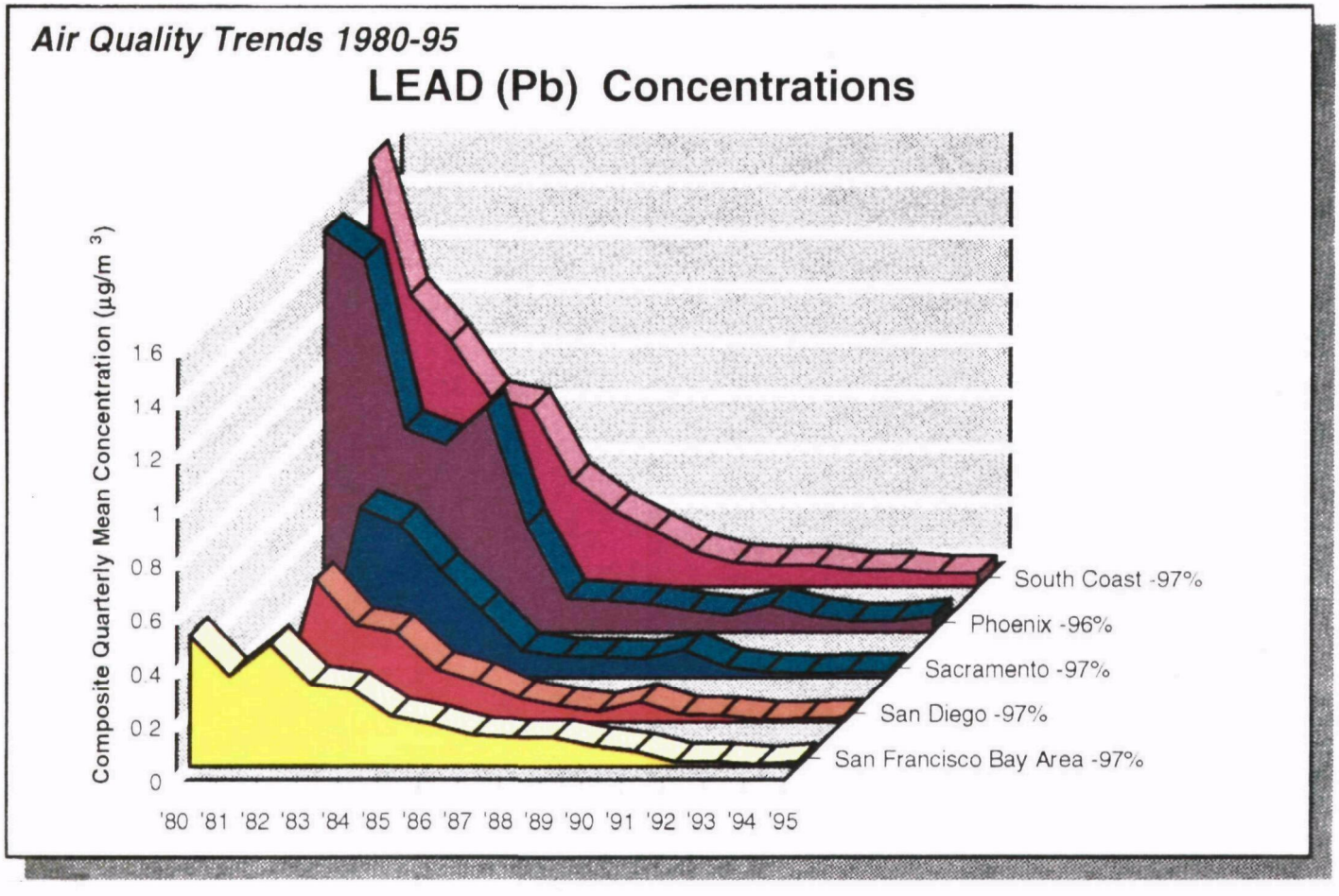
BREATHING EASIER: 1996
A REPORT ON AIR QUALITY
IN CALIFORNIA, ARIZONA, NEVADA, & HAWAII

September 1996

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 9



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Region 9
Air and Toxics Division

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EXECUTIVE SUMMARY

WE'RE BREATHING EASIER:

LONG-TERM PROGRESS TOWARD CLEANER AIR IN THE WESTERN STATES

A year ago, U.S. EPA published the first Breathing Easier report. This update provides evidence that the long-term trend toward cleaner air in the western region is continuing, though trouble spots remain.

