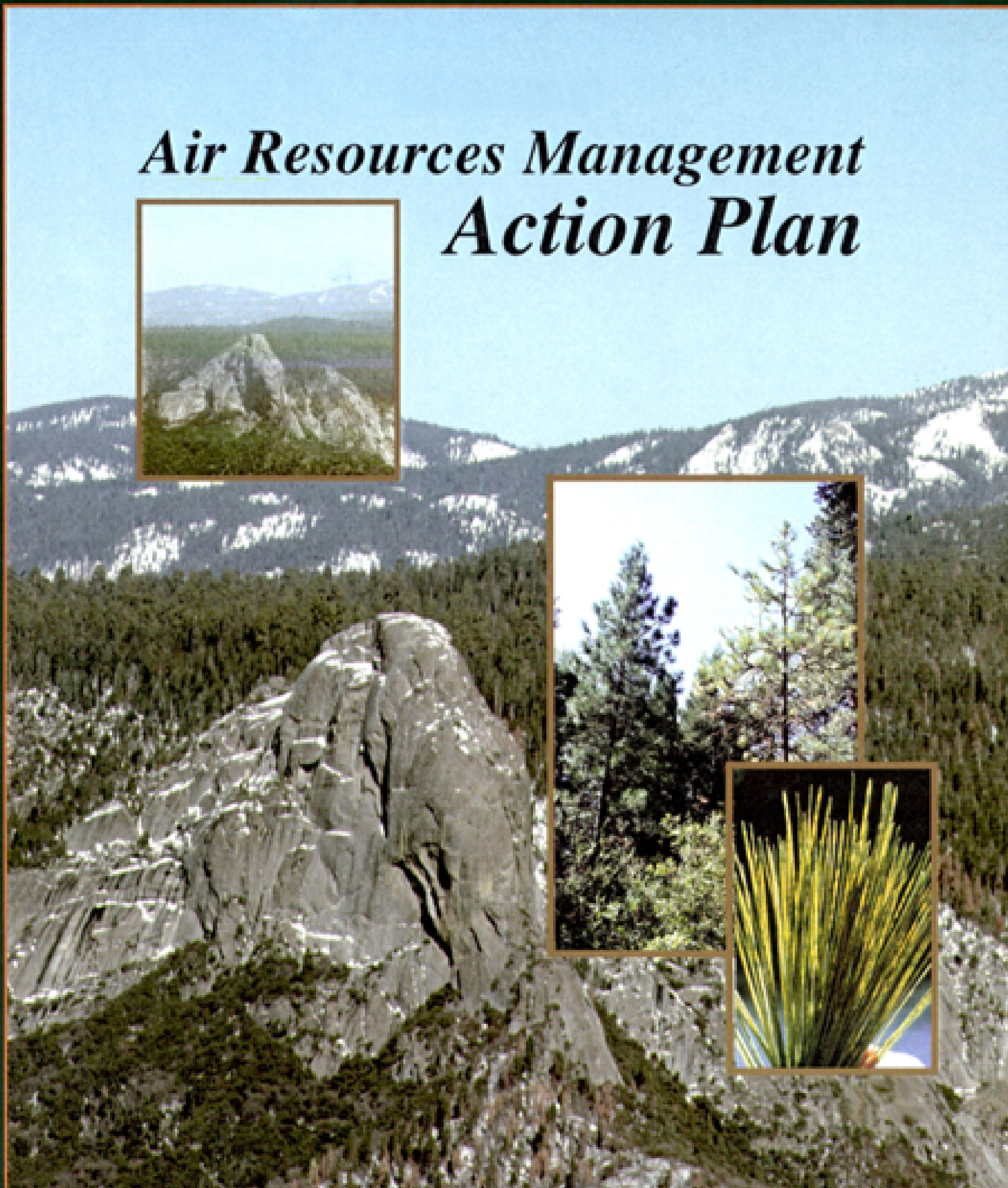
Air Resources Management Action Plan



United States Department of the Interior
National Park Service
Sequoia and Kings Canyon National Parks

November 1999

AIR RESOURCES MANAGEMENT ACTION PLAN
SEQUOIA AND KINGS CANYON NATIONAL PARKS

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Cover: Background photo is good visibility view of Moro Rock in Sequoia National Park. Upper left insert photo is poor visibility view of Moro Rock. Middle insert photo is a healthy pine (left) and an ozone injured pine (right). Lower left insert is visible ozone injury on pine needles. Photos taken by the National Park Service.

POSTSCRIPT

(for Air Resources Management Action Plan)

The development of the Air Resources Management Action Plan (ARMAP) began in 1994 with the goal of providing guidance for managing Sequoia and Kings Canyon National Parks air quality related resources. In a parallel effort with the Parks' development of a strategic plan, the goal was to complete the document in conjunction with the strategic plan's 1997 deadline. The first final draft of this plan was printed in September 1996. After intensive reviews, substantial comments were gathered and later incorporated into ARMAP.

Unforeseen circumstances and the departure of the Air Resources Specialist in January 1997 created delays in the final printing of this plan. Therefore, data summaries, regulations, policies, and other information reflect that which was understood and/or in place at the end of 1996.

Current schedules call for revising the plan in 2002.

ACKNOWLEDGMENTS

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Executive Summary

Air pollution is one of the most serious external threats to Sequoia and Kings Canyon National Parks (SEKI). Ozone levels at the parks frequently exceed State and occasionally exceed Federal air quality standards. These high levels of ozone have significantly affected park resources. Researchers have observed visible ozone injury on giant sequoia seedlings, black oaks, and 45% of the parks' Jeffrey and ponderosa pines. This type of injury can result in plant growth reductions and altered metabolism; the incidence of such injury has increased over the last 15 years. High levels of air-borne particulates limit annual average visibility at Ash Mountain to 47 miles, compared to 250 miles in a completely clean atmosphere. Additionally, measurements indicate that acid deposition may be occurring in high enough concentrations to affect invertebrates and cause episodic acidification and nitrogen saturation. The complexity and seriousness of air pollution issues at SEKI necessitates inclusion of an Air Resources Management Action Plan in the Natural and Cultural Resources Management Plan (National Park Service 1994).

Many Federal and State mandates guide air resources management at the park level; the two most important pieces of legislation are the Federal and California Clean Air Acts (CAA and CCAA, respectively). These acts give primary regulatory authority for air pollution control to the Environmental Protection Agency (EPA), states, and local air districts. The CAA does, however, give Federal land managers affirmative responsibility to protect air quality-related values (including visibility) in Class I areas. Many national parks, including SEKI, are designated Class I areas. The National Park Service (NPS) has a dual responsibility to protect park resources from external threats and to protect air resources in Class I areas. The NPS acknowledged this responsibility when it established the following long-term goal in the 1997 NPS Strategic Plan: air quality in at least 50% of Class I park areas improves or does not degrade from 1997 baseline conditions. SEKI, in turn, acknowledged its responsibility to protect air quality when it established the following 5-year goal in the 1997 SEKI Strategic plan: air quality in the parks improves or does not degrade from 1997 baseline conditions. SEKI air resources will reach the ultimate desired future condition when park air quality returns to its natural range of variability.

Although the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) has primary regulatory authority for air pollution control in the San Joaquin Valley, SEKI has a crucial role to play in protecting park air quality. Management decisions and actions taken at SEKI need to comply with mandates while striving to achieve park and NPS goals. This plan provides a list of recommended actions which, based on current knowledge, will assist these parks in achieving these goals. Recommended actions fall into several categories: research, inventory and monitoring, park planning and regulatory compliance, education, external relations, information management, and funding. All categories are of equal importance but actions within categories are prioritized as high, medium, or low priority. Each year, management will determine the recommended actions to be taken that year. These actions will be identified in annual work plans, and the work plans will be included as addenda to this plan. The plan itself will be reviewed every 5 years. The 5-year review will consider new information, regulatory changes, and past effectiveness of management actions; review findings will be used to re-prioritize and revise the recommendations.

Section 1. Introduction

PURPOSE

Sequoia and Kings Canyon National Parks (SEKI) have some significant environmental problems caused entirely or partly by air pollution. High ozone concentrations damage susceptible vegetation, acidic deposition degrades water quality in lakes and streams, and particulates severely reduce visibility at scenic vistas.

The predominant source of these problems is air pollution transported from the valley floor of the San Joaquin Valley Air Basin (SJVAB). Projections of rapid population growth in the San Joaquin Valley portend continued air pollution problems in SEKI. In 1994, the San Joaquin Valley's population equaled 2.9 million people. By the year 2000, the valley's population is projected to grow 27% to 3.7 million people, an increase exceeding the existing population of Fresno County, the most populous county in the San Joaquin Valley.

Without careful, coordinated planning, these future population increases will exacerbate SEKI's air pollution problems. The San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) faces the difficult task of reducing pollution levels within the context of this predicted population growth. The SJVUAPCD has developed several plans designed to reduce ambient ozone and particulate matter concentrations throughout the San Joaquin Valley Air Basin, including SEKI. Those plans are described in Section 2.

The National Park Service (NPS) has established several national resource management policies, many of which contain air-quality regulatory policies, goals, and objectives. These include the Natural Resource Management Guideline, 1991, and the Statement for Management Revised Draft, 1991, both of which are summarized in Appendix C.

PROGRAM

The goal of the SEKI air resources management program is to achieve and maintain the natural range of air quality in these parks and protect park natural and cultural resources, employees, and visitors from human-caused air pollution-related threats.

The objectives of the program are as follows:

- # monitor park air pollution levels, and impacts on cultural and natural resources;
- # educate park staff, visitors, and public and regulatory authorities about park air quality issues;
- # participate in Federal, State, and local regulatory actions that affect park air quality and operations;
- # ensure park compliance with air pollution regulations;
- # integrate air resources management into park planning and operations;
- # support sustainable use and development (minimum impact);
- # coordinate with SEKI park staff, other parks' staff, other agencies, the public, and academia on air resource issues;
- # develop the necessary technical expertise to implement the air resources management program; and

- evaluate the effectiveness of the air resources management program.

OTHER PARK PLANS

In 1995, SEKI began preparing a Strategic Plan and Annual Performance Plan, as required by the Government Performance and Results Act (GPRA) of 1993. All parks are required to have a strategic plan by September 30, 1997. The park's draft Strategic Plan is currently being revised to meet draft National Park Service Strategic Plan requirements and new guidelines developed by the GPRA Task Force. In addition, SEKI's General Management Plan is undergoing revision. The goal and objectives as stated in this section will require updating to be consistent with the Strategic Plan and General Management Plan once they are completed.

THIS PLAN

The goal of the Air Resources Management Action Plan (ARMAP) for SEKI is to provide guidance for managing SEKI's air quality-related resources. The ARMAP consists of six sections plus references and appendices. Section 1 describes the need for and purposes of this ARMAP within SEKI.

Section 2 provides background information on SEKI, including the dates the parks were established and their size, elevation, and natural resources, including those resources most susceptible to air pollution. Section 2 also contains information on air pollution laws, plans, and regulations as they affect SEKI's operations.

Section 3 describes current air quality conditions within SEKI. Emission sources inside and outside SEKI are described, including the role of pollutant transport from the San Joaquin Valley. Next, recent air pollution trends in SEKI are compared to those in the San Joaquin Valley. This section concludes by discussing the effects of air pollutants on SEKI's natural resources, including impacts on flora and fauna, aquatic resources, visibility, and human health.

Section 4 identifies key elements of SEKI's public education program as it relates to air quality.

Section 5 describes SEKI's data and information management programs.

Section 6 contains the long-range recommendations of the ARMAP which cover six areas:

- inventory and monitoring,
- park planning and regulatory compliance,
- education,
- external relations,
- information management, and
- funding.

Section 2. Background

HISTORY

Sequoia National Park was established in 1890, expanded in 1926 to include Mount Whitney, and expanded again in 1978 to include the Mineral King area. Kings Canyon National Park was established in 1940 and expanded in 1965 to include Tehipite Valley and Kings Canyon. SEKI was established largely to protect the giant sequoia groves and the scenic high Sierra wilderness contained within its boundaries.

Sequoia and Kings Canyon National Parks (SEKI) cover 864,383 acres, measuring 66 miles from north to south and 36 miles from west to east at the widest point. In 1984, Congress designated 85% of SEKI as wilderness (734,725 acres). An additional 91,688 acres (10% of total park acreage) are proposed for Wilderness Area designation. In addition, 31,629 acres (4% of park acreage) are designated as either Outstanding Natural Features (such as the giant sequoia groves) or Natural Environment (undeveloped lands adjacent to park roads, interpretive facilities, and visitor facilities such as picnic areas). Less than 1% of park lands are dedicated as experimental research areas (485 acres), cultural resource areas (507 acres), park roads, visitor centers, and park support facilities. In 1976, SEKI became an International Biosphere Reserve as part of the Man in the Biosphere Program.

NATURAL RESOURCES

SEKI ranges in elevation from 1,500 feet above sea level at the Ash Mountain Park Headquarters to 14,494 feet at Mount Whitney, the highest point in the continental United States. Within the continental United States, SEKI has the second largest roadless area. SEKI has four of the five largest sequoia trees in existence, the largest living organisms on earth (excluding fungi, clones, and reefs). Kings Canyon, reaching a depth of 8,200 feet, is the deepest canyon in the United States. Thirty of the 75 remaining sequoia groves (65% of all sequoia trees) are within SEKI.

SEKI contains a wide array of natural resources, including 1,431 species of plants. New species continue to be added to the parks' flora list. Ninety species of mammals have been identified, 26 species of birds, 25 species of reptiles, 15 species of amphibians, and 13 species of fish. Over 170 caves have been identified in SEKI, and the true number is estimated to be closer to 300. It is one of the most cave-rich areas in the western United States. In addition, within SEKI, 2,650 lakes and ponds and thousands of miles of small rivers, mountain creeks, and intermittent streams are protected.

THREATS TO RESOURCES

Air pollutants degrade SEKI resources in several ways. SEKI's lakes have been identified as being extremely sensitive to acidification from acid deposition. Research has also shown that Jeffrey and ponderosa pines are incurring visible damage from ozone concentrations. Visibility has been degraded at many scenic vistas found throughout the parks. And, at certain times of the year, air pollution levels may pose hazards to human health.

LAWS, POLICIES, AND GUIDING DOCUMENTS

Protecting SEKI's resources from air pollution is mandated by a wide variety of laws, policies, and guiding documents. These fall under seven basic categories:

- # California legislation,
- # federal legislation,
- # National Park Service Air Resources Division,
- # National Park Service Policies and Guidelines,
- # National Park Service regional office, and
- # Sequoia and Kings Canyon National Parks.

Applicable documents for each of the six categories listed above are described in Appendix C.

ROLES AND RESPONSIBILITIES

Organization

Air resource management responsibilities exist at the Federal, State, and local levels of government, which are described below.

U.S. Environmental Protection Agency

Several organizations are responsible for managing air quality in California. The U.S. Environmental Protection Agency (EPA) is responsible for coordinating the implementation of the Federal Clean Air Act (CAA) and other environmental programs (water, waste, toxics, and pesticides).

Although most of the regulatory responsibilities are delegated to the states, EPA retains the power to regulate interstate trucks, military and commercial aircraft, locomotives, ships, and non-road engines under 175 horsepower that are used in construction and agricultural activities. EPA is responsible for implementing regulations, standards, or programs that reduce emissions from sources under its jurisdiction.

California Air Resources Board

The California Air Resources Board (ARB) is a branch of the California Environmental Protection Agency (CalEPA) and is the State-designated air quality agency. CalEPA was formed in 1991 as a single point of accountability for all State environmental programs. The ARB and all other State environmental boards and agencies work as part of CalEPA. The ARB governing board consists of 11 members appointed by the governor with the consent of the senate and the San Joaquin Valley has one seat on the board. The ARB, which oversees all air pollution control efforts in the State has delegated stationary and some area source control to the 34 local air pollution control districts. The ARB retains responsibility for controlling air pollution from motor vehicle emissions and consumer products and identifying and controlling toxic air contaminants. ARB compiles the statewide emission inventory, promulgates air pollutant standards, and conducts air quality monitoring and research.

Vehicle emission control has been ARB's largest program because cars and trucks are a major cause of smog in the State. The ARB has set increasingly more stringent gasoline-fueled vehicle emission standards since 1960. Emission standards for heavy-duty diesel vehicles did not begin until the 1988 model year. In 1990, ARB adopted the Low Emission Vehicle program regulations, which included mandatory production of "zero-emission" electric cars. Since 1990, a statewide excessive smoke, heavy duty vehicle inspection program has been in place. Statewide cleaner burning fuels have been required since 1992, with phase I and phase II reformulated gasoline sold since 1992 and 1996, respectively, oxygenated gasoline sold during winter months since 1992, and reformulated diesel sold since 1993. In 1995, the ARB, EPA, and diesel engine manufacturers worked together to establish national standards for diesel engines.

ARB also has oversight responsibility for interbasin transport within California. The California Clean Air Act (CCAA) designates ARB as the coordinating agency responsible for ensuring that air districts work together to meet the Federal and State ambient air quality standards.

San Joaquin Valley Unified Air Pollution Control District

The SJVUAPCD is responsible for managing air quality within the SJVAB, which includes San Joaquin, Stanislaus, Merced, Madera, Kings, Fresno, and Tulare counties, and a portion of Kern County (SEKI is in Fresno and Tulare counties). The SJVUAPCD formed in 1991 as a result of State legislation. Before 1991, air quality was managed county by county. The SJVUAPCD, with three regional offices in Modesto (northern), Fresno (central), and Bakersfield (southern), has a governing board comprised of 11 locally elected officials: eight county supervisors (one from each county) and three city councilmembers (one from each of the north, central, and south regions of the San Joaquin Valley). It is the largest geographic district in California, comprising 16% of its area.

The SJVUAPCD's responsibilities involve developing and adopting plans and regulations necessary to comply with the CAA and the CCAA. Their primary responsibility is to regulate stationary and area sources. The SJVUAPCD has a uniform rulebook for the entire SJVAB that currently includes 124 rules.

National Park Service

The National Park Service (NPS), an agency within the U.S. Department of Interior, is charged with managing the areas that comprise the national park system. Through the Organic Act, the National Park Service was created and directed to protect park resources and provide for visitor enjoyment for all generations. The NPS is the primary Federal agency responsible for ensuring that park resources, including air quality, are protected in each national park.

The NPS is organized at the Washington, regional, and park levels. NPS guidelines for air resource management roles and responsibilities are in the NPS-77 Natural Resource Management Guideline in Appendix C. Appendix D lists the current SEKI organizational chart and structure.

At the Washington level, the NPS Air Resources Division (ARD) has primary responsibility for the NPS air resource management program, including ensuring compliance with the CAA requirements. (Note that the ARD was previously referred to as the Air Quality Division, or AQD.) NPS regional offices coordinate air-quality-related matters between parks and the ARD. Each regional office designates a regional air quality coordinator who is generally responsible for this coordination function, and park superintendents play a critical role in planning and carrying out air resource management activities.

Sierra Federal Clean Air Partnership

The Sierra Federal Managers (SFM), whose membership consists of park superintendents, forest supervisors, and a U.S. Bureau of Land Management (BLM) district manager, address Federal land management issues in common in the Sierra Nevada. The Sierra Federal Clean Air Partnership, formed in 1991, acts as an air quality technical advisory group to the Sierra Federal Managers. It consists of technical staff from central and southern sierran forests and parks and the BLM Bakersfield District.

Other Agencies and Organizations

Several other regional and State agencies have direct or indirect air quality responsibilities. Those agencies include the local County Association of Governments or Council of Governments (COGs), Transportation Planning Agencies (TPAs), Caltrans, and the California Department of Pesticide Regulation.

COGs and TPAs are responsible for preparing transportation plans that contain transportation projects expected to be constructed within a set time frame. In ozone nonattainment areas, those projects and their associated emissions must be incorporated into ozone State implementation plans. Caltrans has oversight authority for construction and modification of State highway projects, ensuring that new or modified projects do not cause or contribute to exceedances of State or Federal ambient air quality standards. DPR's regulation of pesticides affects air quality through the types (and volatile organic carbon content) of pesticides that can be applied and through the timing and duration of pesticide application that it allows.

FEDERAL AND STATE CLEAN AIR ACTS

The two laws that play the largest role in protecting air quality in SEKI are the CAA and the CCAA, which are described below and in more detail in Appendix C.

Federal Clean Air Act

The Act

The CAA became law in 1963 by the U.S. Congress and has been amended several times, most recently in 1990.

NAAQS

The 1970 CAA required the EPA to establish National Ambient Air Quality Standards (NAAQS) for air pollutants or air pollutant groups that pose a threat to human health or welfare. Primary NAAQS are intended to protect public health with an adequate margin of safety. Secondary NAAQS are intended to protect public welfare, which includes the resources and values found in SEKI, such as water, vegetation, wildlife, and visibility.

EPA has established NAAQS for six criteria pollutants: ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), lead, particulate matter less than 10 microns in diameter (PM10), and carbon monoxide (CO). The entire SJVAB, which includes SEKI, has been classified as a serious non-attainment area for the ozone and PM10 NAAQS (attainment of NAAQS by 1999 for ozone and 2001 for PM10). Table F-1 of Appendix F shows the Federal NAAQS.

Both the ozone and particulate matter standards are currently being reviewed. The EPA has proposed a new primary ozone standard between 0.07-0.09 ppm (averaged over 8 hours) and a secondary "SUM06" standard between 0.025-0.038 ppm (values 0.06 ppm or greater are added from 8:00 am to 8:00 pm over a 3 month growing season).

For particulate matter, the EPA has proposed to supplement the current PM10 annual and 24-hour standards with an annual PM2.5 (particulate matter less than 2.5 microns in diameter) standard of 15 ug/m^3, and a 24-hour PM2.5 standard of 50 ug/m^3. It also has proposed to change the format of the current 24-hour PM10 standard to be more robust (more exceedances allowed). The final ozone and particulate matter standards were announced November 1996 and implemented beginning in June 1997.

SIP

If a NAAQS is exceeded in an area (determined over a 3-year period), the area is designated nonattainment for that NAAQS. A State Implementation Plan (SIP) must be prepared to bring the area back into attainment. If states fail to prepare SIPs or are disapproved by EPA, EPA must prepare Federal implementation plans (FIPs).

Conformity

Federal agencies are required to comply with all State and local air pollution regulations. The 1990 CAA also include specific provisions that regulate Federal actions in nonattainment areas. These provisions are known as general and transportation conformity. Any Federal action in a nonattainment area that generates air emissions must comply with the conformity regulations to ensure that the particular action conforms to the existing SIPs.

Prevention of Significant Deterioration

The Prevention of Significant Deterioration (PSD) program was established in the 1977 amendments of the CAA (Title I, Part C). Subpart 1 concerns permitting of new major stationary sources (or major modification) in NAAQS attainment areas. Subpart 2 sets a national goal to prevent any future, and remedy any existing, human-caused visibility impairment in mandatory Class I areas (regardless of NAAQS attainment designation). Under the program, 157 national parks and wilderness areas were designated as Class I. The Federal land manager is charged with an affirmative responsibility to protect the Air Quality Related Values (AQRV) of designated Class I areas from adverse impacts. The NPS has defined AQRVs to include visibility, odor, flora, fauna, and geological resources; archaeological, historical, and other cultural resources; and soil and water resources (Bunyak 1993).

Subpart 2 required the EPA to establish requirements for reasonable progress towards meeting the national goal. In 1980, the EPA required states to add visibility strategies to their SIPs, but only a few states complied. The 1990 CAA added section 169B to Subpart 2, requiring the EPA and NPS to jointly conduct research on visibility impairment. The section also gives authority to the administrator, or by petition from the governors of at least two states, to establish visibility transport regions and commissions. The EPA was specifically required to establish the Grand Canyon Visibility Transport Commission (GCVTC) within 12 months of the implementation of the 1990 amendments. The GCVTC submitted its recommendations to the EPA in June 1996. In addition to using the GCVTC recommendations, the EPA will use the recent review of the particulate matter standard to establish regional haze requirements. The schedule will be the same as for the particulate matter and ozone standards review.

Acid Deposition

As stated in a report issued in 1995, the 1990 CAA required the EPA to investigate the possibility of setting deposition standards to protect sensitive resources, particularly in Class I wilderness areas and parks. The report concluded that establishing deposition standards, while technically feasible, is not possible because of critical uncertainties related to policy decisions regarding appropriate goals and key scientific unknowns, especially the effects of nitrogen deposition (U.S. Environmental Protection Agency 1995b).

California Clean Air Act

The Act

The 1977 CAA required states to attain the NAAQS by 1987. Failure to comply resulted in loss of mandates after 1987. The California Clean Air Act of 1988, which differs from the CAA in that there are no sanctions and specific deadlines for attainment of the CAAQS, was enacted in response to the need for new requirements. Under this act, attainment is required at the earliest practicable date, and reasonable progress must be made each year.

Plans

The CCAA required state attainment plans for nonattainment areas designated as O_3, CO, SO_2, and NO_2. Requirements depend on the designated nonattainment category. The SJVAB is designated as severe nonattainment for the ozone CAAQS. Ozone attainment plans focus on control of ozone precursors, nitrogen oxides and volatile organic compounds.

Interbasin Transport

The CCAA required the ARB to analyze interbasin air pollution transport. The San Joaquin Valley was identified as a source as well as a receptor of ozone precursors for several upwind and downwind districts. At a minimum, mitigation requires that the best available retrofit control technology (BARCT) be adopted for all but at least 75% of the 1987 emissions of nitrogen oxide (NO_x) and volatile organic compounds (VOCs) from permitted stationary sources (California Air Resources Board 1993b).

STATE IMPLEMENTATION PLANS

Based on air quality monitoring results, the entire SJVAB, which includes SEKI, has been classified as a serious nonattainment area for the ozone and PM10 NAAQS. The SJVAB is designated as severe nonattainment for the ozone CAAQS under the CCAA. This designation triggers the requirement that the SJVUAPCD prepare State and Federal ozone plans and a Federal PM10 plan. Whereas the SJVAB is designated nonattainment for the PM10 CAAQS, a PM10 plan is not required.

Ozone Attainment Plans

Section 182(c) of the Federal Clean Air Act Amendment of 1990 requires all ozone nonattainment areas classified as serious to prepare and submit three plans. The first plan, known as the 1993 Rate of Progress Plan was prepared by the SJVUAPCD in 1993 (San Joaquin Valley Unified Air Pollution Control District 1993). That plan describes how the district will reduce VOCs, also known as reactive organic gas emissions, by 15% between 1990 and 1996. The plan was found by EPA to be incomplete because it contained commitments to adopting measures rather than actual adopted measures.

The Revised 1993 Rate of Progress Plan was prepared in 1994 (San Joaquin Valley Unified Air Pollution Control District 1994a). Most of the 15% reductions will come from controls on Kern County petroleum processing.

The second plan, the Post 1996 Rate of Progress Plan, was also prepared in 1994 (San Joaquin Valley Unified Air Pollution Control District 1994b). The post 1996 plan provides for a 9% reduction by 1999 in the emissions from the 1990 baseline inventory, which is in addition to and separate from the 15% reduction included in the revised 1993 plan. The post 1996 plan has two NO_x measures, one VOC measure, and the same contingency measures as the 15% plan. Most of the 9% reductions will come from Kern County stationary internal combustion engine controls.

The third plan prepared was the ozone attainment demonstration plan or OADP (San Joaquin Valley Unified Air Pollution Control District 1994c). Air districts in serious ozone nonattainment areas must demonstrate by computer modeling that the Federal ozone standard will be met by 1999. The modeling analysis must include all possible control measures necessary to reach attainment. The overall results of the modeling analysis predict substantial improvement in air quality by 1999, and attainment of the Federal ozone standard appears to be achievable.

The OADP used the photochemical grid model, SARMAP (San Joaquin Valley Air Quality Study/Atmospheric Utility Signature Predictions and Experiments Regional Model Adaptation Project) Air Quality Model (or SAQM), to demonstrate attainment. SAQM is the result of a massive effort that began in 1988 with a major field study completed in 1990. Modeling indicated that the San Francisco Bay area and Sacramento Valley contribute up to 27%, 10%, and 7% to ozone concentrations in the north, central, and south San Joaquin Valley, respectively.

The CCAA requires the district to report its progress in meeting the ozone CAAQS and to revise its 1991 Air Quality Attainment Plan to reflect changing conditions. The 1994 triennial progress report and plan revisions were included as Chapter 8 of the OADP. In addition, the post 1996 plan was revised in 1995 to be consistent with the OADP (San Joaquin Valley Unified Air Pollution Control District 1995). Several control measures were removed and some minor changes were made.

PM10 Attainment Plans

The CAA 1990 amendments designated all areas in non-attainment of PM10 as "moderate" in that attainment of PM10 would be achieved by December 1994. The SJVUAPCD's 1991 PM10 plan required the implementation of reasonably available control measures (RACM) and included regulations on residential wood burning, fugitive dust, and open-burning. The plan did not predict attainment by 1994, and the EPA redesignated the San Joaquin Valley as a "serious" nonattainment area in February 1993. This redesignation requires that the SJVUAPCD prepare a new PM10 plan.

The SJVUAPCD prepared a 1994 Serious Area PM10 Plan with best available control measures (BACM) (San Joaquin Valley Unified Air Control District 1994d). The PM10 plan sets forth the direction and framework that the SJVUAPCD will pursue to reach attainment of the PM10 24-hour and annual Federal standards. The PM10 plan presents a strategy to EPA to continue adopting and revising control measures that effectively mitigate the PM10 problem that is unique to the San Joaquin Valley. The SJVUAPCD is required to submit an air quality modeling analysis that demonstrates PM10 emissions reductions necessary to attain Federal standards for PM10 by February 8, 1997. The Federal Clean Air Act Amendments set December 31, 2001, as the deadline for the SJVUAPCD to meet Federal PM10 standards. The SJVUAPCD submitted the PM10 plan to ARB in November 1994.

Section 3. Current Conditions

SAN JOAQUIN VALLEY AIR BASIN EMISSIONS

Emission inventories generally are divided into two types: specific day inventories and planning inventories. Specific day inventories, based on detailed estimates of emissions on a particular day, are used as inputs for modeling and allow model results to be calibrated to monitored pollutant levels. Planning inventories represent typical or average daily emissions rather than emissions on a specific day. The following emission inventory discussion for the San Joaquin Valley Air Basin (SJVAB) and SEKI is based on a planning inventory.

The SJVAB economy is predominantly agricultural and not heavily industrialized. There is, however, a substantial petroleum industry in Kern County and timber harvesting activities on private and public forest lands along the east side. Approximately 31% of the SJVAB is under public ownership, with 94% being federally owned.

Figure 3-1 shows the SJVAB planning emission inventory for 1991, divided into stationary and mobile sources (California Air Resources Board 1994a). The detailed emission inventory on which Figure 3-1 is based can be found in Appendix I, Table I-1. Appendix G lists, by county, all stationary emission sources within the SJVAB that have air permits allowing them to emit 50 tons or more per year of one or more criteria pollutants. Sources emissions are shown for reactive organic gases (ROG), nitrogen oxides (NO_x), sulfur oxides (SO_x), and PM10 (inhalable particulate matter less than 10 microns in diameter).

Existing NO_x emissions within the SJVAB originate from approximately 40% stationary sources and 60% mobile sources. Figure 3-2a shows that primary contributors to NO_x emissions are on-road motor vehicles (44.0%); fuel combustion (34.5%); and other mobile sources (17.8%), including trains, construction, and agricultural equipment (California Air Resources Board 1994a).

Existing SJVAB ROG emissions of 573 tons per day originate from approximately 60% stationary sources and 40% mobile sources. Figure 3-2b shows that the primary contributors to ROG emissions are on-road vehicles (29.7%); petroleum processing (22.7%); solvent use (15.7%); and miscellaneous sources, such as pesticide application (13.8%). Although emission inventories only include anthropogenic sources, ROG emissions can be dominated by biogenics, with two-thirds attributable to the Sierra Nevada (San Joaquin Valley Unified Air Pollution Control District 1994c).

Primary (directly emitted in the atmosphere) PM10 emissions within the SJVAB primarily originate from area sources included in the miscellaneous processes subcategory of stationary sources. Figure 3-3a shows that the primary generators of PM10 are fugitive dust from agricultural lands and unpaved areas (37.3%), entrained road dust (36.4%), and farming (12.8%) (California Air Resources Board 1994a). Nitrate, sulfate, and organic particles are secondary particles (formed in the atmosphere) that can contribute over 50% to the total PM10 (San Joaquin Valley Unified Air Pollution Control District 1994d). The highest PM10 levels in the SJVAB occur during the winter.

Fifty percent of sulfur oxide emissions within the SJVAB are produced from stationary sources, and 50% are produced from mobile sources. Figure 3-3b identifies the primary contributors as fuel combustion (primarily within the oil and gas processing industry) (48%), on-road vehicles (33.5%), and other mobile sources (16.0%) (California Air Resources Board 1994a).

The San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) is working to update and improve the PM10 emission inventory. These efforts include working with the San Joaquin Valleywide Air Pollution Study Agency, a partnership consisting of Federal, State, and local agencies; industry; and the University of California to develop and conduct a San Joaquin Valley Regional PM10 Air Quality Study. This study will include technical support studies, PM10 modeling assessment, demonstration studies, chemical analyses, air quality field studies, and modeling. Certain components of the demonstration studies may soon be available for use in updating the PM10 emission inventory (San Joaquin Valley Unified Air Pollution Control District 1994d).

PARK EMISSION SOURCES

Emissions within SEKI are produced by a wide variety of sources. Emissions vary substantially by season of the year. On-road mobile sources are greatest in the summer when visitation is highest. Emissions from combustion of oil, propane, and wood are highest in winter. Wildland fire (planned and unplanned) is the largest source of emissions in SEKI. These emissions are highest in the spring, summer, and fall.

Table G-2 of Appendix G lists each of the emission sources within SEKI for which a permit to operate is held with the SJVUAPCD. The 14 active permits for park sources include eight emergency generators, five gasoline dispensing facilities, and one wood chipper (not listed in Appendix G).

Additional emission sources include five wastewater and water treatment plants; paints and solvents; herbicides and pesticides and small engines (chain saws, snowblowers, and landscape maintenance equipment); boilers; gas and diesel stations and tanks; snowmobiles; small engines (wood chippers, stump grinders, and welders); residential wood stoves, furnaces, and water heaters; fugitive dust; and concession sources.

Minor amounts of toxic air and water pollutants are released at several sites within SEKI. Chlorine is used at the wastewater and water treatment plants located within the park. Also, small amounts of herbicides and pesticides are used as part of SEKI's integrated pest management plan. These include from 5 to 10 gallons of herbicides per year and a small amount of pyrethrin-based pesticides. Gasoline evaporative emissions that include substances such as benzene are released near gasoline refueling stations (equipped with vapor recovery equipment). Old structures with asbestos insulation still remain in some areas of the parks (e.g., existing housing in Giant Forest). Also, minor quantities of toxics may be released from solid waste (heavy metals) stored at Ash Mountain, generated by the Clover Creek Sewage Treatment Plant (Schwarz and Bornholdt pers. comms.) and the Ash Mountain Research Lab (phenols).

GENERAL CLIMATE AND METEOROLOGY

The highly variable midlatitude westerlies govern the weather of the United States and Canada (Moran and Morgan 1995). These winds result from the semipermanent subtropical anticyclone (high-pressure region) centered over the Pacific ocean, often called the Pacific or Hawaiian High, and they interact with migratory cyclones (low-pressure regions) in the Gulf of Alaska. The perpendicular orientation of the Sierra Nevada to the westerly flow results in orographic lifting of the air mass. Given sufficient moisture and lifting, precipitation will occur on the windward (western) side leaving the leeward (eastern) side in a rainshadow.

The Pacific High strengthens and shifts north in the summer, blocking northern storm systems (Huning 1978). This results in dry, hot summers in California. Occasional summer

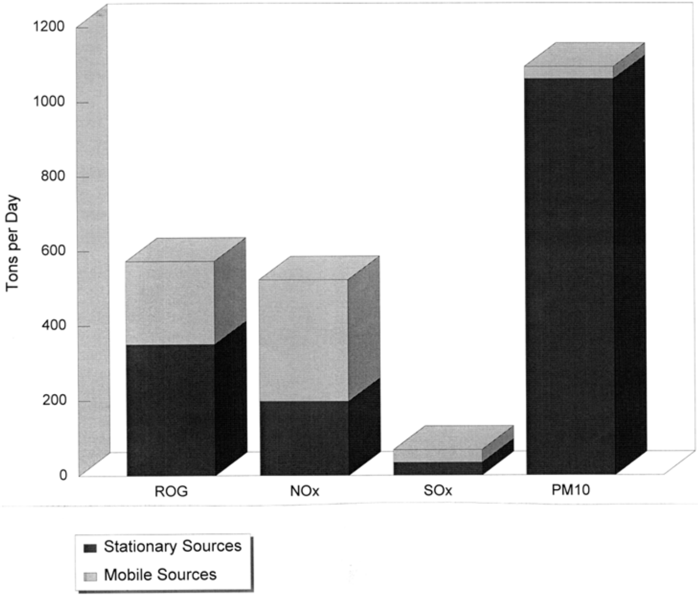


Figure 3-1
San Joaquin Valley Air Basin
1991 Emissions Inventory

Figure 3-2a. San Joaquin Valley Air Basin 1991 NOx Emissions

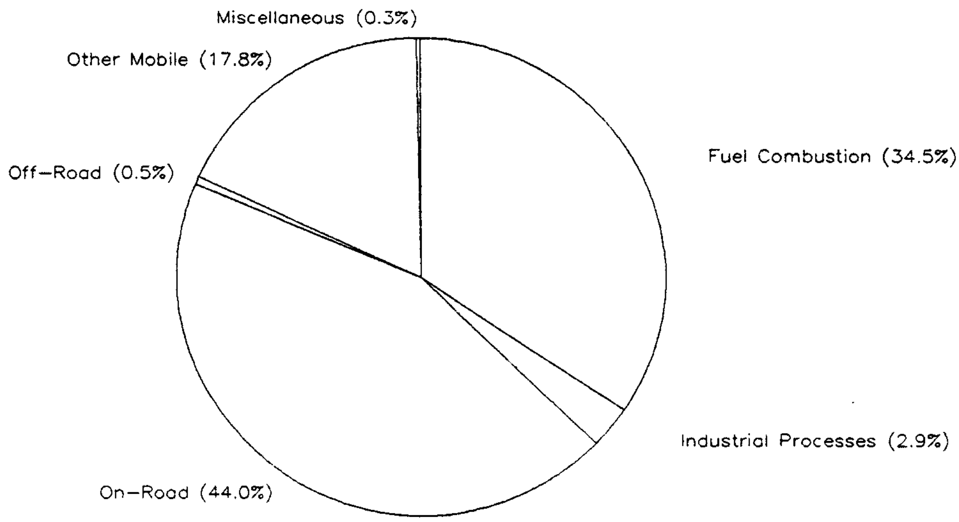


Figure 3-2b. San Joaquin Valley Air Basin 1991 ROG Emissions

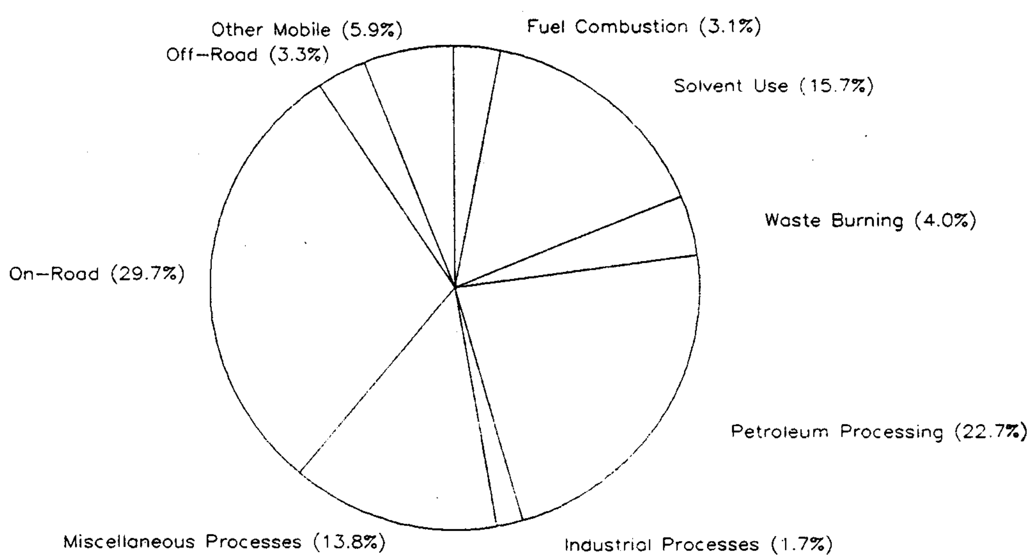


Figure 3-3a. San Joaquin Valley Air Basin 1991 PM10 Emissions

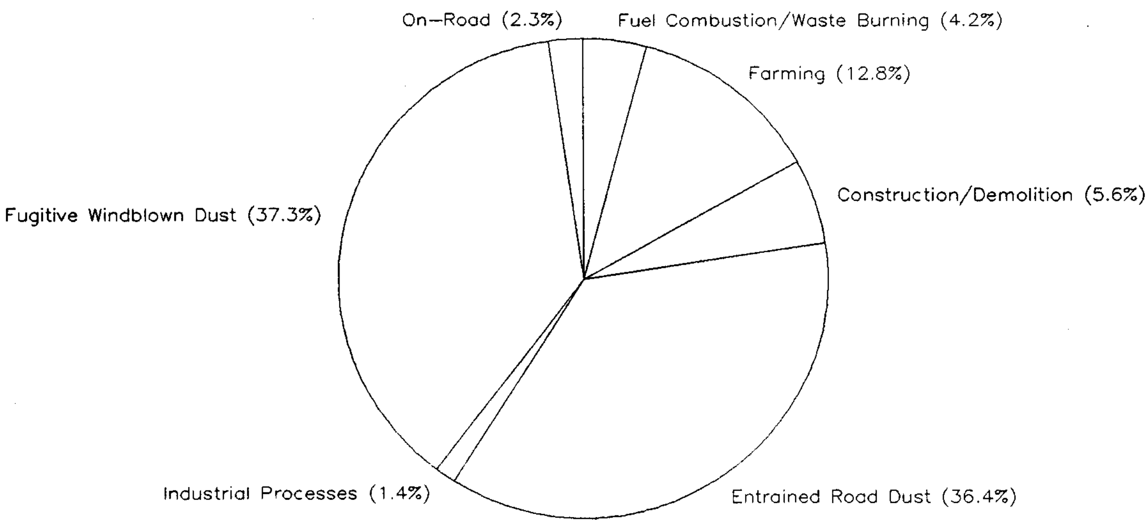
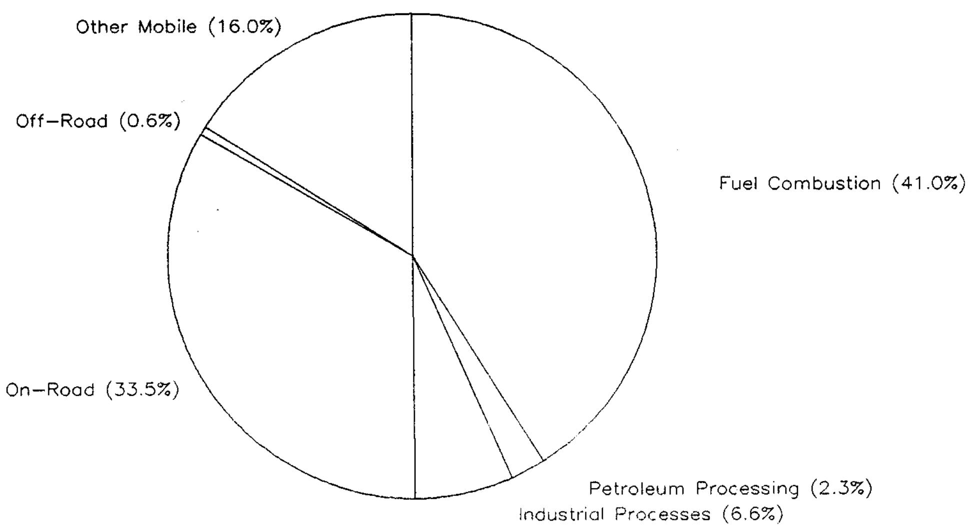


Figure 3-3b. San Joaquin Valley Air Basin 1991 SOx Emissions



Sierran thunderstorms result from warm, moist air being drawn up from the Gulf of Mexico or Gulf of California from a surface low over the Sonoran desert (monsoon circulation). Additionally, orographic lifting from the typical westerly wind flow can sometimes cause scattered afternoon thunderstorms at higher elevations. These storms contribute little to the annual precipitation in the Sierra Nevada. In the winter, the Pacific High weakens and shifts south, allowing storm systems to penetrate into California. The majority of the precipitation in the Sierra Nevada is in the form of snow. Precipitation increases with elevation up to about 8,000 feet, after which it decreases.

