

To address safety and operational problems, Generals Highway is being reconstructed. The traveled way is being widened to a consistent 22 feet (two 11-foot lanes), with a 1- to 2-foot paved shoulder on the cut side of the roadway, plus other improvements.

The reconstruction project improved several access roads and parking areas along the highway, including the power plant road, Chief Sequoia entrance sign parking area, the Sycamore Drive intersection, the Cammerer Way approach and parking area, and visitor parking areas at the Foothills visitor center. As part of the reconstruction, the one-lane, one-way bypass road at Tunnel Rock was reconstructed as a standard 22-foot road with 1-foot shoulders to accommodate two-way traffic.

The reconstruction project is also removing unsafe pullouts, improving (or formalizing) several existing informal pullouts, and correcting several sight-distance hazards. For pedestrian safety reasons, Generals Highway is scheduled to be rerouted at the General Sherman Tree so that the shuttle stop and the only parking area will be on the same side of the highway as the General Sherman Tree (east of the highway). In addition, the existing aerial power and telephone lines that run along the road are to be placed underground.

Previous pavement overlays have raised the roadbed over existing drainage ditches and catch basin inlets, creating a safety hazard at the edge of the roadway. Certain drainage features are being reconstructed to address this problem.

Other Road Improvements

A structurally deficient bridge at Cedar Grove needs to be replaced.

PARKING

Existing Conditions

Sequoia and Kings Canyon National Parks have at least 37 parking areas. Parking is provided at most major activity areas and attractions, as well as most trailheads. Some areas have recurring capacity problems, and the capacity of some lots is diminished by snow accumulation.

The 1998 "Visitor Use Study" examined occupancy (spaces used at a given time), duration (length of time a single vehicle is parked), and turnover (number of times a space is used in a given time) at 19 lots with an approximate total capacity of 900 spaces (capacity was not measured at two of the lots). Of the lots studied, those at General Sherman Tree (including the roadside pullout), Big Stump, and the Grant Grove visitor center all overflowed at least once during the study period (BRW, Inc., and Lee Engineering 1999). The lot at General Sherman Tree has perhaps the most severe shortage; this lot is scheduled to close (see "Planned and Ongoing Parking Improvements" below).

Parking activity at trailhead locations is characterized by longer stays and lower turnover, as hikers tend to spend more time out of their cars than do other visitors. While parking at Mineral King Valley trailheads exceeds demand on some summer holidays, the rest of the trailhead parking areas do not exhibit capacity problems, even during the busiest summer months.

When parking overflows, safety, resource preservation, and visitor experience problems occur. Visitors unable to find a space in a designated parking area may either park in an undesignated area or leave the area without being able to see the attraction. Undesignated parking creates a safety problem when parked vehicles block traveled ways or access to routes or amenities. Such blocking of travel lanes is a particular problem at roadside turnouts, especially those on the primary roads in the parks. The winding character of these roads limits sight distance, and parked vehicles even partially blocking the road can present a potentially serious hazard. Vehicles parked outside designated areas may

also park on or near sensitive resources and cause damage. Visitors who are unable to experience an attraction or are forced to wait because of parking capacity deficiencies are probably more likely to have negative impressions of their visit.

Planned and Ongoing Parking Improvements

Since the 1998 "Visitor Use Study," new parking has been planned for the Giant Forest museum parking and museum overflow parking areas. The museum parking area would be open year-round with 107 spaces for cars, 2 spaces for visitors with disabilities, and 10 spaces for buses or RVs. The overflow parking area would be open from late May through September (depending on snowfall) and would accommodate approximately 71 cars. Additionally, adjacent to the museum are two government vehicle parking spaces and seven spaces for visitors with disabilities. Near General Sherman Tree, all parking is to be removed and a new, larger parking area (called Upper Sherman Tree) is to be provided near Wolverton Road. This area would have 230 vehicle spaces, 5 spaces for visitors with disabilities, and 12 spaces for buses or RVs; a safe pedestrian trail would provide access to the General Sherman Tree. The Pinewood picnic area would have 34 vehicle spaces and 2 spaces for visitors with disabilities.

Wuksachi village was not completed when the 1998 "Visitor Use Study" was undertaken, so parking capacity and occupancy data were not available. All parking to support future buildout at Wuksachi has been completed, and no additional parking is anticipated on the site.

Visitor Experience

Visitor experiences in the parks include many different elements — the character of the parks, the visitation patterns, educational and recreational opportunities, and visitor services, as well as affordability.

PARK CHARACTER

Park character is comprised of both the setting (the natural and built environment) and the human activities that are associated with it. There are rustic, basic, and traditional components of park character at Sequoia and Kings Canyon.

- *Rustic* refers to the character and quality of the built environment (both site and architecture) as maintained by various guidelines. Visitors continue to enjoy park facilities and site elements evoking the CCC era. New public use facilities continue this rustic heritage. Rustic architecture often uses natural materials such as wood and rough, irregular, and occasionally massive stonework. Building forms are generally simple and small, with steeper roof lines, some overscaled and textured elements, as well as informal wrought-iron metal work. Signs, benches, fencing, drinking fountains, walls, overlooks, pavement, bridges, and other site elements may also reflect a rustic character.
- *Basic* character of the parks includes the setting and customary or historical activities (hiking, camping, lodging, backcountry use, and scenic driving through the parks). Other established activities include cave tours, winter recreation, water play, and fishing. Visitors have access to many areas with examples of natural and cultural resources for which the park is significant — sequoia groves, designated wilderness, range of ecosystems and terrain (from foothills to alpine), regionally or locally significant historic structures or districts, wild and scenic rivers, and caves. While basic activities remain, some facilities related to these established activities may have been moved or modified to improve resource conditions or experiences and to meet newer laws and policy. For example, campgrounds, lodging, and other facilities were removed from the Giant Forest to restore the sequoia grove. Backcountry use permits are required so that use can be dispersed and tracked. More space is being provided between campsites when campgrounds are redeveloped to improve experiences. Some visitor facilities have been made more accessible to users with disabilities.
- *Traditional* patterns of use that date from the late 1890s through the 1960s continue, but in very modified forms. Hiking, stock, and vehicles are still the three primary ways that people enjoy the parks. But in the first half of the 20th century smaller groups visited the parks and stayed overnight for longer periods of time. Since the 1960s new groups of visitors are using the parks. Backcountry use peaked in the 1970s. The regional population has doubled since 1980 and is expected to double again within 10 years. Changing vacation patterns have resulted in shorter and more numerous vacations, more day use, and increased spring and fall use. Overnight visitors stay for shorter periods in both the front- and backcountry. While the backcountry still comprises approximately 97% of the land in the parks, backcountry use accounts for only 2%–3% of the visitation. While virtually all visitors continue to arrive by private vehicles, there has also been an increase in tour buses. Grant Grove is congested during the summer, with driving experiences similar to urban areas. Waits and delays of up to a half hour are common at the Big Stump entrance station during summer. Parking at Lodgepole is inadequate during summer. To protect resources, visitors are no longer permitted to park in sensitive sites such as meadows, so finding a parking spot may be difficult during high-use times. Giant Forest is now a day use area — a significant change from its past

overnight uses. The conversion of Giant Forest to a day-use area has resulted in the replacement of parking; eventually a summer shuttle system will be required. Recreational stock use has declined substantially since 1955 and is more regulated to protect resources. Recreational communities, comprised of privately owned cabins, continue but are subject to land protection plans, easements, and permit conditions.

VISITATION

Visitation is estimated by multiplying the number of vehicles entering by an average number of passengers per vehicle, currently estimated at 2.3. Counting the number of visitors is complicated because there are two parks with multiple entrance stations, and visitors can be double counted or not counted at all. The primary entrances are at Big Stump and Ash Mountain. Other access points by way of local roads do not have entrance stations — North Fork, South Fork, Redwood Canyon, Mineral King, and Dillonwood. In 1992 the counting procedures were changed to reduce the likelihood of double counting. A further complication is that visitors to the northern unit of Giant Sequoia National Monument and some of Sequoia National Forest areas must pass through the park's Big Stump entrance station.

As shown in Table 10, annual visitation has fluctuated over the last two decades, reaching a high of 2.2 million in 1987 and 1991. Visitation in 2001 was estimated at 1.4 million. The lowest visitation recorded over the 20-year period was 1.35 million in 1996.

VISITOR USE PATTERNS

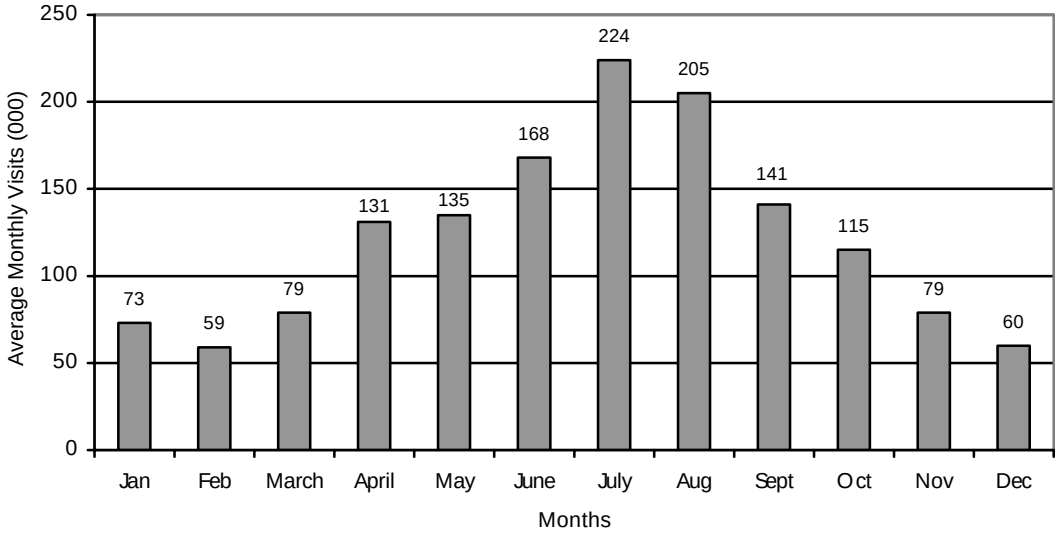
Visitation is heavily seasonal, with most visits occurring in the summer months. Figure 5 shows average visitation trends graphically. July and August are typically the most popular months, followed by June, May, September, and October. Winter use depends on the weather and snow conditions, with the lowest visitation levels in December, January, and February.