There has been a substantial improvement in air quality in U.S. EPA's western region -- California, Arizona, Nevada, and Hawaii -- over the last ten years. Despite an increase in auto travel of almost 50% over the past decade, air pollutant levels have decreased overall by about one-third. Both the number of days on which air pollution has exceeded federal air quality standards and the air pollutant concentration levels have decreased for the six major air pollutants targeted for reduction under the federal Clean Air Act.

Of the six pollutants, the greatest reductions have been recorded for lead (86%), followed by carbon monoxide (35%), and particulate matter (26%). The tremendous reduction in lead levels has resulted mostly from the phase-out of lead in gasoline. Particulate matter, carbon monoxide, and smog-forming ground-level ozone present the most serious remaining challenges. However, all six pollutants are being steadily reduced.

Long-Term (1986-95) Air Quality Trends

Ten-year trends show that air quality has improved for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead. Although particulate matter has only been monitored for eight years, levels have decreased during that period.

Changes in air pollutant levels between 1986 and 1995 (the most recent year for which complete data are available) for all long-term monitoring sites in California, Arizona, Nevada, and Hawaii are as follows:

- Lead (Pb): 86% decrease
- Carbon Monoxide (CO): 35% decrease
- Particulate Matter (PM_{10}): 26% decrease
- Sulfur Dioxide (SO_2): 21% decrease
- Nitrogen Dioxide (NO_2): 15% decrease
- Ozone (O_3): 12% decrease

Most Improved Areas

Many of the geographic areas that failed to meet federal air quality standards when the Clean Air Act Amendments were passed in 1990 have improved enough to meet the standards based on data from

more recent years (1993, 1994, and 1995). Areas in this "most improved" category, for each of the six pollutants, are:

- Ground-level Ozone (O_3): Reno, Monterey Bay, Chico, and Yuba City areas.

- Particulate Matter (PM_{10}): Sacramento, Mojave Desert, and Mono Lake, California; Ajo, Bullhead City, Douglas, Hayden, Miami, Nogales, Paul Spur, Payson, Rillito, and Yuma, Arizona.

- Carbon Monoxide (CO): San Francisco Bay Area, San Diego, Sacramento, Fresno, Stockton, Modesto, Bakersfield, Chico, Lake Tahoe, Reno and Tucson.

- Sulfur Dioxide (SO_2): All areas with man-made sources met the federal standards. In earlier years, violations had occurred near nonferrous metal (copper) smelters in Arizona, but none have been recorded recently. The only recent violations were from naturally-occurring volcanic emissions at Hawaii Volcanoes National Park.

- Nitrogen Dioxide (NO_2): All areas met the federal standard. The last violation of the standard was in the South Coast Air Basin (Los Angeles Area) in 1991 That area met the standard from 1992 through 1995.

- Lead (Pb): All areas met the federal standard.

Where Problems Remain

- Ground-level Ozone (O_3) violations were recorded in most of Southern California, the San Joaquin Valley, San Francisco Bay Area, Sacramento Area, and Phoenix.

- Particulate Matter (PM_{10}) violations were recorded in the South Coast Air Basin, Southeast Desert, Great Basin Valley, San Joaquin Valley, Reno, Las Vegas, and Phoenix.

- Carbon Monoxide (CO) violations occurred in the South Coast Air Basin, Phoenix, Las Vegas, and Calexico.