For several months every winter, a warm, westerly ocean current named El Niño occurs when the normal trade winds blow near the west coasts of Ecuador and northern Peru. Every three to seven years, El Niño lasts for a year or longer, affecting planetary-scale circulations and resulting in mild winters in the northern United States and southern Canada. Many of the wettest years in Central California are during El Niño years, although some extremely dry winters have also occurred in this period (Linse pers. comm.).

The San Joaquin Valley has a northwest to southeast orientation with approximate dimensions of 100 miles wide by 300 miles long. Air movement is restricted in both the vertical and horizontal directions. Vertical air movement is restricted by radiation and subsidence inversions. Radiation inversions, caused by thermal radiation of heat from the earth's surface into space, occur almost nightly in the San Joaquin Valley. The temperature of the air next to the cooled ground is reduced faster than that of the air above, and the depth of the cool layer grows throughout the night. Cool air drainage from the surrounding mountains can add to the cool layer around the edges of the valley. Within the inversion layer, air is stagnant with little movement. After sunrise, the sun heats the ground, warming the cool layer, which lifts the inversion.

In the valley, the inversion base is 500 feet or less (at the surface for a ground-based inversion) in the morning during all seasons. In winter, the inversion base is 1,500 feet or less throughout the day because heating from the sun is reduced (lower sun angle). During the rest of the year, the inversion base is often lifted by midday to 1,500-3,000 feet or more. In the summer, the inversion layer is often dissipated by the afternoon. Local nightly radiation inversions in mountain valleys such as Cedar Grove are also common.

A subsidence inversion is caused by the downward moving air aloft on the east side of an anticyclone. The inversion base is usually 2,000 to 2,500 feet above the ground. Subsidence inversions from the semipermanent anticyclone over the Pacific Ocean often affect west coast cities. In the summer, the cool marine air will sometimes penetrate the northern valley, reducing vertical mixing. Subsidence inversions in the valley are often associated with migratory anticyclones that stagnate before continuing eastward. These stagnation periods typically last three to five days but can last a week or more and are usually associated with pollution episodes in the valley. After vertical mixing improves following these episodes, high pollution levels occur in the Sierra Nevada and other downwind areas. Subsidence inversions are reinforced by radiation inversions.

Horizontal air movement is restricted by the mountains that surround the San Joaquin Valley on three sides: the coastal mountains to the west (with peaks over 5,000 feet), the Tehachapi Mountains to the south (with peaks over 6,000 feet), and the Sierra Nevada to the east (with peaks over 14,000 feet). In the spring and summer when the marine layer is shallow, westerly winds enter through low coastal gaps, primarily the Carquinez Straits, and flow up the valley toward the southeast (see Figure 3-4). As the valley heats up, daytime wind speeds increase, becoming strongest in the afternoon. During storm-free periods in the fall and winter, flow is more variable with light wind speeds, resulting in less air movement. Computer modeling during a summer pollution episode showed that the Bay Area and Sacramento Area contributed 27%, 10%, and 7% to the ozone exceedances in the northern, central, and southern valley, respectively

(San Joaquin Valley Unified Air Pollution Control District 1994c).

During the day, air near the mountain slopes is heated, resulting in upslope and up-valley winds. At sunset, the process is reversed. Terrain-driven winds provide a means to diurnally transport pollution out of and back into the valley (Blumenthal et al. 1985). Several tracer studies have demonstrated pollutant transport into the mountains (Lehrman et al. 1994, Shair 1987, and Tracer Technologies 1992).

Nocturnal radiation inversions prevent air flow over the mountains. The typical north-westerly air flow in the summer is blocked by the Tehachapi Mountains to the south and flows counterclockwise back toward Fresno. This flow has been named the Fresno Eddy. Also common in the summer is the low-level nocturnal jet, which results from the air flow above the radiation inversion being released from the frictional effects of the ground. The jet peaks around midnight at 1,000 feet over the valley floor and can reach speeds of over 40 mph. It provides a mechanism for rapid transport of pollutants from north to south with increased dilution, whereas the eddy spreads pollutants throughout the southern part of the valley and possibly into higher levels (Roberts et al. 1990).

In the winter, with variable and calm winds and persistent inversions, the primary mechanism for air exiting the valley is from frontal storms (see Figure 3-5). The residence time of any given pollutant has been estimated to be one to two days in the summer and two to eight days in the winter (Smith et al. 1981).

The Owens Valley on the east side of the Sierra Nevada trends north-northwesterly bounded by the Sierra Nevada to the west and the White-Inyo Mountains to the east. The predominant surface winds are from the south in the summer and from the northwest the remainder of the time. The diurnal mountain and valley winds predominate on the mountain slopes.

The east side has very few local sources of air pollution. Smoke from woodstoves in the town of Mammoth Lakes can cause local PM10 exceedances. Sustained high winds blowing across the dry Owens Lake bed and the relicted lands of Mono Lake in late fall, winter, and early spring cause extensive dust storms, resulting in PM10 exceedances over ten times the Federal standard (Saint-Amand et al. 1986). During hot weather, dust storms are rare and never large, even under high wind conditions. Gigantic dust storms occur during northerly winds that are usually associated with the passage of low pressure troughs. More frequent but less severe storms occur whenever the winds blow in excess of 15 mph in any direction. Dust has been transported as high as the Sierra Nevada crest and over 100 miles downwind. Over 90% of the particles are smaller than 0.1 micrometers in diameter.

Studies have shown that air pollutants are transported over the Sierra Nevada from the San Joaquin Valley (California Air Resources Board 1989b). Violations of the State and Federal ozone standards in the town of Mammoth Lakes have been attributed to transport from the San Joaquin Valley. As a result, Mono County was designated as nonattainment for the State ozone standard in 1995 (current designation is nonattainment-transitional). Although less conclusive, evidence indicates that air pollutants are also transported from southern California through the southeast desert into the Great Basin. Transport from southern California into the southeast desert has been well documented, and there are no effective barriers between the southeast desert and the Great Basin.

OZONE

Introduction

Ozone, a colorless, pungent gas consisting of three oxygen atoms, is formed as a result of chemical reactions between oxygen (O_2), volatile organic compounds (VOC), and nitrogen oxides (NO_x) in the presence of sunlight, especially during hot, dry weather. Ozone is produced naturally in small amounts from lightning, forest

Figure 3-4

CALIFORNIA PREDOMINANT SURFACE WIND FLOW PATTERNS

SUMMER (JUN. - JUL. - AUG.)

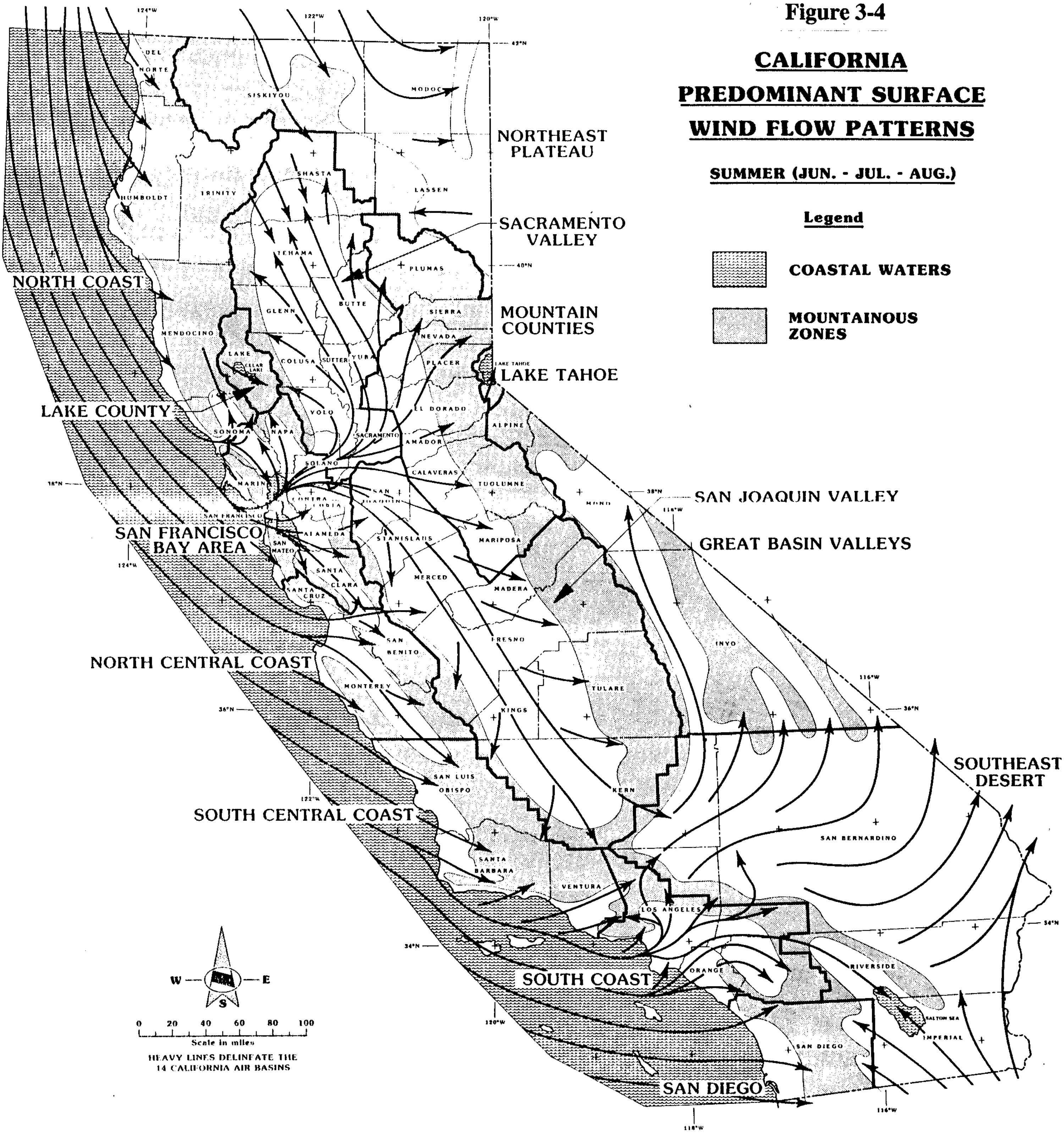


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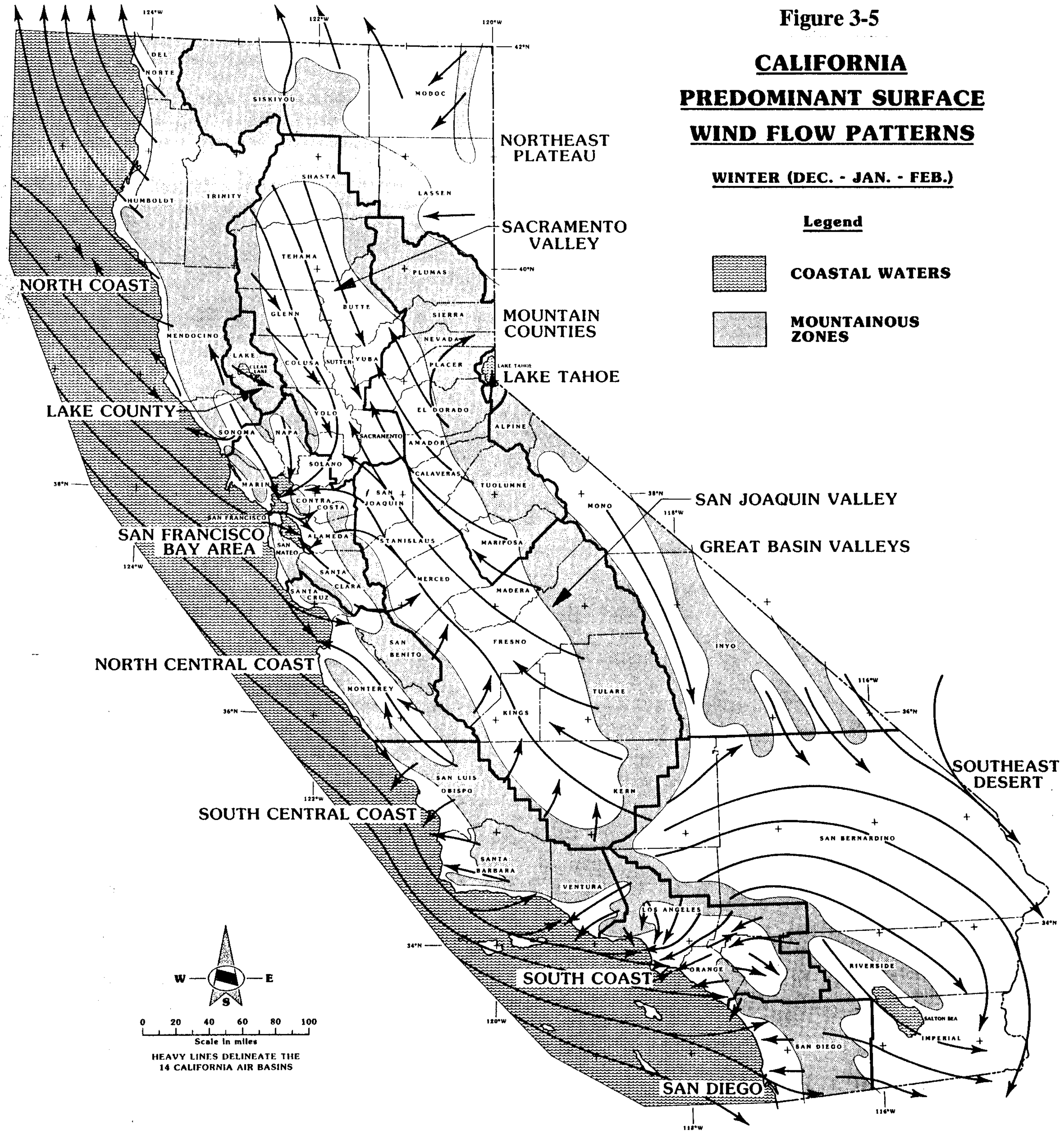
Figure 3-5

CALIFORNIA PREDOMINANT SURFACE WIND FLOW PATTERNS

WINTER (DEC. - JAN. - FEB.)



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fires, vegetation, and stratospheric intrusions in the troposphere.

VOCs, also known as reactive organic gases and non-methane organic compounds, are a subclass of hydrocarbons that contribute to ozone formation. While they are not a criteria air pollutant, they must be controlled in order for ozone levels to be controlled.

Although ozone in the upper atmosphere (stratosphere) is beneficial to life by shielding the earth from the sun's ultraviolet rays, high concentrations of ozone at ground level are a major health and environmental concern. At ground level, natural background levels of ozone are between 0.02-0.04 parts per million (ppm).

Monitoring Locations and Types

Figure 3-6 shows the four ozone monitoring sites located in SEKI where ozone is monitored year round: Lookout Point (4,000 feet), Ash Mountain (1,800 feet), Giant Forest (also known as Lower Kaweah, 6,300 feet), and Grant Grove (6,500 feet). The Ash Mountain and Lower Kaweah ozone monitoring sites have been operating since 1982, Lookout Point since 1983 (data are not available from 1983-91) and Grant Grove since 1990.

The Lookout Point station is solar powered. The other sites are operated on commercial power. Belfort rain gauges are located at each station. Lower Kaweah is the only station with a fully equipped meteorological tower.

Figure 3-7 shows the network of SJVAB monitoring stations in relation to the SEKI monitoring sites. The Wilsonia site is the location of the Grant Grove site shown in Figure 3-6. All the SJVAB gaseous pollutant monitors shown in Figure 3-7 measure ambient ozone concentrations, with the exception of the Claremont site in Stockton, which monitors only carbon monoxide.

Monitoring Results

Figures 3-8 and 3-9 show the number of days that the ozone NAAQS (average hourly concentration exceeding 0.124 ppm) and the more stringent ozone CAAQS (an average hourly concentration exceeding 0.09 ppm), respectively, were exceeded at the SEKI monitoring stations from 1982 to 1994 (National Park Service 1994). The closest urban stations to the west in the SJVAB are also shown for comparison (California Air Resources Board 1994c). Ozone CAAQS and NAAQS exceedances occur from May through October, with the majority of exceedances occurring June through September. In general, the ozone NAAQS and CAAQS are exceeded more often at the urban stations than at the SEKI stations. The ozone NAAQS is exceeded only a few times, and the ozone CAAQS is exceeded up to half of the days from May through October at the SEKI stations. The number of exceedances has not changed substantially from year to year, although variation is noticeable. A recent California Air Resources Board (ARB) report also states that ozone concentrations within the San Joaquin Valley Air Basin did not significantly change between 1981 and 1990 (California Air Resources Board 1992). Fortunately, levels have not increased. This balance has occurred despite large increases in population and road travel.

Figure 3-10 shows the highest peak-hour concentrations for the SEKI stations, compared to the peak-hour concentrations of the closest SJVAB urban stations. Peak concentrations varied greatly from year to year, but to a lesser extent at SEKI than at the urban stations.

In contrast to Figures 3-8 through 3-10, Figures 3-11 through 3-16 show that SEKI stations have higher average monthly (Figures 3-11 and 3-14), peak daily (Figures 3-12 and 3-13), and average hourly (Figures 3-13 and 3-16) ozone concentrations than the corresponding urban stations for July 1993. Figures 3-11 and 3-14 show that average monthly values are near or above 0.06 ppm at the SEKI stations and under 0.05 ppm at the urban stations from June through September. Sensitive plant species incur ozone injury at ozone concentrations between 0.05 and 0.06 ppm (California Air Resources Board 1992).

Figures 3-12 and 3-15 show that peak hourly ozone concentrations at SEKI are mostly higher than at the urban stations. Whereas the average monthly and peak daily curves (Figures 3-11, 3-12, 3-14, 3-15) track fairly well with respective urban curves, the average hourly curves (Figures 3-13 and 3-16) do not. The urban stations have much more pronounced diurnal curves than the SEKI stations. The SEKI curves are typical of rural sites on the fringe of urbanized valleys (Böhm 1992). During the sunless hours, ozone concentrations drop substantially in urban areas, but not in rural areas. This phenomena is attributed to the lack of significant nocturnal NO_x sources in rural environments (U.S. Environmental Protection Agency 1986). Also, the highest ozone concentrations occur several hours later in the day at SEKI stations than at the urban stations, which indicates a transport lag.

VISIBILITY

Introduction

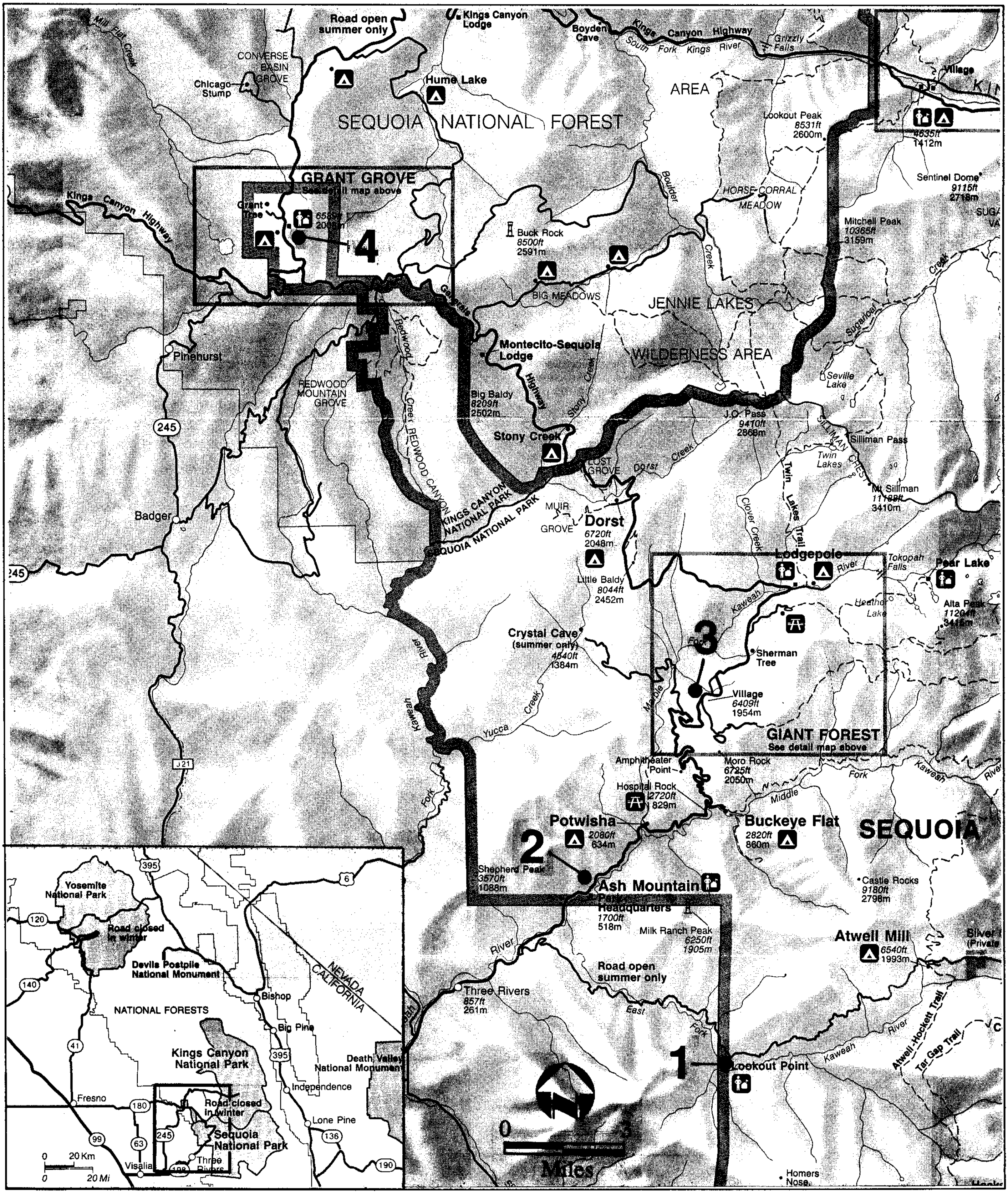
Visibility is the clarity or ease with which landscape features can be seen. It is reduced by fine particles (less than 2.5 microns in diameter) and gases that absorb or scatter light. The result is reduced clarity, color, texture, and form, or total obstruction of objects from view. Nitrates, sulfates, and organic particles are the primary cause of visibility impairment. In addition, NO_2, in high enough concentrations (such as in Los Angeles) produces a brown color.

Air pollution is visible in three forms: uniform haze, layered haze, and plumes. Uniform haze is a homogeneous discoloration that reduces visibility in every direction from the observer. Layered haze is a confined layer (or layers) of visible air pollution and is distinguishable from the background by abrupt color changes (darker or brighter). A plume is layered haze coming from a nearby source or close grouping of sources.

Long-term visibility monitoring in 35 national parks in the United States since 1978 has shown that air pollution affects visibility over 90% of the time (Energy and Resource Consultants 1988). Layered haze can be seen over the San Joaquin Valley as viewed from higher elevations at SEKI, most often in the winter and in the morning during the summer when low inversion heights are common. By afternoon in the summer, when the inversions are lifted to higher levels, uniform haze is most commonly seen at SEKI. Plumes, with the exception of smoke from wildland fires, are not commonly seen from SEKI. Such fires contribute to down-wind haze.

The light extinction coefficient (LEC), standard visual range (SVR), and deciview are used to characterize uniform haze; and plume contrast and color difference (Delta E) are used to characterize plumes. Extinction can be measured directly by an observer, with instruments that measure transmittance over a known path or by summing independent instrument measurements of scattering and absorption (such as transmissometers and nephelometers). Visibility can also be estimated by using particle data, telephotometry, or photographic films.

SVR is the distance from an observer at which a black object is just discernable against the horizon under standard conditions. (Standard conditions are Rayleigh conditions at 1800 meters elevation.) LEC is a measure (km^{-1}) that is proportional to the light scattered and absorbed away from the observer as the light passes through the atmosphere. This is the measure used for the California State visibility standard (Table F-1 in Appendix F). The deciview is an index that is linear to human perception. A 1.0 deciview change represents about a 10% change in LEC. Delta E is an index of the color difference between a plume and the background (1 Delta E = 1 just noticeable difference). Plume contrast is the percent difference in contrast between a plume and the background.



Base map: National Parks Service Sequoia and Kings Canyon map.

Figure 3-6
Detailed Map of Ozone Monitoring Stations in Sequoia and Kings Canyon National Parks

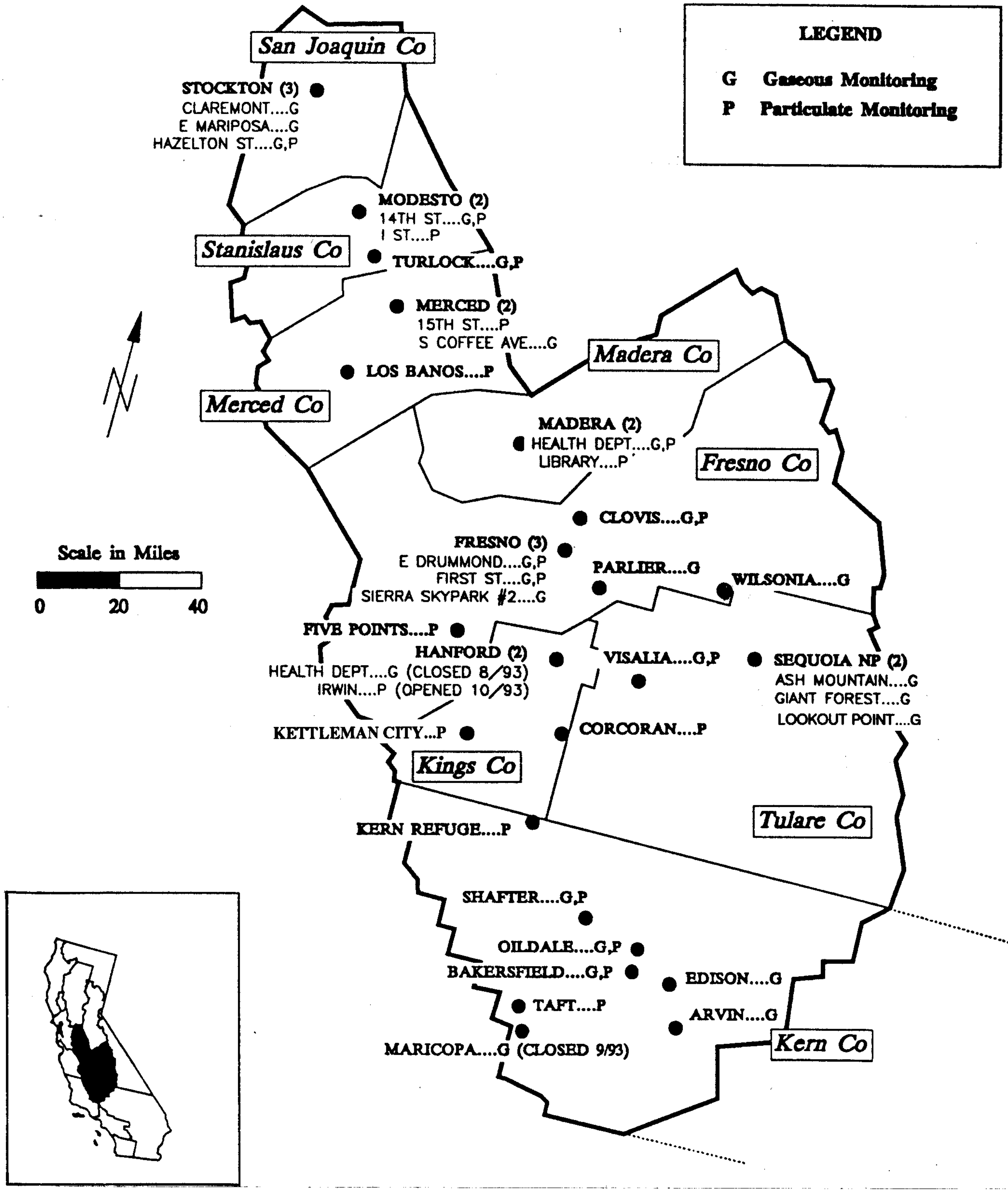
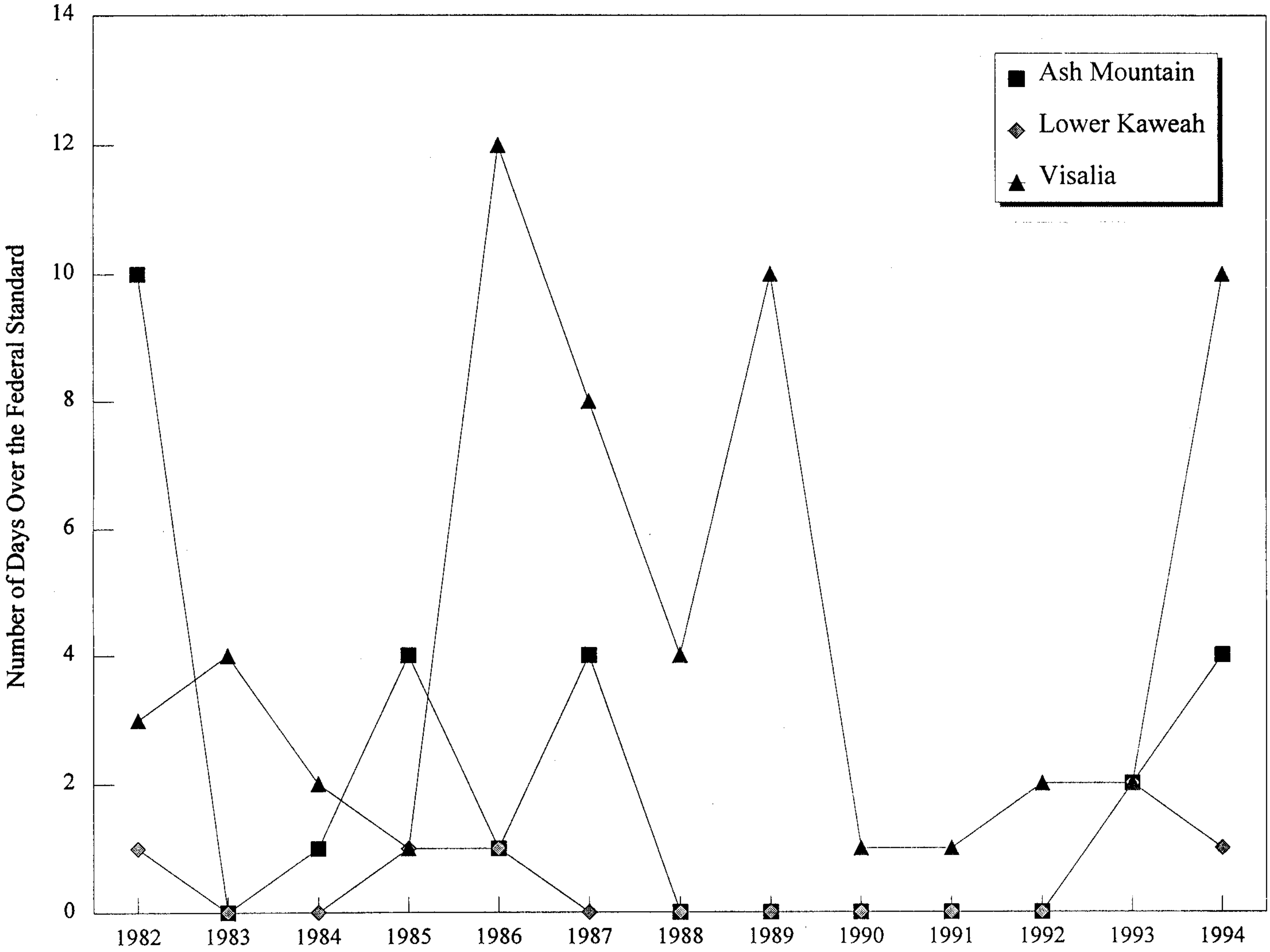
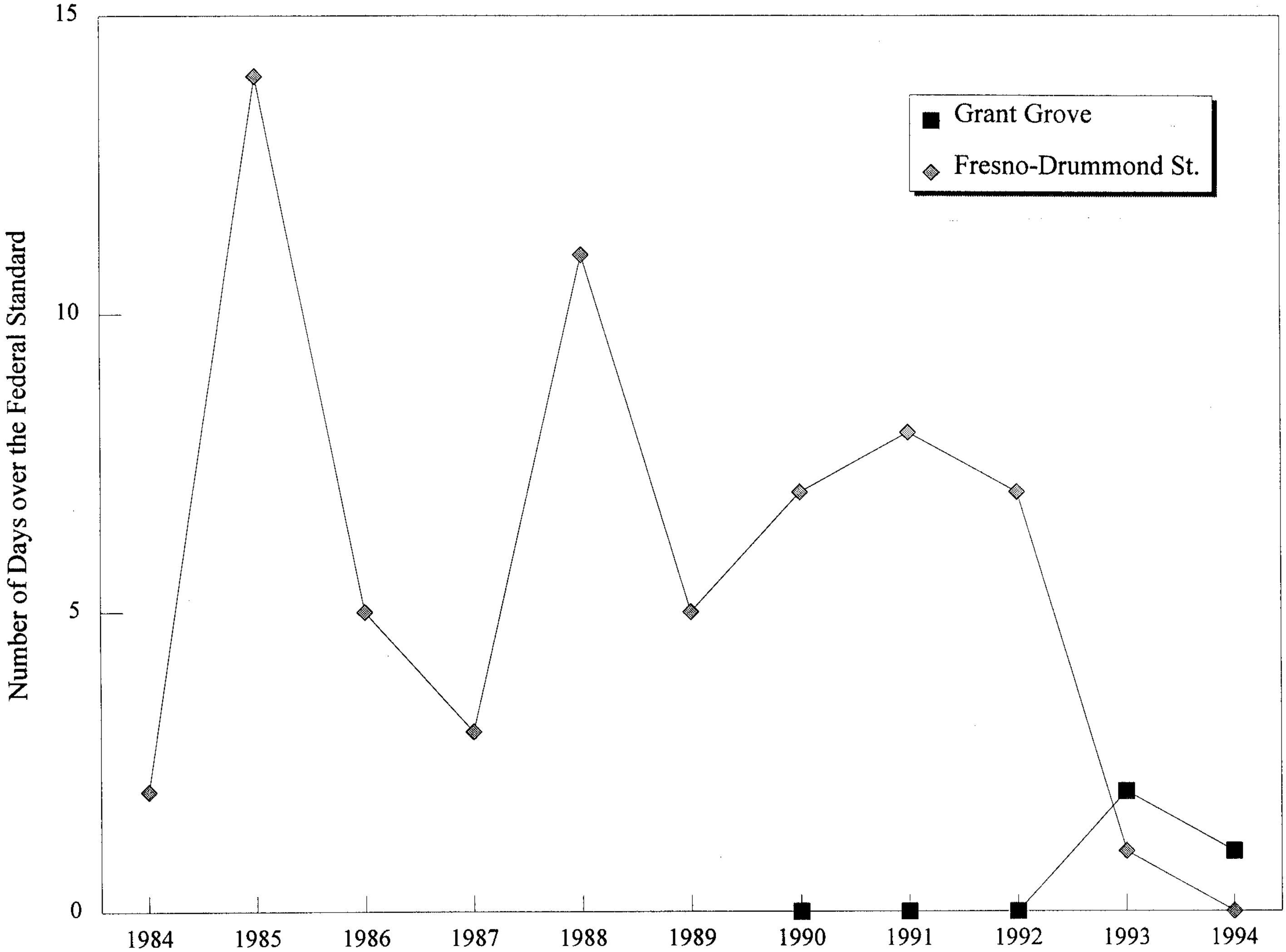


Figure 3-7
San Joaquin Valley Air Basin Monitoring Stations Operating during 1993



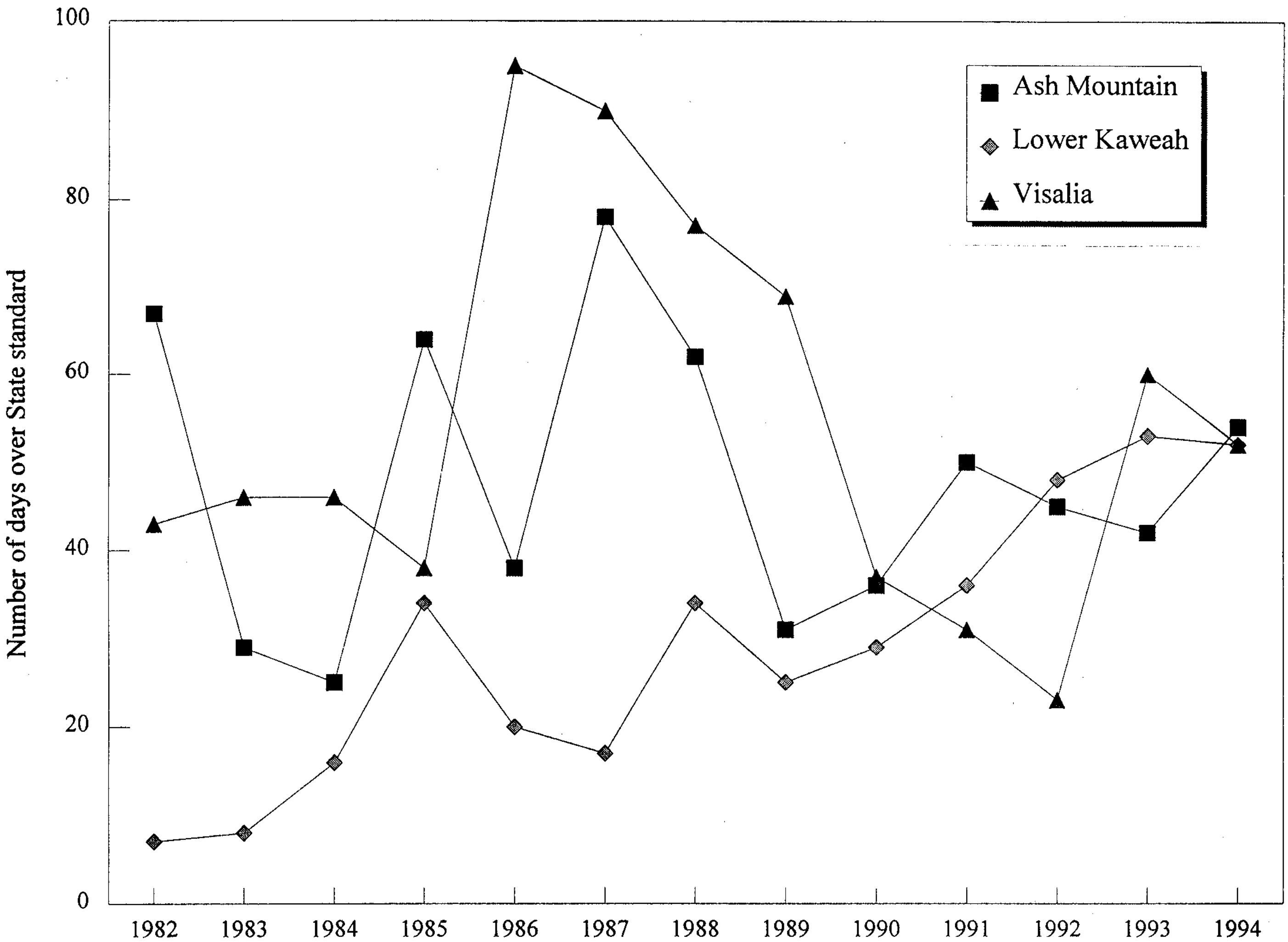
Federal ozone standard equals 0.12 ppm hourly average.

Figure 3-8a
Days above Federal Ozone Standard
Ash Mountain, Lower Kaweah, and Visalia Monitoring Stations



Federal ozone standard equals 0.12 ppm hourly average.
Monitoring began at Grant Grove in 1990, and at Fresno-Drummond St. in 1984.

Figure 3-8b
Days above the Federal Ozone Standard
Grant Grove and Fresno-Drummond St. Monitoring Stations



State ozone standard currently equals 0.09 ppm hourly average.
State ozone standard prior to 1988 equalled 0.10 ppm hourly average.