TABLE 10: SUMMARY OF ANNUAL VISITATION, 1985–2004

	Kings Canyon National Park		Sequoia National Park		Total for Both Parks		
Year	Actual Use	Percentage Change	Actual Use	Percentage Change	Actual Use	Percentage Change	Comments
1985	874,456		939,486		1,813,942		
1986	1,028,785	17.6%	1,056,527	12.5%	2,085,312	15.0%	
1987	1,081,172	5.1%	1,139,389	7.8%	2,220,561	6.5%	
1988	1,007,695	-6.8%	1,031,129	-9.5%	2,038,824	-8.2%	
1989	1,037,349	2.9%	1,056,020	2.4%	2,093,369	2.7%	
1990	1,062,867	2.5%	1,063,538	0.7%	2,126,405	1.6%	
1991	1,120,278	5.4%	1,120,278	5.3%	2,240,556	5.4%	
1992	637,446	-43.1%	961,095	-14.2%	1,598,541	-28.7%	Counting procedures changed
1993	636,515	-0.2%	1,066,649	11.0%	1,703,164	6.5%	
1994	725,930	14.1%	1,034,133	-3.1%	1,760,063	3.3%	
1995	832,794	14.7%	844,582	-18.3%	1,677,376	-4.7%	Road construction begins on Generals Highway
1996	502,749	-39.6%	838,060	-0.8%	1,340,809	-20.1%	
1997	484,718	-3.6%	1,008,931	20.4%	1,493,649	11.4%	
1998	540,212	11.5%	861,663	-14.6%	1,401,875	-6.1%	Giant Forest Lodge closed
1999	559,534	3.6%	873,229	1.3%	1,432,763	2.2%	
2000	528,987	-5.5%	838,947	-4.1%	1,367,934	-4.5%	
2001	541,787	2.4%	870,327	3.7%	1,412,114	3.2%	
2002	545,420	0.7%	920,292	5.7%	1,465,712	3.8%	
2003	555,987	1.9%	979,297	6.4%	1,535,284	4.8%	
2004	525,035	-5.6%	1,000,177	2.1%	1,525,212	-0.7%	

SOURCE: NPS Statistics Office, 1979–2004 data.

FIGURE 5: AVERAGE VISITS BY MONTH TO SEQUOIA AND KINGS CANYON — 1992–2001



SOURCE: http://www2.nature.nps.gov/stats/

Dispersal of Visitation

Frontcountry areas (about 2.5% of the parks) receive around 98% of the use, and backcountry areas about 2%. These roadless areas can only be reached by trails and include designated wilderness. This relationship means that heavily used frontcountry areas are likely to be crowded, especially during the summer. Crowding in the backcountry is a different order of magnitude, and just seeing other backcountry users can be perceived as too many people for some visitors.

Length of Stay

In summer 1997 a survey was conducted to determine the length of visitor stays; visitors were surveyed as they left the park at either Ash Mountain, Big Stump, or Mineral King. A comparable survey of spring visitors was conducted in March and May 1998. About 45% of summer visitors exiting at Ash Mountain, Big Stump, or Mineral King were day visitors who stayed an average of 4.5 hours (BRW and Lee Engineering 1998). About 14.6% stayed two days, and 14% three days. About a quarter of all visitors stayed four days or longer. The overall average summer length of stays in the parks was 2.6 days. Mineral King visitors tend to stay longer, and more that half stay longer than three days.

Summer use contrasts sharply with use during other times of the year. In spring the majority of visitors (78%) are day visitors, while 19% stay two or three days, and only about 4% four days or longer (BRW and Lee Engineering 1999).

Population growth in the Central Valley and changing visitor populations have resulted in different park uses. Historically park visitors came for longer periods (a week), were predominantly Caucasian, well educated, included smaller size nuclear families or same-age backpacking groups, and were interested in hiking and seeing resources for which the parks are known. Observation and surveys suggest that the visitor mix now includes more diverse racial groups, more multi-generational groups, and larger families. Larger family camping, picnicking, and day use facilities are in demand.

Opportunities for Visitors with Disabilities

Because of the rugged terrain in the parks, all caves, and most alpine areas, natural features, and trails are inaccessible to a great many users with disabilities. Accessible parking is striped/signed at paved parking lots. Projects to make comfort stations and visitor centers more accessible are programmed. At renovated campgrounds sites are being provided that meet new accessibility guidelines. Stock use could provide accessibility for users with disabilities in both the front- and backcountry, and one stock concessioner has made modifications to accommodate disabled users.

VISITOR PROFILE

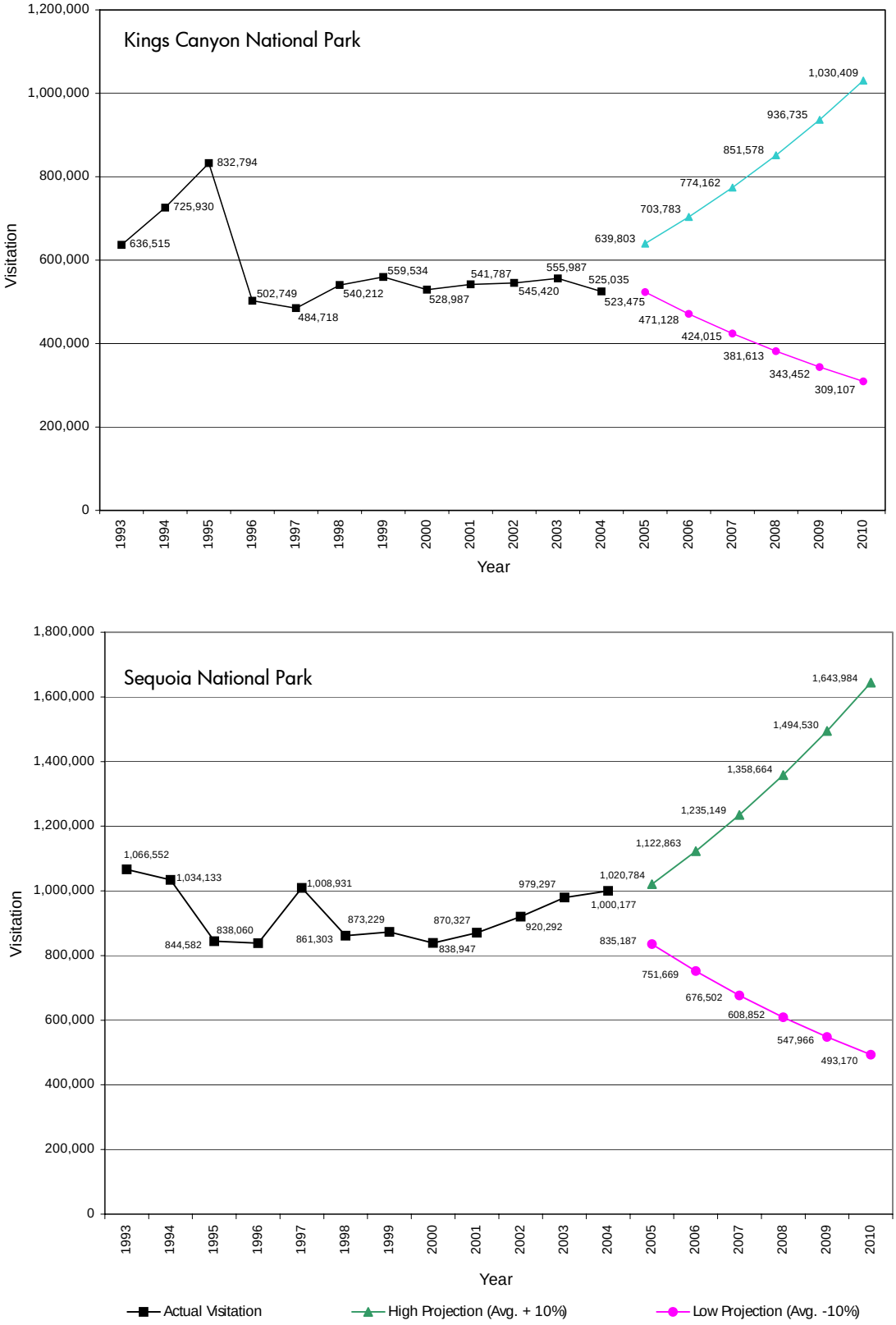
A 1994–95 visitor use survey revealed the following visitor profile (NPS 1995e):

- Respondents were highly educated: 20% had completed graduate school, another 41% were college graduates, and an additional 20% had completed some college.
- Of the survey respondents 83% listed themselves as white, 9% Hispanic, and 8% other groups.
- Visitors speak a variety of languages — 80% English, 7% German, 6% Spanish, and French more than 1%.
- Families were the predominant group type, with nearly 39% of the respondents visiting as a family with children and 28% as family groups without children. Family and friends groups accounted for almost 14% of the respondents. Groups of friends made up 12% of the total, and people visiting alone were only 5% of the groups.
- About 8.5% of the respondents had some form of impairment (mobility, vision, hearing, other) that limited their visit.
- Visitor origins were as follows: 62% from California; 2% each from New York and Texas; 1% each from Alabama, Arizona, Connecticut, Florida, Illinois, Maryland, Michigan, Missouri, Ohio, New Jersey, Pennsylvania, Utah, Washington, and Wisconsin; 6% came from other states; and 14% from other countries. Regarding the foreign visitors origins: 35 % came from Germany, 16% from the United Kingdom, 12% from Switzerland, 11% from the Netherlands, 13% from other European countries, and 13% from other countries.
- Sequoia and Kings Canyon were the trip destinations for 79% of the respondents.
- First-time visitors were 45% of those interviewed, and the rest were repeat visitors, with 14% having visited the park 10 or more times.
- Of the respondents, 51% entered at Ash Mountain, 46% at Big Stump, 2% at Mineral King, and 1% at other places.

VISITOR USE PROJECTIONS

In 1993 errors in how the parks were counting visitors were corrected. Unreliable traffic counters have been a continuing problem, and caution must be exercised when forecasting future visitor use. Historically, the data show a slight downward trend in visitation: an average of -0.5% for Kings Canyon and -1.0% for Sequoia from 1993 to 2000. For future projections, it was assumed that visitation growth would likely fall within a plus 10% to a minus 10% range (a simple linear projection), and that the average visitation for the past eight years (605,666 for Kings Canyon and 920,762 for Sequoia) were reasonable starting positions. The projections shown in Figure 6 offer a reasonable forecast of visitation one to five years into the future. It is unlikely that visitor use would either rise or fall at a steady 10% rate or remain exactly the same over the next few years. A more likely scenario would be random increases or decreases from year to year averaging 1% to 3% over a five-year period, with extraordinary spikes of plus or minus 10%, much like the patterns of the actual visitor use data.