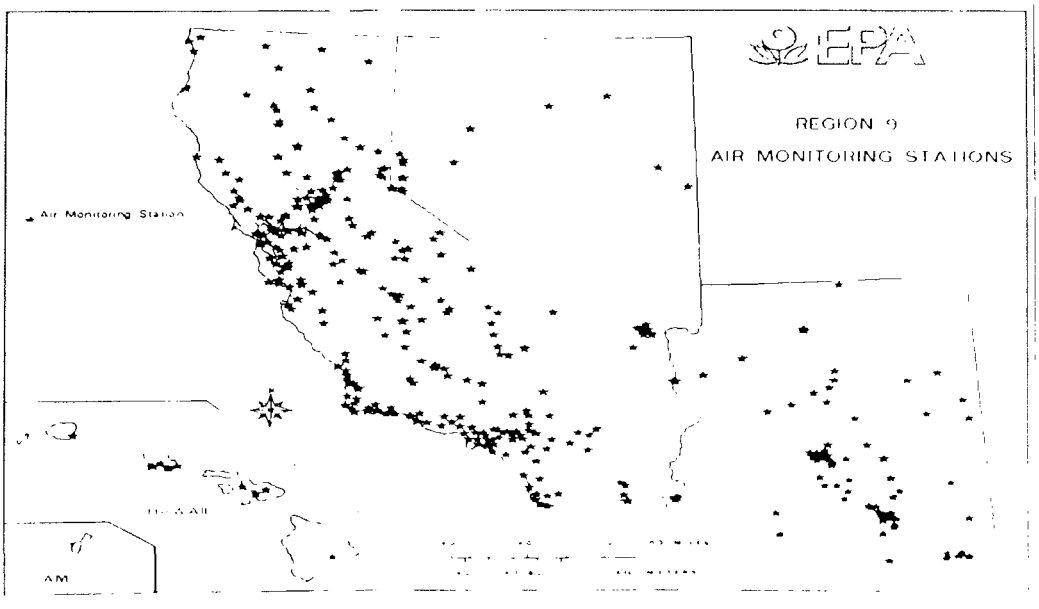


Figure ESa - Air Monitoring Stations, 1993-1995.

INTRODUCTION

This report presents air quality information for areas within EPA Region 9, consisting of Arizona, California, Hawaii, Nevada, and the Pacific Islands. Current air quality (through 1995) and ten-year trends are presented for the six air pollutants for which National Ambient Air Quality Standards (NAAQS) have been developed. These air pollutants are carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), lead (Pb), and particulate matter with aerodynamic size of 10 microns or less (PM_{10}). In addition to the 10 year (1986-1995) air quality trend statistics, which are presented for comparison with the national numbers, air quality graphs are presented for the 16 year period from 1980 through 1995 to show long-term changes.

The Federal standards are presented in Table 1. Although most of the standards are in units of parts per million (ppm), some text and graphics in this report use parts per billion (ppb) units. The conversion factor is 1000 ppb equals 1 ppm. State air quality standards may differ from the NAAQS.

The air quality data for this report were collected from several hundred monitoring sites (see Figure ESa) throughout Region 9 by local, state, and Federal agencies and private organizations. Most of the data are stored on EPA's Aerometric Information Retrieval Systems (AIRS) data base. The data, analysis methods, and emissions estimates used in this report are taken from EPA's annual "National Air Quality and Emissions Trends Report", but are tailored specifically to EPA Region 9. The reader may refer to that document for technical details and for air quality information about areas outside of Region 9.

The information presented here is organized by pollutant and is intended to show general air quality and trends for areas within Region 9 and for the Region as a whole. In most cases, air quality information is not presented for individual monitors.

Table 1

National Ambient Air Quality Standards (NAAQS)

Pollutant	Primary (Health Related)		Secondary (Welfare Related)	
	Type of Average	Standard Level Concentration[a]	Type of Average	Standard Level Concentration
CO	8-hour[b]	9 ppm (10 mg/m^3)	No Secondary Standard	
	1-hour[b]	35 ppm (40 mg/m^3)	No Secondary Standard	
Pb	Maximum Quarterly Average	1.5 µg/m^3	Same as Primary Standard	
NO_2	Annual Arithmetic Mean	0.053 ppm (100 µg/m^3)	Same as Primary Standard	
O_3	Maximum Daily 1-hour Average[c]	0.12 ppm (235 µg/m3)	Same as Primary Standard	
PM-10	Annual Arithmetic Mean[d]	50 µg/m^3	Same as Primary Standard	
	24-hour[d]	150 µg/m^3	Same as Primary Standard	
SO_2	Annual Arithmetic Mean	80 µg/m^3 (0.03 ppm)	3-hour[b]	1300 µg/m^3 (0.50 ppm)
	24-hour[b]	365 µg/m^3 0.14 ppm		

[a] Parenthetical value is an approximately equivalent concentration.