Figure 3-9a
Days above State Ozone Standard
Ash Mountain, Lower Kaweah, and Visalia Monitoring Stations

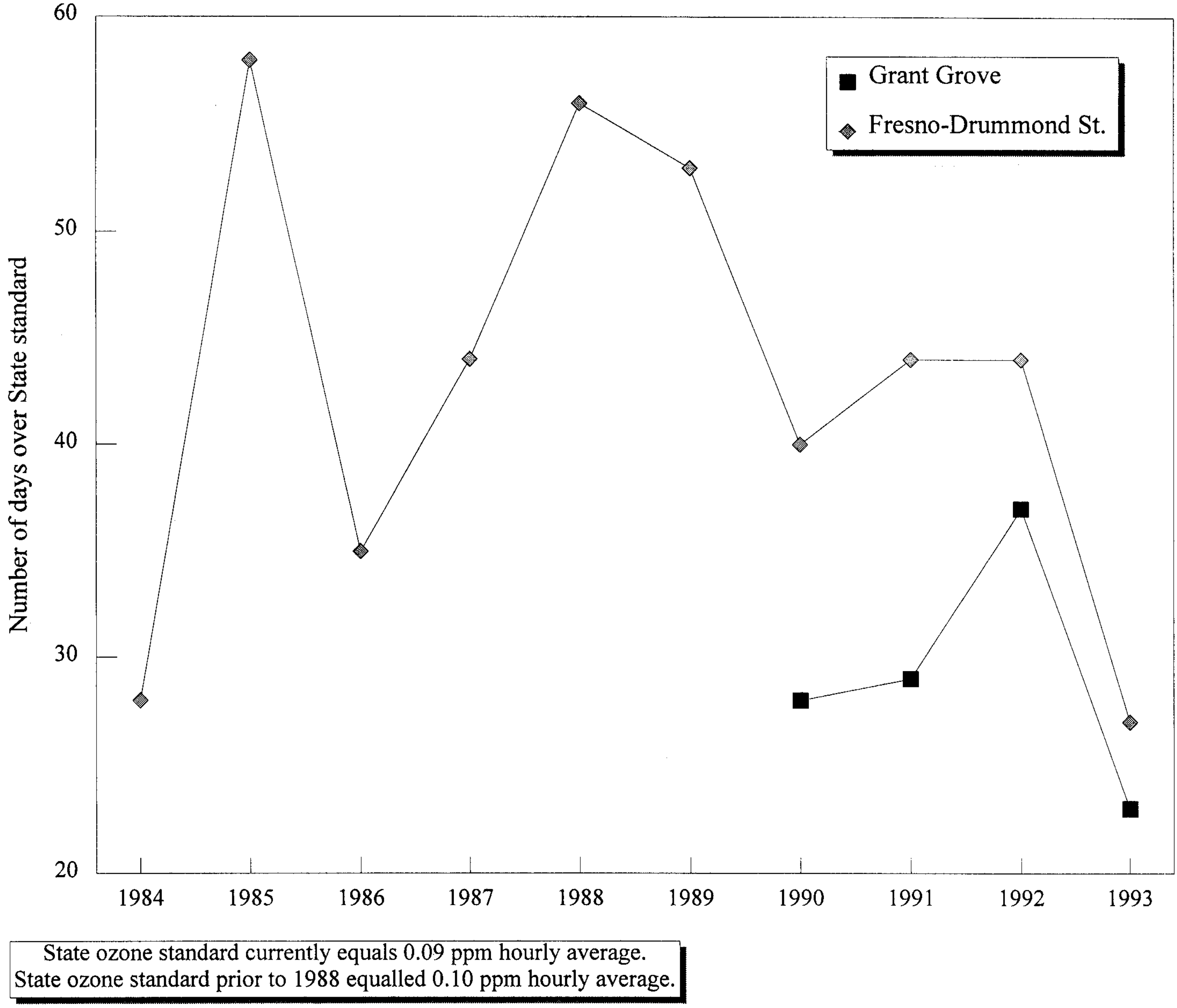


Figure 3-9b

Days above State Ozone Standard

Grant Grove and Fresno-Drummond St. Monitoring Stations

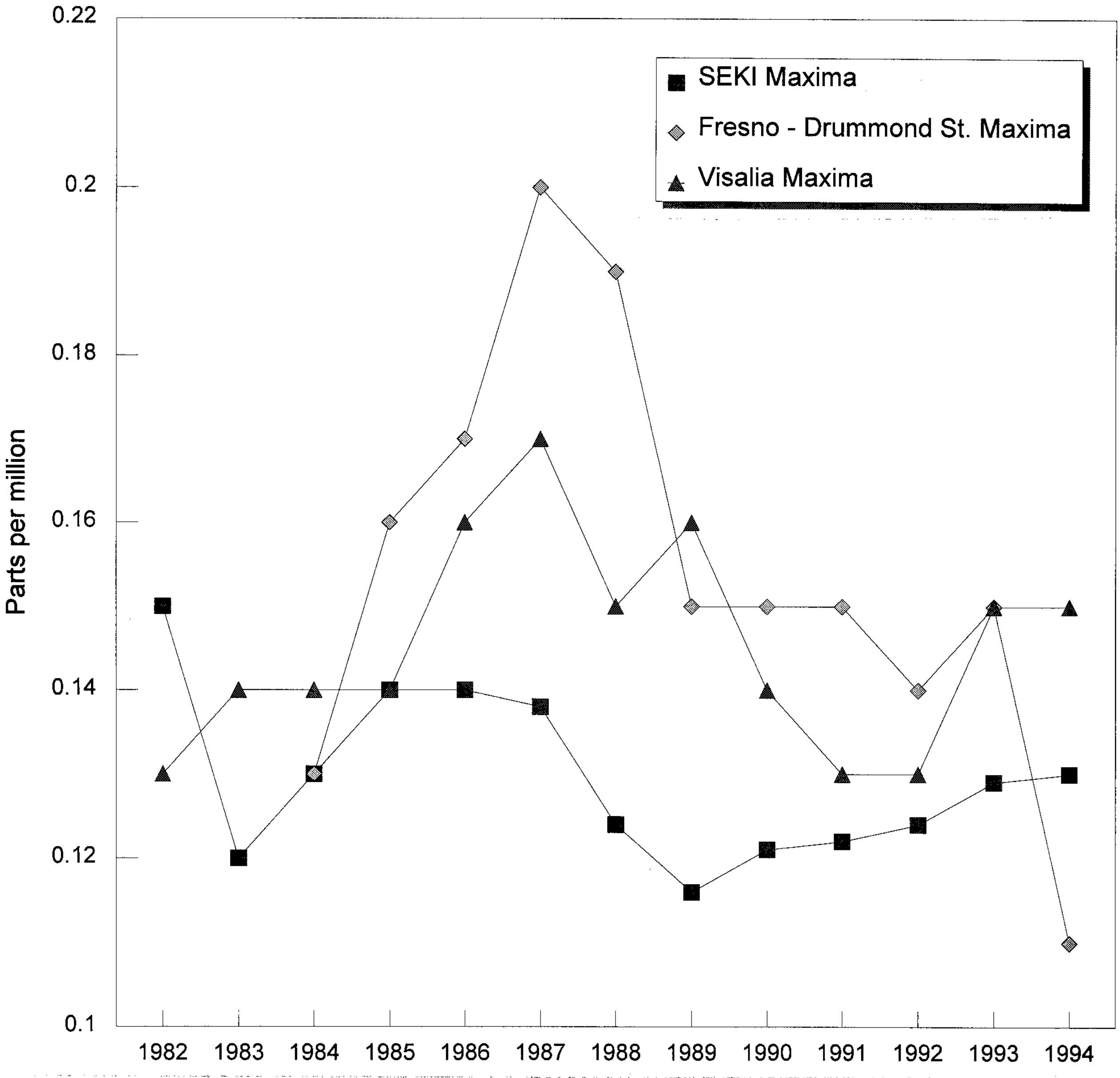


Figure 3-10
Comparison of Peak Ozone Concentrations
SEKI, Fresno-Drummond St., and Visalia

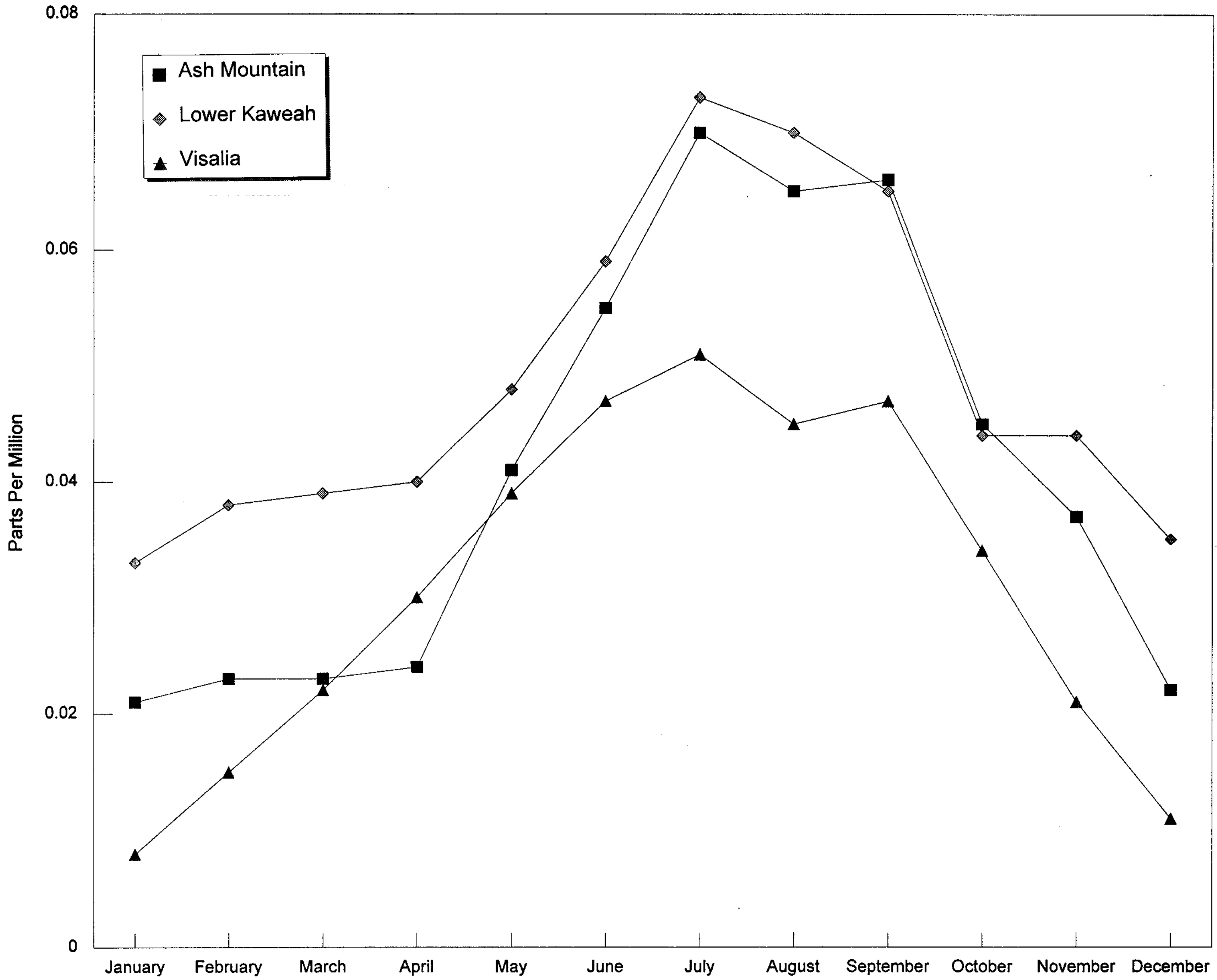
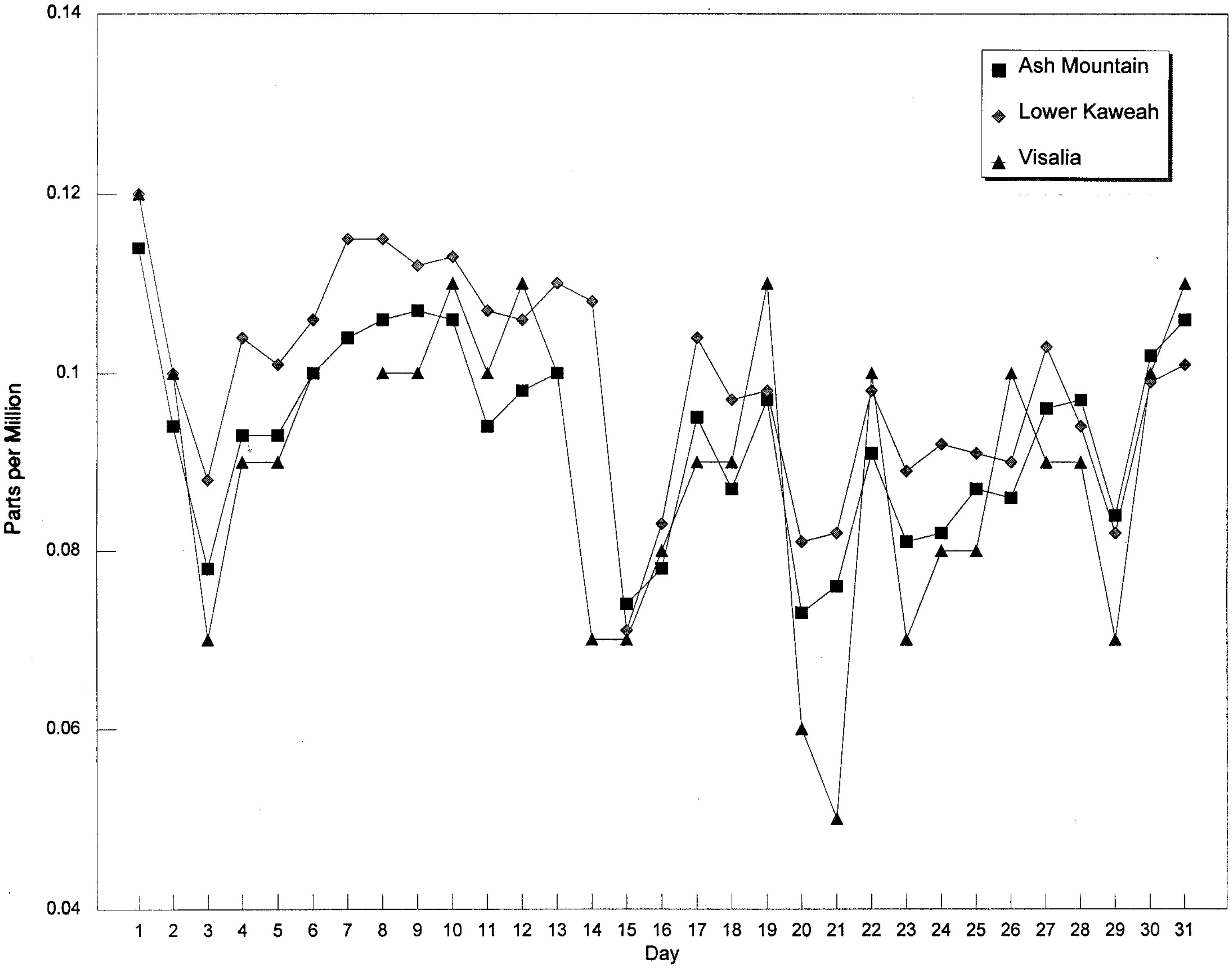


Figure 3-11
Average Monthly Ozone Concentrations, 1993



Missing Data: Visalia - July 7th, Ash Mountain - July 14th

Figure 3-12
Peak Daily Ozone Concentrations, July 1993

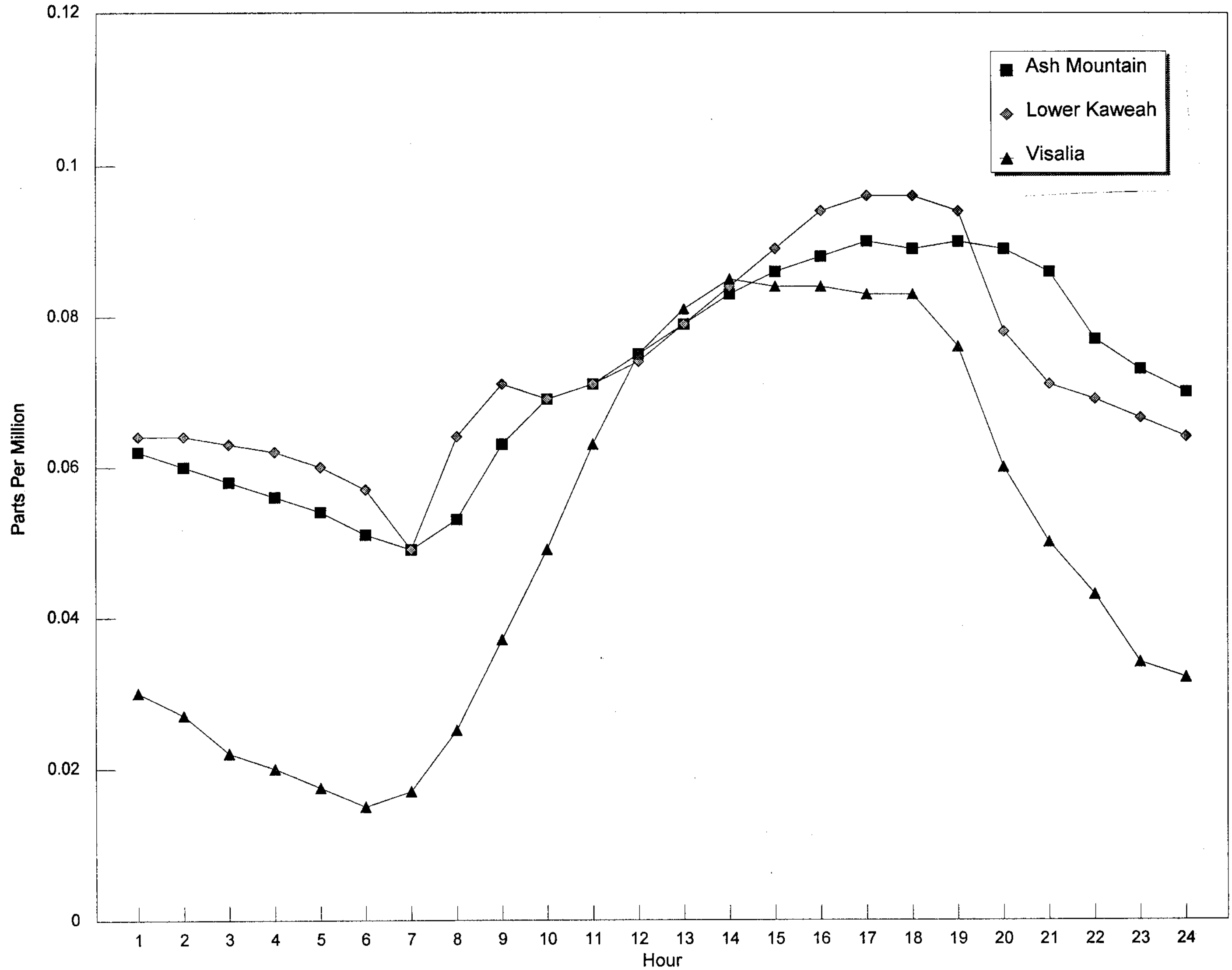


Figure 3-13
Average Hourly Ozone Concentrations, July 1993

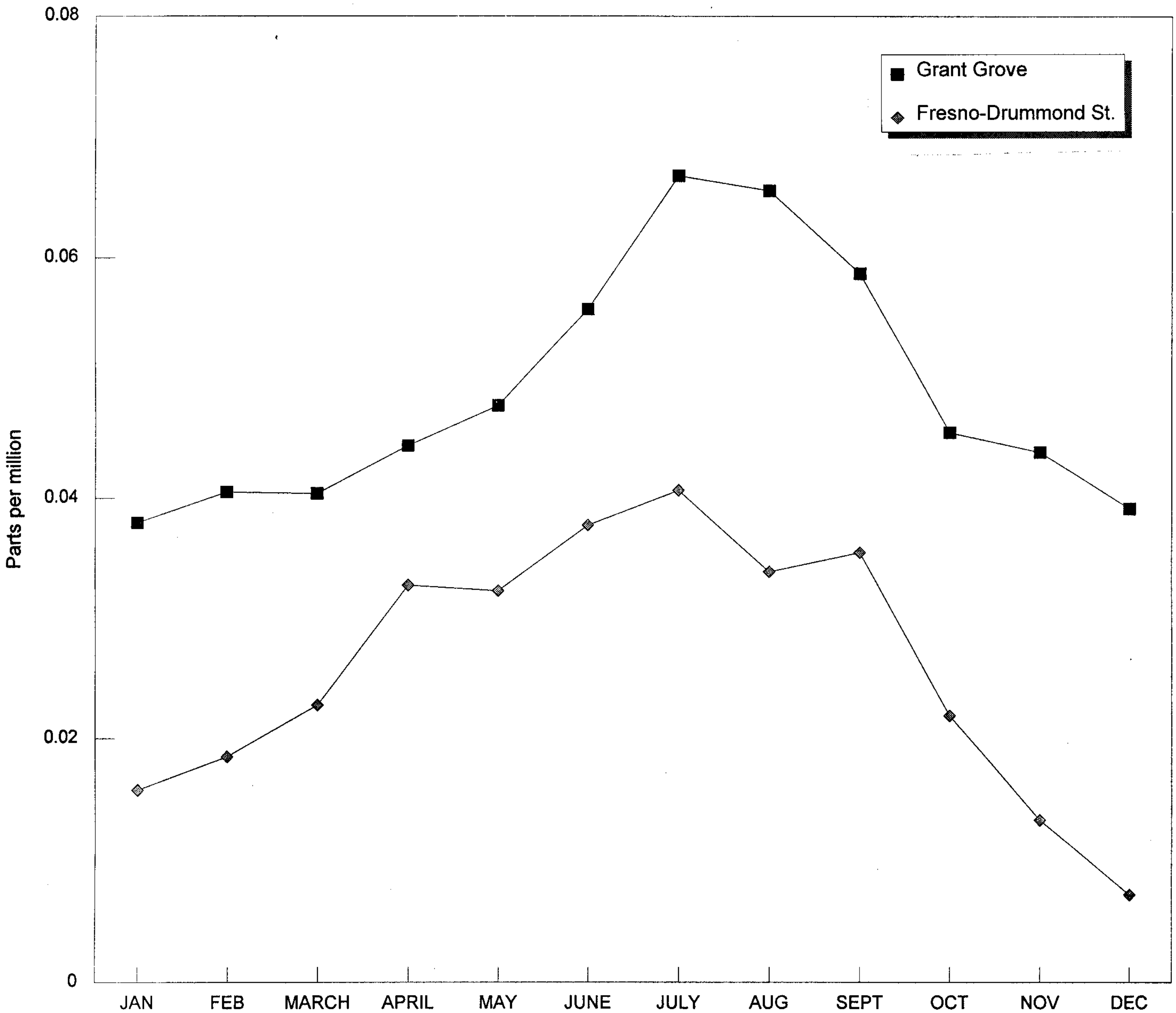


Figure 3-14
Average Monthly Ozone Concentrations, 1993

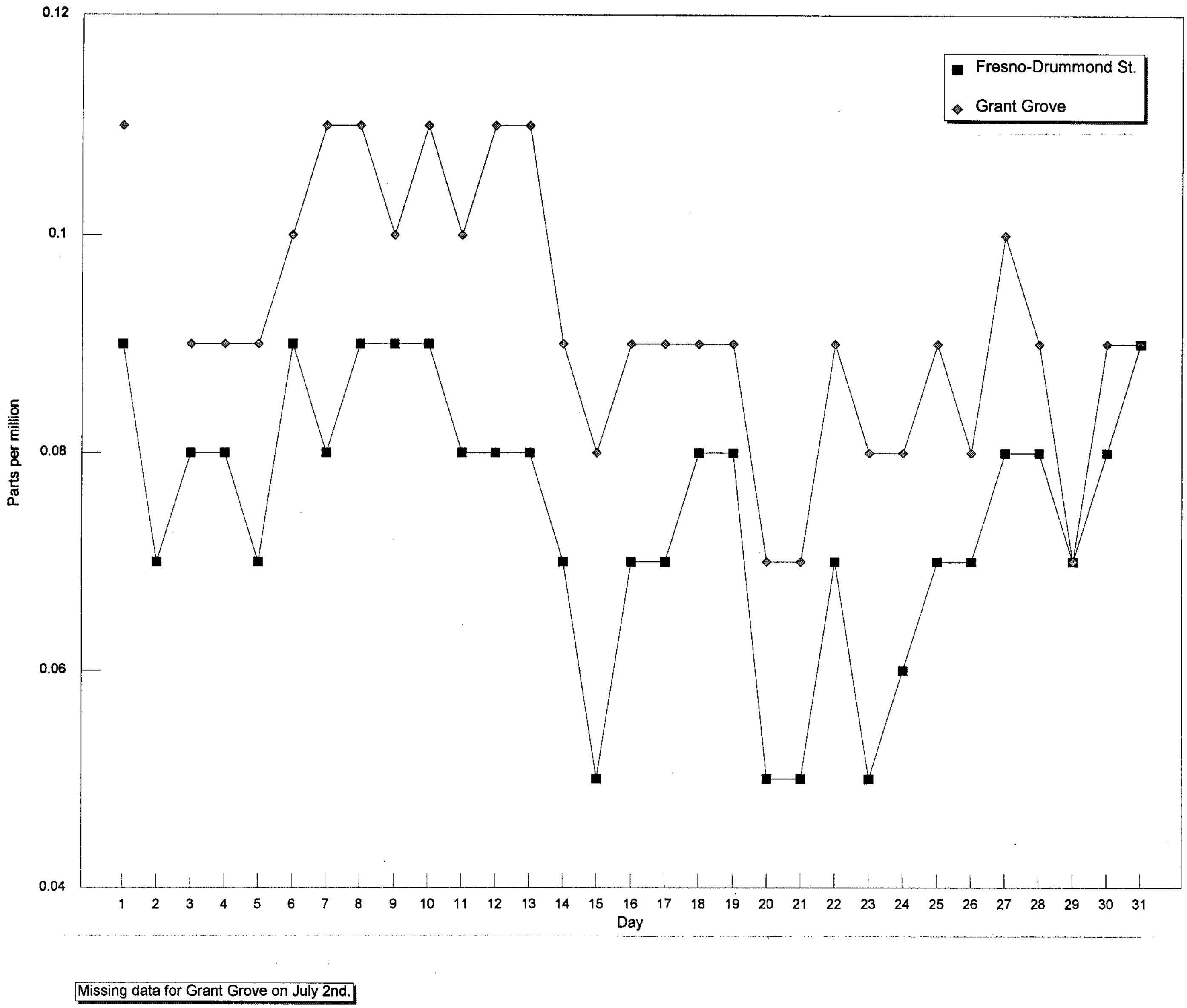


Figure 3-15
Peak Daily Ozone Concentrations, July 1993

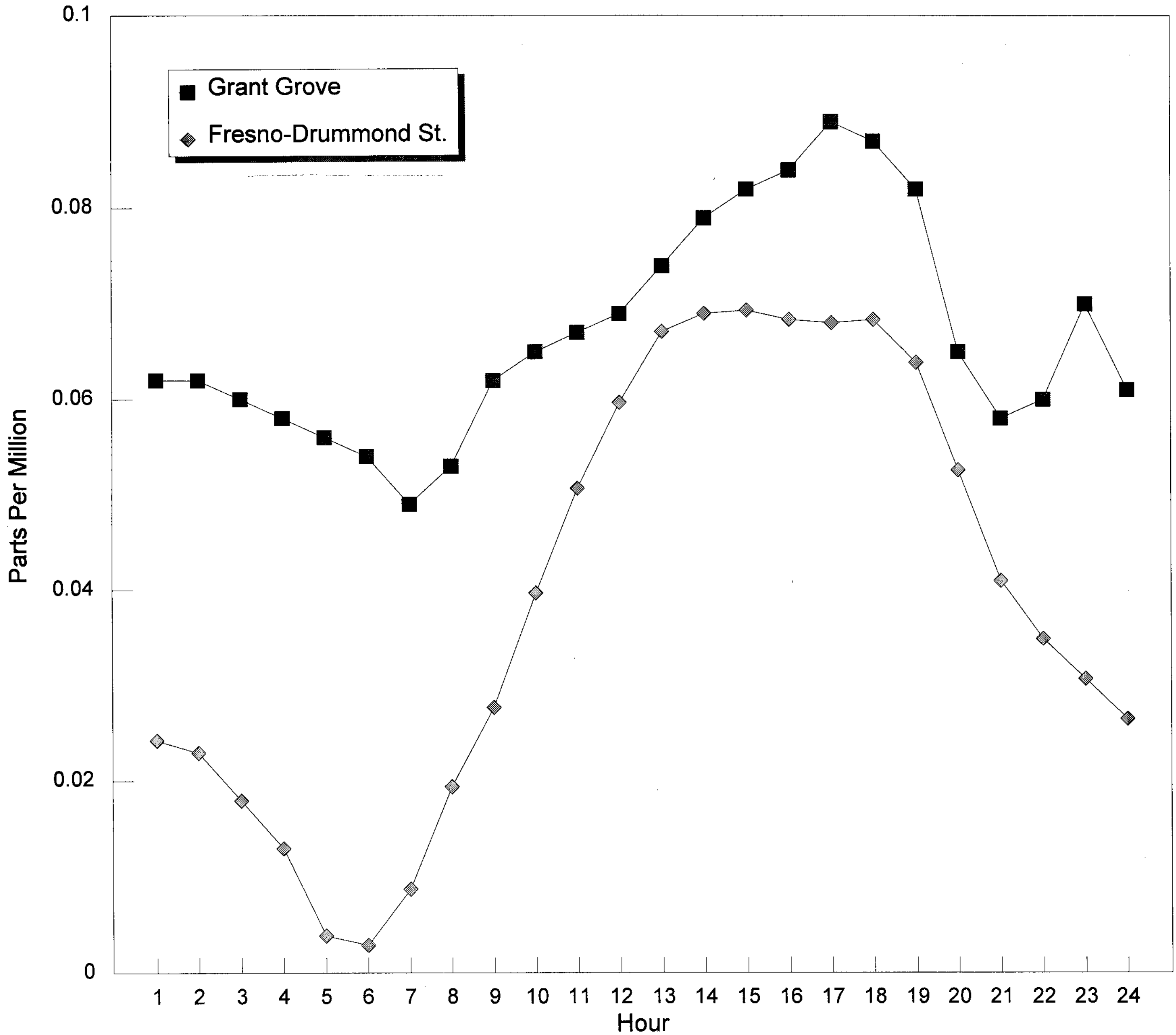


Figure 3-16
Average Hourly Ozone Concentrations, July 1993

The NPS Air Resources Division (ARD) uses the following threshold levels of change when reviewing PSD permit applications for significant impacts in Class I areas: Delta E of 2.0, plume contrast of 0.05, and deciview of 1.0 (or LEC of 10%).

Monitoring Locations and Types

Camera Systems. SEKI operates two visibility camera systems that take pictures automatically three times a day. One camera has been located in Giant Forest at the Lower Kaweah research and monitoring site since 1983. This camera points westward toward the San Joaquin Valley.

The second camera was purchased by the Sequoia Natural History Association in 1989 to establish baseline visual range estimates and provide a slide set (ranging from good to poor visibility) for interpretive programs for each major area in the parks.

Nephelometer. SEKI has been operating a model 1590 Nephelometer at the Ash Mountain ozone station since 1992. Nephelometers are used to measure the total amount of light scattering by an aerosol sample. Because of funding limitations, the data collected by the Nephelometer are not being summarized or analyzed (Ewell 1994).

IMPROVE Monitoring. Additional visibility monitoring at SEKI is being conducted through the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. The IMPROVE program began in 1988 as a cooperative visibility monitoring effort between the EPA, Federal land management agencies, and State air agencies. The objectives of the program are to establish current background visibility in Class I areas, identify chemical species and emission sources responsible for existing human-made visibility impairment, and document long-term visibility trends.

Because of resource and funding limits, the IMPROVE monitoring program was unable to measure visual quality in all 157 mandatory Class I areas that are afforded visibility protection by the Clean Air Act. Initially, 36 IMPROVE and NPS/IMPROVE protocol sites were selected to represent the distribution of visibility and aerosol concentrations over the United States. In California, the original IMPROVE sites established in 1988 included Redwood, Lassen Volcanic, Point Reyes, Yosemite, Pinnacles, and San Gorgonio. SEKI received an IMPROVE site at Ash Mountain (1800 feet) in March 1992 (Sisler et al. 1993).

The IMPROVE sampler consists of four modules (A, B, C, and D), each designed to measure different aerosol components. The IMPROVE sampler at SEKI was originally installed with modules A and B only. In July 1993, modules C and D were added. Modules A, B, and C measure PM2.5 components including mass, absorption, nitrates, organics, and the elements hydrogen, carbon, sodium, lead, and sulfur. Module D measures PM10 mass and sulfur dioxide. The samplers run for 24-hours (midnight to midnight) every Wednesday and Saturday. The University of California at Davis (UC Davis) provides calibration and maintenance and quarterly data reports on the IMPROVE sampler.

Monitoring Results

The following discussion focuses on the IMPROVE monitoring results. No summary monitoring information is available from the nephelometer or the camera systems because of lack of funds to analyze the data.

Figures 3-17 and 3-19 illustrate total PM10 mass and fine PM2.5 24-hour mass contours for the IMPROVE network for the winter (December 1993 to February 1994) and summer quarters (March to May 1993). Figures 3-18 and 3-20 illustrate ammonium sulfate and ammonium nitrate 24-hour contours for the same quarters. Compared to the other sites in the western United States, SEKI has some of the highest concentrations of PM10, PM2.5, ammonium sulfate, and ammonium nitrate. PM10 and PM2.5

concentrations are about two times higher in the summer than the winter quarter (the opposite is true for valley locations). Nitrate concentrations are highest in the winter quarter (Figure 3-18), whereas sulfate concentrations are highest in the summer quarter (Figure 3-20). The hot, dry conditions of summer tend to breakdown nitrates and favor sulfate formation.

Figure 3-18 shows that SEKI and San Gorgonio National Forest (Southern California) have the largest concentrations of nitrates in the network. In addition, SEKI has the largest concentrations of sulfates in the western part of the network. SEKI nitrate and sulfate levels are about two times higher that those in Yosemite. The lower elevation of the SEKI site (1,800 feet) compared to the YOSE site (5,300 feet) may contribute to some of the difference, but the higher pollution levels in the southern valley is the more likely cause. Air pollutants accumulate in the southern half of the valley (see previous section on General Meteorology and Transport Mechanisms). In addition, oil and gas development in Kern County is a large source of sulfur, and ammonia emissions from cattle feedlots provide for rapid neutralization of nitric acid to ammonium nitrate.

Figures 3-21 through 3-24 include the available data from the IMPROVE and the California Acid Deposition Monitoring Program (CADMP) samplers for PM10, PM2.5, and sulfates and nitrates. The CADMP sampler is located in Giant Forest at 6,300 feet elevation and samples once every six days. The IMPROVE sampler is located at Ash Mountain at 1,800 feet elevation and samples twice a week. The figures illustrate the seasonal variation in PM10 and PM2.5, with the lowest concentrations occurring during the winter months and the highest concentrations occurring in late summer and early fall. As shown in Figures 3-22 and 3-24, nitrate concentrations are highest in the winter and sulfate concentrations are highest in the summer. The highest monitored concentrations are associated with local sources. The high IMPROVE PM10 and PM2.5 concentrations from October 1993 through August 1994 were associated with the Generals Highway reconstruction project. The high (offscale) CADMP PM10 concentrations on October 9, 1992 were associated with the Suwannee wildfire.

The extinction budget derived from the IMPROVE data from March 1993 through February 1994 is shown in Figure 3-25. While local road construction was occurring from October 1993 to February 1994, the data were not significantly affected until after February 1994 (see Figure 3-21). The spring, summer, autumn, and winter quarters correspond to March to May, June to August, September to November, and December to February, respectively. Data for coarse (PM10) and organic particles are missing for spring so there are no annual averages. Based on the other quarters, spring values were probably most similar to summer values.

Standard visual range (SVR) in kilometers and haziness index in deciviews (dv) were calculated from the extinction coefficients. Dirtiest and cleanest signify the highest and lowest PM2.5 mass, respectively, and median signifies PM2.5 mass in the middle of the distribution. The five principal visibility reducing particles are sulfate, nitrate, organics, soot (diesel exhaust and smoke), and PM10 (soil). Rayleigh is the natural scattering of light by atmospheric gases and is assumed to be constant.

The dirtiest and cleanest days occurred in the autumn and winter. The dirtiest days resulted from peaks in nitrates. Mean SVR was highest in winter. The lowest SVR was 29 km (17.4 miles) and the highest was 139 km (83.4 miles). SVR in a clean atmosphere can be up to 400 km (240 miles).

VEGETATION

Fumigation experiments are used to determine species sensitivity to air pollution. After sensitivity is established, field studies are conducted to determine the extent and severity of the air pollution injury.

Sensitivity to ozone pollution varies among plant species. Controlled exposure studies

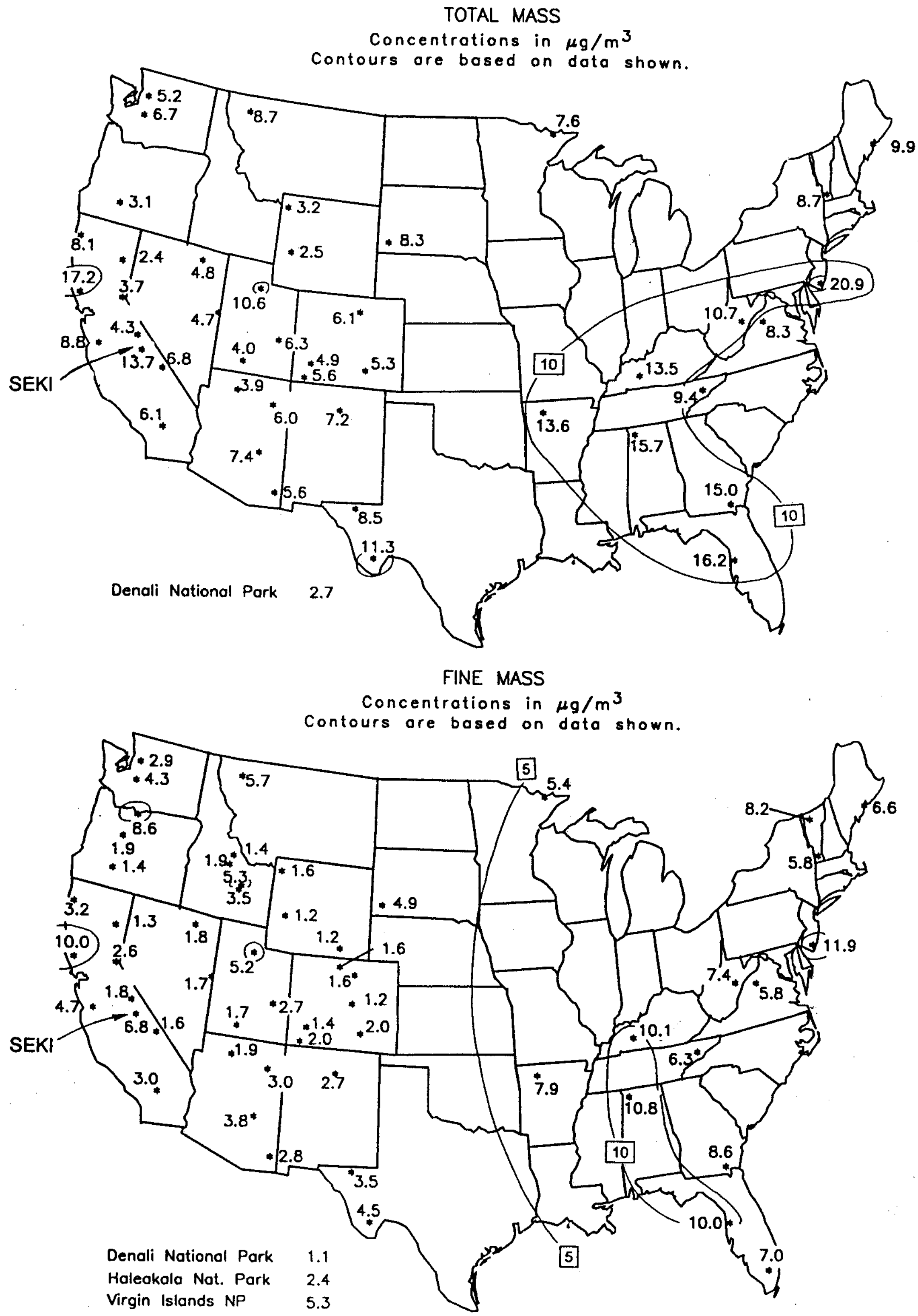
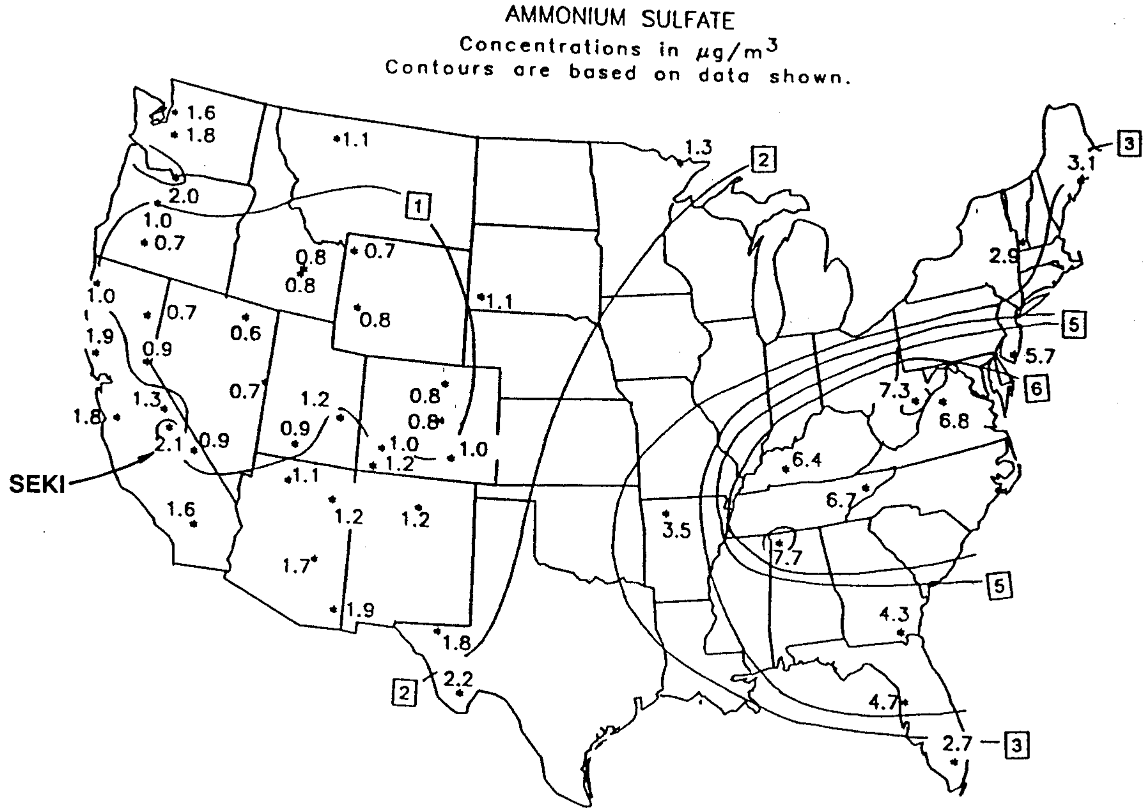


Figure 3-17
IMPROVE Particulate Network for Total Mass and Fine Mass (December 1993-February 1994)



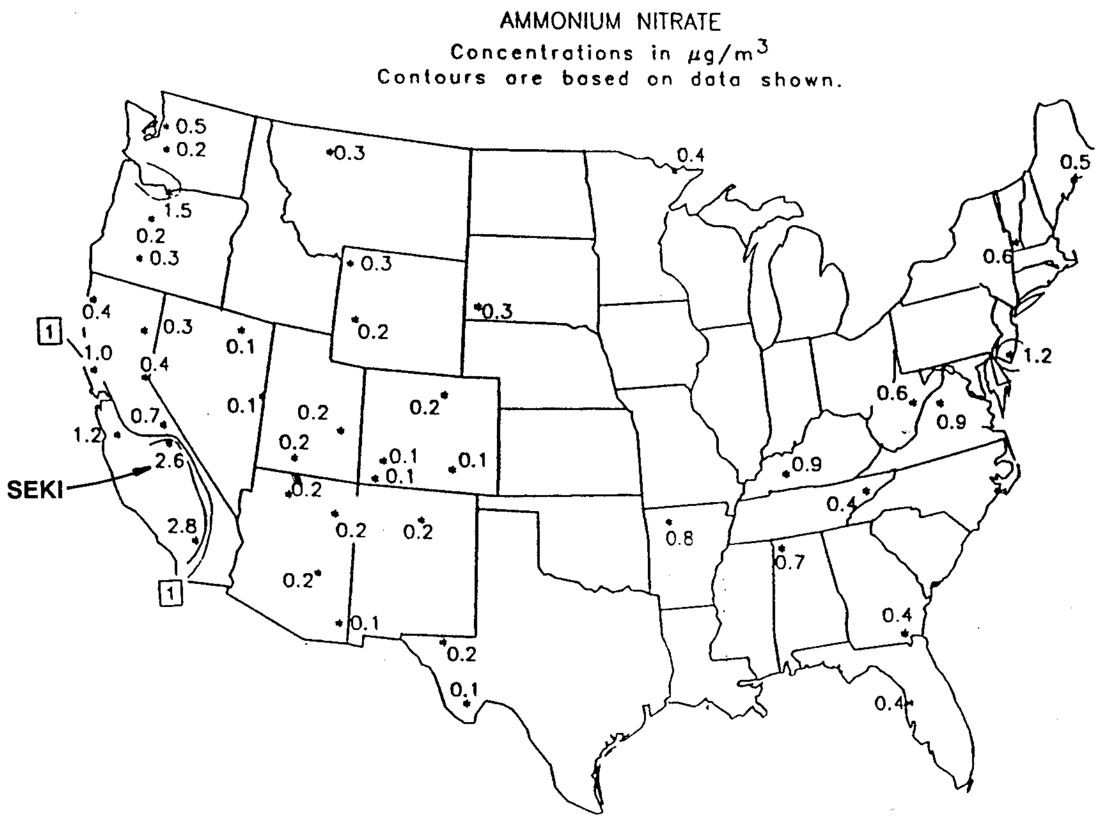
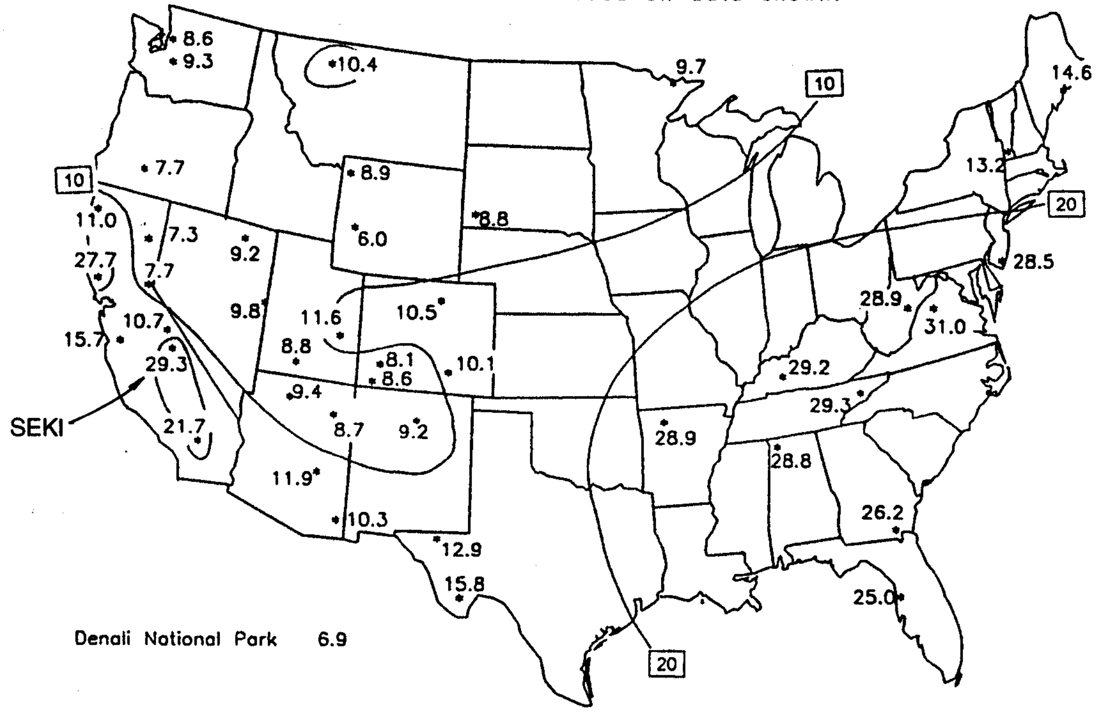


Figure 3-18
IMPROVE Particulate Network for Ammonium Sulfate and Ammonium Nitrate (December 1993-February 1994)

IMPROVE PARTICULATE NETWORK
JUN 1993–AUG 1993

TOTAL MASS
Concentrations in $\mu g/m^3$
Contours are based on data shown.