FIGURE 6: ACTUAL AND PROJECTED VISITATION



SOURCE: Historical data from NPS, Public Use Statistics Office, WASO-TNT.

EDUCATIONAL OPPORTUNITIES

Educational Facilities

Visitor educational facilities interpret different aspects of the parks. The Cedar Grove visitor center provides an information desk and a sales area, but no interpretive exhibits. The Kings Canyon visitor center interprets the cultural and natural history of Kings Canyon National Park. The Lodgepole visitor center focuses on the forests and alpine regions, and the Walter Fry Nature Center at Lodgepole has numerous interactive exhibits, many especially appealing to children. A historic building is being adaptively reused as the Giant Forest museum, with a focus on sequoias. The Beetle Rock education center in the former assembly hall serves group needs. The recently remodeled Foothills visitor center at Ash Mountain focuses interpretation on the foothills environment. The Mineral King visitor contact station interprets a variety of historic stories and natural features.

Interpretation, Waysides, and Exhibits

Educational programs include ranger-led walks, campfire programs, Junior Ranger programs, and exhibits at the Grant Grove, Lodgepole, and Foothills visitor centers, the Mineral King ranger / visitor contact station, and the Walter Fry Nature Center. There are fewer interpretive walks and programs than in the past. Interpretive media include the park newspaper, limited numbers of waysides at park features such as the Sherman and Grant trees, and self-guided literature (the Grant Tree area and the Big Stump Basin near Grant Grove village, and Congress Trail, Hazelwood, and Big Trees Trail at Round Meadow in Giant Forest). Recently, wayside exhibits have been added to explain the move from Giant Forest. The Sequoia Natural History Association also provides educational seminars, guided activities, and overnight trips, as well as running bookstores in park visitor centers and educational tours of Crystal Cave.

Visitor Outreach

The park has a small community outreach program, providing information and programs to those outside the parks. Interpretive staff visit schools and community groups in the region, provide environmental education programs for schools at the parks in the spring and fall, and work with educational partners such as the Heritage Project and the University of California, Merced.

RECREATIONAL OPPORTUNITIES

Recreational opportunities are provided in a range of front- and backcountry settings — foothills, canyons, wild and scenic rivers, granite domes, caves, chaparral, sequoia groves, mountain meadows, pine/fir forests, and alpine areas. While trail-based activities are the most common, other activities are allowed or facilitated.

Historically established activities include hiking, backpacking, horseback riding / pack trips, caving, picnicking, fishing, sightseeing, late season water play in rivers, and some use of nonmotorized watercraft. Several types of guided Crystal Cave tours are available for a fee through the Sequoia Natural History Association. The parks also have three concession-operated stables / pack stations that offer a variety of riding and backcountry packing services. Commercial business permits are issued to service providers of pack operations (horse, mule, llama), backpacking, and guided hiking or ski tour trips.

Additional Activity Information

Stock Opportunities

Stock use is allowed in the parks with regulation, and a monitoring program based on standards and indicators has been established that has allowed both administrative and other stock use to continue at sustainable levels. Stables and corrals where horses or mules may be rented for guided day or backcountry use include Cedar Grove, Grant Grove, and Mineral King. Pack operations at Wolverton were suspended in 2002 due to safety considerations and other uses for the site.

The operation would be relocated if an appropriate site could be found.

Stock use trails may be heavily eroded in some frontcountry areas like Wolverton / Giant Forest. There are three kinds of stock use — commercial, private, and administrative. Monitoring and research are continuing to define the stock carrying capacity of areas (the use an area is capable of supporting without resource impairment). Current regulations open and close meadows based on precipitation, residual forage, and use. Trailhead and backcountry rangers record data on stock use, along with mailback cards available at wilderness permit-issuing stations. Around half of the stock users enter from adjacent USFS areas, so not all stock use may be reported.

Facilities for Stock Use. Many backcountry trails were built and are maintained to standards needed for stock use. Other facilities include hitch posts, drift fences, bridges, and parking sized for stock trailers at trailheads.

Type of Stock. Horses, mules, burros, and llamas are the only stock permitted. No other domestic animals are allowed. Goats are not allowed because bighorn sheep populations are extremely vulnerable to introduced disease.

Winter Use

Cross-country skiing, snow play, snowshoeing, and sledding are popular activities for regional visitors. Both Grant Grove and Wolverton have snow play areas that attract hundreds of users. Cross-country skis and snowshoes can be rented at Grant Grove and Wuksachi, and cross-country ski lessons are provided at Lodgepole. Lower winter use levels mean visitors may find solitude once they are outside the heavily used snowplay areas. Snowmobiles are allowed on private roads for use by inholders and on public roads for permit holders to reach their cabins.

Fishing

Sport fish were stocked in previously fishless backcountry lakes beginning in the 1870s and have contaminated native fish stocks in the rivers (Knapp 1996). Sport fish are being removed from some areas. Recreational fishing occurs in the Marble and Middle Forks of the Kaweah River and the South Fork of the Kings River, as well as in backcountry lakes and streams. Fishing is highly regulated, but is not supported by any facilities.

Activities on Adjacent Federal and Private Land

Some visitors enjoy activities in the adjacent national forests and Giant Sequoia National Monument. Backcountry trailheads that provide access to the parks include the very popular Mount Whitney trailhead in Inyo National Forest. Boat and bicycle rentals are available at Hume Lake, which is also a popular swimming and fishing location. Boyden Cave provides guided tours for a fee. Montecito-Sequoia Lodge offers a variety of recreational programs, including winter activities and guided programs. Hunting, camping, fishing, and snowmobiling are allowed on USFS land, but hunting and snowmobiling are not allowed in the park. However, most of the national forest was designated as Giant Sequoia National Monument in April 2000, and it is managed under a plan completed in 2003.

Trail Systems

Hiking is the most common recreational activity, with the extensive trail system and opportunities for cross-country exploration attracting hikers from around the world. Because the parks' elevation ranges from 1,300 feet to over 14,000 feet, trails are often very steep, and elevation changes may negatively affect the capability and health of some visitors. There are 89.5 miles of maintained trails in the frontcountry — 42 miles in the low-use frontcountry zone, 40 miles in the high-use frontcountry zone, 2.5 miles in the high-use scenic driving zone, and 5 miles in the development zone (see Table 11 for locations). In very heavily used areas, some frontcountry trails are paved and edged by fencing to protect adjacent soil and vegetation. There are 728 miles of maintained trails in the backcountry, plus an additional 114.4 miles of abandoned and unmaintained trails, for a total of 842.4 miles of backcountry trails. Because of the terrain, very few trails are accessible to visitors with disabilities.

Backcountry Use

Backcountry users hike to their destinations or use horses, mules, burros, and llamas. Commercial operators also carry packs to predetermined campsites while their clients hike in. Fees are charged for overnight backcountry permits (both hiking and stock trips). Permits are issued at five areas (Cedar Grove, Grant Grove, Lodgepole, Ash Mountain, and Mineral King). There are 42 trailheads (25 in the parks and 17 on adjacent USFS lands) that provide 852 parking spaces for backcountry users. The number of visits by backcountry users has declined since 1992, according to backcountry permits, as shown in Figure 7.

In 2001 there were 23,099 users; the average hiker group size was 2.91, and the average number of people in stock parties was 5. Most of the backcountry is untrailed, and experienced visitors can hike or ride cross-country where permitted. Some high-use backcountry areas have designated campsites with bear-proof food storage boxes and toilets to protect resources and visitors. There is one high Sierra camp at Bearpaw Meadow, a concessioner run tent-hotel that provides food service and showers. August is the most popular month for backcountry use, followed by July and September, June and October.

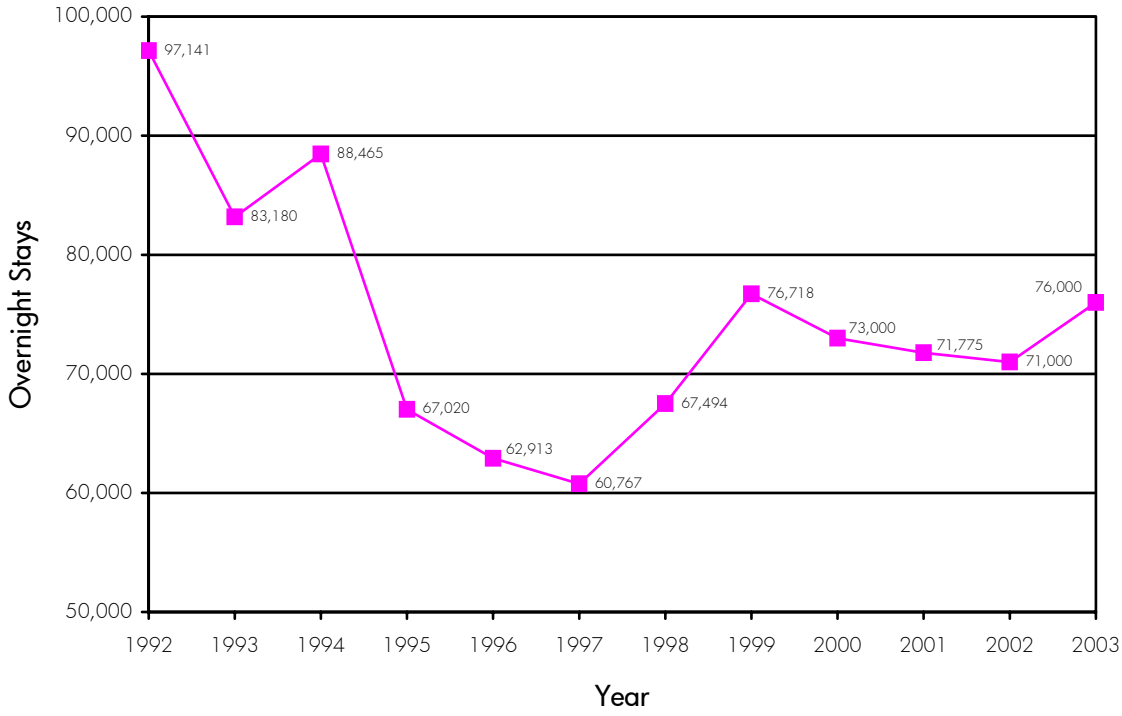
Backcountry Stock Use

Backcountry stock use has decreased from nearly 45,000 stock nights in 1955 to 5,714 in 2000. The amount of stock use stayed near 4% of backcountry use between 1998 and 2000. In 2000 there