[b] Not to be exceeded more than once per year.

[c] The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than one, as determined according to Appendix H of the Ozone NAAQS.

[d] Particulate standards use PM-10 (particles less than 10µ in diameter) as the indicator pollutant. The annual standard is attained when the expected annual arithmetic mean concentration is less than or equal to 50 µg/m^3; the 24-hour standard is attained when the expected number of days per calendar year above 150 µg/m^3 is equal to or less than one; as determined according to Appendix K of the PM NAAQS.

OZONE

BACKGROUND and HEALTH EFFECTS

Ground-level ozone (O_3) is the major component of smog. While ozone in the upper atmosphere benefits life by shielding the earth from the sun's harmful ultraviolet radiation, high concentrations of ozone at ground level are a major health and environmental concern. Ozone is not emitted directly into the air, but is formed through complex chemical reactions between precursor emissions of volatile organic compounds (VOC) and nitrogen oxides (NO_x) in the presence of sunlight. These reactions are stimulated by sunlight and temperature, so that peak ozone levels typically occur during the warmer times of the year. Both VOC and NO_x are emitted by motor vehicles and industrial sources.

The reactivity of ozone causes health problems because it damages lung tissue, reduces lung function, and sensitizes the lungs to other irritants. Scientific evidence indicates that ambient levels of ozone not only affect people with impaired respiratory systems, such as asthmatics, but healthy adults and children as well. Exposure to ozone for several hours at relatively low concentrations has been found to reduce lung function significantly in normal, healthy people during exercise. This decrease in lung function generally is accompanied by symptoms including chest pain, coughing, sneezing, and pulmonary congestion. Ozone also damages agricultural crops and forests.