FINE MASS
Concentrations in $\mu g/m^3$
Contours are based on data shown.

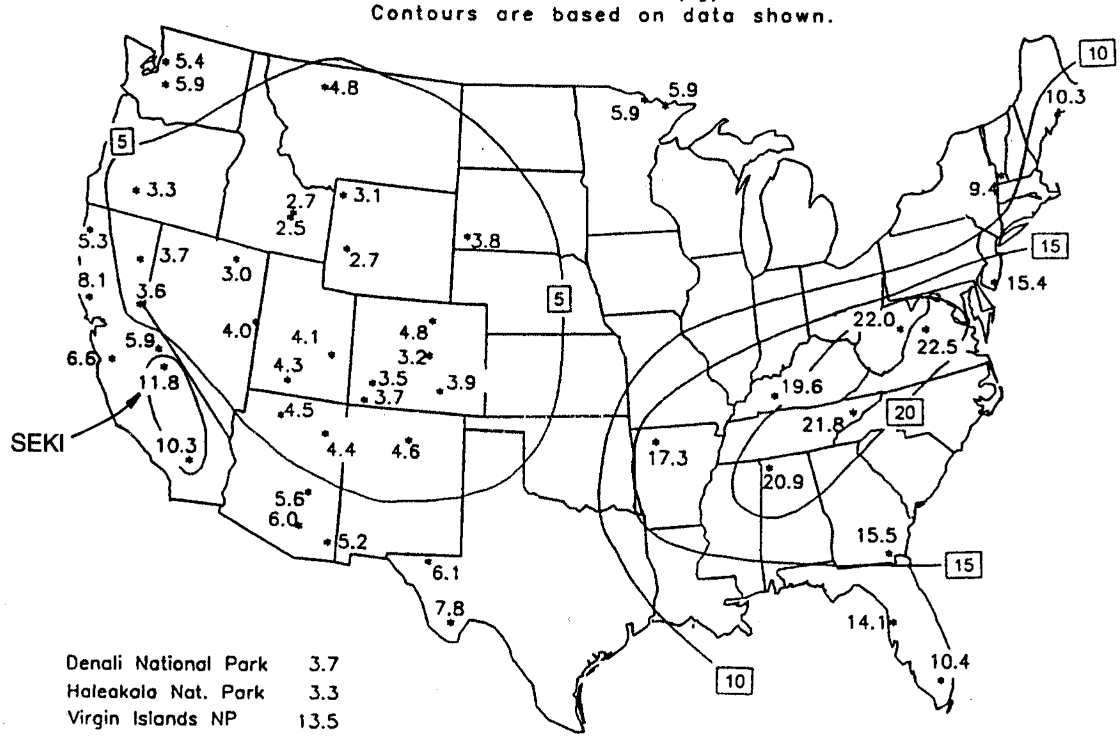
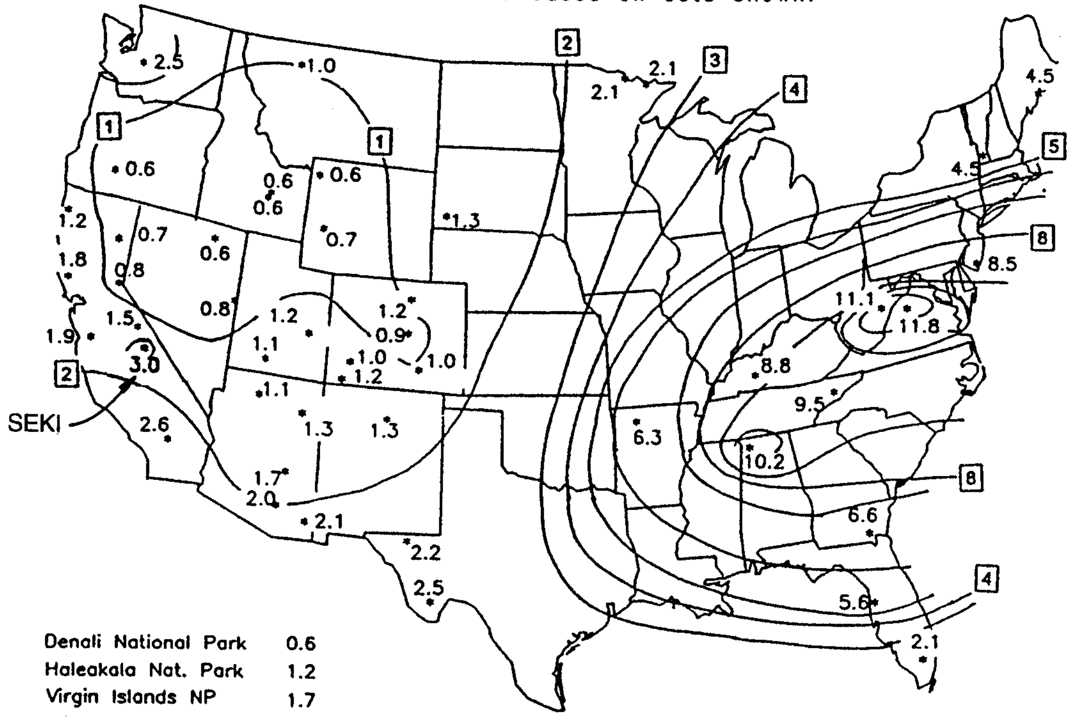


Figure 3-19
IMPROVE Particulate Network for Total Mass and Fine Mass (June-August 1993)

IMPROVE PARTICULATE NETWORK
JUN 1993–AUG 1993

AMMONIUM SULFATE
Concentrations in $\mu g/m^3$
Contours are based on data shown.



AMMONIUM NITRATE
Concentrations in $\mu g/m^3$
Contours are based on data shown.

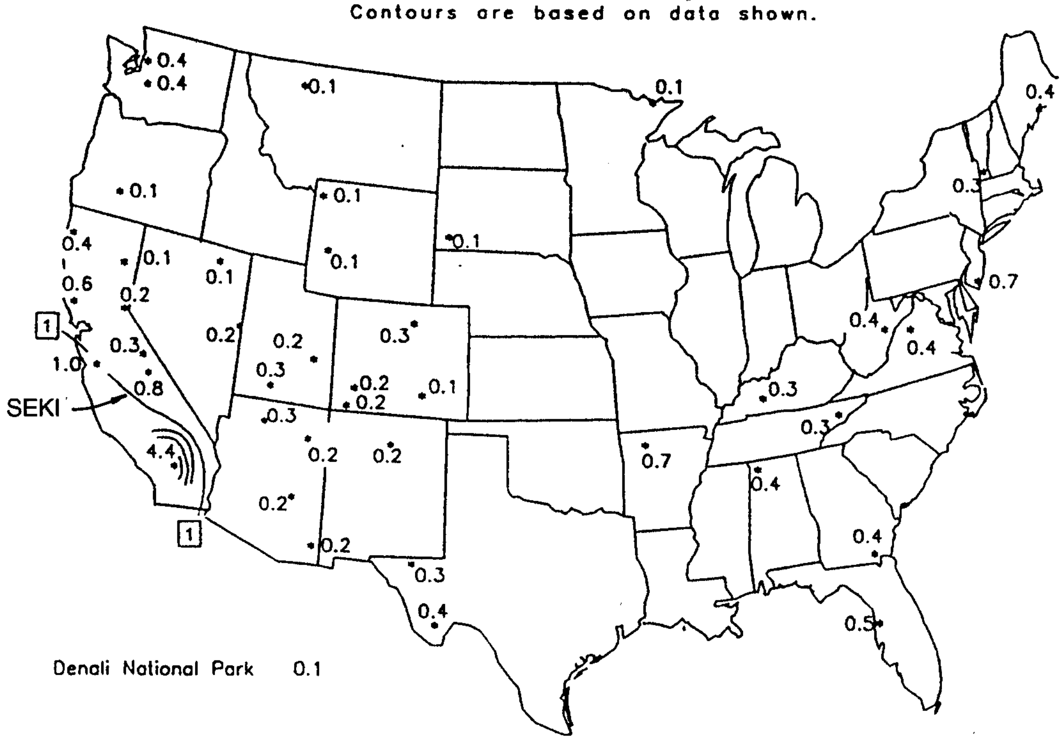


Figure 3-20
IMPROVE Particulate Network for Ammonium Sulfate and Ammonium Nitrate (June - August 1993)

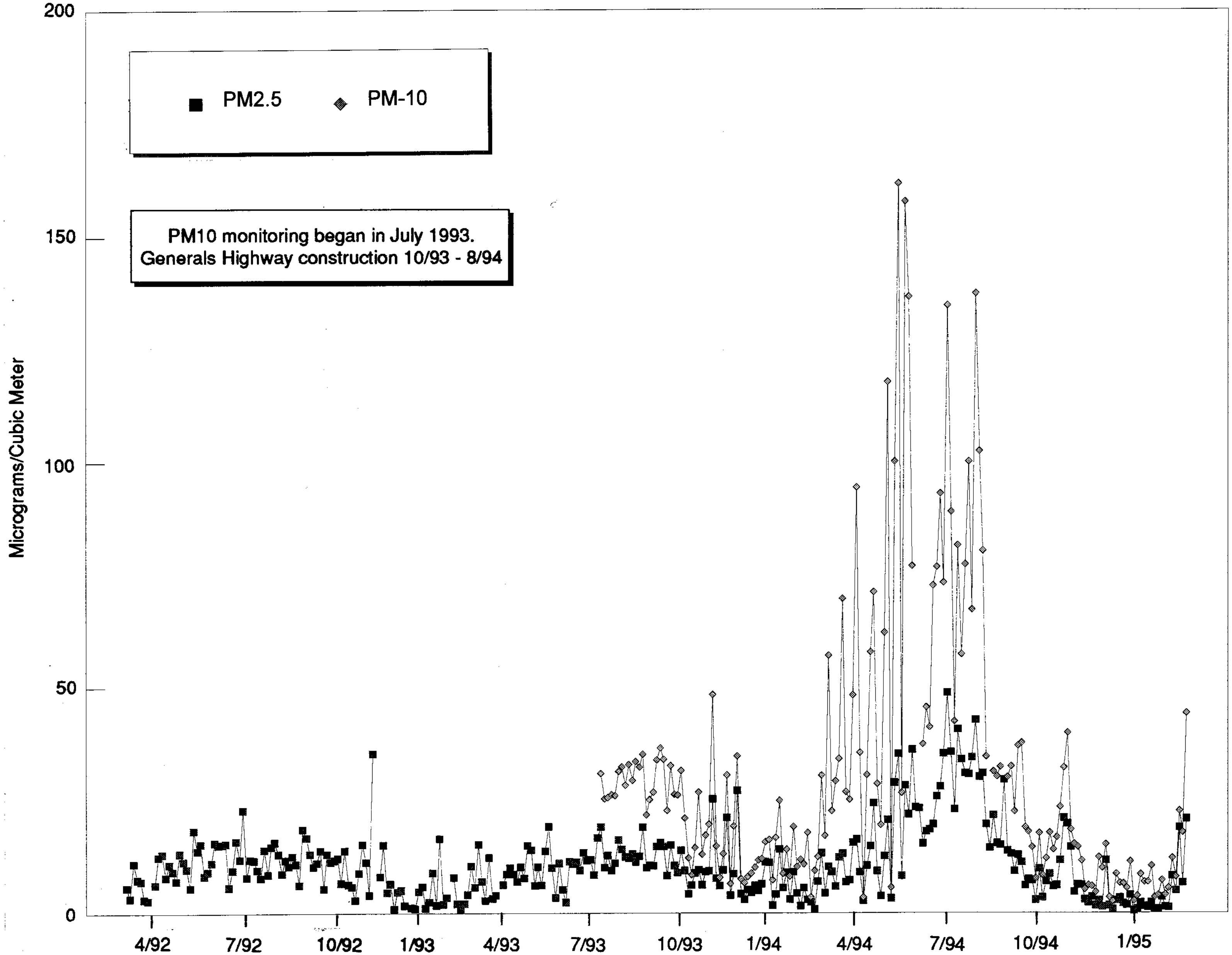


Figure 3-21
IMPROVE 24-Hour Total Mass and Fine Mass at Ash Mountain
March 1992 through February 1995

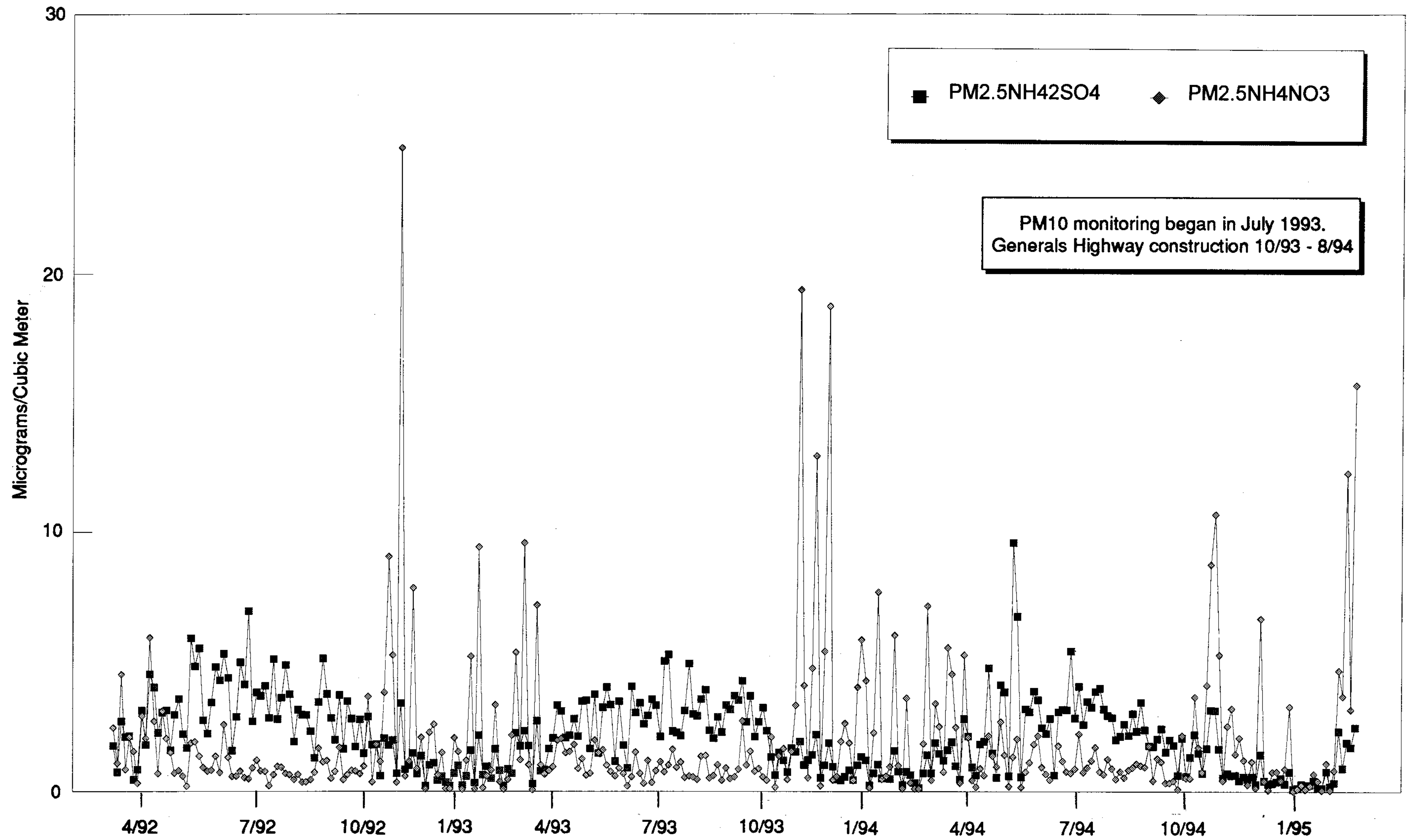


Figure 3-22

IMPROVE 24-Hour Ammonium Sulfate and Ammonium Nitrate at Ash Mountain

March 1992 through February 1995

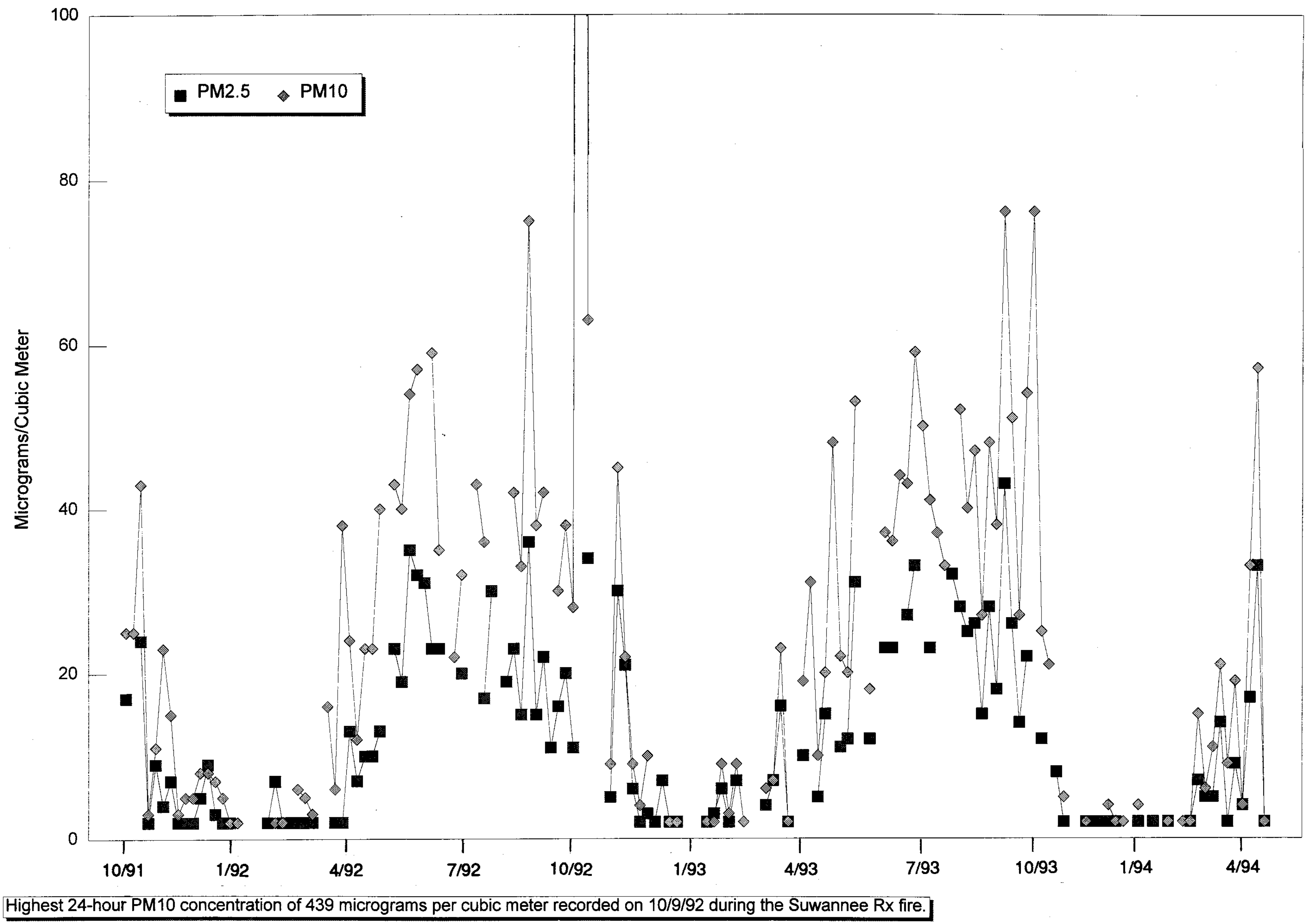


Figure 3-23
CADMP 24-Hour Total Mass and Fine Mass at Giant Forest
October 1991 through April 1994

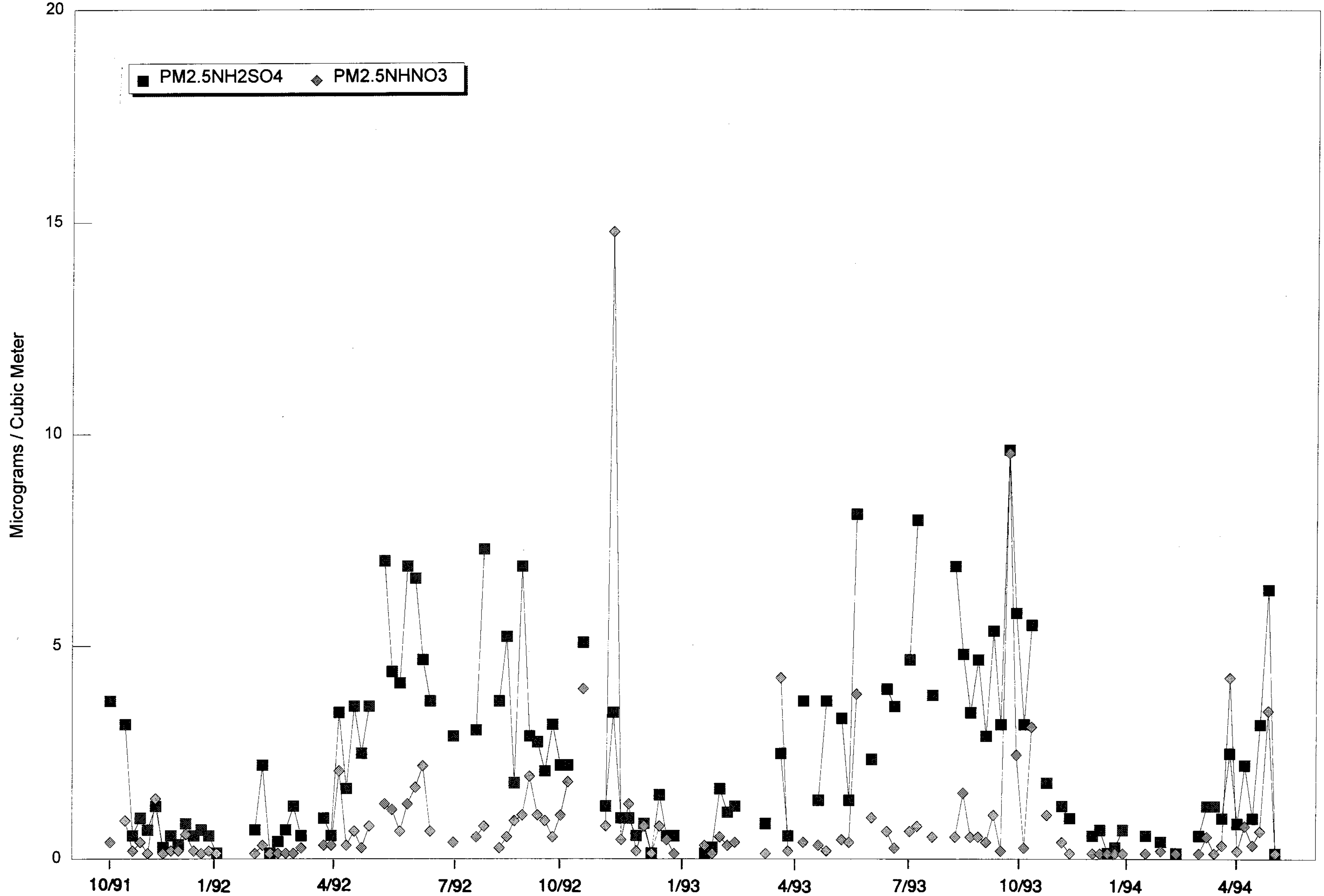
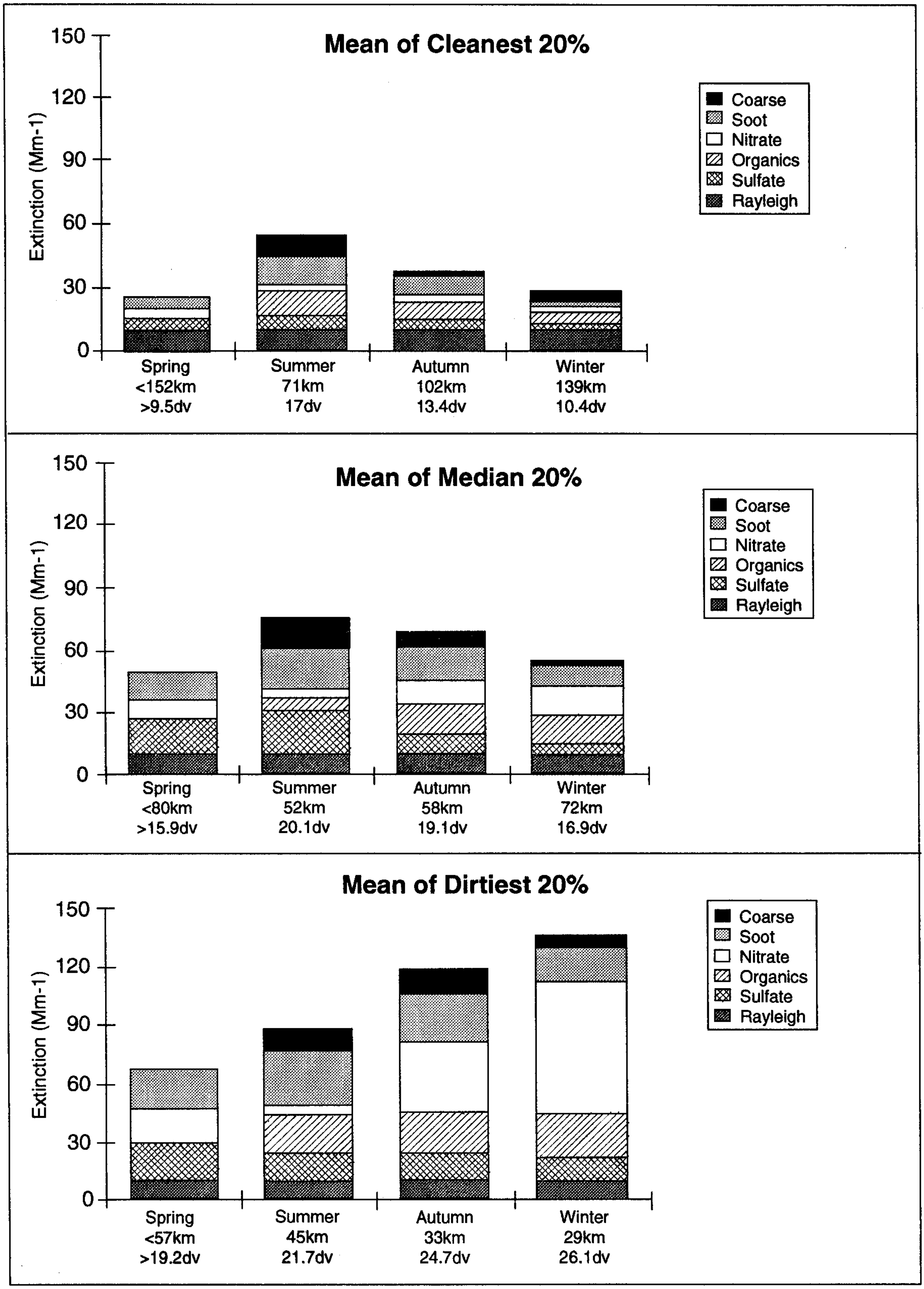


Figure 3-24
CADMP 24-Hour Ammonium Sulfate and Ammonium Nitrate at Giant Forest
October 1991 through April 1994



*Coarse and organic data missing for spring.

Figure 3-25
Reconstructed Extinction Budgets for Ash Mountain
March 1993 - February 1994

have demonstrated that sensitive genotypes of ponderosa and Jeffrey pines begin to show visible ozone injury symptoms at ozone concentrations between 0.05 and 0.06 ppm. Both the NAAQS for ozone (0.12 ppm hourly average) and the CAAQS for ozone (0.9 ppm hourly average) are insufficient to protect sensitive species from injury (California Air Resources Board 1992).

Limited studies on vegetation have shown several species to be sensitive to ozone injury (Stolte et al. 1992). Visible foliar injury is the most easily identified biological response to ozone exposure and is used for detecting and rating damage. Other reported impacts of ozone on conifers include reduced foliar growth and retention, abnormal branch mortality, needle tip necrosis, reduced needle length and needle retention, decreased photosynthetic capacity, reduced tree height and diameter growth, increased root death, and tree mortality. In addition, ozone-stressed trees or stands are more susceptible to natural and human-caused stresses such as pests, pathogens, drought, and pollutants other than ozone. Table 3-1 lists Sierra tree species and their relative sensitivity to ozone.

Little is known about the sensitivity to ozone of flowering plants, forbs, and brush species that occur in the Sierra Nevada. A list of 45 potentially sensitive species for the western United States was compiled, and six species were fumigated at the U.S. Forest Service (USFS) Center for Forest Environmental Studies in 1994 for ozone sensitivity (Mavity et al. 1995). Plants were selected if ozone-like symptoms had been observed in the field or if taxonomy was related to species known to be sensitive. Six species were tested before work was discontinued because of lack of funding. *Prunus virginiana, Physocarpus capitatus, Rubus parviflorus* (young plants only), and a *Vaccinium* species were found to be good potential bioindicators, whereas *Sambucus racemosa and Artemisia douglasiana* were not.

Additional species that might serve as bioindicators for ozone are *Amorpha californica* (skunk bush), *Elymus glauca* (rye grass), and *Rhus trilobata* (squaw bush), but they have not been studied in the Sierra Nevada (Miller pers. comm.). All but *Amorpha californica* are known to be present in the parks (Appendix K).

Numerous studies in the Sierra Nevada have shown visible ozone injury to ponderosa and Jeffrey pines (Peterson et al. 1987; Duriscoe and Stolte 1989; Patterson and Rundel 1989; Ewell and Gay 1993; Rocchio et al. 1992). Injury severity varies and generally increases from north to south. Average ambient ozone concentrations also tend to increase from north to south in the Sierra Nevada.

Jeffrey and ponderosa pines at SEKI showed an increase in incidence of visible ozone injury from 30% to 45% over a 10-year period (Ewell and Gay 1993). Similar observations have been made by others in the Sierra (Miller 1996). In another SEKI study, selected Jeffrey pines have shown an 11% decrease in radial growth since 1965 (Peterson et al. 1987). A 1986 survey in Yosemite National Park found that 30% of the trees had visible ozone injury. A 1991 resurvey of Jeffrey pine in the Lake Tahoe Basin on plots established in 1987 showed greater incidence of visible ozone injury: 29% of the trees surveyed in 1987 showed ozone injury, and 40% of the trees surveyed in 1991 showed ozone injury. The USFS has followed a network of 54 permanent plots on the Sierra and Sequoia National Forests since 1977. Approximately 55% of the trees on the plots have visible ozone injury. In all cases, the number of whorls retained on branches was much less on ozone-injured trees compared to uninjured trees.

The Forest Ozone Response Study, or Project FOREST, is a Sierran bioregional study involving the USFS, NPS, UC Davis, and ARB that began in 1991. The primary objective of Project FOREST is to evaluate the relationship between Jeffrey and ponderosa pine ozone injury and exposure. The study area for Project FOREST includes 11 sites on five national forests and in four national parks in the Sierra Nevada, including two sites in SEKI. An additional site in the San Bernadino Mountains in southern California has been included in the study as a reference for greater ozone exposure.

Each study site includes an ozone monitor, meteorological tower, and three associated pine tree plots. The study sites are located at elevations ranging between 4,000 and 6,500 feet (Rocchio et al. 1992). Methods from Miller et al. (1996) are used to establish the plots and collect the field data.

Preliminary results have documented that foliar injury occurs at all sites in the study. Significantly more foliar injury was reported at the three southernmost sites: Grant Grove, Giant Forest, and Mountain Home (Rocchio et al. 1992). Field work will be conducted on a cyclic schedule of every two to three years.

Chamber studies also have analyzed foliar injury and growth responses of ponderosa pines exposed to a range of environmental stressors, including varying levels of ozone, wet and dry deposition, and drought. One study showed that rain pH and dry deposition had no direct effects on growth of ponderosa pines. However, ozone exposure contributed to needle loss and reductions in radial stem growth and coarse-root growth. Seedlings exposed to dry deposition and ozone had more foliar injury compared to seedlings only exposed to ozone (Temple et al. 1992b).

Another study assessed regional growth changes in ozone-stressed ponderosa pine. That study found no evidence of recent large-scale growth changes in ponderosa pine in the Sierra Nevada, but growth reductions were indicated at some of the southern sites (Peterson et al. 1991).

Black oak trees were evaluated for ozone injury in 1983 and 1984 at ten sites in the parks (Miller et al. 1984). The most severe symptoms observed were classed as moderate, and the majority were classified as slight to none. Injury was greatest at sites in the Middle and Marble Fork drainages of the Kaweah River and at lower elevations. Ozone chlorotic-like symptoms were observed on interior live oak and sycamore in a 3-day survey of three watersheds in the parks (Miller et al. 1987).

A nationwide study on *Populus tremuloides* clones included clones taken from Sequoia and Yosemite National Parks (Berrang et al. 1991). Results indicated that ambient ozone levels may be eliminating ozone-sensitive clones from natural populations.

Although fumigation studies have found that mature giant sequoia are not sensitive to ozone, giant sequoia seedlings have been identified as sensitive to ozone up until they are 5 years of age (Grulke and Miller 1994).

Wetmore (1985, 1986) conducted a limited lichen survey, including some chemical analysis, along SEKI roads and in the Kern Canyon. He found no indication of air pollution impacts. Eversman and Sigal (1985) report that ozone can affect lichen distribution, morphology, photosynthesis, and ultrastructure. The USFS and NPS conducted a workshop in 1991 to review what was known about air pollution and lichens, and a report was written with recommendations for monitoring (Huckaby 1993).

AQUATIC RESOURCES AND ACID DEPOSITION

Introduction

The lakes, streams, and forests of SEKI are sensitive to acid deposition because of their location on granitic bedrock and due to the low alkalinity of high-elevation lakes and streams. Although there have been no cases of chronic acidification of lakes, streams, or ponds, episodic acidification has been measured in some lakes and streams. Many headwater basins have little remaining capacity to assimilate excess nitrogen or acids (Stoddard 1995).

NO_x and SO_x are the principal precursors in acidic deposition of nitric acid and sulfuric acid, respectively. These precursors can be transported long distances, creating uncertainties about the relative contributions from upwind sources. In addition, studies have indicated organic acids may also play a role in acidic deposition, although further research is needed (Harrington et al. 1991). Dry deposition of ammonium nitrate and

Table 3-1. Sierra Tree Species and Ozone Sensitivity

Sensitive	Intermediate	Tolerant
Ponderosa pine *Pinus ponderosa*	White fir *Abies concolor*	Sugar pine *Pinus lambertiana*
Jeffrey pine *Pinus jeffreyi*	Incense-cedar *Calocedrus decurrens*	Douglas-fir *Pseudotsuga mensiesii*
Western white pine *Pinus monticola*	Lodgepole pine *Pinus contorta*	Giant sequoia* *Sequoiadendron giganteum*
California sycamore *Platanus racemosa*		Gray pine *Pinus sabiniana*
Quaking aspen *Populus tremuloides*		Western juniper *Juniperus occidentalis*
California black oak *Quercus kelloggii*		

Source: Pronos, pers. comm.

* Giant sequoia seedlings have been found to be sensitive up to five years of age (Grulke and Miller 1994).

sulfate particles can acidify soils and waters following dissolution.

Acid deposition has the potential to alter ecological systems in two distinct ways. First, acid components and nitrogen can alter the chemical characteristics of soils and aquatic systems. In addition, by altering those systems, acid deposition may affect species that are dependent on those systems.

Another potential impact of acid deposition is that it can potentially erode buildings, structures, statues, or other human-made or natural attributes of the SEKI landscape. To date, no evidence has been gathered to suggest that acid deposition is the cause of erosion of buildings or other SEKI cultural resources (see the following section on cultural resources). Also, acid deposition does not appear to be affecting SEKI's caves, which are well buffered from such processes (Despain pers. comm.).

The Sierra Nevada has a higher percentage of lakes vulnerable to acidification than any other area in the United States (California Air Resources Board 1994b). Approximately 40% of Sierra Nevada lakes are highly susceptible to acid deposition damage. Acid deposition can occur in a variety of forms, such as rain, snow, fog, or dry deposition.

Although wet deposition rates in California are lower than in the eastern United States and Europe, California's high-elevation watersheds may be more susceptible to injury by acidity than other locations. Many of these watersheds appear less able to neutralize acids because of the geochemical makeup of the soils surrounding them. Damage from dry deposition, considered an important part of total acidic deposition, is not yet completely understood. (California Air Resources Board 1994b.)

Sensitive waters are defined as those that have low surface-water alkalinity (less than 200 microequivalents per liter) and low concentrations of dissolved materials, and are situated on granitic watersheds with thin soils that have little ability to neutralize incoming acids. Located in the southern Sierra Nevada, Sequoia National Park contains a large number of lakes and streams that meet these criteria (U.S. Environmental Protection Agency 1995b).

Acid Deposition Monitoring Studies

Begun in 1982 primarily under the auspices of the National Acid Precipitation Assessment Program, the SEKI watershed research program is a long-term, interdisciplinary study of chemistry and potential effects of atmospheric deposition on natural ecosystems. Cooperative efforts have scientists from Federal, State, and private organizations working at three study sites (watersheds) spanning an elevation gradient from 2,460 feet to 11,204 feet. These sites include Elk Creek (foothills), Log Meadow (mixed conifer), and Emerald Lake (subalpine). The subalpine site was the focus of a 10-year integrated watershed study sponsored by ARB.

At each site, baseline data have been collected to assess future changes in atmospheric inputs and their effects on natural ecosystems. NPS studies include analysis of precipitation, stream and soil solution chemistry, stream hydrology, meteorology, nutrient fluxes, and vegetation structure and dynamics. The potential role of fire, a frequent natural occurrence in the area, in buffering effects of acidic inputs is also being evaluated.

In 1983, ARB established the CADMP to measure acidic compounds in wet (including clouds) and dry deposition. In SEKI, Ash Mountain and Giant Forest are CADMP monitoring sites (see Figure 3-26).

ARB operates a CADMP dry deposition network (Figure 3-27), which was initiated in 1986 under the Atmospheric Acidity Protection Program. The ARB dry deposition sampler and meteorological tower at Lower Kaweah were installed in May 1988, one of ten such sites in California. Every sixth day, two 12-hour samples (6:00 am to 6:00 pm and 6:00 pm to 6:00 am) of PM10 and PM2.5 are collected onto filter packs. The filters are analyzed by ARB for elemental, sulfur and nitrogen species, and gravimetric mass. Another particulate sampler is located at Ash Mountain and is discussed in the next section on visibility. Finally, the National Oceanic and Atmospheric Administration has operated a dry deposition tower at Wolverton that has sampled on a one-week integrated basis since 1986. In addition, wet deposition monitoring of rain and snow has been conducted by the University of California at Santa Barbara (sponsored by ARB) at high elevation sites in the Sierra Nevada, including SEKI.

The National Atmospheric Deposition Program/National Trends Network (NADP/NTN) is a nationwide wet deposition monitoring program used to characterize geographical patterns and temporal trends in precipitation chemistry in the United States. A NADP/NTN site has been at Giant Forest since 1980 (see Figure 3-26).

As part of the U.S. Global Change Research Program, the National Aeronautics and Space Administration (NASA) has implemented the Earth-Observing System Scientific Research Program that is part of the Mission to Planet Earth (MTPE) (National Aeronautics and Space Administration 1991). The program includes the launching of satellites and on-the-ground field research to help interpret the images. A study to monitor hydrology and chemistry of the Sierra Nevada snowpack is part of this program.

Monitoring Results

In contrast to ecosystems in the eastern United States and Canada, the Sierra Nevada ecosystems appear in the short term (over several decades) to have compensated for acidic inputs. The longer term outlook is less certain because adverse impacts seen elsewhere occurred only after many decades of acidic deposition.

CADMP wet and dry deposition monitoring results for 1988-1994 at Giant Forest are included in Table 3-2 (Blanchard et al. 1996). Dry deposition was reported both quarterly and annually, and wet deposition was reported annually only. Sulfate deposition was highest in quarters 2 and 3, and nitrate deposition was highest in quarters 1 and 4. These same trends were also seen in ambient nitrate and sulfate concentrations in Figures 3-18, 3-20, 3-22, and 3-24. The other nitrogen species (HNO_3^-, NO_2, NH_3, and NH_4^+) were highest in quarters 2 and 3, however. Total nitrogen far exceeded total sulfur deposition annually and quarterly, and for both wet and dry deposition. Also, total nitrogen and sulfur wet deposition was two to three times greater than dry deposition. The opposite was true for urban sites.

Acid deposition research at SEKI has found the following:

- Precipitation varies along the elevation gradient, with the mass deposition of sulfate, nitrate, and ammonium greater at low-elevation and mid-elevation sites (Ash Mountain and Giant Forest) (Melack and Stoddard 1991).

- Studies have indicated that organic acids may also play a role in acidic deposition, although further research is needed (Harrington et al. 1991).

- Tracer experiments have shown that pollutants are transported from the SJVAB (Rappolt and Quon 1992).

- Episodic events (spring snowmelt and intense summer storms) cause depressions in the acid-neutralizing capacity and pH and peaks in nitrate concentrations. During these episodes, surface-water alkalinity is often reduced to zero (Melack and Stoddard 1991).

- The population of brook trout in the Emerald Lake drainage does not appear to be affected by episodic acidification (Melack and Stoddard 1991).

- Experimental stream acidification shows that a variety of invertebrate taxa respond to acidic inputs, particularly *Baetis*

Table 3-2. Wet and Dry Deposition at Giant Forest (kg/ha/yr)[1]

QUARTER									
Dry	SO_2	HNO_3	NO_2	NH_3	NO_3^-	SO_4^{-2}	NH_4^+	N	S
1	0	0.01	0	0.25	0.35	0.1	0.1	0.35	0.1
2	0.47	3.74	0.1	0.55	0.29	0.49	0.19	1.51	0.4
3	0.66	6.74	0.1	0.92	0.27	0.52	0.18	2.48	0.5
4	0.1	0.55	NA	0.24	0.51	0.1	0.13	0.54	0.1
ANNUAL									
Dry	0.3	2.76	0.1	0.49	0.35	0.3	0.14	1.22	0.25
Wet	---	---	---	---	5.06	2.36	2.09	2.76	0.79

[1] QUARTER = calendar quarter.
NA = missing data.
N = total nitrogen.
S = total sulfur.
--- = not applicable.

Source: Blanchard et al. 1996.