TABLE 11: SUMMARY OF TRAILS

Location	Popular Trails / Comments
Kings Canyon National Park	
Backcountry	Pacific Crest trail John Muir trail
Cedar Grove area	Zumwalt Meadow trail
Grant Grove area	General Grant Tree area has paved trails. Big Stump area is 1.5 miles.
Redwood Mountain	10+ miles
Generals Highway	Big Baldy Little Baldy
Sequoia National Park	
Backcountry	Pacific Crest trail High Sierra trail John Muir trail
Dorst area	Muir Grove trail
Wuksachi	
Lodgepole	Tokopah Falls trail — very heavily used (1.7 miles)
Wolverton	Popular backcountry trailhead to Alta peak, Heather, Emerald and Pear Lakes
Giant Forest Trail system being renovated	Large day use trail system (40+ miles) includes: "Big Trees Trail" — a 0.75-mile paved accessible trail. Congress Trail Hazelwood self guided nature trail Crescent Meadow day-use trails Trail center at the Giant Forest museum Trail center at Sherman Tree?
Ash Mountain / Foothills	Marble Falls trail Paradise Creek trail Middle Fork trail
North Fork	Colony Mill Road
South Fork	Ladybug trail Garfield Sequoia Grove trail Trailhead to Hockett Meadow area
Mineral King	Popular day use trails to area lakes Backcountry trailheads to Farewell Gap, Franklin Pass, and Sawtooth Pass
Dillonwood	None

FIGURE 7: BACKCOUNTRY OVERNIGHT STAYS — 1992–2003



SOURCE: Sequoia and Kings Canyon National Parks, 2005.

were 936 stock users, and the number of stock per person in a group averaged 1.5. Stock users stayed on average a little over four days, a half day longer than hikers stayed.

New or Non-established Recreational Activities

New activities are assessed using federal regulations and NPS policy guidelines.

Bicycling is allowed only on park roads and is most common within campgrounds. Bicycling may be dangerous on major park roads, such as Generals Highway, because of narrow shoulders and hairpin curves where vehicles commonly overlap lanes.

Snowmobiling is only allowed on public roads that provide private landholders and permit cabin users access to their cabins or land.

In the last five years, when water conditions are high enough, visitors have kayaked on the Middle Fork of the Kaweah River. The river has class IV conditions, appropriate only for expert kayakers. Use of the Middle Fork inside the park by kayakers is seasonal, but is subject to growth. NPS staff are monitoring use and the associated impacts along the river.

No air tour companies currently operate in the parks, although two companies have applied to the Federal Aviation Administration for operating authority.

VISITOR SERVICES

The parks provide numerous facilities and services for visitors. Both food service and overnight stays can be accommodated within a variety of price ranges.

Campgrounds

Frontcountry Camping

There are 1,284 frontcountry campsites in 14 campgrounds within the parks. All frontcountry campgrounds can be reached by automobile, and the size and character of these campgrounds vary from small and primitive (with 10 sites and pit toilets) to large and developed (over 200 sites with pull-through sites and nearby free RV dump stations). Several campgrounds (Azalea, Lodgepole, Potwisha, and South Fork) remain open year-round, while Dorst, four campgrounds at Cedar Grove, two at Grant Grove, and two at Mineral King are closed from late fall until late spring. Azalea and Lodgepole have winter camping in snow conditions. Public showers are close to campgrounds in Cedar Grove, Grant Grove, Lodgepole, and Mineral King. Laundry facilities are nearby at Lodgepole and Cedar Grove. Prices are comparable to those offered regionally and depend on the location and services provided. A single small campground remains in a sequoia grove at Atwell Mill, which has 21 sites and a few pit toilets. Other camping opportunities in sequoia groves were removed beginning in 1962 to protect visitors since sequoia trees and limbs can fall without notice.

Kings Canyon National Park. There are seven frontcountry campgrounds in Kings Canyon with over 113,000 overnight stays in 2000.* Campground use appears generally consistent but depends on the weather. Overnight stays for 2000 were as follows:

Cedar Grove

- Canyon View (only campground that does not allow RVs, but has group sites) — over 5,900 group overnight stays
- Moraine — over 4,100 overnight stays and more than 700 RV stays
- Sentinel — over 17,200 overnight stays in 2000, and around 6,100 RV overnight stays
- Sheep Creek — around 15,000 overnight stays and around 4,000 RV stays.

Grant Grove

- Azalea — around 14,600 overnight stays, and over 4,700 RV overnight stays
- Crystal Springs — around 6,700 overnight stays and over 1,900 RV stays
- Sunset — over 12,500 tent, over 3,700 RV, and 125 group overnight stays

Sequoia National Park. There are seven frontcountry campgrounds in Sequoia National Park that had over 128,000 overnight stays in 2000:

- Dorst — around 32,000 overnight stays, 9,300 RV stays, and 226 group overnight stays
- Lodgepole — around 30,000 overnight stays and 23,000 RV overnight stays
- Buckeye Flat — over 6,500 overnight stays
- Potwisha — over 11,500 overnight stays and over 5,200 RV overnight stays
- South Fork (no RV sites) — around 500 overnight stays
- Atwell Mill (no RV sites) — around 2,000 overnight stays
- Cold Springs (no RV sites) — 8,000 overnight stays

U.S. Forest Service. Additional camping opportunities are provided in the adjacent national forests, with 291 campsites in nine campgrounds

Backcountry Camping

Over 5,000 backcountry permits are issued annually for parties traveling by foot or stock animal. Some heavily used backcountry areas have designated campsites, but in other areas visitors are free to camp where they desire. Designated wilderness campsites exist in the following areas: Paradise Valley, Emerald Lake, Pear Lake, Bearpaw, Kern Hot Springs, Upper Funston, and Lower Funston. Sites are not specifically assigned, but established camping areas are marked, and camping must be confined to these locations.

* One person staying one night equals one overnight stay.

Lodging

There are over 200 rooms / cabins available in the parks (see Table 12). Concession contracts also allow lodging to be expanded or renovated. Kings Canyon Park Services provides lodging at Cedar Grove and Grant Grove, and. Delaware North Parks Services at Wuksachi and Bearpaw Meadow (high Sierra camp).

Types of Facilities

Concession lodging facilities range from the Bearpaw high Sierra camp (a remote backcountry camp with tent-top cabins) to rustic cabins with or without baths, to lodge rooms and suites. Historically, the parks have had small cabins with baths, rustic cabins or tent tops without baths, and medium size lodges. The John Muir Lodge at Grant Grove and three lodge buildings at Wuksachi village offer new medium size facilities that continue the rustic architectural traditions of the parks.

Lodging Availability / Seasonality / Occupancy

Year-round lodging is provided at Grant Grove village in Kings Canyon National Park and at Wuksachi in Sequoia National Park. In July and August occupancy rates are 95% or better, but November through March occupancy rates fall to around 33%.

Cedar Grove has motel lodging, generally from April through October or November. Its annual occupancy rate was 76% to 86% for 1998–2000, averaging 5,000–7,700 overnight stays annually. Grant Grove had an annual occupancy rate of 58% to 66% for 1998–2000, averaging 25,000–36,000 overnight stays annually. Winter season use occupancy at Grant Grove is 20%–40%.

Wuksachi replaced Giant Forest Lodge in 1999. In 2000 Wuksachi had around 51,000 overnight stays, compared to about 120,000 annual stays at the larger Giant Forest Lodge. Non-peak season annual occupancy at Wuksachi averages over 60%, and the winter occupancy rate 20%–40%.

The Bearpaw Meadow high Sierra camp operates from June through September. Occupancy is highest in July and August (typically in the mid 90% range), while occupancy in June and September depends on the weather. Typically there are over 1,000 overnight stays at Bearpaw; in 1996 there were over 2,000.

Non-Park Public Lodging in the Area

Overnight accommodations in the adjacent national forest / monument are offered at Montecito-Sequoia Lodge and Stony Creek Lodge south of Grant Grove; Kings Canyon Lodge on the Kings Canyon Highway; and the Silver City Resort in the Mineral King area. Private organizational camps include the Hume Lake Christian Camp.

TABLE 12: SUMMARY OF LODGING AVAILABLE IN 2000

Location / Quantity	Type	Daily Rate / Comment
Cedar Grove • 20 rooms	Lodge	• $90
Grant Grove • John Muir Lodge – 30 lodge rooms / suites • 9 cabins with bath • 43 cabins with central bathhouses • Future permitted buildout includes 9 additional cabins and 19 renovated cabins	 • Bath cabins • Bath cabin #9 • Remodeled rustic cabins • Rustic cabins • Tent cabins • Lodge • Suite	 • $88 • $93 • $55 with central bathhouse • $45 with central bathhouse • $38 with central bathhouse • $128 • $215
Wuksachi Village • 102 rooms • Future buildout include 312 additional rooms	 • Standard room • Deluxe room • Superior Room	 • $120 • $135 • $165
Bearpaw Camp (11-mile hike to backcountry camp) • 12 beds	Tent cabins	• $150 includes breakfast and dinner. Central bathhouse.

Other Visitor Services and Facilities

Food Service

Concession-owned restaurants operate at Grant Grove and Wuksachi (see Table 13); limited food service such as snack bars / market or deli service are available at Lodgepole, Grant Grove, Wolverton (winter only), and Cedar Grove (summer only). Outside the parks, several seasonal and year-round facilities provide various types of food service, including Stony Creek Lodge, Kings Canyon Lodge, Silver City Resort, and Montecito-Sequoia. Hours and days of service may be limited.

Gift Shops, Stores, Supplies, Post Offices, and Gasoline Stations

Supplies may be purchased at Grant Grove, Lodgepole and Cedar Grove. Gift shops are located at Grant Grove, Lodgepole, Cedar Grove, and Wuksachi. There are post offices at Grant Grove and Lodgepole. Limited supplies can also be obtained at Silver City Resort and Stony Creek Lodge (which is outside the parks). Gasoline is no longer available in the parks but may be purchased at Kings Canyon Lodge and Hume Lake, and at Stony Creek along the Generals Highway between Dorst and Quail Flat.