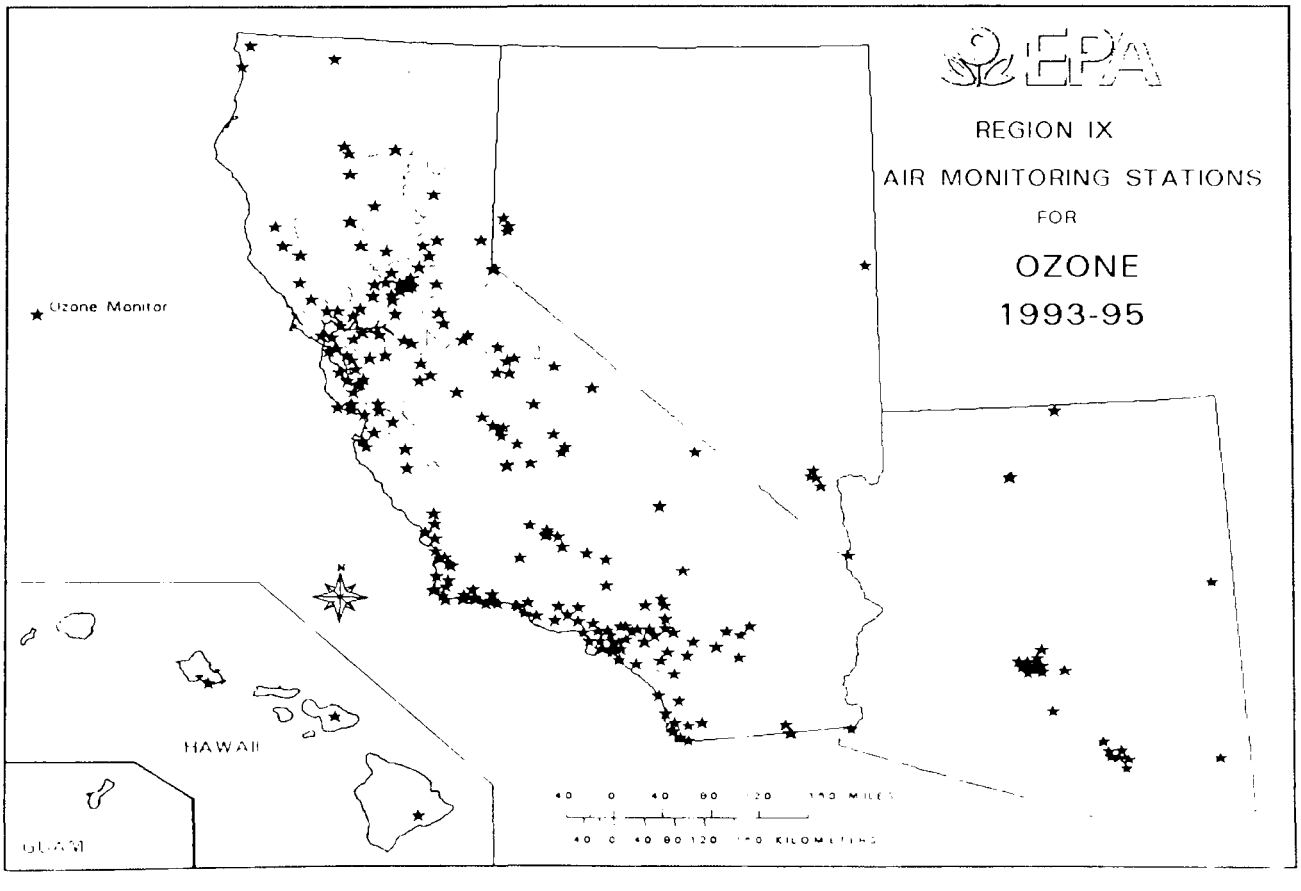


Figure 1a

The national health standard for O_3 is defined in terms of the daily highest (1-hour average) concentration. Ambient O_3 concentrations should not exceed 120 ppb more than one day per year, based on a three-year average.

RECENT OZONE AIR QUALITY IN REGION 9

For the three-year period 1993-95, O_3 was monitored at 251 sites in Region 9. Figure 1a shows the geographic distribution of O_3 monitors throughout the Region. In general, more monitors are located in or near urban areas than in rural areas.

The 81 monitoring stations where ozone pollution exceeded the NAAQS during 1993-95 are shown on the map in Figure 1b as the vertical "spikes". The height of each spike is proportional to the number of days per year that the NAAQS was exceeded. The most serious O_3 problem in the Region (and in the nation) is in the South Coast Air Basin (Los Angeles area). Other areas that violated the O_3 NAAQS include San Diego, Ventura, and Santa Barbara counties, the California Southeast Desert, San Joaquin Valley, San Francisco Bay Area, Sacramento, and Phoenix.

LONG-TERM OZONE TRENDS

With respect to ozone, air quality has improved over the last ten years in most areas of California, Arizona, Nevada, and Hawaii. The exception is Phoenix, the one urban area that has had an increase in peak ozone concentrations over the last ten years. Also, the number of days per year above the ozone standard in Phoenix has been higher in recent years than in the late 1980s.

The San Francisco Bay Area, which typically exceeds the ozone standard two to three days per year, had 13 days above the standard in the latest year, 1995. This unexpected increase in high ozone days appears to be continuing into the 1996 ozone season.

For the Region as a whole, there were 141 long-term monitors that operated for the ten-year period. These monitors, as a group, showed a 12% decrease in O_3 concentrations between 1986 and 1995 (based on the second highest daily 1-hour maximum concentration). This compares to a 12% decrease at 549 sites nationwide.

Figure 1c shows the number of days that the O_3 Stage 1 ("smog alert") level of 200 ppb was reached in the five most serious O_3 pollution areas of Region 9. Ozone air quality measured by this air quality indicator has improved remarkably over the last ten years. The South Coast had 102 Stage 1 days in 1980 compared to 11 in 1995. Likewise, the Southeast Desert has improved from a high of 24 Stage 1 days in 1980 to one day in 1995. Stage 1 days have not occurred for several years in San Diego or Ventura counties. Imperial County reached Stage 1 levels in 1993 and 1995.