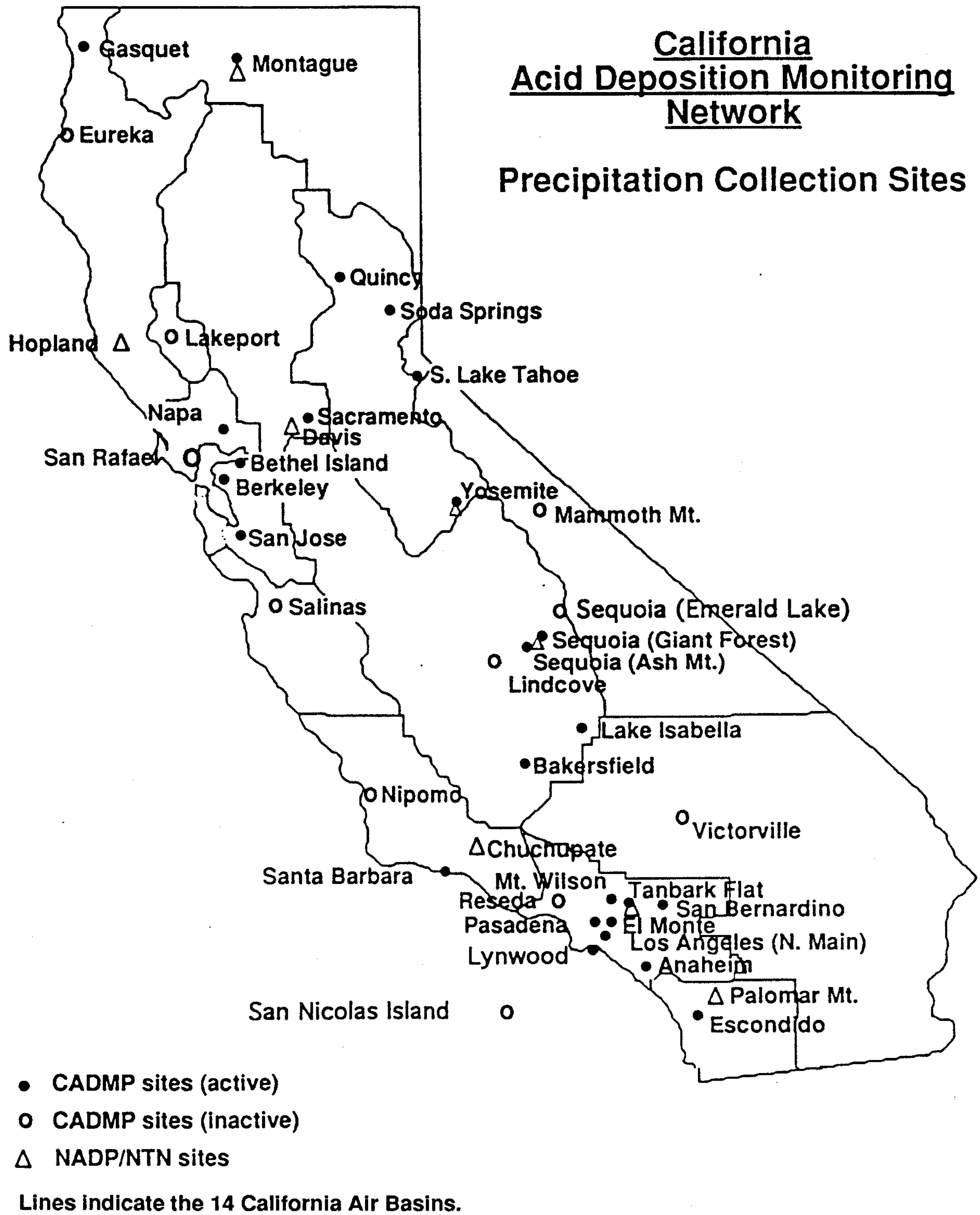


Figure 3-26
Wet Deposition Network: Location of Monitoring Sites

Figure 3-27
Dry Deposition Network: Location of Monitoring Sites

(mayfly larvae) and *Daphnia* (a zooplankton) (Hopkins et al. 1989).

- Paleolimnological studies show no significant change in lake pH over the last 150 years (Whiting et al. 1989).

- Thirteen years of precipitation chemistry data from the National Atmospheric Deposition Program/National Trends Network showed a 28% increase in ammonium and a 71% decrease in hydrogen ions, with no significant changes in other ionic concentrations or free acidity (Lynch et al. 1995). It is likely that free acidity did not decrease because of the increase in ammonium. The large increase in ammonium may be related to increases in the cattle industry in the San Joaquin Valley.

- Snow monitoring studies have shown that acidic anions accumulate in the snowpack until they are preferentially washed out during spring snowmelt. Although the acidic loads are low, they are substantial enough to temporarily acidify small lakes with low ANC, but not high enough to cause nitrogen saturation (such as in the Rockies) or extensive episodes (such as in the eastern United States) (Stoddard 1995, Williams et al. 1996).

- The Giant Forest mixed-conifer watershed biologically assimilated most of the acidifying ions, and weathering reactions produced ample quantities of basic solutes, indicating that nitrogen saturation was not occurring (Williams and Melack, in press).

- Cloudwater is another source of wet acidic deposition. Cloudwater pH at Giant Forest ranged from 4.4 to 5.7 (Collett et al. 1990). In the absence of large ammonia inputs, pH values would be significantly lower. Cloudwater interception occurred 3% of the time during a 12-month period in 1987-88. The relative contribution of cloudwater to total wet deposition is uncertain but is less than precipitation.

WILDLAND FIRES

Recent research studies have shown that an increase in the acreage burned in SEKI is needed to restore the role of fire in maintaining healthy fire-dependent ecosystems (Parsons and Botti 1996). This must be balanced with the potential adverse impacts smoke has on human health and visibility. The majority of particulates from fires are in the very fine size class (less than 1 micrometer in diameter) (Sandberg and Martin 1975), which causes the most adverse impacts on human health and visibility. Additionally, toxic compounds from smoke include carbon monoxide, acrolein, formaldehyde, and possibly polycyclic aromatic hydrocarbons (PAH) (Reinhardt et al. 1994). Benzene is a toxic compound emitted from gasoline used in fire equipment. A recent study indicated that the nitrogen oxide and hydrocarbon emissions from fires can impact ozone concentrations as far as 80 km downwind (Roberts and Anderson 1991).

Smoke transport and impacts within the parks and to the San Joaquin Valley air basin and the Great Basin Valleys of the east side of the Sierra Nevada are of primary concern. Smoke management is a component of the park's Fire Management Plan, currently under revision. When revised, the section on Smoke Management will be added to Appendix E of this plan for consistency. Park staff are working with the SJVUAPCD to include historic and future emissions from park fires in the next SIP revision. Park staff are also participating in the development of a Memorandum of Understanding (MOU) between the SJVUAPCD and the various resource agencies for prescribed burning to minimize and reduce PM10 emissions. When complete, the MOU and emissions information will also be included in Appendix E of this plan. Concurrently, the SJVUAPCD is developing a separate rule for prescribed fires (including natural prescribed fires), because the current regulation has little applicability to the prescribed burning conducted in these parks. The parks will also participate in this rule development process.

HUMAN HEALTH

The major air pollutants and their potential effects on human health are summarized in Table 3-3. The populations most at risk include children, the elderly, those with anemia or coronary and respiratory diseases, and those who exercise (American Lung Association 1996). The pollutants of greatest concern to public health in SEKI include ozone, PM10, and CO. PM10 and CO are a concern primarily during prescribed fires and wildfires. Ozone concentrations exceeding health standards are a problem when high levels of ozone produced in the SJVAB is transported into SEKI by prevailing winds.

GLOBAL CLIMATE CHANGE

In 1991, the National Biological Service field research staff stationed at SEKI and Yosemite National Park designed an interdisciplinary research program to evaluate the potential effects of predicted greenhouse gas-induced global climate change. The program, which is a cooperative venture with other agencies and university scientists, aims at understanding and predicting the effects of changing climatic parameters on the distribution and abundance of species and the storage of water in the southern and central Sierra Nevada.

The research projects include: 1) modern studies, largely designed to acquire the basic understanding necessary to build predictive models; 2) paleoecological studies, largely designed to test predictive models; and 3) predictive studies, designed to integrate understanding of ecological processes into models capable of projecting changes in forest pattern and dynamics under different climatic scenarios, and to assess possible management strategies for adapting to climatic change.

Previous fire history research efforts in the parks have provided information on long-term climatic trends in the southern Sierra Nevada using analyses of tree ring data. Those studies have found, through analysis of giant sequoia tree-ring data, that the 20th century has had below-average frequency of extreme droughts as reconstructed from 101 B.C. to 1988 (Hughes and Brown 1992). They also have found that tree-ring data from subalpine conifers in the southern Sierra Nevada indicate that precipitation equaling or exceeding 20th-century levels occurred infrequently in the 1,000+ years of record (Graumlich 1993).

AMPHIBIAN DECLINE

The Sierra Nevada is one of the many regions worldwide that have experienced recent dramatic declines in amphibians, mainly frogs and toads. Of the 30 native amphibians in the Sierra Nevada, nine are frogs and toads, and 21 are salamanders. Four (44%) of the frog and toad species, and nine (43%) of the salamander species are in need of protection, are extinct, or threatened with extinction in the near future (Jennings 1996). SEKI has five frog and toad species, two of which are in serious decline, the mountain yellow-legged frog (*Rana muscosa*) and Yosemite toad (*Bufo canorus*), and one that is extinct, the foothills yellow-legged frog (*R. boyleii*). Very little is known about the status and occurrence of SEKI's salamander species.

Since frogs and toads have permeable eggs and skin, they can be very sensitive to changes in the environment. Many of the declines remain unexplained. The consequences of amphibian loss are also largely unknown. Amphibians are a vital link in ecosystems. For example, the decline of the mountain yellow-legged frog was correlated to a decline in the garter snake, a predator (Jennings et al. 1992).

Pesticides and acid deposition may be contributing factors. Research has indicated that pesticides applied in the San Joaquin Valley are transported to the Sierra Nevada, with levels decreasing with increasing distance and elevation from the valley floor (Zabik and Seiber 1993).

Table 3-3. Major Air Pollutants and Potential Effects on Human Health and Welfare

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Ozone:

Irritates the mucous membranes of the respiratory system and can cause coughing, wheezing, chest pain or tightness, dry throat, headache, nausea, shortness of breath or pain during deep breaths, and impaired lung function. Ozone aggravates chronic respiratory diseases such as asthma and bronchitis. Ozone is the pollutant that is most injurious to plant life.

Particulate Matter:

Inhaled particulate matter can directly irritate the respiratory tract, constrict airways, and interfere with the mucous lining the airways. Particulate matter may carry toxic materials, allowing those materials to enter the lungs where they can be absorbed into the bloodstream. Increased risk of cardiopulmonary disease and premature death have been associated with exposure to high particle concentrations. It also damages paint, soils clothing, and reduces visibility.

Nitrogen Oxides:

Nitrogen oxides can irritate the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory diseases such as influenza. In children, it may cause respiratory illness, such as chest colds and coughing with phlegm. In high concentrations, can damage plants. Is a precursor for ozone, particulate matter, and acid deposition.

Carbon Monoxide:

Carbon monoxide causes death at high concentrations from heart failure or asphyxiation. It can cause impaired perception and difficulty in thinking. Reflexes are slowed, judgement is weakened, and drowsiness occurs. Pregnant women can have adverse prenatal impacts.

Sulfur Dioxide:

At high concentrations, sulfur dioxide can affect human health, especially among asthmatics. It can damage vegetation and metals. Is a precursor for particulate matter and acid deposition.

Indirect evidence suggests that acid deposition may not be a factor in the decline of high elevation amphibians in the Sierra Nevada, although direct evidence is still lacking (Bradford et al. 1994a, 1994b).

Other suspected factors include predation, drought, disease, recreational use, isolation, and unnatural levels of UV radiation exposure.

CULTURAL RESOURCES

Air pollutants can damage many types of materials. Most well-known examples are the collapse of a girder in a London railway station from sulfur corrosion and cracking of rubber tires on cars from ozone oxidation. Pollutants can soil and discolor, form gypsum crust, spall and fracture stone, fade pigments, dissolve paints, embrittle polymers and textiles, and increase erosion of stone (except granite) and corrosion of bronze.

Most research has been conducted on outdoor acid-sensitive materials such as metals and carbonate stones. There has also been some research on indoor materials such as paintings, fabrics, microfilm, leather, and paper. For the most part, information is limited. For most pollutants, such as sulfur dioxide, nitrogen dioxide, and ozone, indoor concentrations are normally less than those outdoors. For pollutants that have indoor sources, such as volatile organic compounds and particulates, indoor concentrations can exceed those outdoors. However, if outdoor air exchange rates are high, indoor concentrations will approximate those outdoors. High humidities or wetting and certain combinations of pollutants can increase the damage. Some pollutants can act to protect materials from damage. For example, particles from soil are usually alkaline and can neutralize acid deposition.

The parks have a fairly extensive and diverse array of cultural resources. Human influence has been present in the parks for at least 2,500 years and almost certainly longer. Cultural resources include prehistoric archeological sites, ethnographic use areas, cultural landscapes, historic sites and structures, and museum collections. In the parks, there are 183 recorded archeological sites (including pictographs). Twenty historic structures, features, or districts are listed in the National Register of Historic Places. Forty-three historic districts/structures are included in the List of Classified Structures. An additional 78 structures are identified as significant, and another 196 structures 50 years old or older are not yet evaluated. The museum collection at the park headquarters in Ash Mountain is estimated to contain 7,700 archeological artifacts, 174 ethnological objects, 8,400 historic artifacts, 10,000 historic images, 1,370 archive documents, 9,000 biological specimens, 12 paleontological specimens, and 108 geological specimens (SEKI Natural and Cultural Resources Management Plan 1992).

Air pollution effects on cultural resources have not been formally evaluated in the parks. A first step would be to conduct a literature review to identify materials sensitive to air pollutants and pollutant levels. The EPA's periodic review of the air pollution standards includes summary information on welfare affects. The National Acid Precipitation Assessment Program is another good source of information. Other sources of information include the Smithsonian Institution and the National Archives. This research information, along with information on park ambient pollutant concentrations and cultural resource types, should help to determine whether air pollution effects are a potential concern. The next step would be to develop a monitoring program to determine if specific cultural resources are being adversely affected, e.g., prehistoric pictographs and their pigments. If adverse effects are recognized, in some cases preservation methods are available to prevent or slow down environmental damage. Some examples are control of indoor pollutants via activated carbon filtration, using protective coatings such as lacquer for metals, washing of rain-sheltered stonework, and avoiding outside paints with water-soluble constituents such as calcium carbonate.

Section 4. Education Program

SEKI's education program has several active components. One element involves educating park visitors about air quality issues facing the park and steps they can take to minimize air pollution. Another element involves educating residents of the SJVAB about air pollution and its effects in the park. A third element involves issuing air pollution advisories so that visitors, employees, and residents in the park can take steps to minimize exposure during elevated pollutant episodes.

The key elements of SEKI's public education program are summarized in this section, which is divided into four parts:

- publications,
- exhibits/visual displays,
- interpreter presentations, and
- air pollution advisories.

PUBLICATIONS

Several publications are available to the public during the course of a typical visit or by phone request. Many of those publications carry articles or references to air pollution issues faced by SEKI. Five SEKI publications that cover air quality issues are described in Table 4-1.

In addition, the SJVUAPCD has several publications that discuss various air quality issues. Those publications are listed in Table 4-2.

EXHIBITS/VISUAL PROGRAMS

Air quality issues are also addressed at the parks through several exhibits and visual displays, including interpretive displays and slide shows located at visitor centers, campgrounds, and roadside exhibits located throughout SEKI. Table 4-3 lists these exhibits.

SEKI also participates in developing displays and activities for the Impact Center, a multimedia facility operated by the Tulare County Office of Education as a service to the school districts of Tulare County. The center is in the Tulare County Office of Education building located in the County Civic Center in Visalia.

The NPS received funding to create a multimedia program in Spanish for the Impact Center. This effort will include a sound track, teacher's guide, and handout on how students and families can learn from and enjoy SEKI (Myers pers. comm.). This program has a small portion on air quality issues and is primarily for grades K-8.

In addition, SEKI has written a script for a slide program that will be seen by hundreds of San Joaquin Valley schoolchildren. The program, which focuses on grades 3 and 4, describes SEKI, its history, and significant resources. An air quality message will be included in the text. It is hoped that the program will encourage more valley neighbors to realize SEKI's importance to them and explore the parks. SEKI ultimately would like to instill in San Joaquin Valley residents a sense of stewardship and pride in having these parks in their "backyards". An activity guide will be produced for teachers to follow up on the program and a one-page activity sheet describing available park activities will be given to students to share with their families. Air quality issues that affect SEKI will be addressed (Myers pers. comm.).

INTERPRETER PRESENTATIONS

Interpreter presentations are another key element of SEKI's public education program. SEKI's interpreter program, as it relates to air quality, consists of an interpreter's handbook, slide collection, and various interpretive programs for park visitors. The key elements are summarized in Table 4-4.

OTHER EDUCATION ACTIVITIES

SEKI has been active in several other types of educational activities including participation in local events such as Earth Day Celebrations, Clean Air Week, and Bike Commute Day; presentations to local groups and schools; participation in the SJVUAPCD Spare the Air Program; and responding to media requests (TV, magazines, radio, newspaper).

Table 4-1. Educational Materials

Sequoia and Kings Canyon National Parks: A Complete Guide to Planning Your Stay

Free, available in motel rooms, restaurants, and other public areas. Provides information on activities, dining, lodging, maps, trails, and history. Contains a section on preserving the parks and includes a discussion on air quality. Discusses reduced visibility and smog and its impact on vegetation.

Sequoia and Kings Canyon, A Guide to Sequoia and Kings Canyon National Parks, California. Official National Park Handbook

Handbook 145 produced by the Division of Publications, National Park Service, includes a brief discussion of air quality problems facing the parks. Available for purchase at visitor centers.

The Sequoia Bark

SEKI newspaper for visitors, residents, and employees (usually 4-12 pages). All visitors receive a free copy of the latest edition at the entrance stations. It is published 11 times per year, every 2 weeks in summer and less frequently in the off season. Air quality is generally not discussed except during clean air week and ride share week (Crapsee pers. comm.).

OZONE - The Invisible Poison

One page, two-sided handout for Sequoia and Kings Canyon National Parks. It includes sections on: What is ozone? Where does ozone come from? What are the effects of too much ozone? Ozone monitoring, air pollution: How does it get in the parks? Is it hurting our forests?

The handout on ozone is given to inquisitive visitors in the visitors center and also used for mailouts when written information is requested by mail.

On the Air: Sequoia and Kings Canyon National Parks

Color pamphlet (also available in Spanish) discusses air quality in SEKI. It includes pictures showing a high versus low visibility day and healthy and ozone-injured ponderosa pine trees. It includes a discussion on possible solutions and is distributed at visitor centers to interested individuals.

Table 4-2. San Joaquin Valley Unified Air Pollution Control District
Air Quality Publications

Air Pollution Fact Sheet
Air Pollution and Health pamphlet
Asbestos brochure
Burning Issues brochure
California's Acid Rain handbook
California Air Quality handbook
Cargo Tanks pamphlet
Employer Introduction to Rule 9001
Guide to Rule 9001 (commute-based trip reduction) brochure
Major Air Pollutants fact sheet
Metal/Plastic Parts pamphlet
1993 Natural Gas Vehicles
Pollution Standards Index fact sheet
Protective Actions for Air Pollution Episodes pamphlet
REMOVE (Reduce Motor Vehicle Emissions) brochure
Smog and California Crops pamphlet
Small Business Assistance brochure
25 Ways You Can Help Clean the Air brochure
Visible Emissions handbook
Woodburning Curtailment brochure
When to Call Time Out brochure
Spare the Air brochure

Table 4-3. Educational Exhibits and Visual Programs

Eleven Range Overlook and Moro Rock

Air quality wayside exhibits

Lodgepole

Slide show at Visitor Center includes air quality

Air quality display at Visitor Center

Walter Fry Nature Center often has activities related to air quality

Foothills Visitor Center

Air quality will be included in new exhibits

Grant Grove

Visitor Center slide includes air quality

Visitor Center display on air quality

Lookout Point Entrance Station

Wayside exhibit on solar power and its relationship to air quality

Payne's World on Air Pollution in the Sierra

Video and Teachers Guide designed for grades 7-12 is a takeoff on Wayne's World and was distributed in 1995 to 560 schools in San Joaquin Valley

Tulare County Impact Center

"On the Wings of the Condor" slide program for grades 3 and up at the multi-media educational theater in Visalia includes air quality

World-Wide Web Homepages

Sequoia and Kings Canyon National Parks has a homepage with a link to ozone monitoring: http://www.nps.gov/seki/ozone.htm

The NPS Air Resources Division will be developing homepages on air pollution for each park: http://www.aqd.nps.gov/ard

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Table 4-4. Naturalist Programs

Interpreter's Handbook, Sequoia and Kings Canyon National Parks 1994 edition

Used for training interpretation staff; includes the following sections:

- # Ozone Pollution and Research (including subsections on Ozone, Damage, and Research in Parks)
- # Air Quality (includes summaries of chemicals of concern, including oxides of sulfur and nitrogen, CO, CO_2, hydrocarbons, ozone, and particulates)
- # Climate Change in National Parks and Other Natural Areas
- # Acid Deposition

Slide Collections on Air Quality

Available for use by interpreters

Interpreter/Naturalist Programs

Evening programs in the summer are presented throughout the parks in various locations:

- # Lodgepole/Giant Forest: 2-3 times per night
- # Grant Grove: once per night
- # Cedar Grove: once per night
- # Mineral King: twice a week
- # Foothills: twice a week

Air quality is mentioned in 25% of these programs. Programs given during the day are numerous, and air quality is mentioned in the majority of them. Every day in the Giant Forest at Moro Rock, a ranger gives an explanation on Moro Vistas with the intention of enabling the visitor is able to identify at least one source of the reduced visibility in the park. On the Grant Grove Buena Vista walk, visitors usually encounter the problem firsthand, because views are hindered by poor air quality. On the Giant Sequoia walks, the visitor is asked: What effect might poor air quality have on the big trees?

Section 5. Information Management

A wide array of air quality and biological effects monitoring data is collected within SEKI by both NPS and others. A list of the most significant databases is included in Appendix J. The databases include:

- hydrology;
- ozone;
- ozone injury to Jeffrey and ponderosa pines;
- particulates (dry deposition, visibility);
- water chemistry; and
- wet deposition.

In addition, "short-term" air quality and biological effects monitoring data are collected intermittently to satisfy the needs of special resource studies or resource management needs.

These databases do not reside in a centralized repository or master database but instead are individually managed by various agencies such as the EPA, ARB, NPS, ARD, and SEKI. Much of these data are summarized in annual publications or can be obtained from the agency that maintains the database. Some data, however, such as the nephelometer and camera data, have not been compiled into a database for subsequent analysis. In addition, much of the data have not undergone analysis beyond simple summary statistics and graphical presentation. More extensive treatment is needed to determine trends and relationships among variables.

Both SEKI and the USFS are exploring the potential use of a geographic information system (GIS) to help understand and manage air quality issues. SEKI is currently planning to develop a GIS that runs in a personal-computer-desktop environment. SEKI's GIS committee is developing a GIS wilderness management pilot project that will seek input from all park divisions and provide widespread benefits to SEKI's resource managers.

A USFS Region 5 resource management workshop was conducted in 1993 to explore potential uses of GIS in air resource management applications. A paper was presented that lists 18 potential GIS air quality products. Although several of the GIS products are not directly applicable to SEKI, a few are potentially useful to air resources management. Those products include:

- a map showing documented foliar injury in stands of ponderosa and Jeffrey pines within SEKI. Such a map might allow queries based on factors such as elevation, aspect, and soil type to investigate potential relationships;
- a map showing existing gridded emission inventories within SEKI and in the San Joaquin Valley, using the air inventories collected during San Joaquin Valley modeling studies. It would be extremely useful if future inventories could be added to the GIS (as a new data layer) so that future concentrations within SEKI could be estimated;
- a display of predicted downwind PM10 concentrations that would result from a prescribed burn unit; and
- maps showing individual pollutant concentrations at monitoring sites, which could be extrapolated using contour analysis. Such an analysis may be useful

for determining additional monitoring and biological effects study locations.

The USFS has established an air resources information strategy project to identify information needs, determine priority computer applications, evaluate the usefulness of existing software, and provide a strategy for integrating information management into the air resources program (Blett et al. 1993). The first information priority addressed by the executive steering committee was the Air-Quality-Related Value Application project, with national implementation in 1997. GIS was a component of that effort.

GIS costs can vary widely, depending on the type and extent of data that need to be entered into the system. Use of GIS to manage and evaluate SEKI's air quality should not be attempted without a thorough evaluation of the end product(s) expected from the system, the costs that will be incurred to enter the data and develop requisite maps, and the anticipated use of these maps.

Since understanding the effects of air pollutants on natural resources requires specialized expert knowledge and access to a diverse body of scientific information, the ARD and the U.S. Fish and Wildlife Service-Air Quality Branch are building an Air Quality Information Management System (AQUIMS). This system will provide air quality information and expert opinion to natural resource managers and policy experts (Nash pers. comm.). AQUIMS is designed to run on a personal computer running under the Windows operating system. The AQUIMS software includes site-specific resource information, general information on air pollutants and their effects on natural systems, decision support systems (DSSs) to provide guidance on identifying resources most "at risk", bibliographic and photographic resources, and site-specific (where available) air pollution monitoring data. Capturing expert knowledge in electronic DSSs makes this information available to users in remote locations. Providing interpreted data and expert opinion, rather than simply retrieving data, is a significant feature of AQUIMS. This software system will allow resource managers to quickly make better-informed decisions on air quality issues. The AQUIMS system is being designed to eventually accommodate a wide variety of natural resource-related databases, rather than only air quality data. Currently, two DSSs are being developed, one to assist the user to interpret ozone effects data and the other to help interpret acid deposition data.

The ARD is also developing an Air Atlas. It will be an electronic collection of air resource related maps illustrating themes such as the location of monitoring sites or air pollution sources with supporting data. A prototype has been developed for Great Smoky Mountains National Park. Eventually there will be maps for other park units, including SEKI.

Another source of natural resource information is the NPS-Natural Resource Information Division (NRID), located in Ft. Collins, Colorado. This office develops and maintains several natural resource-related databases, including the Resource Management Plan Database, Natural Resource Management and Assessment Program Database, and the Investigators' Annual Report Database. Staff from the NRID are developing new technologies to supply NPS-produced and "external" information to park units via the internet and world wide web. The NRID is also writing a "database of databases", which will contain descriptive information and contact numbers for natural resource databases produced by NPS or NPS-sponsored research.

SEKI has a PROCITE bibliography that includes the citations and abstracts of all documents related to research and monitoring at SEKI.

The State and Federal agencies have developed Internet World Wide Web home pages with relevant information on air quality and related issues:

- NPS: http://www.nps.gov
- NPS ARD: http://www.aqd.nps.gov/ard

SEKI: http://www.nps.gov/seki

ARB: http://www.arb.ca.gov

EPA: http://www.epa.gov

NBS: http://biology.usgs.gov/nbs

NOAA: http://www.atdd.noaa.gov

Section 6. Recommended Actions

INTRODUCTION

The following subsections contain actions that have been recommended to reach the goal of the park air resources management program, which is to achieve and maintain the natural range of air quality in the parks. The information presented in this section is meant to clarify program direction and assist in establishing priorities for park planning and annual work plans. The recommendations are divided into five program elements. Recommendations that are already being implemented are included to emphasize their importance.

All program elements are addressed by several recommendations, one of which emphasizes the need for coordination with other parks and public agencies, the private sector, the public, special interest groups, and academia. Because air quality issues are regional (and in some cases global), coordination is critical. Coordination includes sharing information and resources, participating actively in partnerships, and conducting joint studies and training. Better coordination is needed in all elements to improve efficiency, quality, and consistency.

Finally, all program elements must be evaluated periodically for effectiveness in achieving progress towards better air quality in the parks.

INVENTORY AND MONITORING

Actions needed to understand air pollution impacts are addressed in this element. Inventory and monitoring information is needed to determine current conditions, detect short and long term trends, and predict changes. Existing inventory and monitoring data are described in Section 3 (Current Conditions) and Appendix J (Air Quality Database) of this plan.

Ambient monitoring has focused on ozone and wet deposition. Monitoring of visibility, particulates, toxics, smoke, pesticides, and light pollution are lacking, as are meteorological data needed to determine transport and exposure. Most monitoring has been restricted to areas with commercial power, which excludes most park lands. Biological effects studies have focused primarily on ozone effects to ponderosa and Jeffrey pines with little information on other air-pollution-sensitive species.

Air Pollution and Deposition Monitoring

- Conduct ambient air pollution and deposition monitoring (including meteorology and visibility) sufficient to document current conditions, detect trends and episodes, predict changes, and complement studies on the effects of air pollution;

- explore use of portable equipment, including passive ozone samplers and solar powered PM10 samplers, for use in areas without commercial power (such as Mineral King and the back country) as an alternative to more expensive types of monitors and to complement biological effects studies and special studies (such as monitoring campground campfire smoke);

- assess status of air quality at Devil's Postpile National Monument, in coordination with the Inyo National Forest;

- # evaluate the need for monitoring air pollution impacts to other resources, such as night sky visibility and cultural resources;

- # evaluate the need for an air toxics monitoring program; and

- # participate with other parks and agencies in the development of a regional prescribed fire smoke monitoring program, with the focus on public health and welfare.

Air Pollution Effects Studies

- # Participate in the development of a Sierra-wide assessment of air pollution levels and effects to identify critical issues and information needs;

- # identify through a screening process additional plant species sensitive to air pollution and develop monitoring programs for field assessments;

- # participate in Sierra-wide Project FOREST (started in 1991) to monitor trends of ozone injury to Jeffrey and ponderosa pines;

- # conduct periodic ozone injury assessments to monitor long-term trends of permanent Jeffrey and ponderosa pines and black oak plots established in the early 1980s;

- # conduct modeling studies to determine critical loads for acid deposition effects on soils and surface waters;

- # insure that there is continued long-term monitoring of watershed and surface water parameters linked to deposition impacts;

- # investigate the effects of pesticides and other airborne pollutants on amphibians;

- # conduct periodic park-wide ozone injury surveys to document population-level impacts and monitor trends for known sensitive species; and

- # evaluate the need for a lichen monitoring program to establish a baseline and assess air pollution impacts.

PARK PLANNING AND REGULATORY COMPLIANCE

Air resource issues must be addressed in park planning. It is necessary that park staff be aware of substantial air resource issues for analysis and design of programs and projects. NEPA analysis must be followed when proposed actions may have significant impacts on air resources.

The number of air pollution regulations affecting park operations is increasing. Increased regulatory control has resulted in increased work loads for park staff. Compliance is essential to avoid substantial fines and develop and maintain effective relationships with the regulatory agencies; it is therefore necessary that park staff be aware of applicable regulations. Regulatory staff generally do not have a strong understanding of NPS responsibilities and operations, and regulatory development may not consider NPS circumstances. The following steps are necessary to ensure regulatory compliance:

- # Review this plan annually and update it every five years;

- # ensure that air quality concerns are addressed adequately in all park planning and program and project implementation;

develop programs to ensure compliance with air pollution regulations in all park and concession operations;

minimize air pollution emissions from park operations; for example, implementing the use of cleaner fuels, energy efficient lighting, rideshare programs, and EPA-certified woodstoves; and

assess impacts of park emissions on air quality and develop mitigation programs.

EDUCATION

This element addresses actions needed to educate park staff, park visitors, the public, schools, and other agencies and organizations about air quality issues. Air quality is a challenging subject because of its complex, sometimes negative and controversial aspects. The educational experience is especially dependent on presentation. An approach that provides a strong, positive vision that empowers rather than overwhelms the audience will be much more effective. The study of air quality involves many disciplines and is a difficult subject to condense and simplify for the layperson without losing meaning and accuracy. As a result, more effort is needed, in comparison with other issues, to achieve the same level of understanding.

Understanding of air quality issues is considerably lacking in every sector of the population. Although many educational materials have been developed on general air quality issues, more effort is needed to disseminate the information, and more materials must be developed that are specific to these parks and the Sierra Nevada. Educational materials are being developed at many levels (public and private) with very little coordination, and minimal feedback is taking place on the effectiveness of educational materials and programs. The following steps are needed for educational purposes:

Provide training to park staff on air quality issues and regulatory responsibilities;

develop an educational awareness program for employees and visitors that provides information on air pollution levels, potential health and ecosystem effects, and protective actions;

educate visitors and the public on park air pollution issues through park interpretive programs, outreach programs, media, and special events;

develop additional programs for presentation at the Tulare County Office of Education Impact Center;

develop a visitor survey to assess the effects of air pollution on the visitor experience;

develop and regularly update educational materials and make them available in different languages;

develop a program for monitoring the effectiveness of educational materials; and

develop and participate in programs to promote clean air.

EXTERNAL RELATIONS

This element addresses actions needed to achieve effective external relations, which, especially with agencies involved in land-use planning and air pollution regulation, are critical to the goal of achieving and maintaining the best possible air quality in these parks. The strength of external relations depends on how well each program element is implemented. Through external relations, the park can directly influence the regulatory control of external air pollution sources. Involvement with outside regulatory activities is lacking, and this has resulted in many lost opportunities.

The San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) includes Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare counties. It is the largest geographic air pollution control district in the State. The district does not meet the Federal and State standards for ozone and PM10 (particulate matter less than 10 microns in diameter) and, as a result, was required to develop plans to meet the standards, known as State implementation plans. These plans, and any associated regulations, constitute one of the primary means for improving air quality in the San Joaquin Valley. The following steps are needed to achieve effective external relations:

- Build credibility and support through productive partnerships, training and meetings, use of scientifically valid and accepted methods, and professional publications;

- participate in studies and modeling development efforts designed to address regulatory requirements;

- participate in regulatory planning, development, and actions;

- track and review applicable air pollution regulatory issues;

- seek opportunities to educate and obtain input from regulatory and land-use planning agencies on critical air quality issues on a continuing basis through field trips, correspondence, meetings, and special events; and

- provide peer review of relevant air-pollution-related documents to ensure completeness and accuracy.

INFORMATION MANAGEMENT

This element addresses actions needed to manage information to minimize data collection needs and maximize data utilization. Although it is typical to all programs to have more data than can be reasonably managed, it is particularly problematic for air quality data. Air quality data are often collected using sensitive electronic instrumentation that are affected by meteorological conditions, pollutant loading, and handling. Actual values are often derived from equations developed from frequent calibrations. Data processing and validation can be time-consuming and expensive. Timely data validation is needed to ensure data quality and maximize data capture.

Air quality data can be analyzed in an almost infinite number of ways. Choosing the best indicator for determining trends or exposure is difficult. Complex statistical analysis is often required. Existing databases are not being effectively used. Data analysis is a critical component of the overall air resources management program and is inadequate at present. The results are duplication of efforts, inability to determine data quality and needs, and insufficient knowledge of resource conditions. The following actions are needed to effectively manage information:

- Summarize, analyze, publish, and interpret data collected in the past, and do the same for current data at regular intervals;

- centralize data archives to improve accessibility; and

- explore the use of GIS for data analysis and presentation.

FUNDING

Program funding and staffing at the current level are not adequate to manage the park air resources. Efforts should be made to coordinate the efficient use of resources with others whenever possible.

Following are examples of potential funding sources and/or cooperators:

- SEKI Foundation;
- SEKI Natural History Association;
- NPS Air Resources Division;
- IMPROVE project funds;
- other Federal agencies such as the National Biological Survey, the U.S. Forest Service (USFS), and the Environmental Protection Agency (EPA);
- state agencies such as the California Air Resources Board (ARB);
- local agencies such as the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD);
- private-sector organizations such as utility companies and foundations;
- schools; and
- non-profit groups such as the National Parks Foundation.

Section 7. Citations

PRINTED REFERENCES

Ashbaugh, L. L., J. G., Watson and J. C. Chow. 1989. Estimating fluxes from California's dry deposition monitoring data. Presented at the 82nd Annual Air & Waste Management Association Meeting, June 25-30, 1989, Anaheim, CA.

American Lung Association. 1996. Health effects of outdoor air pollution. Washington, D.C.

Bay Area Air Quality Management District. 1985. Air quality and urban development guidelines for assessing impacts of projects and plans. San Francisco, CA.

Berrang, P., D. F. Karnosky, and J. P. Bennett. 1991. Natural selection for ozone tolerance in *Populus tremuloides*: an evaluation of nationwide trends. Canadian Journal of Forestry Research 21:1091-1097.

Blanchard, C. L., H. Michaels, and S. Tanenbaum. 1996. Regional estimates of acid deposition fluxes in California for 1984-1994. (Contract 93-332.) Prepared for California Air Resources Board, Research Division, Sacramento, CA.

Blett, T., L. Hudness, and S. Boucher. 1993. Air resource management information strategy project. U.S. Forest Service.

Blumenthal, D. L., T. B. Smith, D. E. Lehrman, R. A. Rasmussen, G. Z. Whitten, and R. A. Baxter. 1985. Southern San Joaquin Valley ozone study. Final report. Prepared for Western Oil and Gas Association, Los Angeles, CA, by Sonoma Technologies, Inc., and Systems Applications International, Inc., Santa Rosa, CA.

Böhm, M. 1992. Air quality and deposition. Chapter 3 in R. K. Olson, D. Binkley, and M. Böhm (eds), the response of western forests to air pollution. Springer-Verlag. New York, New York.

Bradford, D. F., M. S. Gordon, D. F. Johnson, R. D. Andrews, and W. B. Jennings. 1994a. Acidic deposition as an unlikely cause for amphibian population declines in the Sierra Nevada, California. Biological Conservation 9(6):155-161.

Bradford, D. F., S. D. Cooper, and A. D. Brown. 1994b. Distribution of aquatic animals relative to naturally acidic waters in the Sierra Nevada. California Air Resources Board. Sacramento, CA.

Bunyak, J. 1993. Permit application guidance for new air pollution sources. (Natural Resources Report NPS/NRAQD/NRR-93/09.) National Park Service, Natural Resources Publication Office. Denver, CO.

Bytnerowicz, A. 1994. Studies on nitrogen deposition to forests in California. In J. Solon, E. Roo-Sielenska, and A. Bytnerowicz (eds.) - Proceedings: climate and atmospheric deposition to forests in California. Warsaw, Poland.

California Air Resources Board. 1984. California surface wind climatology. Sacramento, CA.

________________. 1987. Effect of ozone on vegetation and possible alternative ambient air quality standards. Sacramento, CA.

________________. 1988. The health and welfare effects of acid deposition in California: an assessment. Research Division. Sacramento, CA.

________________. 1989a. The health and welfare effects of acid deposition in California: technical assessment. Research Division. Sacramento, CA.

________________. 1989b. Proposed identification of districts affected by transported air pollutants which contribute to violations of the state ambient air quality standard for ozone. Staff report. October 1989. Sacramento, CA.

________________. 1991. The atmospheric acidity program: annual report to the governor and legislature, 1990. Research Division. Sacramento, CA.

________________. 1992. Ozone air quality trends in California (1981-1990). Sacramento, CA.

________________. 1993a. The atmospheric acidity program: annual report to the governor and legislature, 1992. Research Division. Sacramento, CA.

________________. 1993b. Assessment and mitigation of the impacts of transported pollutants on ozone concentrations in California, triennial review. Staff report. Sacramento, CA.

________________. 1994a. Emission inventory 1991. Technical Support Division. Sacramento, CA.

________________. 1994b. The atmospheric acidity protection program: annual report to the governor and the legislature, 1993. Sacramento, CA.

________________. 1994c. Air quality data. Sacramento, CA.

Christiano, J., and M. Scruggs. 1985. Permit application guidance for new air pollution sources. (Natural Resources Report Series No. 85-2.) National Park Service - Air Resources Division Permit Review and Technical Support Branch. Denver, CO.

Collett, J. L., B. C. Daube, Jr., and M. R. Hoffman. 1990. The chemical composition of intercepted cloudwater in the Sierra Nevada. Atmospheric Environment 24A(4):959-972.

Copeland, S., K. Savig, J. Adlhoch, and J. Sisler. 1995. Integrated report of optical, aerosol, and scene monitoring data, Sequoia National Park - March 1993 through February 1994. Corporate Institute for Research in the Atmosphere, Colorado State University. Ft. Collins, CO.

Duriscoe, D. M., and K. M. Stolte. 1989. Photochemical oxidant injury to ponderosa pine (*Pinus ponderosa*) and Jeffrey pine (*Pinus jeffrey*) in the national parks of the Sierra Nevada in California. Pages 261-278 in R. K. Olson and A. S. Lefohn (eds.), Effects of air pollution on western forests - Proceedings of the 82nd Annual Meeting of the Air and Waste Management Association, June 25-30, 1989, Pittsburgh, PA. (APCA Transactions Series No. 16.)

Energy and Resource Consultants, Inc. 1988. Air quality in the national parks. Prepared for the National Park Service, Air Resources Division. Denver, CO.

Eversman, S., and L. L. Sigal. 1985. Ultrastructural effects of gaseous pollutants and acid precipitation on lichens. Pages 62-78 in Biomonitors, bioindicators, and bioassays of environmental quality - American Association for the Advancements of Science Symposium.

Ewell, D. M. and D. T. Gay. 1993. Long-term monitoring of ozone injury to Jeffrey and ponderosa pines in Sequoia and Kings Canyon National Parks. Presented at the 86th annual meeting of the Air and Waste Management Association, June 13-18, 1993, Denver, Colorado.

Ewell, D. M. 1994. Air resources management program Sequoia and Kings Canyon National Parks 1993 annual report. Science and Natural Resources Management Division. Three Rivers, CA.

Grulke, N. E., and P. R. Miller. 1994. Changes in gas exchange characteristics during the life span of giant sequoia: implications for response to current and future concentrations of atmospheric ozone. Tree Physiology 14:659-668.

Graumlich, L. J. 1993. A 1000-year record of temperature and precipitation in the Sierra Nevada. Quaternary Research 39:249-255.

Guthrey, R., S. Schilling, and P. Miller. 1993. Initial progress report of an interagency forest monitoring project Forest Ozone REsponse STudy (FOREST). Revised June 1993. USDA Forest Service Pacific Southwest Research Station, Project 4451, Forest Fire Laboratory. Riverside, CA.

Harrington, R. F., A. W. Gertler, and P. Amar. 1991. Network operations and preliminary monitoring results for the receptor modeling of acidic air pollutants to forested regions of the Sierra Nevada study - Proceedings of the 84th Annual Air and Waste Association Meeting, June 16-21, 1991, Vancouver, Washington.

Hopkins, P. S., K. W. Kratz, and S. D. Cooper. 1989. Effects of an experimental acid pulse on invertebrates in a high altitude Sierra Nevada stream. Hydrobiologia 171:45-48.

Huckaby, L. S. (ed.). 1993. Lichens as bioindicators of air quality. (General Technical Report RM0224.) U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Hughes, M. K., and P. M. Brown. 1992. Drought frequency in central California since 101 B.C. recorded in giant Sequoia tree rings. Climate Dynamics 6:161-167.

Huning, J. R. 1978. A weather primer for the national parks of the Sierra Nevada. Yosemite and Sequoia Natural History Associations.

Jennings, M. R., D. F. Bradford, and D. F. Johnson. 1992. Dependence of the garter snake *Thamnophis elegans* on amphibians in the Sierra Nevada of California. Journal of Herpetology 26:503-505.

Jennings, M. R. 1996. Sierra Nevada ecosystem project: final report to Congress, Volume 2: Assessments and scientific basis for management options, Chapter 31: Status of amphibians. University of California, Davis, Centers for Water and Wildland Resources. Davis, CA.

Lehrman, D. E., T. B. Smith, W. R. Knuth, and C. E. Dorman. 1994. Meteorological analysis of the San Joaquin Valley Air Quality Study, Atmospheric Utilities Signatures, Predictions and Experiments Program (SJVAQS/AUSPEX). Prepared for PG&E and the California Air Resources Board, Sacramento, CA, by Technical and Business Systems, Inc.

Lynch, J. A., J. W. Grimm, and V. C. Bowersox. 1995. Trends in precipitation chemistry in the United States: a national perspective, 1980-1992. Atmospheric Environment 29(11):1231-1246.

Mavity, E., D. Stratten, and P. Berrang. 1995. Effects of ozone on several species of plants native to the western United States. USFS Center for Forest Environmental Studies.

Melack, J., and J. Stoddard. 1991. Sierra Nevada, California. Chapter 15 in D. F. Charles (ed.), Acidic deposition and aquatic ecosystems: Regional case studies. Springer-Verlag, New York.

Miller, P. R., K. W. Stolte, T. L. Franklin, A. P. Gomez, and C. A. Kazmier. 1984. Ozone effects on important tree species of the Sequoia-Kings Canyon National Parks. Final report. National Park Service, Division of Air and Water, and U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station. Riverside, CA.

Miller, P. R., R. Wilborn, T. L. Franklin, and A. P. Gomez. 1987. Ozone effects on important tree species of the Sequoia-Kings Canyon National Parks. Final report. National Park Service, Division of Air and Water, and U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station. Riverside, CA.

Miller, P. R. 1996. Biological effects of air pollution in the Sierra Nevada. In Volume III Sierra Nevada Ecosystem Project Final Report to Congress, Status of the Sierra Nevada. Wildland Resources Center Report #38. Centers for Water and Wildland Resources, University of California, Davis. Davis California.

Miller, P. R., K. W. Stolte, D. M. Duriscoe, and J. Pronos (eds). 1996. Evaluating ozone air pollution effects on pines in the western United States. (General Technical Report, PSW-GTR-155.) U.S. Forest Service, Pacific Southwest Research Station. Riverside, CA.