TABLE 13: SUMMARY OF VISITOR FACILITIES

	Cedar Grove	Grant Grove	Dorst / Lodgepole / Wuksachi / Giant Forest	Ash Mountain / Foothills	Mineral King
NPS Facilities					
• Visitor use buildings	2	2	10	4	2
• Visitor centers / museums / education facilities		1	4	1	
• Visitor Contact Station	1				1
• Comfort Stations / Restrooms	24	21	36	5	14
• Picnic Areas		1	2	2	
• Campgrounds	4	3	2	3	
Concession Facilities in the Parks					
• Lodging	X	X	X (Wuksachi only)		
• Food Service	X	X	X (Lodgepole, Wolverton [winter] and Wuksachi only)		
• Gift Shops	X	X	X (Lodgepole and Wuksachi only)		
• Store / Supplies	X	X	X (Lodgepole only)		
• Laundry / Showers		X	X (Lodgepole only)		
• Gas / Service Stations					
• Post Office		X	X (Lodgepole)		

Facilities at Inholdings in Giant Sequoia National Monument (Silver City Resort, Montecito-Sequoia, Kings Canyon Lodge, Stony Creek Lodge)	
• Lodging	X
• Food Service	X
• Gift Shops	X
• Store / Supplies	X
• Laundry / Showers	X

Private Land and Special Use Permits on Park Land

National parks are publicly owned lands set aside to protect our nation's most precious natural and cultural resources. In addition to public lands within Sequoia and Kings Canyon National Parks, there are two types of non-public ownership or use — private land (referred to as inholdings) and permitted special park uses (e.g., permits for utilities, non-profit uses, and private cabins at Mineral King). Additionally the adjacent Alley property is considered in the general management plan.

PRIVATE LAND

Kings Canyon National Park — Wilsonia

When General Grant National Park (later Kings Canyon National Park) was established in 1890, a 200-acre area inside the park boundary was privately owned. Later the tract was subdivided and sold and is now known as Wilsonia. The subdivided land contains primarily seasonal use cabins. Grant Grove village is adjacent to the private land in Wilsonia. Wilsonia is hidden from public view since it is off the Kings Canyon Highway and is not within public use areas. Most visitors would not be aware of it. Early in the 20th century a goal was identified to purchase all private inholdings, but that goal was not accomplished. Since then the National Park Service has purchased private land in Wilsonia from willing sellers and managed the area in accordance with a *Land Protection Plan* (NPS 1986c). In many cases multiple generations of families have enjoyed their cabins, in other cases the owners are relatively new. Some seasonal cabins are being converted for year-round use. Current estimated average property value is $60,000; total property taxes (paid to Fresno County) amount to around $93,000.

The 1986 *Land Protection Plan* predates Wilsonia's 1996 designation as a historic district, so the National Park Service's stated goal is still to acquire private property from willing sellers in order to restore the land to natural conditions (NPS 1986c). The *Land Protection Plan* does not allow commercial use of private property. Today private landownership encompasses 190 acres and 56 tracts. The National Park Service owns 92 tracts, 10 of which have a reservation of use and occupancy by the former owner. Some government-owned properties contain structures contributing to the historic district, and those structures have been retained pending the completion of a new land protection plan following approval of the general management plan.

The Grant Grove area has limited water supplies but Wilsonia has no impact on the NPS public water supplies. Water in the Grant Grove area is ultrapure, which results in the leaching of copper from the distribution system. Potable water comes from 11 wells and 8 storage tanks scattered throughout Wilsonia. There is no information about wastewater systems. The Park Service provides utilities to facilities that it owns and maintains.

Snowmobiles are allowed on private land and roads, but a snowmobile trail through the park to what is now Giant Sequoia National Monument is now closed.

Sequoia National Park

Oriole Lake. Oriole Lake is a rare lake in the foothills environment in a remote area of Sequoia National Park; the area is surrounded by designated wilderness. Originally there were eight tracts of privately owned property on 9 acres; currently there are four private landowners and five cabins, and the National Park Service owns four tracts. Access is by way of a primitive narrow dirt road that is gated, restricting public access. The Park Service has negotiated with landowners to provide public pedestrian access to Oriole Lake. At one time there was a small airplane runway, which has been removed and the area returned to more natural conditions.

The 1986 *Land Protection Plan* proposes the purchase of private inholdings at Oriole Lake from willing sellers so that the area can be returned to natural conditions (NPS 1986c). After acquisition and the removal of development, the area could be designated wilderness. The value of each property (land plus improvements) is estimated at $40,000, and property taxes totaled $3,000. The Park Service provides minimal services. The condition of water and sewer facilities is unknown.

Silver City. Silver City was one of the earliest settlements along the Mineral King Road, dating from 1884. It evolved from a lumber and mining support community into a seasonal recreation community. The 160-acre area has 35 tracts with approximately 40 cabins, as well as a small resort north of the road with 14 rental cabins, public showers, and a restaurant / store. Silver City is visible to visitors on the Mineral King Road. The National Park Service has acquired four large tracts in Silver City, and it maintains the Mineral King Road and provides emergency response. The road is closed seasonally and gated but residents have keys for access. Snowmobiles are allowed only on the road to provide access to private facilities / land.

The 1984 *Land Protection Plan* does not envision additional purchase of land, and it proposes scenic easements to retain the area's rustic character (NPS 1984). The current estimated value for each lot and improvements range from $40,000 to $60,000. About $39,000 in total property taxes are collected from the area. Silver City has its own water and sewer systems, and electricity for the resort is provided by a generator.

Kaweah Han. Adjacent to and below Silver City is Kaweah Han, a 60-acre privately owned property that straddles the East Fork of the Kaweah River. It was constructed in 1937 and consists of a large Bavarian-style lodge (over 5,000 square feet of living space), a small guest or caretaker's house, and a hydroelectric system using a 3,800-gallon tank. The property is off the Mineral King Road and cannot be seen from the road. Residents have keys permitting access when the Mineral King Road is closed. Snowmobiles are allowed only on the road to provide winter access to the private facilities.

The 1984 *Land Protection Plan* envisions a continuation of the present residential use of the lodge (NPS 1984). The lodge was purchased by a private owner in 2002 and is expected to remain in residential use.

Mineral King Valley Private Properties. A total of 29 acres in two tracts are privately owned in the Mineral King Valley — the Cedar Point mine and mill site, and No. 1 North on the Empire mill site. Trailhead parking is located on one tract, as well as two cabins with 99-year leases. Residents have keys for access when the Mineral King Road is closed, and as described for Silver City and Kaweah Han, snowmobiles are allowed only on the road to provide winter access. The structures can be seen by trailhead users and constrain access near the trailhead. The property is valued at $227,461; property taxes are $2,400.

SPECIAL USE PERMITS ON PARK LAND

Utility Use — Hydroelectric Facilities

In the early 1900s Congress authorized the development of hydroelectric facilities along forks of the Kaweah River adjacent to and within Sequoia National Park. Reauthorization is required every 10 years for the facilities to continue to operate, and the secretary of the interior is authorized to renew the permit until September 8, 2026. Some of the facilities, which are owned, maintained, and operated by Southern California Edison, are eligible for listing on the National Register of Historic Places. Facilities include several hydroelectric plants outside the park that seasonally generate 50,000 kilowatts of power, and the park receives a rebate on its electricity use.

Stone, concrete, and masonry facilities in the park include two dams, flumes, and channels in the Ash Mountain / Potwisha area. Above the Mineral King area are four concrete dams that

have created small lakes — Monarch, Eagle, Franklin, and Crystal Lakes. The lakes are used as camping areas. A 1992 report of these dams classified them as a "significant-hazard facility," a statement of the potential adverse impact on human life and downstream development if a dam should fail" (NPS 1992b). Failure of these dams "has the potential to jeopardize lives in at least one dwelling in the community of Mineral King" and "the potential to jeopardize lives at Cold Spring Campground" (NPS 1992b).

There are also wood / metal and concrete flumes in and adjacent to Sequoia National Park. Water impoundments outside the park are used for local and park fire fighting. In addition to concerns about the structural integrity of the concrete dams, there are also concerns about introduced sport fish and the impact of fire (both natural and prescribed) and earthquakes on flumes and facilities in remote and difficult-to-reach locations.

Facilities are visible from the Potwisha campground, and campers use the access route to the Potwisha dam for hiking. Motorists driving the Generals Highway are generally not aware of these facilities. Many users in the Mineral King area may not know that the lakes are part of the hydroelectric system and were enlarged by concrete dams.

Nonprofit Use — Camp Wolverton (Sequoia National Park)

Since 1937 the Western Los Angeles County Council of the Boy Scouts of America has operated Camp Wolverton a mile or so from the Generals Highway and adjacent to Giant Forest. The camp is near an old road (now a trail) that connects Lodgepole with the Sherman Tree area of Giant Forest. It covers approximately 2 acres of coniferous hillside and includes a water distribution system, pit toilets, group campsites, and parking. Water use is metered and is billed to the Boy Scouts by the National Park Service (in 2000, 18,000 gallons of water were used at a cost of $358.20). Garbage collection is provided by contract.

The camp is authorized through an NPS special use permit, renewable every five years, with an annual permit fee of $100. The council has a written non-discrimination policy in place. The permit conditions state that the camp shall be made available on a space-available basis for non-profit recreational and educational purposes. Boy Scouts and Girl Scouts from the region use the facility 90% of the time. During the rest of the season, Camp Wolverton is used by university researchers and park volunteers. While some visitors using the Wolverton picnic area drive by the location, it is not obvious or visible to the majority of park visitors.

Mineral King Permit Cabins — Cabin Cove, West Mineral King, East Mineral King

The Mineral King area was first opened to public use in 1879 with the construction of a road. Many early visitors were local Tulare County residents escaping summer heat in the Central Valley. Most of the cabins in this area date from the USFS cabin program of the 1920s to 1940s. The 1978 legislation that added the Mineral King area to Sequoia National Park authorized the continuation of permits for cabins on public land but limited the permit extensions to the life of the 1978 permittee of record. Public Law 108-447, passed in 2004, allows permits to be transferred to heirs, successors, and assigns. In 1999 the Mineral King Road Cultural Landscape District was established, with many cabins listed as contributing elements (see the discussion under the "Historic Structures, Districts, and Cultural Landscapes" section, beginning on page 37).

There are approximately 60 active permits in three areas — Cabin Cove, West Mineral King, and East Mineral King. There are also a few cabins that were not removed when the permittee of record died, pending the outcome of the general management plan. Fees for the special use permits consist of a use fee ($386 in 2001) that is forwarded to the U.S. Treasury and an administrative fee ($374 in 2001) that remains in the park, for a total fee of $760 in 2001. The fees were set in a 1994 appraisal and have been

increased annually in accordance with the consumer price index. Tulare County possessory interest taxes paid annually total around $4,900.