Moran, J. P., and L. W. Morgan. 1995. Essentials of weather. Prentice Hall. NJ.

National Aeronautics and Space Administration. 1991. EOS reference handbook.

National Atmospheric Deposition Program. 1993. NADP/NTN annual data summaries, precipitation chemistry in the United States (summaries from 1981 through 1993). Fort Collins, CO.

National Park Service. 1984. Air resource management manual. Air Resources Division. Denver, CO.

________________. 1992. Sequoia and Kings Canyon National Parks natural and cultural resources management plan.

________________. 1994. Air quality data. Air Resources Division. Denver, CO.

National Research Council. 1993. Protecting visibility in national parks and wilderness areas. National Academy Press. Washington, DC.

Parsons, D. J., and S. J. Bolti. 1996. Restoration of fire in national parks. Pages 29-31 in C. C. Hardy and S. F. Arno (eds.), The use of fire in forest restoration - A general session at the annual meeting of the Society of Ecological Restoration, Sept. 14-16, 1995, Seattle, WA. U.S. Forest Service, Intermountain Research Station, General Technical Report INT-GTR-341.

Patterson, M. T., and P. W. Rundel. 1989. Seasonal physiological response of ozone stressed Jeffrey pine in Sequoia National Park, California. Pages 419-427 in R. K. Olson and A. S. Lefohn (eds.), Effects of air pollution on western forests - Proceedings of the 82nd Annual Meeting of the Air and Waste Management Association, June 25-30, 1989, Pittsburgh, PA. (APCA Transactions Series No. 16.)

Peterson, D. L., M. J. Arbaugh, V. A. Wakefield, and P. R. Miller. 1987. Evidence of growth reduction in ozone-injured Jeffrey pine (*Pinus jeffrey* Grev. and Balf.) in Sequoia and Kings Canyon National Parks. Air Pollution Control Association Journal 37(8).

Peterson, D. L., M. J. Arbaugh, and L. J. Robinson. 1991. Regional growth changes in ozone-stressed ponderosa pine (*Pinus ponderosa*) in the Sierra Nevada, California, USA. The Holocene 1 (1):50-61.

Peterson, D. L., D. L. Schmoldt, J. M. Eilers, R. W. Fisher, R. D. Doty. 1992. Guidelines for evaluating air pollution impacts on Class I wilderness areas in California. (General Technical Report PSW-GTR-136.) U.S. Forest Service.

Rappolt, T. J., and S. Quon. 1992. Transport of acidic air pollutants to forests and alpine regions of the Sierra Nevada. (Final Report No. A932-141.) California Air Resources Board. Sacramento, CA.

Ray, J. D., and M. Flores. 1994. Passive ozone sampler study II, 1993 results. National Park Service Air Resources Division. Denver, CO.

Reinhardt, T. E., A. Hanneman, and R. Ottmar. 1994. Smoke exposure at prescribed burns. Final report. U.S. Forest Service, Pacific Northwest Research Station. Seattle, WA.

Roberts, P. T., and J. A. Anderson. 1991. Pollutants measured in forest fires and agricultural burn plumes and their potential influence on exceedances of the ozone standard - Proceedings of the 84th Annual Air and Waste Association Meeting, June 16-21, 1991, Vancouver, Washington.

Roberts, P. T., T. B. Smith, C. G. Lindsey, D. E. Lehrman, and W. R. Knuth. 1990. Analysis of San Joaquin Valley air quality and meteorology. Final report. Prepared for San Joaquin Valley Air Pollution Control Study Agency, Sacramento, CA.

Rocchio, J. E., D. M. Ewell, C. T. Proctor, and D. K. Takemoto. 1992. Project FOREST: the forest ozone response study. Presented at the George Wright Society Meeting, 7th Conference on Research and Resource Management in Parks and on Public Lands, Jacksonville, FL, November 16-20, 1992.

Saint-Amand, P., L. A. Mathews, C. Gaines, and R. Reinking. 1986. Dust storms from Owens and Mono Valleys, California. (NWC-TP-6731.) Naval Weapons Center, China Lake, CA.

Sandberg, D. V., and R. E. Martin. 1975. Particle sizes in slash fire smoke. (Research Paper PNW-199.) U.S. Forest Service, Pacific Northwest Research Station. Portland, OR.

San Joaquin Valley Unified Air Pollution Control District. 1993. 1993 rate of progress plan. Fresno, CA.

________________. 1994a. Revised 1993 rate of progress plan. Fresno, CA.

________________. 1994b. Post-1996 rate of progress plan. Fresno, CA.

________________. 1994c. The ozone attainment demonstration plan. Fresno, CA.

________________. 1994d. 1994 serious area PM10 plan. Fresno, CA.

________________. 1994e. New developments in Title V. Valley Air News, December 1994.

________________. 1995. Revised 1996 Rate of Progress Plan. Fresno, CA.

________________. 1996. Rules and Regulations. Fresno, CA.

Shair, F. 1987. Atmospheric tracer experiments aimed at characterizing upslope/downslope flows along the southwestern region of the Sierra Nevada Mountains. California Air Resources Board. Sacramento, CA. Prepared by California Institute of Technology, Pasadena, CA.

Sisler, J. F., D. Huffman, D. A. Latimer, W. C. Malm, and M. L. Pitchford. 1995. Spatial and temporal patterns and the chemical composition of the haze in the United States: an analysis of data from the improve network, 1988-1991. Cooperative Institute for Research in the Atmosphere, Colorado State University. Fort Collins, CO.

Smith, T. B., D. E. Lehrman, D. D. Reible, and F. H. Shair. 1981. The origin and fate of airborne pollutants within the San Joaquin Valley. Volumes 1-7. California Air Resources Board. Sacramento, CA. Prepared by MRI, Altadena, CA, and CalTech, Pasadena, CA.

Stoddard, J. L. 1995. Episodic acidification during snowmelt of high elevation lakes in the Sierra Nevada mountains of California. Journal of Water, Air and Soil Pollution 85:353-358.

Stolte, K. W., D. M. Duriscoe, E. R. Cook, and S. P. Cline. 1992. Methods of assessing responses of trees, stands, and ecosystems to air pollution. In R. K. Olson, D. Binkley, and M. Böhm (eds.), The response of western forests to air pollution. Springer-Verlag. New York, NY.

Temple, P. J., G. H. Riechers, P. R. Miller, and R. W. Lennox. 1992a. Growth responses of ponderosa pine to long-term exposure to ozone, wet and dry acidic deposition, and drought. Canadian Journal of Forestry Research 23:59-66.

Temple, P. J., G. H. Riechers, and P. R. Miller. 1992b. Foliar injury responses of ponderosa pine seedlings to ozone, wet and dry deposition, and drought. Environmental and Experimental Biology 32:101-113.

Tracer Technologies. 1992. Transport of acidic air pollutants to forests and alpine regions of the Sierra Nevada (TAAPS). Prepared for the California Air Resources Board by Tracer Technologies, San Marcos, CA.

Tonnessen, K. A. 1991. The Emerald Lake watershed study: introduction and site description. California Air Resources Board. Water Resources Research 27(7):1537-1539.

U.S. Environmental Protection Agency. 1986. Air quality criteria for ozone and other photochmeical oxidants, Volume III. (EPA-600/8-84/020cF.) Environmental Critieria and Assessment Office. Research Triangle Park, NC.

________________. 1993. Interagency workgroup on air quality modeling (IWAQM) phase I report: interim recommendation for modeling long range transport and impacts on regional visibility. Research Triangle Park, NC.

________________. 1995a. Breathing easier: a report on air quality in California, Arizona, Nevada, & Hawaii. (EPA 909-R-95-001.) Region IX. San Francisco, CA.

________________. 1995b. Acid deposition standard feasibility study report to Congress. (EPA 430-R-95-001a.) Region IX. San Francisco, CA.

U.S. Forest Service. 1995. Air quality conformity handbook: a handbook for land managers. Pacific Southwest Region, Air Resources/Fire Management. San Francisco CA.

Wetmore, C. M. 1985. Lichens and air quality in Sequoia National Park. Final report. Supported by National Park Service Contract #0001-2-0034. Botany Department, University of Minnesota. St. Paul, MN.

________________. 1986. Lichens and air quality in Sequoia National Park. Supplementary report. Supported by National Park Service Contract #0001-2-0034. Botany Department, University of Minnesota. St. Paul, MN.

Whiting, M. C., D. R. Whitehead, R. W. Holmes, and S.A. Norton. 1989. Paleolimnological reconstruction of recent acidity changes in four Sierra Nevada lakes. Journal of Paleolimnology 2:285-304.

Williams, M. R., and J. M. Melack. [in press.] Atmospheric deposition, mass balances, and processes regulating streamwater solute concentrations in mixed-conifer catchments of the Sierra Nevada, California. Submitted to Biogeochemistry, January 1996.

Williams, M. W., J. Baron, N. Caine, R. Sommerfield, and R. Sanford. 1996. Nitrogen saturation in the Rocky Mountains. Environmental Science and Technology 30:640-646.

Zabik, J. M., and J. N. Seiber. 1993. Atmospheric transport of organophosphate pesticides from California's Central Valley to the Sierra Nevada mountains. Journal of Environmental Quality 22:80-90.

PERSONAL COMMUNICATIONS

Bornholdt, G. Safety officer. National Park Service, SEKI, Three Rivers, CA. October 19, 1994 - conversation.

Crapsey, Malinee. Editor. Sequoia Bark, National Park Service, SEKI, Three Rivers, CA. January 13, 1995 - telephone conversation.

Despain, Joel. Caves naturalist. National Park Service, SEKI, Three Rivers, CA. November 20, 1994 - telephone conversation.

Linse, Erich. Meteorologist. California Air Resources Board, Sacramento, CA. 1995 - review of section on General Meteorology and Transport Mechanisms.

Maniero, Tonnie. Biologist. National Park Service, Air Resources Division, Denver, CO. January 23, 1995 - telephone conversation.

Miller, Paul. Scientist. U.S. Forest Service, Pacific Southwest Forest Experimental Station, Riverside, CA. 1996 - telephone conversation.

Morse, Dee. Environmental Protection Specialist. National Park Service Air Resources Division, Denver, CO. January 12, 1995 - telephone conversation.

Myers, Lisa. Interpreter. National Park Service, SEKI Division of Interpretation, Three Rivers, CA. October 10, 1994 - conversation.

Nash, Bruce. Scientist. National Park Service Air Resources Division, Denver, CO. May 2, 1996 - conversation.

Pronos, John. Forest plant pathologist. U.S. Forest Service Region 5 Forest Pest Management, Stanislaus National Forest, Sonora, CA - telephone conversation.

Ritter, J. T. Superintendent. National Park Service, SEKI, Three Rivers, CA. February 22, 1994 - letter.

Schwarz, P. Public health officer. National Park Service, SEKI, Three Rivers, CA. November 15, 1994 - telephone conversation.

Appendix A. List of Acronyms

LIST OF ACRONYMS

AQRV	Air Quality Related Value
AQUIMS	Air Quality Information Management System
ARB	California Air Resources Board
ARD	Air Resources Division (of the National Park Service)
ARMAP	air resources management action plan
BACM	Best Available Control Measure
BACT	Best Available Control Technology
BARCT	Best Available Retrofit Control Technology
BLM	U.S. Bureau of Land Management
BRD	USDI Biological Resources Division
CAAQS	California Ambient Air Quality Standards
CADMP	California Acid Deposition Monitoring Program
CalEPA	California Environmental Protection Agency
CCAA	California Clean Air Act
CO	carbon monoxide
DPR	California Department of Pesticide Regulation
dv	deciview
EPA	U.S. Environmental Protection Agency
FCAA	Federal Clean Air Act
FIP	federal implementation plan
FR	Federal Register
GIS	geographic information system
GCVTC	Grand Canyon Visibility Transport Commission
HAP	Hazardous Air Pollutant
IMPROVE	Interagency Monitoring of Protected Visual Environments
$\mu g/m^3$	micrograms per cubic meter
LAER	Lowest Achievable Emission Rate
NAAQS	National Ambient Air Quality Standards
NADP/NTN	National Atmospheric Deposition Program/National Trends Network
NAPAP	National Acid Precipitation Assessment Program
NASA	National Aeronautics and Space Administration
NBS	National Biological Service
ng/m^3	nanograms per cubic meter
NOAA	National Oceanic and Atmospheric Administration
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPS	National Park Service
NRID	NPS Natural Resource Information Division
NSPS	New Source Performance Standards
NSR	New Source Review
OADP	Ozone Attainment Demonstration Plan
O_3	ozone
PAH	polycyclic aromatic hydrocarbons
PM2.5	inhalable particulate matter less than 2.5 microns in diameter
PM10	inhalable particulate matter less than 10 microns in diameter
ppm	parts per million
Project FOREST	Forest Ozone Response Study

LIST OF ACRONYMS (...continued)

PSD	Prevention of Significant Deterioration
RACT	Reasonably Available Control Technology
RACM	Reasonably Available Control Measure
ROG	reactive organic gases
SAQM	San Joaquin Valley Air Quality Study (SJVAQS) and Atmospheric Utilities, Signatures and Prediction Experiment (AUSPEX) Air Quality Model
SEKI	Sequoia and Kings Canyon National Parks
SFCAP	Sierra Federal Clean Air Partnership
SFM	Sierra Federal Managers
SIP	state implementation plan
SJVAB	San Joaquin Valley Air Basin
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SVR	Standard Visual Range
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service
VOC	volatile organic compound

Appendix B. Glossary

Acid Neutralizing Capacity (ANC): The measure of how well a stream can neutralize any acidity it receives, expressed as microequivalents per liter (µeq/L). Streams with capabilities from 100 to 200 µeq/L are classified as moderately sensitive, those between 50 and 100 µeq/L are sensitive, and those from 0 to 50 µeq/L are extremely sensitive.

Acidic Deposition: Also known as "acid rain" or "acid precipitation", wet and/or dry deposition of acidic materials to water or land surfaces. The pH of rain is considered acid when it is lower than approximately 5.2 on the pH scale. The chemicals found in acidic deposition include nitrate, sulfate, ammonium, and organics.

Aerosol: Fine particles of solid matter or liquid droplets suspended in the air, usually of less than 2.5 micrometers in aerodynamic diameter (also called $PM_{2.5}$ and fine particles). Aerosols can be transported for hundreds of miles.

Air Quality Related Value: Values of Class I wilderness areas that may be affected by air pollution emissions from a proposed facility, including affects to visibility, odor, flora, fauna, and geological resources; archaeological, historical, and other cultural resources; and soil and water resources.

Air Pollution Control (or Management) District (APCD): County or regional agency in California with authority to regulate stationary, indirect, and area sources of air pollution.

Air Toxics: A general term for chemical(s) in the air, especially those harmful to health such as the chemicals listed under the EPA's hazardous air pollutant program or California's AB 1807 toxic air contaminant program.

Alkalinity: The alkaline quality of a solution, also called acid neutralizing capacity (ANC). It is used to measure of how well surface waters can neutralize acidic inputs as expressed in microequivalents per liter (see pH, acid deposition, cation, anion).

Anion: Negatively charged ion such as chlorine, nitrate, and sulfate ions that contributes to acidity (see acid deposition, Ph, alkalinity, cation).

Attainment Area: A geographic area that is in compliance with the National and/or California Ambient Air Quality Standards (NAAQS or CAAQS). An area may have an acceptable level for one criteria air pollutant but may have unacceptable levels for others (see nonattainment area).

Best Available Control Measure (BACM): Control measures developed by the EPA for residential wood combustion, fugitive dust, and prescribed and silvicultural burning in "serious" PM10 nonattainment areas (more stringent than RACM).

Best Available Control Technology (BACT): Methods, techniques, and production processes available for achieving the greatest feasible emission reductions for given regulated air pollutants and processes on new sources (more stringent than RACT).

Best Available Retrofit Control Technology (BARCT): Emission limitation based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of already existing source (CCAA 40406).

California Air Resources Board (ARB): California's lead air quality agency consisting of an 11-member governor-appointed board and supporting staff fully responsible for motor vehicle pollution control, and having oversight authority over California's air pollution management program.

California Ambient Air Quality Standards (CAAQS): Specified concentrations and durations of air pollutants recommended by the California Department of Health Services and adopted into regulation by the ARB. These standards relate the intensity and composition of air pollution to undesirable effects. CAAQS are the standards that must meet the requirements of the California Clean Air Act.

California Clean Air Act (CCAA): A California law passed in 1988 that provides the basis for air quality planning and regulation independent of federal regulations. A major element of the CCAA is the requirement that local air districts in violation of the CAAQS must prepare attainment plans that identify air quality problems, causes, trends, and actions to be taken to attain and maintain California's air quality standards by the earliest practicable date.

Carbon Monoxide (CO): A colorless, odorless gas resulting from incomplete combustion of fossil fuels. Over 80% of the CO emitted in urban areas is contributed by motor vehicles. CO interferes with the blood's ability to carry oxygen to the body's tissues and results in numerous adverse health effects. CO is a criteria pollutant.

Cation: Positively charged ions such as calcium, magnesium, ammonium and sodium ions that contributes to alkalinity (see acid deposition, pH, alkalinity, anion).

Chronic Acidification: ANC of the streams is lost over the long term, and the pH drops as a consequence of the addition of sulfuric acids to watersheds.

Class I, II, and III Areas: Under the 1977 FCAA, Part C, Subpart 1 (PSD permitting), all international parks, national parks greater than 6000 acres, and national wilderness areas greater than 5000 acres were designated Class I areas. All other areas were designated Class II. Although some Class II areas can be redesignated to Class I areas, none have ever been established. Increment increases of certain pollutants (SO_2, TSP, NO_2, and PM10) were set for each class with Class I having the most stringent.

Coarse Particles: Particles with a diameter larger than 2.5 micrometers.

Conformity: Section of the Federal Clean Air Act that prohibits federal agencies from permitting, approving, providing financial assistance, or supporting in any way any activity that does not conform to a SIP.

Criteria Air Pollutant: An air pollutant for which acceptable levels of exposure can be determined and for which a federal or state ambient air quality standard has been set. Examples include ozone, carbon monoxide, lead, nitrogen dioxide, sulfur dioxide, and PM10.

Deciview (or Haziness Index): A visibility index that is linear to human perception so that a 1.0 deciview change represents approximately a 10% change in the light extinction coefficient.

Delta E: An index of the color difference between a plume and the background (1 Delta E = 1 just noticeable difference).

Emission Offsets: Approval of a new or modified stationary source is conditional on the reduction of emissions from other existing stationary sources.

Emissions Inventory: An estimate of the quantity of pollutants emitted into the atmosphere over a specific period such as a day or a year. Considerations that go into the inventory include type and location of sources, the processes involved, and the level of activity.

Episodic Acidification: Episodes are hydrologic events accompanied by rapid increases in stream flow. These events or episodes are driven by rainfall and snowmelt and can result in rapid loss of acid-neutralizing capacity and depression in pH. Other chemical changes that may affect fish populations during episodes include increases in aluminum concentrations and decrease in calcium concentrations during these flow increases.

Federal Clean Air Act (FCAA): A federal law passed in 1963 and amended in 1970, 1977 and 1990, which forms the basis for the national air pollution control efforts. Basic elements of the act include NAAQS for major air pollutants, air toxics standards, acid rain control measures, and enforcement provisions.

Federal Implementation Plan (FIP): In the absence of an approved SIP, a plan prepared by the EPA which provides measures that nonattainment areas must take to attain the NAAQS.

Fine Particles: Particles with a diameter of less than 2.5 micrometers.

Hazardous Air Pollutants (HAPs): A list of pollutants from the 1990 FCAA and EPA (replaces NESHAPs) that may present a threat of adverse health or environmental effects, such as asbestos, beryllium, mercury, benzene, coke oven emissions, radionuclides, and vinyl chloride.

Increments: See Class I, II, and III areas.

Inhalable Particulate Matter (PM10): A major air pollutant consisting of tiny solid or liquid particles of soot, dust, smoke, fumes, and mists. The size of the particles (10 microns or smaller) allows them to easily enter the air sacs deep in the lungs where they may be deposited, resulting in adverse health impacts. PM10 also causes visibility reduction and is a criteria pollutant.

Inversion: A layer of warm air in the atmosphere that lies over a layer of cooler air, trapping pollutants.

Layered Haze: A confined layer (or layers) of visible pollution, distinguishable from the background by abrupt color changes (darker or brighter).

Light Extinction Coefficient: A measure that is proportional to the light scattered and absorbed away from the observer as the light passes through the atmosphere in km^{-1}. This is the measure used for the California State visibility standard.

Lowest Achievable Emission Rate (LAER): Emission standards for new and modified sources in nonattainment areas.

Major Stationary Sources: In a nonattainment area, any source that has the potential to emit more than 100 tons per year. In attainment areas, the level may be either 100 or 250 tons per year, depending on the type of source.

National Ambient Air Quality Standards (NAAQS): Standards set by the federal EPA for the maximum levels of air pollutants that can exist in the ambient air without unacceptable effects on human health (primary) or the public welfare (secondary).

New Source Performance Standards (NSPS): Emission level standards set by the EPA for new sources.

New Source Review (NSR): A general term for preconstruction review requirements for new and modified major and minor stationary sources.

Nitrogen Oxides (NO_x): A general term pertaining to compounds of nitrogen oxide (NO), nitrogen dioxide (NO_2), and other oxides of nitrogen. Nitrogen oxides are typically created during combustion processes and are major contributors to smog formation and acid deposition. NO_2 is a criteria pollutant and may result in numerous adverse health effects.

Nonattainment Area: An area identified by the EPA and/or ARB as not meeting either the NAAQS or CAAQS for a given pollutant. An area may have an acceptable level for one criteria air pollutant but may have unacceptable levels for others (see attainment area).

Ozone (O3): A strong-smelling, bluish, reactive gas consisting of three oxygen atoms and resulting from the photochemical process involving the sun's energy. Ozone is a secondary pollutant that is formed when nitrogen oxides (NO) and reactive organic gases (ROG) react in the presence of sunlight. Ozone, a criteria pollutant, causes numerous adverse health impacts and is a component of smog.

Ozone Precursors: Chemicals, such as ROG and NO_x, occurring either naturally or as a result of human activities, which contribute to the formation of ozone. Ozone precursors are emitted directly from sources into the atmosphere.

PM2.5: A subset of PM10, PM2.5 consists of inhalable particles 2.5 microns or less in diameter. These particles are usually the primary contributors to reduced visibility.

parts per million (ppm): Standard measurement of concentration by which ozone or other atmospheric gases are measured.

pH: A measurement of the acidity or alkalinity of a solution.

Plume: A layered haze coming from a nearby source or close grouping of sources.

Plume Contrast: The percent difference in contrast between a plume and the background.

Precursor Pollutants: Primary pollutants that contribute to the formation of other pollutants; for example, nitrogen oxides and hydrocarbons forming ozone in the presence of sunlight.

Prevention of Significant Deterioration: A permitting program for new major stationary sources, or modifications of major stationary sources in attainment areas (Part C, 1977 FCAA).

Primary Pollutants: Pollutants that are emitted directly into the air, such as dust, nitrogen dioxides, and sulfur oxides.

Rayleigh Scattering: The natural scattering of light by air molecules. A pure "Rayleigh atmosphere" has a visual range of 130 miles.

Reactive Organic Gas (ROG): A reactive chemical gas composed of hydrocarbon compounds that may contribute to the formation of smog by their involvement in atmospheric chemical reactions.

Reasonably Available Control Measure (RACM): Control measures developed by the EPA for residential wood combustion, fugitive dust, and prescribed and silvicultural burning in "moderate" PM10 nonattainment areas (less stringent than BACM).

Reasonably Available Control Technology (RACT): The lowest emissions limit that a source is capable of meeting using technology that is reasonably available and technologically and economically feasible (less stringent than BACT).

San Joaquin Valley Air Basin (SJVAB): An air basin established by ARB that has similar meteorological and geographical conditions and includes all of San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, and Tulare Counties and the valley portion of Kern County.

San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD): The air district responsible for air quality within the SJVAB.

Secondary Pollutants: Pollutants that are not directly emitted into the air but form from primary pollutants, such as ozone, sulfates, and nitrates.

Standard Visual Range (SVR): The distance from an observer at which a black object is just discernable against the horizon under standard conditions (standard conditions are Rayleigh conditions at 1,800 meters elevation).

State Implementation Plan (SIP): A document prepared by each state describing existing air quality conditions and measures that will be taken to attain and maintain NAAQS. Non-attainment area SIPs are designed to attain NAAQS by specific deadlines, maintenance plans are to maintain NAAQS once non-attainment areas reach attainment, and attainment area plans are to prevent non-attainment of NAAQS.

Uniform Haze: A homogeneous haze that reduces visibility in every direction from the observer.

U.S. Environmental Protection Agency (EPA): The federal agency charged with setting policy and guidelines and carrying out legal mandates for the protection of national interests in environmental resources.

Vehicle Miles Traveled (VMT): A total number of vehicle miles traveled within a specified geographical area over a given time period.

Visibility: The clarity or ease with which landscape features can be seen.

Volatile Organic Compounds (VOC): Hydrocarbon compounds that contribute to the formation of smog and may be toxic. VOC emissions are a major precursor to the formation of ozone. See also reactive organic gases or ROG.

Wet Deposition: Also known as precipitation, includes chemicals and water collected as rain, snow, sleet and hail, along with "occult" deposition (fog and cloudwater).

Appendix C. Laws, Policies, and Guiding Documents

CALIFORNIA LEGISLATION

Air Toxics Related Legislation, 1987 and 1992

Assembly Bill (AB) 1807 (identify and control air toxics) was amended in 1992 (AB 2728) to coordinate with the Federal air toxics program (see below). The State has identified 20 compounds and eight control measures (five on the U.S. Environmental Protection Agency's [EPA's] list). Seven thousand sources are affected in California. AB 2588 (air toxics hot spots inventory) was amended in 1992 (SB 1731) to require risk reduction audits and plans for facilities identified as a significant risk. Actions by the sources determine how the reductions are accomplished. If sources make voluntary reductions, public notice is not required.

California Clean Air Act, 1988

Introduction. California began addressing air pollution as early as 1955. The Bureau of Air Sanitation set the original California Ambient Air Quality Standards (CAAQS) which are more stringent than the NAAQS (Table E-1 in Appendix E). NAAQS are stated for the six criteria pollutants, and CAAQS are in place for visibility reducing particles, sulfates, hydrogen sulfide, and vinyl chloride. In 1960, the Motor Vehicle Pollution Control Board was formed to regulate tailpipe emissions. In 1968, 2 years before the EPA was established, these two agencies were combined under the California Mumford-Carrell Act to form the California Air Resources Board (ARB). In 1978, in response to the Federal Clean Air Act 1977 amendments, ARB designated most counties as lead agencies for State implementation plan (SIP) development.

The Act. The 1977 FCAA required states to attain the NAAQS by 1987. Areas that did not meet the deadline lost their mandates after 1987. The California Clean Air Act (CCAA) of 1988 was enacted in response to the need for new requirements. (Since 1988, the CCAA was been amended several times.) The CCAA differs from the FCAA in that there are no sanctions or specific deadlines for attainment of the CAAQS. Instead, attainment is required at the earliest practicable date. The act substantially adds to the authority and responsibilities of the local air pollution control districts throughout the State. It designates air districts as lead air quality planning agencies, requires them to prepare plans to meet California Ambient Air Quality Standards (CAAQS), allows a fee program for implementing programs, and adds clarification to their responsibilities, especially regarding transportation and indirect source control. It also adds to ARB's authority and mandates, including adding consumer products and some off-road motor vehicle control responsibilities. The CCAA requires designation of attainment and nonattainment areas with respect to State ambient air quality standards.

Plans. The CCAA requires state attainment plans for O_3, CO, SO_2, and NO_2 CAAQS nonattainment areas. Beginning in 1988, using the 1987 emissions inventory as the base year, the CCAA requires a 5% or more emissions reduction per year (averaged over 3 years) until these CAAQS are attained. Moderate, serious, severe, and extreme ozone nonattainment categories are areas with peak ozone concentrations exceeding 0.09, 0.12, 0.15, 0.20 ppm, respectively. The requirements increase in stringency with the severity level.

The SJVAB is designated as severe nonattainment for the ozone CAAQS. Ozone attainment plans focus on control of ozone precursors, nitrogen oxides, and volatile organic carbons. Although the SJVAB is in nonattainment for the PM10 CAAQS, the CCAA does not require PM10 plans. However, control of ozone precursors, which are also precursors of particulate matter, reduces PM10 as well as ozone. Severe area ozone attainment plans require:

- no net increase in permitted emissions (those sources that emit or have potential to emit 10 tons/year or more);
- no net increase in vehicle emissions after 1997, and average commute ridership of 1.5 by 1999;
- best available retrofit technology on existing stationary sources;
- achievement of significant number of low-emission motor vehicles by fleet operators; and
- reduction of per capita exposure by 25% (1994), 40% (1997), and 50% (2000).

Interbasin Transport. The CCAA required the ARB to analyze interbasin air pollution transport. The San Joaquin Valley was identified as an overwhelming source of ozone precursors to the Southeast Desert Air Basin, Great Basin Valleys, and Mountain Counties Air Basins, and as a significant source for the South Central Coast Air Basin and the broader Sacramento area (California Air Resources Board 1993b). In addition, the San Joaquin Valley is identified as being impacted from upwind areas, including San Francisco and the broader Sacramento area. At a minimum, mitigation requirements of the San Joaquin Valley must adopt the best available retrofit control technology (BARCT) for all but at least 75% of the 1987 emissions of NOx and VOCs from permitted stationary sources. Mitigation must include sufficient measures for the Southeast Desert Air Basin, the Great Basin Valleys, and that portion of the Mountain Counties Air Basin south of the Amador-El Dorado County border to attain the ozone standard by the earliest practicable date during air pollution episodes of specified conditions (California Air Resources Board 1993b).

California Environmental Quality Act, 1970

The California Environmental Quality Act (CEQA) is California's broadest environmental law. CEQA applies to all discretionary activities proposed to be carried out or approved by California public agencies, unless an exemption applies. CEQA does not apply to private activities unless they require discretionary governmental approvals. CEQA grants public agencies five basic types of authority to enable them to carry out the objectives of the law:

- require changes in a project to lessen or avoid significant effects, when feasible;
- disapprove a project to avoid significant effects;
- approve a project with unavoidable significant effects if the project's benefits outweigh those effects;
- comment on other agencies' environmental documents;
- impose fees on project applicants for CEQA implementation.

Enacted in 1970, CEQA was modeled after the National Environmental Policy Act (NEPA). Like NEPA, CEQA requires agencies to prepare environmental impact assessments of proposed projects with significant environmental effects and to circulate these documents to other agencies and the public for comment before making decisions.

California Wilderness Act, 1984

The California Wilderness Act of 1984 designated 736,980 acres (85%) of Sequoia and Kings Canyon National Parks as wilderness. By designating this acreage as wilderness, these lands became subject to the provisions of the Federal Wilderness Act of 1964 (see below).

FEDERAL LEGISLATION

Endangered Species Act, 1973

This legislation was designed to prevent the taking of any "listed" threatened or endangered species of fish or wildlife. The act defines taking to include harassment, harm (including significant habitat modification or degradation), pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting (16 USC 1532, 50 CFR 17.3).

Federal Clean Air Act 1963 (amended 1970, 1977, 1990)

The Act. The Federal Clean Air Act (FCAA) was passed in 1963 by the U.S. Congress and has been amended several times, most recently in 1990. The FCAA forms the basis for the national air pollution control efforts. Basic elements of the act include National Ambient Air Quality Standards (NAAQS) for major air pollutants (see Table E-1 in Appendix E), air toxics standards, acid rain control measures, and enforcement provisions.

NAAQS. The 1970 FCAA required the EPA to establish National Ambient Air Quality Standards (NAAQS) for air pollutants or air pollutant groups that pose a threat to human health or welfare. Primary NAAQS are intended to protect public health with an adequate margin of safety. Secondary NAAQS are intended to protect public welfare. Included are the resources and values found in SEKI, such as water, vegetation, wildlife, and visibility. EPA has established NAAQS for six criteria pollutants: ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), lead, particulate matter less than 10 microns in diameter (PM10), and carbon monoxide (CO). The NAAQS are to be reviewed by EPA at least every 5 years and adjusted or revised to reflect the latest scientific evidence.

SIP and FIP. If a NAAQS is exceeded in an area (as determined over a 3-year period), the area is designated nonattainment for that NAAQS. A State Implementation Plan (SIP) must be prepared to bring the area back into attainment. SIPs must specify how the primary and secondary NAAQS will be achieved and maintained. Each state must demonstrate that the measures, rules, and regulations contained in the SIP are adequate to meet and maintain the NAAQS in each nonattainment air basin by specific deadlines. Maintenance plans are designed to maintain the NAAQS after nonattainment areas reach attainment.

Once an SIP is approved by EPA, it is legally binding under both State and Federal law and may be enforced by either government. EPA also has the authority to apply sanctions when SIPs are deemed inadequate. Such penalties can include withholding of Federal highway funds within 24 months of EPA notification and requiring the application of emission offsets at a 2 to 1 ratio within 18 months of notification. If states fail to prepare SIPs or are disapproved by EPA, EPA must prepare Federal implementation plans (FIPs).

Federal Compliance. Under Title 1, Section 101, general planning requirements, Section 118 (1970 and 1990 amendments), the Federal Government, having jurisdiction over any property, facility, or activity resulting in discharge of air pollution, shall be subject to and comply with all applicable Federal, State, interstate, and local air pollution control requirements. This applies to any procedural or substantive requirements, exercises of administrative authority, fee or charges imposed to defray costs of regulatory programs, and any process and sanctions enforced in any manner.

The 1990 FCAA includes additional provisions that regulate Federal actions in nonattainment areas. These provisions are known as general and transportation conformity. Any Federal action in a nonattainment area that generates air emissions must comply with the conformity regulations to ensure that the particular action conforms to the existing SIPs. In November 1993, the EPA adopted the conformity rules, which became effective immediately (40 CFR 6, 51, 93). Because SEKI is in an area designated as nonattainment for the PM10 and ozone NAAQS and CAAQS, SEKI is subject to the conformity rules.

In October 1994, the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) adopted Rule 9110 (General Conformity) by reference (same rule as written by EPA). This rule, which became effective on its adoption date, incorporates the Federal conformity rule by reference. It specifies the criteria and procedures for determining whether Federal actions (except those covered by transportation conformity) conform with the SJVUAPCD's SIP. Federal actions that result in emission increases exceeding de minimus levels are required to conduct detailed conformity determinations.

In the San Joaquin Valley, the de minimus levels are as follows:

- volatile organic compounds (VOCs) or nitrogen oxides (NO_x): 50 tons per year,
- CO: 100 tons per year, and
- PM10: 70 tons per year.

The Federal agency conducting the activity must make a conformity determination. The conformity determination is an impact analysis of both the direct and indirect emissions related to the activity, and over which the Federal agency has control. Specific criteria must be met. Draft and final general conformity determinations must be provided directly to the air quality regulatory agencies, and the public must be notified by publication in a local newspaper. The U.S. Forest Service has developed guidelines for making general conformity determinations (U.S. Forest Service 1995).

In January 1995, the SJVUAPCD adopted Rule 9120 (Transportation Conformity) by reference. It sets forth specific requirements for transportation plans, programs, and projects (such as individual road projects) that are federally developed, funded, or approved for Federal nonattainment areas. The rule sets policy and procedures for demonstrating that such plans, programs, and individual transportation projects conform with the applicable SIPs. Consequently, all new federally funded transportation projects must be shown to conform to the most recently approved SIP. For Federal projects (those requiring Federal funds or approval), metropolitan planning organizations, the Federal Highway Administration, and the Federal Transit Administration are responsible for making the conformity determination. For nonfederal projects, although conformity determinations are not required, the projects must be included in the currently conforming transportation plan or in an emission analysis of the transportation plan.

Prevention of Significant Deterioration. Prevention of Significant Deterioration (PSD) program was established in the 1977 FCAA (Title I, Part C). PSD, Subpart 1, concerns permitting of new major stationary sources (or major modification) with potential to adversely affect Air Quality Related Values (AQRV) in designated Class I areas in NAAQS attainment areas. A major source emits at least 100 tons/year or 250 tons/year, depending on the type of any regulated pollutant. A major modification is a change to a major stationary source which would result in a significant net emissions increase in any regulated pollutant.

One hundred fifty-seven national parks and wilderness areas were designated as Class I. These lands included all international parks, national memorial parks exceeding 5,000 acres, wildernesses exceeding 5,000 acres, and national parks exceeding 6,000 acres that were designated as such areas on August 7, 1977. (The 1990 FCAA redesignated to Class I any new acres added to existing Class I areas since 1977.) All other areas are designated as Class II with a lesser level of protection. Although possible, no Class III areas exist. Forty-eight national parks, including SEKI, are designated as Class I areas. Increments of allowable pollution were set for SO_2, NO_2, and PM10 for each class, with Class I having the lowest increments and therefore the most protection (see Table F-2 of Appendix F).

AQRVs are defined as "all those values possessed by an area except those that are not affected by changes in air quality and include all assets of an area whose vitality, significance, or integrity is dependent on some way upon the air environment. These values include visibility and those scenic, cultural, biological, and recreational resources of an area that are affected by air quality" (43 FR 15016). The NPS has defined AQRVs to include visibility, odor, flora, fauna, and geological resources; archaeological, historical, and other cultural resources; and soil and water resources (Bunyak 1993). The NPS and U.S. Forest Service have permit application guidance documents to assist with the PSD permit review process (Bunyak 1993, Peterson et al. 1992).

PSD, Subpart 2, of the 1977 FCAA sets as a national goal the prevention of any future, and the remedying of any existing, human-caused visibility impairment in mandatory Class I areas (regardless of NAAQS attainment designation). The Federal land manager is charged with an affirmative responsibility to protect the AQRVs of designated Class I areas from adverse impacts.

Subpart 2 also requires states with Class I areas to revise their SIPs to include a long-term strategy to make reasonable progress toward eliminating present and preventing future visibility impairment. The strategy must include steps to protect any "integral vistas", which are Class I area views that are important to an observer's visual experience of an area (National Research Council 1993). Integral vistas for SEKI are listed in Appendix H.

Subpart 2 required the EPA to establish requirements for reasonable progress towards meeting the national goal. In 1980, the EPA required States to add visibility strategies to their SIPs, but only a few states complied. The 1990 FCAA added section 169B to Subpart 2 requiring the EPA and NPS to jointly conduct research on visibility impairment. The section also gives authority to the administrator, or to requests made by petition from the governors of at least two states, to establish visibility transport regions and commissions.

The commissions are to assess visibility and report to the administrator with recommendations within 4 years of establishment of the region or commission. The administrator, within 12 months of report submission, is to establish emission limits, compliance schedules, and other measures. The EPA was specifically required to establish the Grand Canyon Visibility Transport Commission (GCVTC) within 12 months of the 1990 amendments. The visibility research must address expansion of visibility-related monitoring, assessment of current sources of visibility-impairing pollution and clean air corridors (areas from which unpolluted air flows to Class I areas), adaptation of regional air quality models for the assessment of visibility, and studies of atmospheric chemistry and the physics of visibility (National Research Council 1993, U.S. Environmental Protection Agency 1993). The GCVTC submitted its recommendations to the EPA in June 1996. They recommended establishing:

- targets for reducing SO_2 emissions, with a regulatory program if targets are exceeded;
- nation-wide low emission vehicle standards;
- annual emission targets for prescribed burns, better integrated visibility concerns, and use of non-fire alternatives whenever possible;
- energy efficiency and conservation, renewable energy sources, and sustainability; and
- additional research, especially on the impact of pollution sources near the Class I areas, road dust, and emissions from Mexico.

The EPA will use these recommendations and the recent review of the particulate matter standard to establish regional haze requirements.

Hazardous Air Pollutants (HAPs). The 1990 FCAA Title III completely overhauled the nation's hazardous air emission program. Title III shifts the emphasis of the air toxics program from a pollutant-by-pollutant regulation to a technology-based regulation of source categories. Section 112 defines a new process that controls a list of 189 air toxic substances, requires the development and promulgation of Maximum Achievable Control Technology (MACT) standards, and the mandates the assessment of residual risk after the implementation of MACT (one removed in 1996). Title III affects the following sources emitting:

- 10 tons per year of any identified hazardous air pollutant (HAP) and
- 25 tons per year combination of any HAP.

For modifications to existing sources, there are de minimis levels for each HAP, although “netting” is allowed where a source can increase emissions of a HAP if it reduces emissions of another HAP.

The EPA is required to establish MACT standards (previously National Emission Standards for Hazardous Air Pollutants) for the HAPs. The EPA has 10 years (until 2000) to develop 174 standards. So far, 14 are final and seven are proposed. If the EPA misses the deadline for establishing MACT standards, major sources (only) must do their own “presumptive MACT determination” (known as the “MACT Hammer”). Once the EPA subsequently establishes a MACT, the source will have 8 years to comply. MACT standards are listed on the ARB electronic bulletin board ARBIS (ARBIS also includes files of rule books for many California air districts.)

Under the accidental release prevention program there are 77 toxics, 63 flammables, and some explosives identified. Sources are required to develop a risk management plan within 3 years of final rule adoption (anticipated by March 1996).

The EPA is allowed to approve State rules as replacement. California has submitted its dry cleaning rule to the EPA for approval. The EPA is also required to develop a residual risk report (due in November 1996) and a strategy for urban area sources.

Acid Deposition Control. The 1990 FCAA Title IV mandates that the EPA implement a control program for sulfur dioxide (SO_2) emissions from 110 power plants located east of the Mississippi River. The program also calls for reductions in NO_x emissions based on EPA tightening of emission standards for boilers. Title IV is primarily applicable to areas in the east and midwest and is unlikely to have a substantial effect on air quality at SEKI.

Permits. The 1990 FCAA Title V was intended to affect all permitted sources, including those subject to Title III requirements. For attainment areas, affected sources are those emitting more than 100 tons per year of any pollutant. For nonattainment areas, affected sources depend on the nonattainment category:

Category	VOC, NOx (tons/year)	PM10 (tons/year)	SO_2, CO (tons/year)
moderate	100	--	100
serious	50	70	100
severe	25	--	100
extreme	10	--	100

Affected sources include those sources subject to 1990 FCAA Title III. The affected sources in San Joaquin Valley are those emitting more than 50 tons per year of VOC or NO_x, 70 tons per year of PM10, and 100 tons per year of CO or SO_2.

The SJVUAPCD submitted its Title V rule for EPA approval in 1995. Once approved, the District has 1 year and 30 days to review and deem permits complete and 3 years to issue all permits. The EPA can object to a permit issuance for the following reasons: improper public notice, permit incomplete, or permit not enforceable. Permits must be renewed every 5 years. It is in question whether the full Title V process would be required if nothing had changed over the 5 years. If MACT or RACT (Reasonably Available Control Technology) changes within 2 years of permit issuance, those changes must be incorporated into the permit conditions. Otherwise, the MACT/RACT changes will be incorporated at the 5-year renewal time. Title V can potentially affect 800 facilities in San Joaquin Valley but more than likely only 250-300 will be ultimately affected because a source can be exempted if actual emissions are 50% below potential emissions.

Stratospheric Ozone Protection. The 1990 FCAA Title VI of the Clean Air Act Amendments of 1990 was written in light of mounting evidence that certain substances deplete the stratospheric ozone layer that acts to shield the earth's surface from ultraviolet light emitted by the sun. Each year, persons who produce, import, or export a substance identified by the EPA as a stratospheric ozone depleter must file a report with EPA setting forth the amount of the substance produced during the preceding reporting period.

Enforcement. The 1990 FCAA Title VII tightens enforcement provisions for previous FCAA amendments by fundamentally changing the administrative approach to enforcement and increasing civil and criminal penalties for noncompliance. Conspiracy, false claims, and mail fraud were changed from misdemeanors to felonies with a minimum 1-year jail sentence.

Federal Occupational Safety and Health Act, 1970

CFR 29 parts 1910.1000 and 1926.55 (1993) provide exposure thresholds. Following are the 8-hour Time Weighted Averages (TWAs) for air pollutants that also have established NAAQS:

Substance	ppm	mg/m^3
CO	50	55
H2S[a]	10	15
Lead (inorganic)	--	0.05
NO_2[b]	5	9
O_3	0.1	0.2
PM (total)	--	15
PM (respirable)	--	5
SO_2	5	13
Vinyl chloride[c]	1	--

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[a] 20-ppm ceiling, 50-ppm maximum
[b] cannot be exceed at any time
[c] 5-ppm maximum

National Environmental Policy Act (NEPA) 1970

The basic national charter for protection of the environment, NEPA provides an interdisciplinary framework for Federal agencies to prevent environmental damage and contains action-forcing procedures to ensure that Federal agency decision makers take environmental factors into account. The act provides an explicit mandate to the National Park Service (NPS) and other Federal agencies to undertake and promote efforts that will prevent or eliminate environmental damage and stimulate human health and welfare.