West Mineral King has a potable community water system, developed by the permittees and maintained by the National Park Service; it also supplies Cold Spring campground and the ranger station. Wastewater disposal is provided by individual private systems. In East Mineral King and Cabin Cove, wells or surface water diversions provide water, and individual septic systems provide sewage treatment. Virtually all permittees have toilets, sinks, and showers in their cabins, and many retain an outhouse for emergency use. In some cases wastewater from sinks is thrown into gravel sumps. Most facilities are close to water sources.

No floodplain studies have been done to determine if cabin structures are within the 100-year floodplain.

The Mineral King Road is closed seasonally and gated but permit holders have keys for access. Snowmobiles are allowed only on the road to provide winter access to privately owned facilities.

Many of the privately owned structures are adjacent to the Mineral King Road, making them visible to all visitors, and various signs suggest private land or ownership. The location of some cabins may physically constrain access within the area. Special use permit cabins often bring into question private ownership within park boundaries.

POTENTIAL BOUNDARY ADJUSTMENTS

The Alley property is ranch property along the North Fork of the Kaweah River. The Colony Mill Road trail, which is used for park access, cuts through the property.

Park Management, Operations, and Facilities

STAFFING

In FY 2001 full-time employees (FTEs) numbered about 262, up from around 220 for 1999 and 2000 (see Table 14). Typically during the summer 250 to 300 seasonal employees are brought on, plus over 1,400 volunteers. Additionally there are about 26 cooperating association employees, 45 interagency staff and researchers, and 250 concession employees.

Park Staff Divisions

Park Management and Administration

The superintendent, five division chiefs, and administrative staff comprise park management. Administrative functions are primarily located at the Ash Mountain headquarters.

Division of Interpretation and Cultural Resources Management

The Division of Interpretation and Cultural Resources offers programs and activities and provides staff at visitor centers and contact stations. While popular with the public, the number of interpretive staff has been reduced as staffing needs for other programs have increased. As a result, the program relies more heavily on volunteers and the cooperating association. The parks have a small staff of cultural resource specialists to manage archeological artifacts, ethnographic resources, historic structures and districts, cultural landscapes, and museum collections, as well as participate in Native American consultations. As part of the parks' cultural resource program, the 1999 *Natural and Cultural Resources Management Plan* called for additional staffing

Division of Fire and Visitor Management

Rangers are responsible for protecting visitors and park resources and for enforcing park rules and regulations. They staff entrance stations, maintain mounted units, provide law enforcement, search-and-rescue, and emergency medical services.

Helicopters are used for fire suppression and monitoring, search and rescue, emergency

TABLE 14: STAFFING SUMMARY 2001

NPS Staff	Number of FTEs	Percentage of FTEs
Park Management	7	2.6%
Park General	13	5.0%
Administration	20	7.6%
Interpretation and Cultural Resources	21	8.0%
Fire Management and Visitor Protection	45	17.2%
Ranger Fees	18	6.8%
Science	22	8.4%
Maintenance Operations	79.2	30.2%
Maintenance SPEC	37	14.1%
Total FTEs	262.2	100%
Estimated Seasonal Staff	290.4	
Estimated Volunteers in the Parks	1,432.8	
Other (Research)	25	NA
Interagency staff (fire crew)	20	NA
Sequoia Natural History Association	26	NA
Concession	100 KCPS 140 DNPS ±24 horse	NA

medical, and snow surveys, and occasionally for supplying backcountry ranger stations. Snowmobiles are used rarely, primarily to facilitate research, snow surveys, and winter search and rescue.

Fires are monitored and managed or suppressed to protect life, private property, and public resources and facilities. In order to restore a natural fire regime, fire history is mapped, and some areas are purposefully burned to improve resource conditions and reduce the likelihood of catastrophic fires. Interagency firefighters are based seasonally in the parks at the Swale fire camp in Grant Grove village.

Division of Natural Resources

Staff in the Natural Resources Division protect and monitor diverse resource conditions. The *Resources Management Plan* and annual work plans guide the work of this division. Staffing has increased as a result of a stronger emphasis on information in the national parks. Tree crews assess the condition of trees in developed areas, and those that pose a public safety hazard are removed on a priority basis. Storms, wind, insects, and disease all cause tree maintenance work. Because sequoia trees have shallow root systems, they have been known to topple without warning, and leaning sequoias are closely monitored.

Division of Maintenance and Construction

The Maintenance Division carries out vital park functions, operating heavy equipment and utility systems and maintaining roads and facilities, as well as providing janitorial services such as cleaning restrooms. Mountainous terrain, aging infrastructure / facilities, and seasonal closures of facilities all affect maintenance operations. Road maintenance, snow removal, and hazard tree removal are time and labor intensive.

Historic Structures. Structures that are eligible for historic recognition are to be maintained according to the "Secretary of the Interior's Standards" (NPS 1995d). Maintaining historic facilities is expensive and labor intensive, and if and when they are altered, law requires them to be made accessible to people with disabilities. When a historic facility that provides public services, such as a restroom, cannot be made accessible (possibly due to type of construction and narrow entrances) additional facilities are provided to meet that need.

Utilities. When a system fails or reaches the end of its life cycle, or the demand changes, there may be conflicts between preserving natural and cultural resources and providing services that meet all environmental regulations. Increasingly stringent state codes result in higher operating and maintenance costs and may lead to utility system closures. The National Park Service is responsible for utility systems serving acquired private property. In some areas, due to tighter state standards, terrain, and soil conditions, vault toilets are being used, resulting in increased park maintenance budgets due to pumping and transport expenses.

Frontcountry Facilities. In the frontcountry the Maintenance Division is responsible for approximately 258 miles of paved two-lane roads and about 38 miles of unpaved roads (generally less than two lanes), 26 miles of paved trails, 497 buildings, over 1,400 campsites, 50 picnic sites, 23 water systems, 5 wastewater systems, and approximately 60 septic systems, as well as signs and benches. Special measures are taken to protect sequoia trees (fencing, paving, and armoring path edges to contain the impacts of pedestrian trampling) and to minimize human/bear encounters (providing bear-proof storage boxes in frontcountry campgrounds, along with maintaining bear-proof refuse containers and dumpsters).

Backcountry Facilities. In the backcountry the Maintenance Division is responsible for over 842 miles of unpaved trails. Trail maintenance supplies and equipment are transported by stock and helicopter to remote locations, and some mechanized equipment is used to provide the maximum amount of public access by reducing the amount of time and labor required to keep up the trail system. Bear-proof storage boxes have been installed in popular backcountry areas.

Backcountry toilets have been provided in some areas to protect resources, requiring routine maintenance and periodic relocation or replacement.

Administrative Stock Use. The parks have established a monitoring program based on standards and indicators to allow both administrative and other stock use to continue at sustainable levels. NPS administrative stock use comprised 38% of total stock use in 2003 (the percentage of use has gradually increased as commercial stock use has fallen). Administrative use includes stock-supported ranger stations (Roaring River, Kern, and Hockett) and trail crew use. The administrative pasture at Ash Mountain may have up to 90 horses and mules grazing at any one time. Most administrative stock winter outside the park. The effect of seasonal grazing at Ash Mountain is moderate.

Administrative Helicopter Use. Helicopters are used by staff for deliveries of backcountry supplies and crews. At times they are considered the minimum tool necessary for trail maintenance activities.

PARTNERS AND OTHER ENTITIES

Sequoia Natural History Association

The association runs bookstores, educational events, and cave tours.

Concessioners

There are two primary concessioners in the parks. Kings Canyon Park Services provide lodging and other facilities in Kings Canyon National Park. Delaware North Parks Services in Sequoia runs facilities at Wuksachi, Lodgepole, and Wolverton, as well as the Bearpaw Meadow high Sierra camp. Two other concessioners provide day rides and pack operations at Cedar Grove, Grant Grove, Wolverton, and Mineral King. Concessioner facilities are further discussed beginning on page 75.

Partners and Volunteers

Over 1,400 volunteers serve in the parks in a variety of capacities.

Commercial Permit Holders

Approximately 60 commercial or incidental business permit holders provide services for visitors. Most of these permits are for bus tours, backpacking services, horseback riding, guiding services, llama packing, and skiing services. These enterprises use park resources to offer recreational opportunities to the public that otherwise may not be available, and they must comply with park regulations.

Inholder and Permit Holder Groups

Groups of inholders and permit holders provide some educational services and help maintain and operate some utility systems.

PARK FACILITIES

Utilities

Water

Water supply and treatment facilities are provided for park developments and some backcountry areas. Water supply depends on annual precipitation, and local recharge may be limited for the water systems at Grant Grove, Lodgepole (including Wuksachi, Wolverton, and Giant Forest), Ash Mountain, Silver City, and Mineral King. (Water use and wastewater data are summarized in appendix E.)

Water usage depends on the type of plumbing fixtures. In facilities with older fixtures an estimated 64 gallons of water are used per day by each overnight visitor. In areas with low-flow fixtures, demand falls to about 42 gallons per overnight visitor. Day use demand is about 10 gallons per person. In campgrounds water use is in-between.

Wastewater / Sewer

The Cedar Grove wastewater treatment facility was replaced in 1998. The Giant Forest facility has been relocated to the Clover Creek wastewater treatment plant near Wuksachi. A few areas cannot be easily connected to wastewater treatment plants, and appropriate conditions for sewage leachfields may not exist. In such cases they are being replaced by vault toilets, which require regular pump out and increased sewage handling expenses.

Electrical Power

Overhead power lines have been replaced in most areas or are scheduled to be replaced. An underground route through Giant Forest, which is difficult to maintain because it goes directly through the grove, is scheduled to be replaced by the longer but more accessible route that follows the road system. Solar and wind power are used at some of the more remote locations, such as the government pack station in Cedar Grove, the Lookout Point entrance station in Mineral King, and Dorst campground. Generators are used at other remote locations, such as the Cold Spring ranger station and Crystal Cave.

Telecommunications

All frontcountry areas have phone systems. There are radio repeaters and microwave equipment in the frontcountry and backcountry.

Gas

Propane is used in all frontcountry development areas. Often screening is used to reduce the visual impact of tanks in more public areas.

Roads

There are around 258 miles of paved two-lane roads in the parks and about 38 miles of unpaved roads (generally less than two lanes). Generals Highway is being rebuilt, continuing the two-lane width, which limits the number of people who can access the parks. Road character guidelines have been developed for the reconstruction. Giant Forest construction projects have reduced the number of parking spaces inside the sequoia grove, but a similar number of parking spaces overall are being provided at other locations outside the grove. The limited parking that remains in the grove is in previously disturbed areas.