The U.S. Forest Service has developed a publication entitled "A Desk Reference for NEPA Air Quality Analyses," which provides guidance for air quality staff in preparing environmental assessments and environmental impact statements. This document is written broadly enough that it can be used by any Federal agency.

NPS Organic Act, 1916 (amended 1970, 1978)

Directs the NPS to "conserve the scenery and natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The 1978 amendment gave authority to the NPS to stop activities causing "degradation of the value and purposes" of an area.

Wilderness Act 1964

The purpose of this act is "to secure for the American people of present and future generations the benefits of an enduring resource of wilderness . . . to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. . . ."

Under this act, "wilderness" is defined as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor and who does not remain . . . an area or undeveloped Federal land retaining its primeval character and influence . . . which is protected and managed so as to preserve its natural conditions."

NATIONAL PARK SERVICE AIR RESOURCES DIVISION

Air Quality Monitoring Strategy, 1991

The purpose of the 1991 air quality monitoring strategy was to downsize the baseline monitoring network due to budget limitations. The strategy, based on a 1991 Air Resources Division issue paper entitled "Redesigning the National Park Service Gaseous Pollutant Monitoring Network to Meet Servicewide Needs," would reconfigure the present network of 42 stations in 35 NPS units to a network of trend stations at 24 NPS units and baseline stations at eight NPS units. Trend stations will be operated indefinitely for meeting long-term monitoring needs. Baseline stations will be operated for 3 to 5 years rotating to various NPS units with a return interval of 5 to 10 years to meet minimum baseline monitoring needs. Implementation of the strategy began in 1992. Sequoia National Park was identified to have a trend station at Lower Kaweah. The Ash Mountain station was to be shut down in fiscal year 1994 and the Grant Grove station in fiscal year 1995.

Additional changes to the monitoring network were described in a December 12, 1994 memorandum from the NPS Associate Director of Natural Resources to all NPS Regional Directors. This memorandum discussed EPA and NPS efforts to install dry deposition monitoring at 17 NPS units in the western United States. The memorandum states that should there be further budget reductions, the network will be further reduced or other cost-saving measures will be adopted. The schedule identified for SEKI is to operate the Grant Grove station in summer 1995 (the station was shut off January 9, 1995) and to shut down indefinitely the Ash Mountain and Grant Grove stations on September 30, 1995. A December 6, 1994 memorandum to the EPA from the NPS Air Resources Division identifies Lookout Point monitoring station as the site for adding EPA dry deposition monitoring.

Air Resources Management Manual, 1984

Developed by the NPS Air Resources Division for use by NPS personnel who have the responsibility to protect park resources from air pollution impacts.

Permit Application Guidance for New Air Pollution Sources, 1993

This document was designed to provide guidance to persons intending to submit Prevention of Significant Deterioration (PSD) permit applications for a new stationary source of air pollutants or modifications to an existing source that have the potential to affect air quality in Class I areas managed by the NPS (Bunyak 1993).

NATIONAL PARK SERVICE POLICIES AND GUIDELINES

NPS Management Policies, 1988

Chapter 4 of NPS Management Policies handbook states: "The NPS will seek to perpetuate the best possible air quality in parks because of its critical importance to visitor enjoyment, human health, scenic vistas, and the preservation of natural systems and cultural resources. Vegetation, visibility, water quality, wildlife, historic and prehistoric structures and objects, and most other elements of a park environment are sensitive to air pollution and are referred to as "air quality related values". The NPS will assume an aggressive role in promoting and pursuing measures to safeguard these values from the adverse impacts of air pollution. In cases of doubt as to the impacts of existing or potential air pollution on park resources, the Park Service will err on the side of protecting air quality and related values for future generations."

"Air resource management will be integrated into NPS operations and planning, and all air pollution sources within parks will comply with all Federal, State, and local air quality regulations. Furthermore, because the current and future quality of park air resources depends heavily on actions of others, the NPS will acquire information needed to participate in decision making that affects park air quality. Management activities will include:

- inventorying air quality related values associated with each park,
- monitoring and documenting the condition of air quality related values,

- # evaluating air pollution impacts and identifying causes, and
- # ensuring healthful indoor air quality in NPS facilities."

"The National Park Service will strive to preserve the natural quiet and the natural sounds associated with the physical and biological resources of the parks."

"The National Park Service will cooperate with park neighbors and local governmental agencies to seek to minimize the intrusion of artificial light into the night scene in parks with natural dark, recognizing the part that darkness and the night sky play in the overall visitor experience."

Chapter 8 states: "The National Park Service and its concessionaires, contractors, and cooperators will seek to provide a safe and healthful environment for visitors and employees."

"Where practicable and not detrimental to NPS mandates to preserve park resources, known hazards will be reduced or removed."

NPS-18 Wildland Fire Management, 1990

Chapter 2 of NPS-18 provides the legal requirements and guidance for a smoke management program. Chapter 2 states: "In order to protect the air resource from the harmful effects of smoke . . . the effects of smoke on air resources must be identified, the current levels of pollutants established, the levels of pollution for different fire management actions estimated, the effects on visitor health and enjoyment identified, and the best means to control/mitigate the smoke emissions and effects energetically pursued."

Chapter 4 is a brief discussion of safety and refers to several other documents.

NPS-28 Cultural Resource Management, 1994

NPS-28 provides guidelines for cultural resource management programs based on pertinent laws, executive orders, regulations, and policies. Key legislation includes the Antiquities Act (1906), the Historic Sites Act (1935), the National Historic Preservation Act (1966), and the Native American Graves Protection and Repatriation Act (1990). "Cultural resource management involves research to identify, evaluate, document, register, and establish other basic information about cultural resources; planning to ensure that this information is well integrated into management processes for making decisions and setting priorities; and stewardship under which planning decisions are carried out and resources are preserved, protected, and interpreted to the public." Although air pollution can affect cultural resources, it is not specifically addressed in NPS-28.

NPS-50 Loss Control Management Program Guideline, 1991

NPS-50 provides guidelines consistent with the Federal Occupational Safety and Health Act of 1970 (Cal OSHA regulations do not apply to the Federal government).

Chapter 16 on Occupational Health provides the following program objectives:

"A. Provide all NPS employees with adequate protection from adverse environmental conditions or substances such as chemicals, noise, radiation, biological agents, and temperature extremes.

B. Assure that all potential health hazards in NPS workplaces are identified and assessed.

C. Provide systematic evaluation of potentially hazardous operations to ensure the elimination or control of occupational health hazards."

Chapter 18 discusses structural and wildland fire safety. Wildland fire safety is also addressed in NPS-18.

Chapter 22 on Public Safety and Health describes requirements for protecting the visiting public from hazards related to NPS facilities or operations.

Chapter 24 on Concessionaire Safety directs the NPS to have sufficient administrative oversight to ensure that NPS concessionaires provide adequate public and employee safety and health programs consistent with NPS operating standards.

Chapter 25 on Off-the-Job Safety encourages sites to promote off-the-job safety for employees and their dependents. Chapter 26 on Tort Claims provides guidance for employee claims for damages and loss of personal property, and personal injury.

Chapter 32 on Respiratory Protection Program has the following objectives:

"A. Identify NPS operations that create airborne hazards and require respiratory protection.

B. Prevent and minimize the risk from harmful airborne contaminants in the workplace through the use of respiratory protection.

C. Institute a viable park Respiratory Protection Program (RPP) establishing standard operating procedures (SOPs)".

NPS-75 Natural Resource Inventory and Monitoring Guideline, 1992

"Knowing the condition of natural resources within the National Park System is fundamental to the Service's ability to protect and manage the parks. Based on legal mandates and NPS policy, the major goals of the Service wide inventory and monitoring program are: to inventory the natural resources and park ecosystems under NPS stewardship to determine their nature and status; to monitor park ecosystems to better understand their dynamic nature and condition and to provide reference points for comparisons with other, altered environments; and to integrate natural resources inventory and monitoring information into NPS planning, management, and decision making. Other goals include establishing natural resources inventory and monitoring as a standard practice throughout the NPS and forming partnerships with other natural resource agencies in order to pursue common goals and objectives."

"Air resource Phase I [data gathering] activities should focus on identifying: (1) sources of air pollution which may be impacting the park's air resource; (2) existing air quality data collected in or near the park; and (3) those park resources that are particularly sensitive to, and may be adversely affected by, air pollution."

"Air quality related values (AQRV) include visibility, odor, fauna, flora, and geological resources; archeological, historical, and other cultural resources; and soil and water resources."

"Air resource monitoring [Phase II] may be required in cases where air pollution or impaired visibility are suspected of affecting park values."

"Work at this level [Phase III, Special Studies] should be undertaken when the problem to be studied requires more than what standard or routine monitoring can accomplish, or when the results of routine monitoring identify a significant resource problem requiring more intensive study to meet critical management needs."

NPS-77 Natural Resource Management Guideline, 1991

The National Park Service's NPS-77 Natural Resources Management Guidelines provide guidance for managing material resources through the NPS system. The following discussion identifies and addresses key statements of NPS-77.

Resource Management Plan (RMP)

"Each park with natural resources to manage will prepare and periodically update a natural resource component for its resource management plan. The plan will identify, define, and program the monitoring, inventory, research, mitigation, and enforcement activities required to perpetuate park natural resources and natural processes, achieve the park's purposes and objectives, and regulate the use of the park."

"Approval of the RMP is the responsibility of the Regional Director, who is required to provide an opportunity for review by the Associate Director, Natural Resources before approving any plan with a natural resources component."

Action Plans

"Action Plan - A plan used to provide more detailed description and analysis of a particularly complex and/or controversial action contained in the RMP."

"Where a management action must be planned in such detail that the scale of treatment is far beyond that of the other projects in the RMP, or where it is so controversial that resolution of the issue through public review of the entire RMP will delay the park's entire natural resources management program, a separate "action plan" may be needed."

"Specific action plans can be considered to be "tiered" from the RMP and as part of or an attachment to the RMP."

"Generally, the RMP is not the document through which environmental compliance is accomplished. Compliance is usually accomplished on a case-by-case basis as funding for a natural resource management activity becomes likely."

Air Resource Management

"Class I areas and other parks with critical or sensitive AQRVs should consider developing comprehensive air resource management 'action plans'."

"When developing comprehensive action plans, parks should work closely with the appropriate regional air quality coordinator and technical experts in the AQD."

"The goal of the NPS air resource management program is the preservation, protection, and enhancement of air quality and air quality related values of units of the National Park System by ensuring compliance with the requirements of the Clean Air Act and the NPS Organic Act."

"It is important for the public to understand how air pollution affects park resources, since the public plays a key role in bringing about those actions needed to remedy existing air pollution problems and prevent future ones."

"When determining whether the changes caused by air pollutants constitute an adverse impact on air quality related values, the NPS primarily looks at whether the national significance of the area would be diminished, whether the structure and functioning of ecosystems would be impaired, or whether the quality of the visitor experience would be impaired."

"These [attainment] plans must include strategies needed to attain NAAQS, to prevent significant deterioration of air quality in clean air areas, and to make reasonable progress toward the national visibility goal."

Fire Management

"The most detailed guidance on fire management is found in NPS-18, the Wildland Fire Management guideline."

Roles and Responsibilities

NPS Air Resources Division (ARD). The major functions of the ARD are (note the Air Quality Division renamed to Air Resources Division in 1995):

"1) to provide support to the director of the NPS, the Federal land manager, and the secretary of the interior. This function includes such activities as: a) developing testimony for congressional hearings on air quality issues that may affect parks; b) preparing information for use in work with other bureaus, agencies, and departments on policies, regulations, or activities with potential air quality impacts on parks; c) reviewing, analyzing, and developing policy positions on proposed federal, state, and local regulations, legislation, or management activities that may adversely affect park resources; and d) reviewing all air quality permit applications for major new and modified industrial facilities whose activities may affect air-quality-related values in parks.

2) to provide policy and technical information and assistance to the parks and regions. The AQD's technical staff assists park and regional personnel in their efforts to identify, document, prevent, and mitigate, remedy, and interpret damage to park resources from air pollution.

3) to plan, design, and implement air-quality-related research and monitoring. The AQD designs and directs air-quality-related research and monitoring for the purposes of a) documenting air quality and air-quality-related-values conditions in NPS units; b) accurately describing the causes and effects of park air pollution problems; and c) seeking solutions to current problems resulting from air pollution in the parks. The AQD coordinates the collection, analysis, and reporting of monitoring data for criteria air pollutants and visibility."

Regional Air Quality Coordinator. NPS regional offices coordinate air-quality-related matters between parks and the ARD. Each regional office designates a regional air quality coordinator (AQC) who is generally responsible for this coordination function. AQC responsibilities include:

"1) providing technical and policy assistance on routine air quality matters to parks and regional management, and ensuring that the AQD is consulted on nonroutine, controversial, or other matters requiring a high level of technical or policy expertise;

2) reviewing park management plans to ensure their adequacy and accuracy in the area of air resource management (including interpretation) and monitoring;

3) seeking the necessary research or monitoring for parks where air pollution is a threat to park resources and values, including soliciting air-quality-related project requests from parks, ranking such projects regionally, and participating in allocation of the servicewide air quality project account;

4) in consultation with the regional chief scientist, reviewing and approving all research programs initiated in regional park units;

5) coordinating park and regional office concurrence on comments/testimony prepared by the AQD on air pollution permit applications and state implementation plans, including ensuring that the timely submittal of those comments to the permitting/regulatory authority; and

6) disseminating air quality data and reports published by the AQD to parks."

Park Superintendent. Park superintendents play a critical role in planning and carrying out air resource management activities. Superintendent responsibilities include:

“1) identifying all air-quality-related values and resource threats related to air quality in the resource management plan(s), including developing management objectives, project statements, and funding requests;

2) submitting for review to the regional office and the AQD any air quality permit applications received from permit applicants or federal, state, or local air quality agencies;

3) being aware of and complying with all federal, state, and local air quality regulations that affect park operations and facilities;

4) ensuring diligent participation by park staff in air quality data acquisition activities, including operation and maintenance of monitoring equipment;

5) in consultation with the AQD, issuing health warnings or alerts to visitors when pollution levels within the park are observed or expected to exceed levels hazardous to human health, and notifying the regional safety officer of this action;

6) being aware of proposed industrial or energy resource development activities that may influence the park’s air quality, including participating in scoping processes for such projects and requesting technical and policy assistance from the regional office or AQD, when necessary;

7) participating in public hearings and meetings when issues relevant to protection of air quality in the parks is the issue;

8) cooperating with other federal, state, or local agencies or research/academic institutions in air quality monitoring or research that may contribute to NPS’s goal to perpetuate the best possible air quality in parks by providing information needed for decision making that affects air quality in parks; and

9) ensuring that interpretive materials and media developed by park staff related to air resource management has been reviewed by NPS technical and policy experts.”

NATIONAL PARK SERVICE REGIONAL OFFICE

NPS Western Region Fire Monitoring Handbook, 1991

The handbook provides guidance on smoke monitoring for prescribed fires (management ignited and natural). Parameters measured include visibility, particulates, carbon monoxide, total smoke production, mixing heights, wind speed and direction, and complaints. The handbook also provides recommended thresholds for change in operations.

SEQUOIA AND KINGS CANYON NATIONAL PARKS

Fire Management Plan, 1992

Objectives for air quality are to "I) mitigate and prevent unacceptable impacts of the prescribed fire program on public health and visibility, and ii) manage smoke from prescribed fire in accordance with Federal, State, and local regulations." Under the air resources management section 10, 17 guidelines and 7 smoke management tactics are listed. A major revision to the Fire Management Plan is planned for 1996.

Interpretive Prospectus, Draft 1995

The draft 1995 Interpretive Prospectus is a concept plan for SEKI's interpretive program (replaces previous prospectus of 1971). It establishes primary interpretive themes and visitor experience goals and outlines any changes necessary for planning and design.

Master Plan, 1971

The master plan addresses general natural resource protection as follows: "Coordinate research and management efforts to identify and apply actions necessary to restore and/or perpetuate desirable environmental conditions as contemplated in the policies for management of natural areas. Natural science research is and will continue to be an important activity in these parks and will be encouraged. It is fundamental to good resource management."

Natural and Cultural Resources Management Plan, 1994

The Air Resources Management Program has four areas of emphasis: 1) monitor ambient levels and trends of air pollutants, 2) monitor effects of air pollutants on vegetation, 3) maintain effective relations with the public and regulatory authorities, and 4) comply with air pollution control regulations. The goals and objectives are the same as those in the SEKI Statement for Management (Draft Revision 1991) under Section 3 of this plan.

Statement for Management Revised Draft, 1991

SEKI's Statement for Management (Revised Draft 1991) management goals which have an air resource component is:

"Protect and perpetuate the full spectrum of natural ecosystems and processes found in these parks so that they may operate essentially unimpaired."

- # “Emphasize the protection and perpetuation of the giant sequoia groves of the Parks together with the ecosystems which occupy them.”

- # “Emphasize the protection and perpetuation of the High Sierra wilderness resource together with its biotic elements and human character.”

- # “Provide for public recreational opportunities that are compatible with the protection of Parks' resources, and emphasize the educational potential of the Parks.”

In addition, the SEKI Statement for Management (Revised Draft 1991) includes the following management and research objectives, which have an air resource component:

- # “Support biological diversity by seeking to prevent loss of species.”

- # “Develop and implement a strategy for reducing or mitigating air quality impacts on the Parks' resources and visitors.”

- # “Manage designated wilderness and related backcountry in a manner which preserves forever its fundamentally pristine natural ecosystems and unique sociological character.”

- # “Manage aquatic environments for ecosystem preservation.”

- # “Encourage scientific research that promotes an understanding of Parks' resources and the impacts that affect those resources.”

- # “Seek understanding of the general ecosystem elements and processes of these Parks, the natural forces controlling them, and the potential for human activities to affect them.”

- # “Enlarge understanding of giant sequoia ecology and the impacts of human activity on the trees and the ecosystems they inhabit.”

- # “Seek understanding of current and potential effects on the Parks' resources from external threats, including alien organism invasions, air pollution, anthropogenic global change, and boundary/island effects.”

- # “Develop a thorough inventory of park resources.”

- # “Develop and implement a comprehensive natural resources monitoring program.”

- # “Develop an information storage and analysis system.”

Appendix D.   SEKI Organizational Charts

AIR QUALITY DIVISION FUNCTIONS

The three major functions of the National Park Service's (NPS's) Air Quality Division (AQD) are:

1) to provide support to the director of the NPS, the Federal land manager, and the secretary of the interior. This function includes such activities as a) developing testimony for congressional hearings on air quality issues that may affect parks, b) preparing information for use in work with other bureaus, agencies, and departments on policies, regulations, or activities with potential air quality impacts on parks; c) reviewing, analyzing, and developing policy positions on proposed federal, state, and local regulations, legislation, or management activities that may adversely affect park resources; and d) reviewing all air quality permit applications for major new and modified industrial facilities whose activities may affect air-quality-related values in parks.

2) to provide policy and technical information and assistance to the parks and regions. The AQD's technical staff assists park and regional personnel in their efforts to identify, document, prevent, and mitigate, remedy, and interpret damage to park resources from air pollution.

3) to plan, design, and implement air quality related research and monitoring. The AQD designs and directs air quality related research and monitoring for the purposes of a) documenting air quality and air-quality-related-values conditions in NPS units; b) accurately describing the causes and effects of park air pollution problems; and c) seeking solutions to current problems resulting from air pollution in the parks. The AQD coordinates the collection, analysis, and reporting of monitoring data for criteria air pollutants and visibility.

REGIONAL AIR QUALITY COORDINATOR RESPONSIBILITIES

NPS regional offices coordinate air-quality—related matters between parks and the AQD. Each regional office designates a regional air quality coordinator (AQC) who is generally responsible for this coordination function. AQC responsibilities include:

1) providing technical and policy assistance on routine air quality matters to parks and regional management, and ensuring that the AQD is consulted on nonroutine, controversial, or other matters requiring a high level of technical or policy expertise;

2) reviewing park management plans to ensure their adequacy and accuracy in the area of air resource management (including interpretation) and monitoring;

3) seeking the necessary research or monitoring for parks where air pollution is a threat to park resources and values, including soliciting air-quality—related project requests from parks, ranking such projects regionally, and participating in allocation of the servicewide air quality project account;

4) in consultation with the regional chief scientist, reviewing and approving all research programs initiated in regional park units;

5) coordinating park and regional office concurrence on comments/testimony prepared by the AQD on air pollution permit applications and state implementation plans, including ensuring that the timely submittal of those comments to the permitting/regulatory authority; and

6) disseminating air quality data and reports published by the AQD to parks.

PARK SUPERINTENDENT RESPONSIBILITIES

Park superintendents play a critical role in planning and carrying out air resource management activities. Superintendent responsibilities include:

1) identifying all air-quality—related values and resource threats related to air quality in the resource management plan(s), including developing management objectives, project statements, and funding requests;

2) submitting for review to the regional office and the AQD any air quality permit applications received from permit applicants or federal, state, or local air quality agencies;

3) being aware of and complying with all federal, state, and local air quality regulations that affect park operations and facilities;

4) ensuring diligent participation by park staff in air quality data acquisition activities, including operation and maintenance of monitoring equipment;

5) in consultation with the AQD, issuing health warnings or alerts to visitors when pollution levels within the park are observed or expected to exceed levels hazardous to human health, and notifying the regional safety officer of this action;

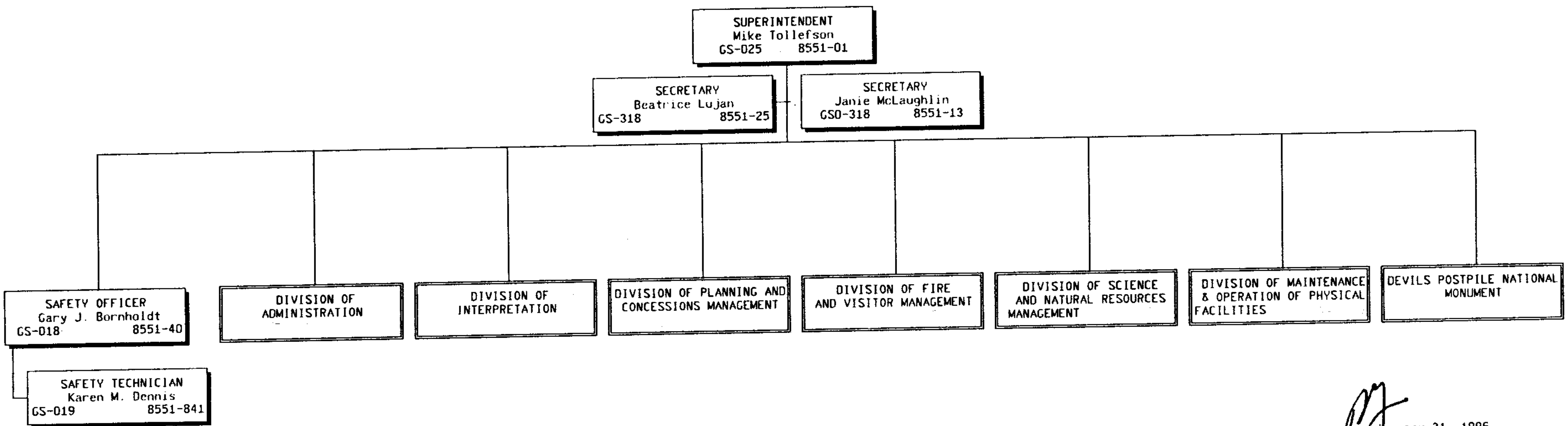
6) being aware of proposed industrial or energy resource development activities that may influence the park's air quality, including participating in scoping processes for such projects and requesting technical and policy assistance from the regional office or AQD, when necessary;

7) participating in public hearings and meetings when issues relevant to protection of air quality in the parks is the issue;

8) cooperating with other federal, state, or local agencies or research/academic institutions in air quality monitoring or research that may contribute to NPS's goal to perpetuate the best possible air quality in parks by providing information needed for decision making that affects air quality in parks; and

9) ensuring that interpretive materials and media developed by park staff related to air resource management has been reviewed by NPS technical and policy experts.

SEQUOIA & KINGS CANYON NATIONAL PARKS
& DEVILS POSTPILE NATIONAL MONUMENT
ORGANIZATIONAL CHART



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DIVISION OF SCIENCE AND NATURAL RESOURCES MANAGEMENT

- **CHIEF, SCIENCE & NATURAL RESOURCES MANAGEMENT** — William L. Bancroft — GS-401 — 8558-01
  - **BUDGET ASSISTANT (O/A)** — Cathy A. Haralson Bleggi — GS-561 — 8558-03
  - **AQUATIC & WILDLIFE MGMT. FISH & WILDLIFE BIOLOGIST** — Harold W. Werner — GS-401 — 8558-05
    - WILDLIFE BIOLOGIST — Jill Oertley — GS-404 — 8558-06
    - PHYSICAL SCIENCE TECH. — Joel Despain — GS-1311 — 8558-008
    - PARK RANGER — GS-025 — 8558-310 & 8558-311
  - **AIR RESOURCES SPECIALIST** — Diane M. Ewell — GS-401 — 8558-17
    - BIOLOGICAL TECHNICIAN — Donna M. Meisky — GS-404 — 8558-703
    - PARK RANGER — GS-025 — 8558-330 & 345
  - **VEGETATION MANAGEMENT**
    - FORESTER — Thomas E. Warner — GS-460 — 8558-12
      - BIOLOGICAL TECHNICIAN — Daniel M. Duriscoe — GS-404 — 8558-13
      - BIOLOGICAL TECHNICIAN — Richard L. Thiel — GS-404 — 8558-701
      - BIOLOGICAL TECHNICIAN — GS-404-5 — 8558-323, 325, 372 & 375
      - BIOLOGICAL TECHNICIAN — GS-404 — 8558-321
      - TREE WORKER — WG-5042 — 8558-320
      - BIOLOGICAL TECHNICIAN — GS-404 — 8558-373
    - TREE WORKER FOREMAN — (vacant) — WS-5042 — 8558-25
      - TREE WORKER — (Vacant) — WG-5042 — 8558-30
      - TREE WORKER — Jack R. Townley — WG-5042 — 8558-931
      - ENG. EQUIPMENT OPERATOR — WG-5716 — 8558-383
      - MOTOR VEHICLE OPERATOR — WG-5703 — 8558-384
      - TREE WORKER — WG-5042 — 8558-392
      - SAWYER (Woodsworker) — WG-5042 — 8558-395
  - **BIOLOGIST-GIS COORDINATOR** — Patrick K. Lineback — GS-401 — 8558-004
  - **SUPVY. NATURAL RESOURCES MANAGEMENT SPECIALIST** — Jeffrey D. Manley — GS-401 — 8558-14
    - RANGE MGMT. SPECIALIST — Charles D. Schelz — GS-408 — 8558-16
    - ECOLOGIST — MaryBeth Keifer — GS-408 — 8558-11
      - BIOLOGICAL TECHNICIAN — Georgia M. Dempsey — GS-404 — 8558-920
      - PARK RANGER — GS-025 — 8558-343 & 346
    - ECOLOGIST — Clarence M. Conover — GS-408 — 8558-015
      - PARK RANGER — GS-025 — 8558-342 & 341
      - BIOLOGICAL TECHNICIAN — David Yemm — GS-404 — 8558-921
    - ECOLOGIST — Anthony C. Caprio — GS-408 — 8558-702

January 31, 1996

Appendix E. Smoke Management

Excerpt from Sequoia and Kings Canyon Fire Management Plan:

10. Air Resources Management

a. Guidelines

The Clean Air Act of 1963 (PL88-206) and its 1977 amendment significantly affects the Parks' fire management program, which must comply with all Federal, State, and local regulations.

The following guidelines will be used to minimize the effects of smoke on the air quality of both the Parks and of the surrounding areas. Exceptions to these guidelines can be granted by the Superintendent.

(1) No new ignitions on weekends or holidays without the Superintendent's approval. The approval may be obtained by identifying the need for weekend ignitions in the burn plan, which is approved by the Superintendent.

(2) No burning in a drainage already affected by large wildfire or prescribed fire (1000 acres or larger).

(3) No burnings below an inversion or on "no burn days"; burning on "no burn" days can be done if a variance is obtained from the appropriate Air Pollution Control District. The local Air Pollution Control District regulations will be followed.

(4) Test fires on major frontcountry burns (1000 acres or larger) should be large enough (10-20 acres) to adequately determine smoke plume direction and effects.

(5) No ignitions when a low pressure area off the coast appears to be stalled (cut-off low).

(6) Conduct major prescribed fires before Memorial Day and after Labor Day, where Smoke Sensitive Areas (SSA's) are likely to be impacted by the fire.

(7) Emphasize the importance of fire, and the resulting smoke, in natural systems to the public and regulatory agencies. Contact with local civic groups, handouts, and interpretive walks will help the public to understand why their vistas are temporarily obscured. Monitoring equipment is needed to give assurance that no health hazard exists to the general public, from prescribed fires and wildfires.

(8) Research is needed to determine the number of acres that can be burning without violating air quality regulations. Monitoring equipment is needed to establish the baseline particulate load in the Parks" air sheds and how much management fires add to it. By knowing how many pounds of particulates or CO are produced per ton of any given fuel, and by studying the indicators of good and bad smoke dispersion days, prescriptions are written for smoke management as is done for fire behavior and effects.

(9) Emphasis will be placed on using management ignited prescribed fire when winds at plume dispersal heights are blowing away from smoke sensitive areas (SSA's). SSA's are Three Rivers, Cedar Grove, Grant Grove, Montecito Sequoia, Stony Creek, Pythian Camp, Eshom, Hartland, Sierra Glen, Whitaker Forest, Hume Lake, Sequoia Lake, and Giant Forest/Lodgepole. Highways are also areas of concern, and smoky sections must be signed as hazardous.

(10) During conditions of stagnant air management ignited prescribed fires should not be conducted where the smoke plume may get into a SSA airspace.

(11) The ignition technique or techniques will be suitable to meet both fire management objectives and air quality standards to the fullest extent possible. Backing fires produce less scorch and particulates than do headfires, but the latter type burns areas more quickly and has shorter smoke episodes, if fuel moisture is low enough to minimize smoldering.

(12) The Prescribed Burn Plan will consider the direction, duration, and effects of smoke both by day and by night. Weather information and fire weather forecasts will be used on all management ignited prescribed fires to determine smoke dispersal.

(13) The California Department of Forestry, adjacent national forests, and Air Pollution Control Districts will be notified prior to any management ignited prescribed fire, and when a fire is declared a prescribed natural fire below 6,000 feet. A copy of the annual management ignited prescribed fire program will be sent to the Air Pollution Control Districts prior to the burning season.

(14) The Parks will coordinate prescribed fires with neighboring agencies and conduct joint management ignited prescribed fires when possible.

(15) Fires that are exceeding air quality objectives will generally be suppressed, following the preparation, review, and approval of an EFSA. The public will be informed that although no new ignitions are occurring, smoke may persist and may even increase as a result of control actions.

(16) If significant smoldering sends smoke into a SSA seven days after the last ignition, mop-up should be seriously considered.

(17) Management ignited prescribed fires should be conducted when prescribed fuel moistures are as low as possible, yet still provide for a controllable fire.

b. Smoke Management Tactics

(1) Smoke management objectives in the management ignited prescribed fire unit plan must be quantifiable and measurable, as are the objectives for scorch height, fuel

reduction, mortality by size class, and other potential prescribed fire objectives. "minimize smoke impact" is not an objective.

(2) Measurable objectives are legal standards, minimum visual range, duration of smoke detected either by sight or smell, transport windspeed, mixing height. As with other objectives, data must be collected by monitors to show if the objectives were met.

Smoke on the highway, lasting even a few seconds, can cause serious, even fatal, accidents. It is the responsibility of the Prescribed Burn Boss to ensure that signs are place which warn the public of smoke on the highway, and post reduced speeds through the area. Required Minimum speed limits are:

Visual Range	Posted Speed (NTE= Not to Exceed)
0-200 feet	15 mph (NTE park posted speed)
201-350 feet	25 mph (NTE park posted speed)
351-550 feet	35 mph (NTE park posted speed)
551+ feet	45 mph (NTE park posted speed)

(3) Warning signs and speed limit signs should be checked frequently (scheduling of patrol is specified on management ignited prescribed fire plan) to ensure that the signs are properly placed and effective. Nighttime smoke in particular tends to flow down drainages, resulting in the pooling of smoke where highways cross the drainage. Such smoke patterns can be anticipated, and signs placed in advance of this occurrence. Monitoring to ensure effective placement is required.

(4) Night burning may have some benefit in reducing foliage scorch. However, the same higher relative humidities which are reducing scorch can also lead to increased smoke production.

(5) The local Fire Weather Office can provide a smoke management forecast, along with spot weather forecasts. The forecasted mixing height should be at least 1,700 feet higher than the fire site, and transport winds greater than nine mph.

(6) Some standard should be specified to gauge public reaction to the smoke. The Prescribed Burn Boss might specify that the management ignited prescribed fire will be suspended or mopped up, with no further ignition, if a given number of written complaints are received. Experience with management ignited prescribed fires near developed areas will give the Prescribed Burn Boss a feeling for the relationship among management ignited prescribed fire size, smoke density and duration, and visitor complaints.

(7) Carbon monoxide monitors and particulate matter monitors should be obtained from the Air Pollution Control District if dense smoke (visual range less than 100 feet) is expected in SSA's, to document the presence or absence of actual air quality violations. Management actions, particularly on similar fires in the future, are guided by these data.

Appendix F. NAAQS/CAAQS/PSD Increments

National and California ambient air quality standards are listed in Table F-1 on the following page. Significant deterioration (PSD) increments are listed in Table F-2. The Federal PSD program is designed to prevent significant deterioration of existing air quality in areas that have relatively clean air. Under the PSD program, Congress designated 158 national parks and wilderness areas as mandatory Class I areas, thereby providing those areas with maximum protection from future air quality degradation. Forty-eight national parks, including Sequoia and Kings Canyon National Parks, are designated as a Class I area. A Class I area is allowed only a very small "increment" of new air pollution, as shown in Table F-2.

Table F-1. Ambient Air Quality Standards Applicable in California

Pollutant	Symbol	Average Time	Standard, as parts per million		Standard, as micrograms per cubic meter		Violation Criteria	
			California	National	California	National	California	National
Ozone	O_3	8 hours	N/A	0.08	N/A	160	N/A	If 3-year average of annual third-highest daily 8-hour maximum exceeds standard
		1 hour	0.09	0.12	180	235	If exceeded	If exceeded on more than 3 days in 3 years
Carbon monoxide	CO	8 hours	9.0	9	10,000	10,000	If exceeded	If exceeded on more than 1 day per year
		1 hour	20	35	23,000	40,000	If exceeded	If exceeded on more than 1 day per year
(Lake Tahoe only)		8 hours	6	N/A	7,000	N/A	If exceeded	N/A
Nitrogen dioxide	NO_2	Annual average	N/A	0.053	N/A	100	N/A	If exceeded
		1 hour	0.25	N/A	470	N/A	If exceeded	N/A
Sulfur dioxide	SO_2	Annual average	N/A	0.03	N/A	80	N/A	If exceeded
		24 hours	0.04	0.14	105	365	If exceeded	If exceeded on more than 1 day per year
		1 hour	0.25	N/A	655	N/A	N/A	N/A
Hydrogen sulfide	H_2S	1 hour	0.03	N/A	42	N/A	If equaled or exceeded	N/A
Vinyl chloride	C_2H_3Cl	24 hours	0.010	N/A	26	N/A	If equaled or exceeded	N/A
Inhalable particulate matter	PM10	Annual geometric mean	N/A	N/A	30	N/A	If exceeded	N/A
		Annual arithmetic mean	N/A	N/A	N/A	50	N/A	If exceeded
		24 hours	N/A	N/A	50	150	N/A	If exceeded on more than 1 day per year

Table F-1. Continued

Pollutant	Symbol	Average Time	Standard, as parts per million: California	Standard, as parts per million: National	Standard, as micrograms per cubic meter: California	Standard, as micrograms per cubic meter: National	Violation Criteria: California	Violation Criteria: National
Fine particulate matter	PM2.5	Annual arithmetic mean	N/A	N/A	N/A	15	N/A	If spatial average exceeded on more than 3 days in 3 years
		24 hours	N/A	N/A	N/A	65	N/A	If exceeds 98th percentile of concentrations in a year
Sulfate particles	SO_4	24 hours	N/A	N/A	25	N/A	If equaled or exceeded	N/A
Lead particles	Pb	Calendar quarter	N/A	N/A	N/A	1.5	N/A	If exceeded no more than 1 day per year
		30 days	N/A	N/A	1.5	N/A	If equaled or exceeded	N/A

Notes: All standards are based on measurements at 25EC and 1 atmosphere pressure.
National standards shown are the primary (health effects) standards.
N/A = not applicable.

Table F-2. PSD Increments

Pollutant	Averaging Time	Allowable Increment ($\mu g/m^3$)		
		Class I	Class II	Class III
SO_2	Annual	2	20	40
	24 hours	5	91	182
	3 hours	25	512	700
PM10	Annual	4	17	34
	24 hours	8	30	60
NO_2	Annual	2.5	25	50

Appendix G. List of Large Stationary Emission Sources in the San Joaquin Valley

Table G-1

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PTAB1LN

CALIFORNIA EMISSION INVENTORY DEVELOPMENT AND REPORTING SYSTEM
FACILITY SUMMARY
DATABASE - 1994
EMISSIONS LIMIT: 50

ONELINE
(AIR BASIN)

COUNTY : FRESNO
AIR BASIN: SAN JOAQUIN VALLEY
DISTRICT : SAN JOAQUIN VALLEY UNIFIED APCD

						********************** EMISSIONS (TONS/YEAR) **********************						
FACILITY	NAME	ADDRESS	CITY	ZIP	FSIC	TOG	ROG	CO	NOX	SOX	PM	PM10
14	FRESNO COGENERATION LP	8105 S. LASSEN	SAN JOAQUIN	93660	4931	6.8	0.1	261.3	53.2	3.5	3.9	3.9
311	CHEVRON U.S.A. INC.	HEAVY OIL PRODUCTION	FRESNO		1311	29.6	7.1	76.9	185.7	1.4	13.7	13.7
354	COALINGA COGENERATION CO.	32812 WEST GALE AVE.	COALINGA	93380	4911	110.2	22.5	42.7	59.0	2.5	33.0	32.8
390	LONESTAR DEHYDRATOR	2730 S. DEWOLF	SANGER	93657	723	0.0	0.0	0.0	0.0	54.0	0.0	0.0
396	SANGER BOAT MANUFACTURING	3316 E. ANNADALE	FRESNO	93725	3732	69.9	52.4	0.0	0.0	0.0	0.0	0.0
494	MOUNT WHITNEY GINNING CO.	25960 W MT WHITNEY	FIVE POINTS	93624	724	0.0	0.0	0.0	0.8	0.0	65.1	40.4
498	FMC CORPORATION	2501 S SUNLAND	FRESNO	93725	2879	0.0	0.0	0.0	0.0	440.8	6.6	5.9
598	GUARDIAN INDUSTRIES CORP.	11535 E MOUNTAIN VIE	KINGSBURG	93631	3211	1.0	0.8	1.2	1094.1	458.7	11.2	9.8
825	MENDOTA BIOMASS POWER, LT	400 GUILLEN PARKWAY	MENDOTA	93640	4911	0.6	0.3	5.0	74.3	12.3	3.6	3.6
948	PPG IND, INC	3333 S. PEACH	FSNO	93745	3211	11.2	8.4	9.3	753.5	92.0	57.8	41.9
1077	SANTA FE PACIFIC PIPELINE	4149 S. MAPLE	FRESNO	93725	4613	70.2	70.2	4.8	2.9	0.3	1.0	1.0
1121	CALRESOURCES LLC	HEAVY OIL PRODUCTION	FRESNO COUNT	93210	1311	13.8	5.2	20.7	117.8	10.5	14.2	14.2
1179	SPRECKLES SUGAR	29400 WHITBRDG RD	FSNO	93640	2063	0.4	0.2	8.7	83.4	76.9	2.8	2.5
1234	TEXACO TRADING	COALINGA PUMP STATIO	FRESNO COUNT		4612	14.3	9.8	20.6	82.8	0.2	4.2	4.2
1301	UNOCAL PIPLINE DEPT.-COAL	SW 1/4 SECTION 32, T	COALINGA	93210	1311	76.4	18.0	110.7	163.0	0.0	0.5	0.5
1385	WESTERN COTTON SRVCS - SI	43939 W. NORTH	FIREBAUGH	93622	724	0.0	0.0	0.0	0.6	0.0	62.4	38.7
1659	UNION OIL COMPANY OF CA	CNU, SEC. 7, T20S,R1	COALINGA	93210	1311	244.2	56.5	62.8	491.4	0.0	1.5	1.5
1820	ULTRAPOWER	3350 S. WILLOW AVE.	FRESNO	93706	4931	1.5	0.7	7.3	69.0	8.7	6.5	6.5
1915	GUARDIAN INDUSTRIES CORP	1485 E CURTIS	REEDLEY	93654	2599	63.7	63.7	0.1	0.5	0.0	0.0	0.0
TOTAL FRESNO	IN SAN JOAQUIN VALLEY					713.8	315.8	632.1	3232.0	1161.8	288.0	221.0