Cedar Grove is closed at the end of November and reopened in early April. Mineral King is closed at the first of November and reopened on Memorial Day, snow conditions permitting. Unpaved portions of the Mineral King Road require heavy annual maintenance. The higher elevations of the Generals Highway are periodically closed by snow; however, roads are opened as soon as possible.

Parking

Table 15 shows the location of the approximately 2,600 public parking spaces (excluding campgrounds); the majority of public parking spaces are in year-round paved areas.

The Ash Mountain headquarters area has parking for staff and other needs. A total of 87 striped staff spaces at Ash Mountain are supplemented by additional paved and unpaved areas in residential and operational areas to meet the needs of small offices, motor pools, maintenance yards, delivery areas, and storage areas. Staff parking at headquarters is insufficient, and carpooling is encouraged.

Other developed areas have similar residential, operational, and concession parking needs.

NPS Non-Residential Facilities

There are numerous public, administrative, and operational facilities in the parks (see Table 16). Most park use is seasonal, requiring extensive preparation to open facilities and to close them down for the winter. Many park facilities have outlived their expected life. Facilities eligible for historic status require special care.

TABLE 15: SUMMARY OF VEHICULAR PARKING AREAS

Location	Public Parking / Trailheads	Lodging Areas (not campgrounds)	Road Pullouts	Staff Parking
Cedar Grove (seasonal)	335 (8 accessible)			
Grant Grove	370 (9 accessible)	33 (including accessible)		
Lodgepole Area*				
• Lodgepole	109			
• Giant Forest / Sherman Tree	497 (33 accessible, 22 RV / bus)			
• Wolverton	300			
• Crescent Meadow / Moro Rock	108			
• Crystal Cave	141			
Wuksachi		258		
Generals Highway (including North and South Fork areas)			60	
Ash Mountain	154		35	112 (including 25 at recreation hall)
Mineral King (seasonal)	92 (all gravel)			
Totals	2,106	291	95	112

NOTE: Accessible means accessible for people with disabilities.
* Includes unofficial spaces.

Historic Facilities

Rental cabins at Grant Grove are maintained by the concessioner.

The Giant Forest market and the Beetle Rock assembly hall are being adaptively reused as a museum and classroom. The Giant Forest restroom has been renovated. Historic features (such as Tharp's Log, the Moro Rock stairs, Cattle cabin, restrooms, and benches at Giant Forest; the fishing cabin at Cedar Grove; the Gamlin cabin and log at Grant Grove) have regular preventive maintenance.

Some buildings in Wilsonia provide additional seasonal housing. Five NPS-owned facilities at Wilsonia are in poor to fair condition.

TABLE 16: SUMMARY OF NPS FACILITIES

Type of Facility	Cedar Grove (seasonal)	Grant Grove	Lodgepole Wuksachi Wolverton Giant Forest	Ash Mountain	Mineral King (seasonal)	Total
Visitor Use	3	3	13	5	3	27
Comfort Stations	25	21	36	5	14	100
Administration	7	7	2	23	6	45
Maintenance	17	28	25	27	12	109
Garages	7		4	16	1	27
Fire Stations / Lookouts	Fire station	Fire station Swale interagency fire camp Lookout	Fire station	Fire station	Fire station Lookout	5 fire stations 2 lookouts
Campgrounds	4	3	2	2	2	13
Campsites						
• Tent only	37	17	168	28	61	
• Tent or RV	314	262	84	52		
• RV only		20*	72			
• Accessible	1	6	9	1		
	352	305	333	81	61	1,132

* Self-contained RVs only.

Historic facilities in the Ash Mountain area include structures from a CCC camp at Sycamore.

At Mineral King, the cultural landscape district includes seven contributing NPS-owned facilities (two garages, one ranger station foundation, three water troughs, and the roadbed itself).

Backcountry ranger cabins and other historic facilities receive preventive maintenance.

Natural Resource Protection

Fence lines and other work at the Grant and Sherman trees have facilitated sequoia grove and meadow restoration. To date, 231 acres of sequoia grove in Giant Forest have been restored, and over 1 million square feet of asphalt have been removed.

NPS Residential Facilities

By Department of the Interior policy, housing is provided only when (1) personnel are required on site to provide essential services, (2) housing is not available in the local market, or (3) no housing is available within a reasonable commuting distance. As a result, former residences within the parks have been converted to office, multi-purpose, and storage spaces, sometimes detracting from a cohesive residential character, especially in the Ash Mountain headquarters area. Grant Grove has the most unified residential area, with housing between the visitor center, maintenance operations, and Wilsonia. The housing area at Lodgepole has some park operations facilities and is close to campgrounds and visitor use areas. Often housing is tucked into available space, so a picnic area at Cedar Grove became a concessioner trailer housing area. Concession housing is usually separate from NPS housing. Housing is summarized in Table 17.

An inadequate housing supply makes hiring seasonal staff and volunteers difficult. In the summer 2001 there were over 80 requests for 40 seasonal park housing units, and it is often difficult for seasonal staff and volunteers to find affordable housing in local communities. Concession housing is also limited, with around 30% of staff having to commute from the outside.

Gateway communities provide services for park staff, but local real estate values make housing too expensive for some staff. While road access to the parks has been improved, the commute to Lodgepole / Wuksachi is still long and arduous. Mineral King is not considered within a reasonable commute distance due to the terrain and road conditions. Carpooling is used to ease parking demand and the lack of onsite housing.

Estimated average daily water requirements for residential use is 64 gallons per day for older plumbing fixtures and 42 gallons per day for low-flow fixtures. Estimated average daily wastewater capacity for housing is similar for overnight and day use.

TABLE 17: SUMMARY OF RESIDENTIAL FACILITIES IN THE PARKS

	Cedar Grove	Grant Grove	Lodgepole / Giant Forest	Ash Mountain	Mineral King	Backcountry
National Park Service						
• Permanent	NA	18	21 15*	20	NA	
• Seasonal	21	23	31	26	7	32
Concessioners		±70	±107			
Inholdings		190 92**			±40 Silver City 8 Oriole Lake	
Permit Cabins (active)					62	
Total (783)	21	±393	±174	46	±117	32

* RV optional concession.
** NPS-owned tracts.

TABLE 18: SUMMARY OF CONCESSION AND PRIVATE FACILITIES

Kings Canyon National Park	Kings Canyon Park Services	Horse / Mule Pack Station, Horse Riding Station — Loverin
Cedar Grove	21-room, 3-story lodge Snack bar / market 4 trailers (housing), 1 comfort station 1 public shower / restroom / laundry	Cedar Grove Pack Station • 9 buildings (including 1 residence, 2 staff cabins, 2 bunkhouses with bath) • 1 public restroom
Grant Grove	30-rooms, two-story lodge Market / post office Gift shop / restaurant 9 cabins with bath 43 cabins with two central bathhouse / shower buildings 4 storage buildings / canopies 1 public comfort station 1 employee comfort station 3 office buildings	Grant Grove Stables • 3 buildings (including residence and bunkhouse, each with bath)
Staffing (100 employees; housing for about 70)	15 employee cabins with central bathhouse (2–3 employees each) 8 dorm rooms with shared bath 10 employee trailers with baths Personal RV spaces as needed	
Sequoia National Park	**Delaware North Parks Services**	**Horse / Mule Pack Station, Horse Riding Station — Page**
Lodgepole	Market/food service Public laundry and showers 1 service station (currently not in service)	
Wuksachi	3 two-story lodges with 102 rooms 1 two-story restaurant / kitchen / administration / gift shop	
Wolverton	1 storage facility 1 snack bar Equipment rental building	
Staffing (140 employees; housing for about 107)	30 rooms (duplex cabins w/central baths) — 2 people / unit 13 dorms w central baths housing — 2–3 people / unit 2 apartments (each for 2–4 people) RV spaces as needed 15 staff live in Three Rivers area and commute	
Bearpaw Meadow Camp	6 guest tents 3 toilets / showers Kitchen / dining tent Storage cabin	
Mineral King	Silver City Resort (privately owned)	Mineral King Pack Station • 1 public restroom • 1 residence • 1 tack shed

CONCESSION FACILITIES

Concessioners in the parks are listed in Table 18. Kings Canyon Park Services operates in Kings Canyon National Park, and Delaware North Parks Services in Sequoia National Park. The concession permits for day rides and pack operations do not require or authorize an expansion of services or the construction of new facilities. Silver City Resort is a private inholding in the Mineral King area that offers visitor accommodations, food, and supplies.

Kings Canyon Park Services

The Kings Canyon Park Services contract runs through October 1, 2011. Contractual obligations require the concessioner to accomplish the following (common to all alternatives because of contractual requirements):

Grant Grove

- Removal of 19 tent-top cabin units
- Construction of 28 cabins with bath
- Replacement of the bathhouse at Meadow Camp
- Construction of employee housing and recreation facilities, as needed
- Construction of a maintenance facility
- Renovation of assigned historic buildings

Cedar Grove

- Construction of employee housing and recreation facilities, as needed

Delaware North Parks Services

The Delaware North Parks Services contract runs through October 31, 2028.

At Wuksachi construction of housing for 12 employees has been recently completed. Additional phases could allow up to 312 lodging units, additional restaurant space, and employee housing.

Other projects that are not included in the contractual obligations include the renovation of the Lodgepole market and the possible use of the Lodgepole gas station building as a food service outlet.

Socioeconomic Environment

Sequoia and Kings Canyon National Parks are entirely contained within Fresno and Tulare counties, California, and most visitors pass through these two counties because of relatively easy access on California 180 from Fresno and on California 198 from Visalia.

Inyo County borders the parks on the east. This side of the parks is much farther from population centers and more difficult to get to because road access through the Sierra Nevada is limited. A small proportion of visitors access the park for wilderness trips from Inyo County but only by foot or horse after passing through Inyo National Forest and the John Muir Wilderness.

The parks' commercial and economic influence on the local environment is heavily skewed toward Fresno and Tulare counties. For these reasons the description of economic and social impacts related to this planning effort focus on these two counties.

DEMOGRAPHIC CHARACTERISTICS

Population

In 2000 California was the most populous state in the United States (see Table 19). Fresno County, one of the 58 counties in California, ranked 10th in population in 1999. From 1980 to 1990 this county grew by nearly 29.8%, slowing to about 19% in the 1990s. Tulare County ranked 21st in population in 1999. Its growth was about 26.9% during the 1980s, slowing to about 17% during the 1990s. The growth rates for both counties exceeded that for California and the United States. In 2000 the combined population of the two counties was 1,167,428.

Income

Total personal income for Fresno County increased by nearly 103.1% during the 1980s (see Table 20), and it further increased by nearly 41.8% in the 1990s. In 1999 total personal income accounted for 1.6% of the state total, and the county ranked 13th in the state.

During the 1980s total personal income for Tulare County nearly doubled and grew another 48.7% by 1997. The county's total personal income ranked 24th in the state in 1999 and made up 0.7% of the state total.

In the 1980s California's total personal income increased by 129%, compared to 111% for the entire country. From 1990 to 1999 state total personal income increased by 51% and national personal income by 59%.

TABLE 19: POPULATION

	1980	1990	2000
Fresno County	517,679	671,709	799,407
Tulare County	247,426	313,907	368,021
California	23,800,800	29,925,531	33,871,648
United States	227,224,719	249,438,712	281,421,906

SOURCE: Bureau of Economic Analysis and U.S. Census

TABLE 20: TOTAL PERSONAL INCOME

	1980	1990	1999
Fresno County	$5,603,436,000	$11,380,484,000	$16,135,625,000
Tulare County	$2,331,687,000	$4,661,069,000	$6,928,875,000
California	$286,228,598,000	$655,567,167,000	$989,590,237,000
United States	$2,313,921,000,000	$4,885,525,000,000	$7,784,137,000,000

SOURCE: Bureau of Economic Analysis.

To get a better perspective on the population and income situation, per capita personal income figures are displayed in Table 21. Over the years both counties have lagged far behind the state in terms of per capita personal income. Fresno County's 1999 per capita personal income ranked 41st in the state; it was only 71% of the state average and 74% of the national average. For the same year, Tulare County's per capita personal income ranked 48th in the state; it was only 65% of the state average and 68% of the national average. Relatively low per capita income in these two counties in a state that has a history of outperforming the national average indicates a less than robust local economy.

TABLE 21: PER CAPITA PERSONAL INCOME

	1980	1990	1999
Fresno County	$10,824	$16,944	$21,146
Tulare County	$ 9,424	$14,849	$19,329
California	$12,029	$21,889	$29,856
United States	$10,183	$19,584	$28,546

SOURCE: Bureau of Economic Analysis.

Major Industries by Earnings

Fresno County earnings increased from $7.4 billion in 1989 to $11.3 in 1999, an average annual growth rate of 4.3%. In 1989 the largest sectors were services (20.7% of total earnings), state and local government (14.8%), and farming (11.2%). Over the next 10 years the services and state/local government sectors gained in importance, and farming declined. As shown in Table 22, the largest economic sectors for Fresno County in 1999 were services (23.5% of total earnings), state/local government (16.4%), and retail trade (10.3%).

In Tulare County the average annual growth rate for earnings from 1989 to 1999 was 5.5%. Total earnings increased from about $2.7 billion to $4.6 billion. The three largest economic sectors in 1989 were state and local government (19.2%), services (15.3%), and farming (13.6%). The situation for farming had improved by 1999, as the largest industry sectors were state and local government (19.7%), services (16.3%), and farming (15.3%).

The $15.9 billion in earnings in the two counties is a substantial economic force. Other economic indicators described below provide additional insight into the functioning of this economic area.

Major Industries by Employment

In 1999 the economy of Fresno County provided 406,823 full- and part-time positions and Tulare County 173,455 total positions (see Table 23). Together this local area provided 580,278 jobs.

TABLE 22: EARNINGS BY INDUSTRY (1999)

Industry Sectors	1999 Earnings			
	Fresno County		Tulare County	
Farm	$639,565,000	5.66%	$699,030,000	15.33%
Agricultural Services, Forestry, & Fishing	$597,736,000	5.29%	$340,324,000	7.47%
Mining	$15,614,000	0.14%	*	–
Construction	$735,035,000	6.50%	$259,171,000	5.69%
Manufacturing	$1,049,730,000	9.28%	$445,477,000	9.77%
Transportation & Public Utilities	$720,477,000	6.37%	$257,086,000	5.64%
Wholesale Trade	$635,316,000	5.62%	$177,968,000	3.90%
Retail Trade	$1,160,647,000	10.26%	$491,261,000	10.78%
Finance, Insurance, & Real Estate	$709,237,000	6.27%	*	–
Services	$2,660,734,000	23.53%	$740,912,000	16.25%
Federal Government	$508,751,000	4.50%	$65,825,000	1.44%
Military	$22,774,000	0.20%	$9,148,000	0.20%
State & Local Government	$1,851,879,000	16.38%	$898,332,000	19.71%
Total	$11,307,495,000	100.00%	$4,558,793,000	100.00%

SOURCE: Bureau of Economic Analysis.

* Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.

TABLE 23: EMPLOYMENT BY INDUSTRY (1997)

Industry Sectors	Number of Full- and Part-time Jobs			
	Fresno County		Tulare County	
Farm	35,944	8.84%	25,689	14.81%
Agricultural Services, Forestry, & Fishing	39,858	9.80%	21,954	12.66%
Mining	441	0.11%	(D)	–
Construction	20,188	4.96%	7,520	4.34%
Manufacturing	29,759	7.31%	13,268	7.65%
Transportation & Public Utilities	16,002	3.93%	5,795	3.34%
Wholesale Trade	16,490	4.05%	5,104	2.94%
Retail Trade	61,243	15.05%	25,254	14.56%
Finance, Insurance, & Real Estate	27,357	6.72%	(D)	–
Services	100,133	24.61%	32,611	18.80%
Federal Government	9,590	2.36%	1,244	0.72%
Military	1,535	0.38%	689	0.40%
State & Local Government	48,283	11.87%	25,325	14.60%
Total	406,823	100.00%	173,455	100.00%

SOURCE: Bureau of Economic Analysis.

For both counties the service and the retail trade sectors provided the most jobs. Fresno County had more than 100,000 jobs in services (nearly 25% of the total), 61,000 jobs in retail trade (over 15%), more than 48,000 jobs in state and local government (11.9%), and 40,000 jobs in agricultural services, forestry, and fishing (9.8%). In Tulare County the service sector provided more than 32,600 jobs (18.8% of the total), the farming, state and local government, and retail trade sectors each accounted for over 25,000 jobs (14.5% each).

Unemployment

Unemployment is another indicator of the health of an economy. In Fresno County the unemployment rate was twice as high as the national average in 1990 and 1996, and three times as high in 2000 (see Table 24). An increasing unemployment rate and increasing population means that even greater numbers of individuals in the workforce were unable to find work in 2000 than in 1990. In Tulare County the situation has been relatively worse.

TABLE 24: UNEMPLOYMENT RATES

	1990	1996	2000
Fresno County	11.7%	13.0%	14.3%
Tulare County	11.8%	15.9%	15.4%
California	5.8%	7.2%	4.9%
U.S.A.	5.6%	5.4%	4.0%

SOURCE: U.S. Bureau of the Census.

Unemployment went from 11.8% in 1990 to 15.9% in 1996 and then fell slightly to 15.4% in 2000. Compared to the California average rates of 5.8% in 1990 and 7.2% in 1996 and 4.9% in 2000, unemployment rates are twice as high as the state levels and 2½ to three times the national level, indicating that the local economy was performing relatively poorly.

Poverty

For 1989, 1993, and 1995, Fresno and Tulare counties had poverty rates that significantly exceeded the state and national averages (see Table 25). In 1995 both counties had poverty rates that exceeded one person in four living below the poverty line. A quarter of the population living below the poverty rate and high unemployment indicate that this is an economically and socially depressed area.

TABLE 25: ESTIMATED PERCENT OF PEOPLE OF ALL AGES IN POVERTY

	1989	1993	1995	1997	2000
Fresno County	21.4%	28.1%	25.2%	25.6%	na
Tulare County	22.6%	28.2%	28.2%	27.9%	na
California	12.5%	17.4%	11.3%	16.0%	12.9%
U.S.A.	13.1%	15.1%	13.7%	13.3%	11.3%

SOURCE: U.S. Bureau of the Census.
na – not available.

PARK BUDGET AND PARK EMPLOYMENT

In 1999 the budget for Sequoia and Kings Canyon National Parks was approximately $10.9 million. In 2000 the budget increased to approximately $11.4 million (the 4.8% increase was just enough to cover increased labor costs.) The budget covers the goods and services (including staff labor) necessary to manage the parks. Infrastructure improvements, new construction, and major maintenance items are not included. As is true of most units of the national park system, the parks have a backlog of needs for many infrastructure items such as housing, water system improvements, and other utility upgrades.

In FY 2001 the parks employed approximately 262 permanent staff. In the summer 250–300 seasonal employees are added. The parks also have an extensive volunteer program, with over 1,400 unpaid volunteers in 2001. The parks' 500–600 permanent and seasonal positions are 0.1% of the total two counties' employed work force of 552,661 (1997 data).

MINERAL KING SPECIAL USE PERMITS ON PARK LAND

In Mineral King there are some 60 permits for private cabins on public land in three areas. Each cabin permit holder pays a use fee based on the appraised value of the privilege ($386 for 2001) and the administrative cost based on the park's labor costs associated with administering the permits ($374 for 2001); fees are escalated each year for inflation by the consumer price index. In 2001 the annual fee was $760, for a total of $47,120. Tulare County receives approximately $4,900 annually for unsecured property tax on the cabins owned by the permit holders.

Local Property Taxes

Inholders, Mineral King cabin permit holders, and concessioners pay real estate taxes to Fresno and Tulare counties for land and/or buildings that they own or use within the parks. Table 26 shows the approximate taxes paid.

TABLE 26: LOCAL PROPERTY TAXES

	Fresno County	Tulare County
Silver City		$ 39,000
Oriole Lakes		3,000
Disney		2,400
Mineral King Special Use Permits		4,900
Wilsonia		93,000
Delaware North (1999)		150,400
Kings Canyon Park Services (1999)	$22,650	16,160
Total	$22,650	$308,860

SOURCE: Fresno and Tulare counties.

REGIONAL COMMUNITIES

Three Rivers

Three Rivers is the gateway community just outside the Ash Mountain entrance to Sequoia National Park. This community offers food (grocery stores and several restaurants), lodging at motels and bed-and-breakfast inns, gasoline, and other goods and services. The community is growing, supported by its proximity to the park.

Squaw Valley and Dunlap

Squaw Valley is a small community on California 180 about 23 miles from Grant Grove. A library, post office, and about 10 other small businesses offer limited services, including food, groceries, some lodging, and a doctor's office.

A half-dozen businesses (e.g., grocery store, mobile home park, etc.) are found closer to the park near Dunlap. The USFS Hume Lake ranger district office in Dunlap is about 16 miles from the Big Stump park entrance.