CALIFORNIA EMISSION INVENTORY DEVELOPMENT AND REPORTING SYSTEM
FACILITY SUMMARY
DATABASE - 1994
EMISSIONS LIMIT: 50

COUNTY : KERN
AIR BASIN: SAN JOAQUIN VALLEY
DISTRICT : SAN JOAQUIN VALLEY UNIFIED APCD

						EMISSIONS (TONS/YEAR)						
FACILITY	NAME	ADDRESS	CITY	ZIP	FSIC	TOG	ROG	CO	NOX	SOX	PM	PM10
33	TEXACO REFINING AND MARKE	AREAS ONE AND TWO	BAKERSFIELD	93308	2911	1295.2	927.6	65.6	610.1	259.9	38.1	36.8
34	TEXACO REFINING AND MARKE	AREA THREE	BAKERSFIELD	93308	2911	191.7	131.2	8.2	53.5	2.9	2.9	2.8
36	SAN JOAQUIN REFINERY	NEAR HWY 99 N. OF HW	BAKERSFIELD	93308	2911	62.8	54.4	16.6	137.1	369.7	32.1	31.2
37	KERN OIL & REFINING COMPA	PANAMA LN & WEEDPATC	BAKERSFIELD	93307	2911	149.3	91.7	69.1	231.7	369.1	18.8	18.1
39	ARCO WESTERN ENERGY	NORTH COLES LEVEE			1321	323.6	101.8	48.3	92.1	0.0	2.6	2.6
40	ARCO WESTERN ENERGY	NORTH COLES LEVEE	TAFT		1321	57.9	11.8	167.8	63.6	6.0	2.0	2.0
42	TEXACO E & P (DENVER)	BUENA VISTA HILLS GA		93309	1321	861.0	179.7	70.0	182.8	0.1	2.3	2.3
43	TEXACO E & P (DENVER)	LOST HILLS GAS PLANT		93309	1321	174.0	43.9	67.2	13.8	0.0	0.9	0.9
48	CHEVRON U.S.A. INC.	1-C GAS PLANT		93249	1321	665.9	174.0	137.0	225.2	0.7	4.9	4.9
49	CHEVRON U.S.A. INC.	17Z GAS PLANT		93249	1321	292.5	91.5	46.1	127.4	0.0	0.8	0.8
57	CHEVRON U.S.A. INC.	WARREN PLANT	WARREN	93249	1321	106.3	26.4	39.0	17.8	0.0	0.6	0.6
71	LONE STAR GAS PLANT	CORNER 7TH STANDARD	SHAFTER	93263	1321	69.1	25.4	1.2	18.9	0.2	2.0	2.0
73	OILDALE COGENERATION	1134 MANOR	BAKERSFIELD	93308	4911	24.4	9.8	67.9	199.5	0.9	23.1	23.0
75	DELANO ENERGY CO., INC.	P.O. BOX 1461	DELANO	93216	4911	0.0	0.0	16.0	134.0	0.0	47.0	46.9
88	KERN RIVER COGEN	OMAR HILL, KERN RIVE	OILDALE	93308	4911	0.0	0.0	67.6	2299.6	3.6	69.3	68.9
91	MT POSO COGENERATION CO.	36157 FAMOSO WOODY R	BAKERSFIELD	93380	1311	3.5	0.6	55.5	186.4	70.8	7.1	2.8
207	SUNLAND REFINERY	2152 COFFEE RD	BAKERSFIELD	93309	2911	73.8	60.7	3.5	15.2	2.7	0.8	0.8
348	WEST KERN WATER DISTRICT	HWY 119 AND CA AQUED	STATION A		4941	39.2	8.0	12.0	95.2	0.0	0.3	0.3
349	WEST KERN WATER DISTRICT	STATION B-2			4941	56.4	11.5	17.3	137.0	0.0	0.4	0.4
350	WEST KERN WATER DISTRICT	STATION G			4941	32.1	6.6	9.9	77.9	0.0	0.2	0.2
353	WEST KERN WATER DISTRICT	WELL 2-01		93268	4941	29.4	6.0	9.0	71.4	0.0	0.2	0.2
382	NAVAL PETROLEUM RESERVE N	ELK HILLS FIELD	TUPMAN	93276	1311	378.8	77.4	472.7	146.1	0.6	3.7	3.7
511	SYCAMORE COGENERATION	SYCAMORE, KERN RIVER	OILDALE	93308	4911	0.0	0.0	42.8	2181.5	4.6	69.9	69.5
695	MCFARLAND COOP GIN INC.	12490 GARZOLI	MCFARLAND	93250	724	0.0	0.0	0.0	0.0	0.0	53.1	32.9
705	FARMERS COOP. GIN INC.	2531 WASCO WAY	BUTTONWILLOW	93206	724	0.0	0.0	0.0	1.6	0.0	153.5	95.2
714	J. G. BOSWELL COMPANY	BEAR MTN BLVD + COLE	BAKERSFIELD		724	0.0	0.0	0.0	0.4	0.0	63.8	39.6
720	UNIVERSITY COGENERATION P	NORTH BELRIDGE FIELD			4911	16.9	16.9	22.9	56.7	0.3	8.6	8.5
878	RICHLAND COOP. GINNING	P.O. BOX 1445	SHAFTER	93263	724	0.0	0.0	0.1	0.9	0.0	72.3	46.7
883	RIO BRAVO (JASMIN & POSO)	P.O. BOX 81077	BAKERSFIELD	93380	1311	16.3	2.9	305.6	275.6	92.2	17.0	6.8
890	ATLANTIC OIL CO.	LIGHT OIL CENTRAL SO		00000	1311	63.7	13.0	19.6	154.6	0.0	0.4	0.4
892	MOBIL CHEMICAL CO.	2024 NORRIS ROAD	BAKERSFIELD	93308	3086	712.3	534.2	0.5	1.8	0.0	1.3	1.2
1109	CALRESOURCES LLC	HEAVY OIL CENTRAL ST	KERN CENTRAL	93251	1311	23.4	8.7	31.4	178.4	14.8	25.9	25.9
1118	HIGH SIERRA LIMITED	10600 OIL FIELD ROAD	BAKERSFIELD	93308	1311	38.8	7.9	146.1	21.2	1.1	7.6	7.6
1119	DOUBLE "C" LIMITED	10245 OIL FIELD ROAD	BAKERSFIELD	93308	1311	65.5	13.4	171.2	17.5	1.2	14.3	14.2
1120	KERN FRONT LIMITED	12241 OIL FIELD ROAD	BAKERSFIELD	93308	1311	42.6	8.7	158.2	22.3	1.1	5.8	5.8
1127	CHEVRON U.S.A., INC.	HEAVY OIL CENTRAL SO	KERN CENTRAL	93302	1311	96.3	22.5	110.6	511.9	5.9	30.3	30.2
1128	CHEVRON U.S.A., INC.	HEAVY OIL WESTERN SO	KERN WESTERN	93249	1321	60.6	14.8	181.1	414.1	26.2	31.3	31.2
1129	TEXACO WEST (DENVER)	WESTERN KERN OILFIEL	MCKITTRICK	93251	1311	3.2	1.9	50.4	227.9	151.6	9.1	9.0
1131	TEXACO E. AND P., INC.	BAKERSFIELD DIVISION	BAKERSFIELD	93388	1311	6.3	2.5	6.3	28.9	84.1	3.6	3.6
1133	ARCO WESTERN ENERGY	HEAVY OIL CENTRAL			1311	8.3	2.0	47.7	162.8	0.7	9.0	9.0
1135	ARCO WESTERN ENERGY	HEAVY OIL WESTERN SS		00000	1311	37.5	9.1	262.4	1011.5	23.1	67.0	66.7

PTAB1LN

CALIFORNIA EMISSION INVENTORY DEVELOPMENT AND REPORTING SYSTEM
FACILITY SUMMARY
DATABASE - 1994
EMISSIONS LIMIT: 50

ONELINE
(AIR BASIN)

COUNTY : KERN
AIR BASIN: SAN JOAQUIN VALLEY
DISTRICT : SAN JOAQUIN VALLEY UNIFIED APCD

FACILITY	NAME	ADDRESS	CITY	ZIP	FSIC	TOG	ROG	CO	NOX	SOX	PM	PM10
						****** EMISSIONS (TONS/YEAR) ******						
1136	ARCO WESTERN ENERGY	LIGHT OIL WESTERN SS		00000	1311	86.0	17.6	496.2	646.8	0.0	2.0	2.0
1141	SANTA FE ENERGY RESOURCES	HEAVY OIL WESTERN S.		93309	1311	38.5	16.5	272.6	326.5	271.4	63.4	62.8
1142	SANTA FE ENERGY RESOURCES	LIGHT OIL WESTERN S.		93309	1311	73.2	15.0	22.5	177.7	0.0	0.6	0.6
1143	SANTA FE ENERGY RESOURCES	HEAVY OIL CENTRAL S.		93309	1311	2.9	1.5	21.2	38.4	58.6	7.7	7.6
1242	BAKERSFIELD ENERGY PARTNE	GAS PLANT, SOUTH BEL		93309	1311	32.4	6.7	22.5	66.6	0.0	0.6	0.6
1249	TANNENHILL ELECTRIC CO.	SOUTH MIDWAY/SUNSET			4911	12.7	2.6	2.9	56.3	0.4	5.1	5.1
1250	BADGER CREEK LIMITED	5801 GRANITE ROAD	BAKERSFIELD	93389	1311	67.2	13.7	0.0	23.5	1.0	10.9	10.8
1371	LAYMAC CORP NAT GAS PLANT	SW OF JNCT. LERDO HW	RIDGE AREA	93303	1321	93.4	34.4	2.9	21.7	0.0	0.2	0.2
1372	UNOCAL	HEAVY OIL WESTERN ST		93301	1311	3.6	1.4	52.5	197.0	8.7	9.0	8.9
1394	CHEVRON U.S.A. INC.	BITTERWATER PUMP STA			4612	1.3	1.1	4.5	49.2	156.0	12.6	11.0
1511	MOBIL OIL CORP	HEAVY OIL WESTERN	BAKERSFIELD	93301	1311	70.6	19.1	59.0	557.9	148.6	57.5	57.4
1512	MOBIL OIL CORP	LIGHT OIL WESTERN	BAKERSFIELD	93301	1311	163.9	34.1	58.2	38.2	0.0	0.6	0.6
1543	CALRESOURCES LLC	GAS PLANT	KERN WESTERN	93251	1311	61.7	22.3	25.3	16.4	0.2	2.0	2.0
1547	CALRESOURCES LLC	HEAVY OIL WESTERN SO	KERN WESTERN	93251	1311	205.9	58.7	307.7	1356.0	38.5	132.6	132.4
1548	CALRESOURCES LLC	LIGHT OIL WESTERN	KERN WESTERN	93251	1311	234.8	48.2	85.9	258.4	0.1	3.4	3.4
1552	MCFARLAND ENERGY CORP.	LIGHT OIL CENTRAL SO		93309	1311	21.0	4.3	7.0	51.0	0.0	0.0	0.0
1737	VINTAGE PETROLEUM, INC.	LIGHT OIL CENTRAL SO			1311	36.8	7.5	11.9	86.8	0.0	0.0	0.0
1738	VINTAGE PETROLEUM, INC.	LIGHT OIL WESTERN SO			1311	262.0	53.5	79.5	628.8	0.0	0.5	0.5
2199	CHEVRON - WARREN GP	LOST HILLS OIL FIELD	LOST HILLS	93249	1321	287.3	65.1	95.1	558.6	0.0	2.7	2.7
2234	NAVAL PETROLEUM RESERVE N	GAS PLANTS	35/30S/23E		1321	4434.4	1273.0	1249.6	696.6	1.3	16.8	16.7
2592	MID-SET COGENERATION CO.	P.O. BOX 80178	BAKERSFIELD	93380	1311	0.0	0.0	42.0	63.4	0.5	10.5	10.4
TOTAL KERN	IN SAN JOAQUIN VALLEY					12268.2	4394.7	5943.4	16321.7	2179.4	1242.6	1091.6

PTAB1LN

CALIFORNIA EMISSION INVENTORY DEVELOPMENT AND REPORTING SYSTEM
FACILITY SUMMARY
DATABASE - 1994
EMISSIONS LIMIT: 50

ONELINE
(AIR BASIN)

COUNTY : KINGS
AIR BASIN: SAN JOAQUIN VALLEY
DISTRICT : SAN JOAQUIN VALLEY UNIFIED APCD

FACILITY	NAME	ADDRESS	CITY	ZIP	FSIC	TOG	ROG	CO	NOX	SOX	PM	PM10
						*********************** EMISSIONS (TONS/YEAR) ***********************						
68	HANFORD PUB.WORK.WASTEWAT	HOUSTON AVE. AND 10T	HANFORD	93230	4959	295.5	221.6	0.0	0.0	0.0	0.0	0.0
259	CENTRAL VALLEY COOP	9845 HANFORD ARMONA	HANFORD	93230	724	0.0	0.0	0.0	0.0	0.0	52.3	32.4
273	CHEVRON U.S.A. INC.	11P GAS COMPRESSOR P	KINGS GAS CO		1321	36.5	7.5	11.2	88.4	0.0	0.3	0.3
283	CHEMICAL WASTE MANAGEMENT	P.O. BOX 471	KETTLEMAN CI	93239	4953	148.9	145.7	0.0	0.0	0.0	26.2	18.3
303	CHEVRON U.S.A. INC.	17Q GAS COMPRESSOR P	KINGS GAS CO		1311	203.2	73.3	4.5	35.9	0.0	0.1	0.1
603	HANFORD, L.P.	10596 IDAHO AVENUE	HANFORD	93230	4931	9.7	6.7	52.2	35.5	32.9	3.2	1.3
678	J.G. BOSWELL COMPANY #2	710 BAINUM AVE	CORCORAN	93212	724	0.0	0.0	0.0	3.4	0.0	175.7	108.9
682	J. G. BOSWELL COMPANY # 1	HIGHWAY 198	LEMOORE	93245	724	0.0	0.0	0.0	0.5	0.0	67.2	41.7
904	PACIFIC GAS & ELECTRIC CO	34453 PLYMOUTH AVE	AVENAL	93204	4922	275.0	56.2	159.6	664.3	0.1	1.0	1.0
1555	J. G. BOSWELL CO	710 BAINUM AVE	CORCORAN	93212	2041	156.0	117.0	0.0	0.0	0.0	58.2	39.6
40047	LEMOORE CITY PUBLIC WORKS	19TH AVE. SOUTH OF H	LEMOORE	93245	4959	165.7	124.3	0.0	0.0	0.0	0.0	0.0
TOTAL KINGS	IN SAN JOAQUIN VALLEY					1290.5	752.2	227.5	828.0	33.0	384.2	243.7

PTAB1LN

CALIFORNIA EMISSION INVENTORY DEVELOPMENT AND REPORTING SYSTEM
FACILITY SUMMARY
DATABASE - 1994
EMISSIONS LIMIT: 50

ONELINE
(AIR BASIN)

COUNTY : MADERA
AIR BASIN: SAN JOAQUIN VALLEY
DISTRICT : SAN JOAQUIN VALLEY UNIFIED APCD

FACILITY	NAME	ADDRESS	CITY	ZIP	FSIC	TOG	ROG	CO	NOX	SOX	PM	PM10
						EMISSIONS (TONS/YEAR)						
16	STEWART & NUSS, INC.	1000 W. NEES	PINEDALE	93714	2951	0.3	0.3	1.3	14.3	22.1	114.3	50.3
41	ANDERSON CLAYTON (WEST CO	25184 ROAD 16	CHOWCHILLA	93610	2074	233.7	175.2	2.0	8.0	0.0	20.4	6.1
261	CERTAINTEED CORP.	17775 AVENUE 23 1/2	CHOWCHILLA	93610	3296	27.5	19.7	17.9	188.0	1.2	61.5	61.1
628	CANANDAIGUA WEST, INC.	12667 ROAD 24	MADERA	93637	2084	0.4	0.1	5.6	67.9	0.0	0.4	0.4
799	MADERA POWER PLANT	11427 FIREBAUGH ROAD	MADERA	93637	4911	2.2	1.0	90.9	39.3	1.5	5.8	5.8
801	MADERA GLASS COMPANY	24441 AVENUE 12	MADERA	93637	3221	3.1	2.3	18.8	1162.8	158.4	68.4	66.5
1411	ZORIA FARMS, INC.	9537 ROAD 29 1/2	MADERA, CA	93637	2034	0.0	0.0	0.0	0.0	57.0	0.0	0.0
1617	SJVEP IV, L.P. (CHOW I)	16700 AVENUE 24 1/2	CHOWCHILLA	93610	4911	10.3	4.6	21.2	120.5	2.1	3.2	3.2
TOTAL MADERA	IN SAN JOAQUIN VALLEY					277.5	203.2	157.7	1600.8	242.3	274.0	193.3

PTAB1LN

CALIFORNIA EMISSION INVENTORY DEVELOPMENT AND REPORTING SYSTEM
FACILITY SUMMARY
DATABASE - 1994
EMISSIONS LIMIT: 50

ONELINE
(AIR BASIN)

COUNTY : MERCED
AIR BASIN: SAN JOAQUIN VALLEY
DISTRICT : SAN JOAQUIN VALLEY UNIFIED APCD

FACILITY	NAME	ADDRESS	CITY	ZIP	FSIC	TOG	ROG	CO	NOX	SOX	PM	PM10
						EMISSIONS (TONS/YEAR)						
1249	FOSTER FARMS- FEED MILL	14519 WEST COLLIER R	LIVINGSTON	95334	2048	0.2	0.1	1.3	5.3	0.0	341.6	99.2
1283	WOODS, J.R. INC.	7916 WEST BELLEVUE R	ATWATER	95301	2037	13.0	2.7	17.7	163.7	0.1	0.9	0.9
2352	MERCED MILLING COMPANY	40 NORTH MARKET STRE	PLANADA	95365	2048	0.0	0.0	0.1	0.4	0.0	58.0	16.8
TOTAL MERCED	IN SAN JOAQUIN VALLEY					13.2	2.8	19.1	169.4	0.1	400.5	116.9

PTAB1LN

CALIFORNIA EMISSION INVENTORY DEVELOPMENT AND REPORTING SYSTEM
FACILITY SUMMARY
DATABASE - 1994
EMISSIONS LIMIT: 50

ONELINE
(AIR BASIN)

COUNTY : SAN JOAQUIN
AIR BASIN: SAN JOAQUIN VALLEY
DISTRICT : SAN JOAQUIN VALLEY UNIFIED APCD

FACILITY	NAME	ADDRESS	CITY	ZIP	FSIC	TOG	ROG	CO	NOX	SOX	PM	PM10
						********************** EMISSIONS (TONS/YEAR)						**********************
180	E.R. CARPENTER CO INC	17100 S HARLAN ROAD	LATHROP	95330	3086	201.9	2.0	0.2	1.4	0.0	24.6	22.2
285	DIAMOND WALNUT GROWERS IN	1050 S DIAMOND	S DIAMOND	95205	2033	120.0	90.0	30.2	28.7	2.3	22.6	10.8
298	EARTH GRAINS COMPANY	2651 S AIRPORT WAY	STOCKTON	95206	2051	81.2	60.8	0.6	2.9	0.0	0.4	0.3
410	HOLLY SUGAR CORP	20500 S HOLLY DR	TRACY	95376	2063	2.1	0.5	16.6	182.1	2.9	24.3	16.5
477	LIBBEY OWENS FORD	500 E LOUISE AVE	LATHROP	95330	3211	7.5	5.6	7.1	409.5	76.3	39.1	36.1
517	THE MARLEY COOLING TOWER	150 N SINCLAIR AVE	STOCKTON	95205	2499	0.0	0.0	0.0	0.0	0.0	62.7	25.1
577	NEWARK SIERRA PAPERBOARD	800 W. CHURCH ST	STOCKTON	95201	2621	1.3	0.5	316.4	80.4	0.5	4.2	4.1
593	OWENS ILLINOIS	14700 W SCHULTE RD	TRACY	95376	3221	5.4	4.7	19.2	790.7	310.9	94.2	89.8
645	POSDEF POWER COMPANY, L.P	2526 WEST WASHINGTON	STOCKTON	95203	4911	7.6	7.2	232.0	84.1	118.3	44.3	18.0
692	RMC LONE STAR INC.	30350 S TRACY BLVD	TRACY	95376	2951	0.1	0.0	0.3	1.2	0.0	63.0	31.5
767	J R SIMPLOT CO.	16777 S HOWLAND AVE	LATHROP	95330	2879	0.3	0.1	1.8	7.2	242.3	28.8	23.8
784	SPRECKELS SUGAR	18800 S SPRECKELS	MANTECA	95336	2063	1.7	0.7	13.8	71.0	13.7	29.1	15.5
802	STOCKTON COGEN COMPANY	1010 ZEPHYR	STOCKTON	95206	4911	5.6	4.1	61.8	101.6	210.6	7.7	3.2
877	TRI/VALLEY GROWERS	26200 GALT RD	THORNTON	95686	2033	0.6	0.2	8.7	103.0	0.1	1.1	1.1
881	TRI-VALLEY GROWERS	3200 E 8 MILE RD	STOCKTON	95201	2033	0.6	0.2	8.5	53.0	6.6	1.7	1.7
1026	THERMAL ENERGY DEVELOPMEN	14800 W. SCHULTE ROA	TRACY		4911	1.1	0.4	151.1	91.0	15.6	43.4	40.3
2355	FEED COMMODITIES	704 ZEPHYR ROAD	STOCKTON	95206	2048	0.1	0.0	0.2	1.4	0.0	148.3	43.1
2429	UNOCAL CORP	9009 HOWARD ROAD	TRACY	00000	1389	60.8	12.4	19.0	148.5	0.0	0.3	0.3
TOTAL SAN JOAQUIN	IN SAN JOAQUIN VALLEY					497.9	189.7	887.5	2157.7	1000.1	639.8	383.2

PTAB1LN ONELINE (AIR BASIN)

CALIFORNIA EMISSION INVENTORY DEVELOPMENT AND REPORTING SYSTEM
FACILITY SUMMARY
DATABASE - 1994
EMISSIONS LIMIT: 50

COUNTY : STANISLAUS
AIR BASIN: SAN JOAQUIN VALLEY
DISTRICT : SAN JOAQUIN VALLEY UNIFIED APCD

FACILITY	NAME	ADDRESS	CITY	ZIP	FSIC	TOG	ROG	CO	NOX	SOX	PM	PM10
						EMISSIONS (TONS/YEAR)						
1626	DEL MONTE CORP	4000 YOSEMITE BLVD	MODESTO	95351	2033	0.9	0.5	9.6	132.7	0.2	1.2	1.2
1662	GALLO GLASS CO	OREGON DR	MODESTO	95353	3221	2.7	2.0	2.8	402.0	238.3	153.4	148.1
1674	HATCH MILLING CO	9500 W MAIN ST	TURLOCK	95380	2048	0.3	0.2	0.8	4.9	0.0	67.3	19.7
1680	STANISLAUS FOOD PRODUCTS	12 & B ST	MODESTO	95350	2033	1.6	0.6	9.7	126.8	0.3	1.7	1.7
1738	ASSOCIATED FEED SUPPLY	5213 W. MAIN	TURLOCK	95380	2048	0.2	0.1	0.4	1.9	0.0	54.6	15.9
1758	BERRY SEED FEED CO	4431 E KEYES RD	TURLOCK	95328	2048	0.2	0.1	0.6	2.8	0.0	125.9	36.6
1913	FOSTER TURKEY PRODUCTS	5001 PRAIRIE	CERES	95334	2048	0.0	0.0	0.0	0.0	0.0	98.4	29.5
1940	A. L. GILBERT	304 N. YOSEMITE AVE	OAKDALE	95361	2048	0.1	0.0	0.3	1.5	0.0	81.1	23.6
1976	HUNT-WESSON FDS	554 S. YOSEMITE	OAKDALE	95361	2033	1.5	0.6	15.3	155.2	1.2	3.8	3.8
1992	J. S. WEST MILLING	709 NINTH ST	MODESTO	95350	2048	0.0	0.0	0.0	0.0	0.0	51.0	14.8
2045	MODESTO ENERGY LIMITED PA	4549 INGRAM CREEK RD	WESTLEY	95387	4911	0.1	0.0	40.3	75.0	31.5	0.0	0.0
2073	OGDEN MARTIN SYSTEM OF ST	4040 FINK ROAD	CROWS LANDIN	95313	4931	0.8	0.6	28.3	320.6	22.4	14.2	14.2
2174	SILGAN CONTAINER CORP	3250 PATTERSON RD	RIVERBANK	95367	3411	240.8	239.3	0.8	3.8	0.0	0.5	0.5
2232	TRI-VALLEY GROWERS-#7	2800 FINCH	MODESTO	95353	2033	1.0	0.4	15.6	75.1	0.3	2.5	2.5
2236	TRI VALLEY GROWERS PT 1	555 MARIPOSA RD	MODESTO	95353	2033	0.2	0.1	3.6	50.8	0.0	0.4	0.4
2303	WESTERN STONE PRODUCTS	LOWE RD	HUGHSON	95326	2951	0.0	0.0	0.4	1.5	4.3	51.7	25.6
3212	UNOCAL CALIFORNIA PIPELIN	PATERSON PUMPING STA			4612	80.1	16.4	24.6	194.7	0.0	0.6	0.6
TOTAL STANISLAUS	IN SAN JOAQUIN VALLEY					330.5	260.8	153.1	1549.3	298.5	708.3	338.6

PTAB1LN

CALIFORNIA EMISSION INVENTORY DEVELOPMENT AND REPORTING SYSTEM
FACILITY SUMMARY
DATABASE - 1994
EMISSIONS LIMIT: 50

ONELINE
(AIR BASIN)

COUNTY : TULARE
AIR BASIN: SAN JOAQUIN VALLEY
DISTRICT : SAN JOAQUIN VALLEY UNIFIED APCD

FACILITY	NAME	ADDRESS	CITY	ZIP	FSIC	TOG	ROG	CO	NOX	SOX	PM	PM10
						EMISSIONS (TONS/YEAR)						
282	SEQUOIA PACIFIC SYSTEMS	1030 N ANDERSON ROAD	EXETER		2759	59.3	59.3	0.0	0.0	0.0	0.0	0.0
285	DINUBA ENERGY INC.	6801 AVENUE 430	DINUBA	93618	4911	0.6	0.3	140.1	69.4	0.4	7.0	7.0
417	WATERMAN INDUSTRIES, INC.	515 SOUTH G STREET	EXETER		3321	0.3	0.2	221.2	1.4	37.4	23.6	16.5
449	MID-VALLEY COTTON GROWERS	21978 ROAD 36	TULARE	93275	724	0.0	0.0	0.0	1.2	0.0	53.2	33.0
523	J.D.HEISKELL CO. INC.	116 WEST CEDAR	TULARE	93275	2048	0.3	0.1	1.7	6.8	0.0	147.0	42.8
525	DAIRYMANS COOP CREAMERY	400 S. M STREET	TULARE	93274	2023	3.2	1.3	31.7	76.2	0.4	27.2	19.6
548	CITY OF TULARE, H20 POL.	1875 SOUTH WEST STRE	TULARE	93274	4959	1.3	0.4	5.6	117.0	1.2	300.5	150.5
643	WATERMAN INDUSTRIES, INC.	25500 ROAD 204	EXETER	93221	3491	2.8	2.1	345.7	0.2	1.5	27.6	19.3
791	RMC LONESTAR	24325 LOMITAS DR	LEMONCOVE	93244	1442	0.0	0.0	0.0	0.0	0.0	72.7	25.3
834	SIERRA POWER CORPORATION	9000 ROAD 234	TERRA BELLA	93270	4911	3.6	1.6	75.7	62.7	0.6	4.9	4.9
1075	STYROTEK, INC.	ROAD 176 AND AVENUE	DELANO		3086	65.0	64.9	1.1	4.2	0.0	0.2	0.2
1985	STYRO-TEK INC/VITITEK INC	ROAD 176 AND AVE 4	DELANO	93215	2821	50.0	37.4	1.4	5.7	0.0	0.3	0.3
TOTAL TULARE	IN SAN JOAQUIN VALLEY					186.4	167.6	824.2	344.8	41.5	664.2	319.4
TOTAL SAN JOAQUIN VALLEY						15578.0	6286.8	8844.6	26203.7	4956.7	4601.6	2907.7

Table G-2

SEQUOIA & KINGS NAT PARKS, ATTN MR SCOTT RUESCH, THREE RIVERS, CA 93271 TEL: (209) 565-3341

BILLING MONTH: 4 FACILITY STATUS: A AREA NO: 1 MAJOR? PO EXP: 04/30/00

EQUIPMENT DESCRIPTION

PERMIT / OLD PERMIT	FEE DESCRIPTION	FEE AMOUNT	QTY.	TOTAL FEES	
FACILITY ID: 2173 — 816,000 BTU/HR BOILER					
S-2173-1-0	660,000 BTU/HR	$ 255.00	1	$ 255.00	
0523-001					PERMIT(s) STATUS: D
FACILITY ID: 2173 — 649,999 BTU/HR BOILER					
S-2173-2-0	560,000 BTU/HR	$ 160.00	1	$ 160.00	
0523-002					PERMIT(s) STATUS: D
FACILITY ID: 2173 — RED FIR MAINTENANCE AREA - ONE 10,000 GALLON UNDERGROUND GASOLINE STORAGE TANK SERVED BY PHASE I VAPOR RECOVERY SYSTEM (G-70--97) AND 1 GASOLINE DISPENSING NOZZLE SERVED BY BALANCE PHASE II VAPOR RECOVERY SYSTEM (G-70-52)					
S-2173-3-0	1 NOZZLE	$ 27.00	1	$ 27.00	
0523-003					PERMIT(s) STATUS: A
FACILITY ID: 2173 — GRANT GROVE MAINTENANCE AREA - ONE 5,000 GALLON UNDERGROUND GASOLINE STORAGE TANK SERVED BY PHASE I VAPOR RECOVERY SYSTEM (G--70-97) AND 1 GASOLINE DISPENSING NOZZLE SERVED BY BALANCE PHASE II VAPOR RECOVERY SYSTEM (G-70-52)					
S-2173-4-0	1 NOZZLE	$ 27.00	1	$ 27.00	
0523-004					PERMIT(s) STATUS: A
FACILITY ID: 2173 — ASH MOUNTAIN MAINTENANCE AREA - ONE 6,000 GALLON UNDERGROUND GASOLINE STORAGE TANK SERVED BY PHASE I VAPOR RECOVERY SYSTEM (G--70-97) AND 1 GASOLINE DISPENSING NOZZLE SERVED BY BALANCE PHASE II VAPOR RECOVERY SYSTEM (G-70-52)					
S-2173-5-0	1 NOZZLE	$ 27.00	1	$ 27.00	
0523-005					PERMIT(s) STATUS: A
FACILITY ID: 2173 — 120 HP DIESEL I.C. ENGINE POWERING A 20 KW DETROIT MODEL #M E5398-5033-8101 EMERGENCY GENERATOR AT THE CEDAR GROVE SEWER PLAN-T					
S-2173-7-0	120 HP	$ 95.00	1	$ 95.00	
					PERMIT(s) STATUS: A
FACILITY ID: 2173 — 110 HP DIESEL I.C. ENGINE POWERING A 30 KW ONAN MODEL #M/300DDA 3R/113450 EMERGENCY GENERATOR AT THE CEDAR GROVE PACKER'S DOR-M					
S-2173-8-0	110 HP	$ 95.00	1	$ 95.00	
					PERMIT(s) STATUS: A
FACILITY ID: 2173 — 110 HP DIESEL I.C. ENGINE POWERING A 30 KW ONAN MODEL #M/300DDA 3R/113450 EMERGENCY GENERATOR AT THE CEDAR GROVE PACKER'S DOR-M					
S-2173-9-0	110 HP	$ 95.00	1	$ 95.00	
					PERMIT(s) STATUS: A

****

SEQUOIA & KINGS NAT PARKS, ATTN MR SCOTT RUESCH, THREE RIVERS, CA 93271 TEL: (209) 565-3341

BILLING MONTH: 4 FACILITY STATUS: A AREA NO: 1 MAJOR? PO EXP: 04/30/00

EQUIPMENT DESCRIPTION PERMIT OLD PERMIT	FEE DESCRIPTION	FEE AMOUNT	QTY.	TOTAL FEES

===FACILITY ID: 2173===

82 HP DIESEL I.C. ENGINE POWERING A 50 KW ONAN MODEL 50VA15R292568 EMERGENCY GENERATOR AT THE SUNSET CAMPGROUND -

S-2173-10-0	82 HP	$ 65.00	1	$ 65.00

PERMIT(s) STATUS: A

===FACILITY ID: 2173===

302 HP DIESEL I.C. ENGINE POWERING 200 KW ONAN MODEL #200DUF17R129255 EMERGENCY GENERATOR AT THE GRANT GROVE SEWER PLANT -

S-2173-11-0	302 HP I.C. ENGINE	$ 195.00	1	$ 195.00

PERMIT(s) STATUS: A

===FACILITY ID: 2173===

463 HP DIESEL I.C. ENGINE POWERING CATERPILLAR MODEL #34088 EMERGENCY GENERATOR AT THE CLOVER CREEK SEWER PLANT -

S-2173-12-0	463 BHP I.C. ENGINE	$ 390.00	1	$ 390.00

PERMIT(s) STATUS: A

===FACILITY ID: 2173===

180 HP DIESEL I.C. ENGINE POWERING DETROIT MODEL #10437305 EMERGENCY GENERATOR AT THE RED FIR MAINTENANCE STATION -

S-2173-15-0	180 HP I.C. ENGINE	$ 95.00	1	$ 95.00

PERMIT(s) STATUS: A

===FACILITY ID: 2173===

180 HP DIESEL I.C. ENGINE POWERING DETROIT MODEL #10437005 EMERGENCY GENERATOR AT THE LODGEPOLE LIFT STATION -

S-2173-16-0	180 HP	$ 95.00	1	$ 95.00

PERMIT(s) STATUS: A

****

SEQUOIA KINGS CANYON NAT PARKS, P.O. BOX 948, KINGS CYN NA/PK, CA 93633 TEL: (209) 335-2860

BILLING MONTH: 1 FACILITY STATUS: A AREA NO: 7 MAJOR? PO EXP: 01/31/01

EQUIPMENT DESCRIPTION

PERMIT	FEE DESCRIPTION	FEE AMOUNT	QTY.	TOTAL FEES
OLD PERMIT				

===FACILITY ID: 2150===

TWO 1,000 GALLON CONVAULT ABOVEGROUND GASOLINE STORAGE TANKS SERVED BY PHASE I VAPOR RECOVERY SYSTEM (G-70-116) AND TWO GASO-LINE DISPENSING NOZZLES. (EXEMPT FROM PHASE II REQUIREMENTS).

-2150-1-0	NOZZLE	$ 27.00	2	$ 54.00

PERMIT(s) STATUS: A

Note: Permit status A = Active and D = Exempt.

Appendix H. Scenic (Integral) Vistas List for Sequoia and Kings Canyon National Parks

Sequoia and Kings Canyon Integral Vistas

Number	Name	Status	Access	View
Group I: Middle Fork of the Kaweah River Canyon				
1	Amphitheater Point	Developed	Paved road	Southeast: Middle Fork Kaweah River Canyon, San Joaquin Valley, Coast Ranges
2	Eleven-Range View	Undeveloped	Paved road	
3	Moro Rock	Developed	Short trail	
4	Eagle view	Undeveloped	Short trail	
5	Alta Peak	Undeveloped	Back country trail	
Group II: Marble Fork Kaweah River Canyon				
6	Sunset Rock	Undeveloped	Short trail	Southwest: Marble Fork Kaweah River Canyon, San Joaquin Valley, Coast Ranges
7	Little Baldy	Undeveloped	Short trail	
8	Redwood Mountain View	Developed	Paved trail	
Group III: King River Canyon				
9	Sierra View	Developed	Paved road	Northeast: Kings River Canyon, Ten-Mile Creek Canyon, Sierra Crest
10	Panoramic Point	Developed	Paved road	
Group IV: Mount Whitney				
11	Mount Whitney	Undeveloped	Back country trail	South, east, north: a large area of eastern California and western Nevada including Inyo Mountains, White Mountains, Panamint Mountains, Spring Mountains, San Bernardino Mountains, Tehachapi Mountains, Coast Range, Mount Ritter, and the Owens Valley

Number	Name	Status	Access	View
12	Mount Langley	Undeveloped Rock climbing	Back country trail	
13	New Army Pass	Undeveloped	Back country trail	
Group V: Central Owens Valley				
14	Forester Pass	Undeveloped	Back country trail	East, northeast, southeast: Owens Valley, Inyo, White Mountains; University Peak, Independence Peak, Northern Ridge, Independence Creek Canyon
15	Kearsarge Pass/ Mt. Gould	Undeveloped	Back country trail	
16	Shepard Pass/ Mt. Williamson	Undeveloped	Back country trail, rock climbing	
Group VI: Northern Owens Valley				
17	Taboose Pass	Undeveloped	Back country trail	East, northeast, north: upper Owens Valley, White Mountains, Inyo Mountains, Shermit Summit, Long Valley
18	Mt. Sill	Undeveloped	Rock climbing	
19	Bishop Pass	Undeveloped	Back country trail	
20	Mt. Agassiz	Undeveloped	rock climbing	
Group VII: San Joaquin River Valley				
21	Mt. Goddard	Undeveloped	Rock climbing	Northwest: San Joaquin River Valley; West: San Joaquin Valley, Coast Ranges; North: Sierra Nevada, White Mountains; South: Sierra Nevada, Tehachapi Mountains
22	Hell for Sure Pass	Undeveloped	Back country trail	

Appendix I. Emission Inventory for San Joaquin Valley

Table I-1. San Joaquin Valley Air Basin Emissions
(tons per day)

	ROG	Percent of total ROG Emissions	NOx	Percent of total NOx Emissions	SOx	Percent of total SOx Emissions	PM10	Percent of total PM10 Emissions
Stationary Sources								
Fuel Combustion	18.0	3.1	180.0	34.5	28.0	40.8	22.0	2.0
Waste Burning	23.0	4.0	0.5	0.1	0.1	0.1	24.0	2.2
Solvent Use	90.0	15.7	N/A	0.0	N/A	0.0	0.1	0.0
Petroleum Processing	130.0	22.7	1.0	0.2	1.6	2.3	0.3	0.0
Industrial Processes	10.0	1.7	15.0	2.9	4.5	6.6	15.0	1.4
Miscellaneous Processes	79.0	13.8	0.1		N/A		1000.0	91.4
Total Stationary Sources	350	61.1	197	37.6	34	49.9	1061	97.0
Mobile Sources								
On-Road	170.0	29.7	230.0	44.0	23.0	33.5	25.0	2.3
Off-Road	19.0	3.3	2.8	0.5	0.4	0.6	0.1	0.0
Other Mobile	34.0	5.9	93.0	17.8	11.0	16.0	8.0	0.7
Total Mobile Sources	223	38.9	326	62.4	34	50.1	33	3.0
TOTAL SAN JOAQUIN VALLEY	573	100.0	522	100.0	69	100.0	1095	100.0

Source: California Air Resources Board, 1994a.

Table I-1. Continued

Notes: N/A indicates that emission estimates rounded off to less than 0.1 tons per day.

SOURCE CATEGORY DESCRIPTIONS:

Fuel Combustion - burning fuel in industrial, commercial, and residential sectors such as oil and gas production, petroleum refining, power plants, domestic heaters, and wood stoves.

Waste Burning - incineration and planned open burning, including prescribed fires for ecosystem management.

Solvent Use - use of all petroleum based and synthetic solvents in industrial, commercial, and residential sectors such as dry cleaning, painting, paving, printing, and consumer products.

Petroleum Processes - fugitive emissions from petroleum processing, storage, and transfer activities such as oil and gas extraction, petroleum refining, and marketing.

Industrial Processes - industrial processes producing articles of commerce such as chemical production and processing, metal production, recovery, and smelting, and wood and paper production.

Miscellaneous Processes - processes not classified in the other categories such as pesticide application, wildfires, vegetation emissions, and dust from farming operations, roads, wind, and construction. ROG emissions include 65 tons per day (tpd) from pesticide application, 7 tpd from farming operations, and 5.9 tpd from waste disposal. PM_{10} emissions include 140 tpd from farming operations, 62 tpd from construction and demolition, 400 tpd from entrained road dust, and 410 tpd from fugitive windblown dust.

On-Road Sources - all vehicles licensed to travel on public roads and highways. Heavy duty diesel trucks, representing only 8% of the miles traveled and 1% of the vehicles on the road, account for 40% of the NO_x, 80% of the SO_x, and 70% of the PM_{10} emissions.

Other Mobile Sources - vehicular and utility equipment emissions not included in on-road category such as off-road vehicles, trains, ships, boats, aircraft, tractors, and 2 and 4 stroke engine equipment.

Appendix J. Air Quality Database

Table J-1[1]

Sample Location	Type	Duration	Primary Data Sites	Primary Sponsor(s), Comments
HYDROLOGY				
Kaweah watershed	stream flow	1983-present	BRD, UCSB	NASA-EOS, Chamise Ck, Mineral King, Giant Forest, Tokopah watershed
park boundaries	river flow	early 1900's	SCE	SCE
METEOROLOGY				
Atwell Mill	tower	1975-present	U.S. Army Corps of Engineers	U.S. Army Corps of Engineers
Crescent Meadow	tower	1984-present	BRD	BRD, watershed research
Elk Creek	tower	1983-present	BRD	BRD, watershed research
Emerald Lake	tower	1985-present	UCSB	CARB, watershed research
Grant Grove	rain gauge	1991-present	SEKI	SEKI, chart only
Lookout Point	rain gauge	1991-present	SEKI	SEKI, chart only
Lookout Point	tower	1997-present	ARD, EPA AIRS	EPA/ARD, NDDN site
Lower Kaweah	tower	1988-present	CARB, ARD	CARB
Lower Kaweah	hygrothermograph	1982-96	SEKI	SEKI, chart only
parkwide	daily weather	1931-present	NOAA, SEKI	SEKI, Ash Mountain, Lodgepole, Grant Grove
parkwide	snow records	1925	DWR	DWR

Table J-1[1] - Continued

Sample Location	Type	Duration	Primary Data Sites	Primary Sponsor(s), Comments
Topaz ("Dome") Lk	tower	1995-present	UCSB	NASA-EOS
Wolverton	tower	1986-present	NOAA	NOAA/BRD, dry deposition tower
OZONE				
Ash Mountain	ozone	1982-present	ARD, EPA AIRS	CARB/ARD, 1982-87 and 1996 summer only
Grant Grove	ozone	1990-95	ARD, EPA AIRS	ARD, 1995 summer only
Lookout Point	ozone	1983, 1988-present	SEKI, ARD, EPA AIRS	ARD, solar powered, became NDDN site in 1997
Lower Kaweah	ozone	1982-present	ARD, EPA AIRS	ARD, 1982-83 at Lodgepole, 1982-87 summer only
OZONE INJURY TO JEFFREY AND PONDEROSA PINES				
Giant Forest and Grant Grove	Project FOREST plots	1991-94	USFS-PSW	SEKI/ARD, 3 plots, 50 trees each
parkwide	permanent plots	1980-82, 1984, 1985, 1989	SEKI	SEKI/ARD, 57 plots, 10-15 trees each (10 collocated black oak plots)
parkwide	one-time survey	1986	SEKI	ARD, 98 points, 15 trees each
PARTICULATES (dry deposition, visibility)				
Ash Mountain	IMPROVE	1992-present	ARD	ARD, 1st year modules A&B only, every Wed/Sat samples

Table J-1[1] - Continued

Sample Location	Type	Duration	Primary Data Sites	Primary Sponsor(s), Comments
Ash Mountain	Nephelometer 1590	1992-96	SEKI	ARD, with RH sensor
Ash Mountain	HI-Vol Sampler	1982-87	CARB	CARB/SEKI, total suspended particulates
Lookout Point	NDDN sampler	1997-present	ARD, EPA AIRS	ARD/EPA, 1 week samples
Lower Kaweah	CADMP Dry Deposition sampler	1988-95	CARB	CARB, PM10 and PM2.5, 1 every 6 day samples
Lower Kaweah	automated camera	1983-present	SEKI	SEKI, 1983-1988 incomplete
Lower Kaweah	HI-Vol Sampler	1982-87	CARB	CARB/SEKI, total suspended particulates
Wolverton	NOAA Dry Deposition tower	1986-present	NOAA	NOAA/BRD, 1 week samples
WATER CHEMISTRY				
Bench Lk and Mt. Pinchot	lake	1992	UCSB, UCLA	
Chamise Ck	stream	1983-present	BRD, WRD	NAPAP/BRD
Emerald Lk	lake	1983-88	CARB	CARB
Emerald Lk outflow	lake outflow	1983-present	BRD, WRD, UCSB	NAPAP/BRD
Emerald/Pear/Topaz Lks	lake	1988-92	CARB	CARB

Table J-1[1] - Continued

Sample Location	Type	Duration	Primary Data Sites	Primary Sponsor(s), Comments
Mineral King	stream	1995-present	BRD, WRD	BRD, Trauger's Ck, Deadman Ck, East Fork Kaweah, 5-yr fire risk reduction project
parkwide	lake	1965, 1980-82	UCR	SCE
parkwide	lake	1985	EPA	NAPAP, Western Lake Survey
parkwide	stream	1978-79	EPA STORET	WRO, contract with USGS
parkwide	lake	1981-82	UCSB	USDI Office of Water Research and Technology
parkwide	lake and stream	1981-1988	EPA STORET	SEKI, only 2 sites in Kings Canyon
Tharps/Log Cks	stream	1983-present	BRD, WRD	NAPAP/BRD
Tokopah watershed	lake and stream	1992-present	UCSB	NASA-EOS
WET DEPOSITION				
Ash Mountain	Aerochemetrics	1983-present	BRD, CARB	CARB, rain gauge w/event recorder
Emerald Lk	Aerochemetrics	1984-present	UCSB	CARB, rain gauge w/event recorder, summer only
Emerald Lk and Mineral King	snow	1990-95	UCSB	CARB

Table J-1[1] - Continued

Sample Location	Type	Duration	Primary Data Sites	Primary Sponsor(s), Comments
Emerald Lk, Pear Lk, Topaz Lk, Tokopah Valley	snow	1983-present	UCSB	CARB/NASA-EOS, watershed survey
Lower Kaweah	Aerochemetrics	1980-present	BRD, WRD, NADP	NADP/BRD, rain gauge w/event recorder
Lower Kaweah	Aerochemetrics	1983-present	BRD, CARB	ARB

1 *ARD* = NPS Air Resources Division, *BRD* = USGS Biological Research Division stationed at SEKI, *CADMP* = California Acid Deposition Monitoring Program, *CARB* = California Air Resources Board, *DWR* = California Department of Water Resources, *EPA AIRS* = Environmental Protection Agency Aerometrics Information Retrieval System, *IMPROVE* = Interagency Monitoring of Protected Visual Environments, *NADP* = National Atmospheric Deposition Program, *NAPAP* = National Acid Precipitation Assessment Program, *NASA-EOS* = National Air and Space Administration/Earth Observing System, *NDDN* = EPA's National Dry Deposition Network, *NOAA* = National Oceanic and Atmospheric Administration, *Project FOREST* = Forest Ozone Response Study, *SCE* = Southern California Edison, *SEKI* = Sequoia and Kings Canyon National Parks, *UCR* = University of California Riverside, *UCSB* = University of California Santa Barbara, *USFS-PSW* = U.S. Forest Service Pacific Southwest Research Station, *USGS* = U.S. Geological Survey, *WRD* = NPS Water Resources Division, *WRO* = NPS Western Regional Office. For specific references, contact staff at SEKI or find in SEKI procite bibliographical database.