Figure 1d shows the number of days in which ozone levels exceeded the O_3 standard of 120 ppb for each year since 1980 in various areas of the Region. Note that the number of days is a "basin-wide" composite from all O_3 monitors in an air basin. It represents the number of days during the year that the O_3 standard was exceeded at one or more monitors.

The largest reduction in ozone pollution has been in the California South

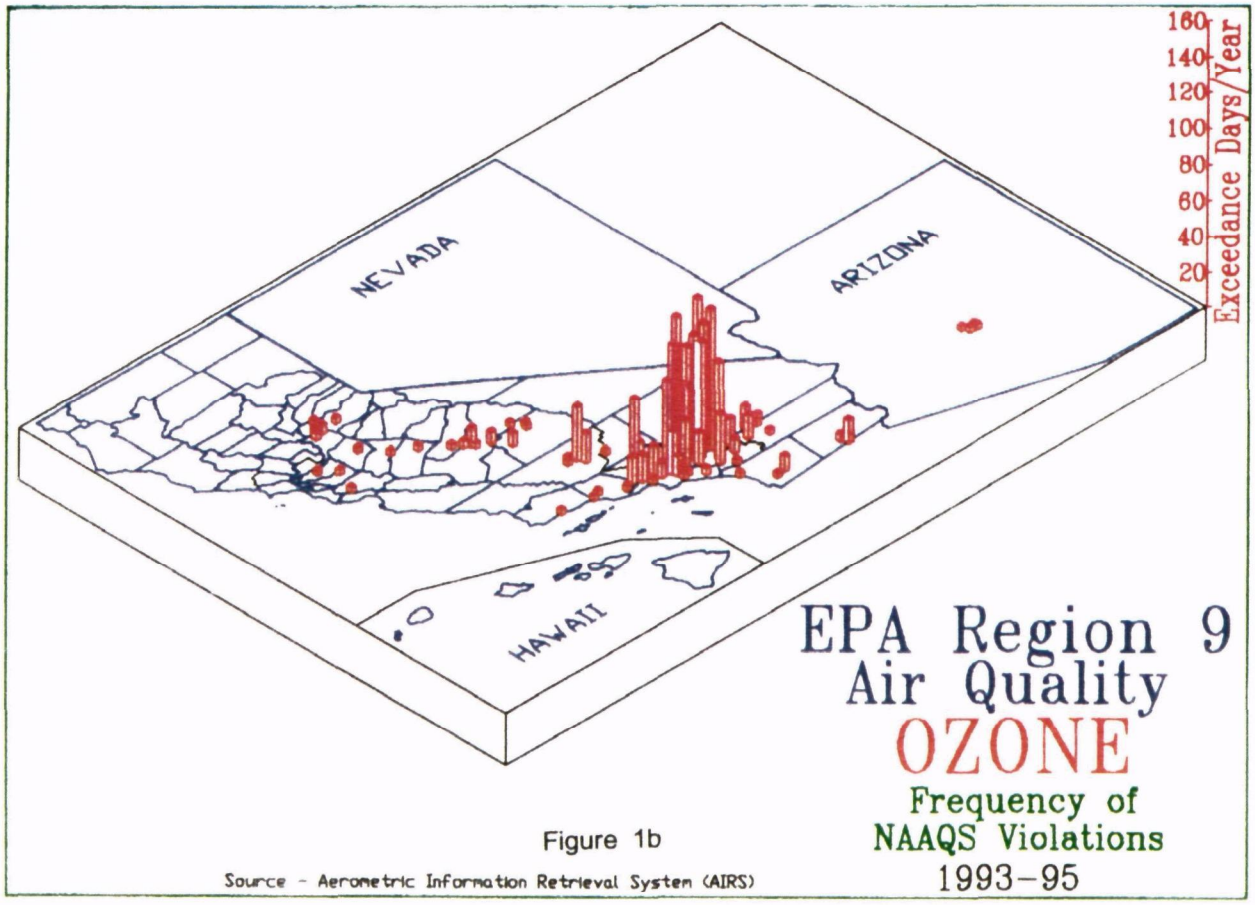


Figure 1b

Source - Aerometric Information Retrieval System (AIRS)

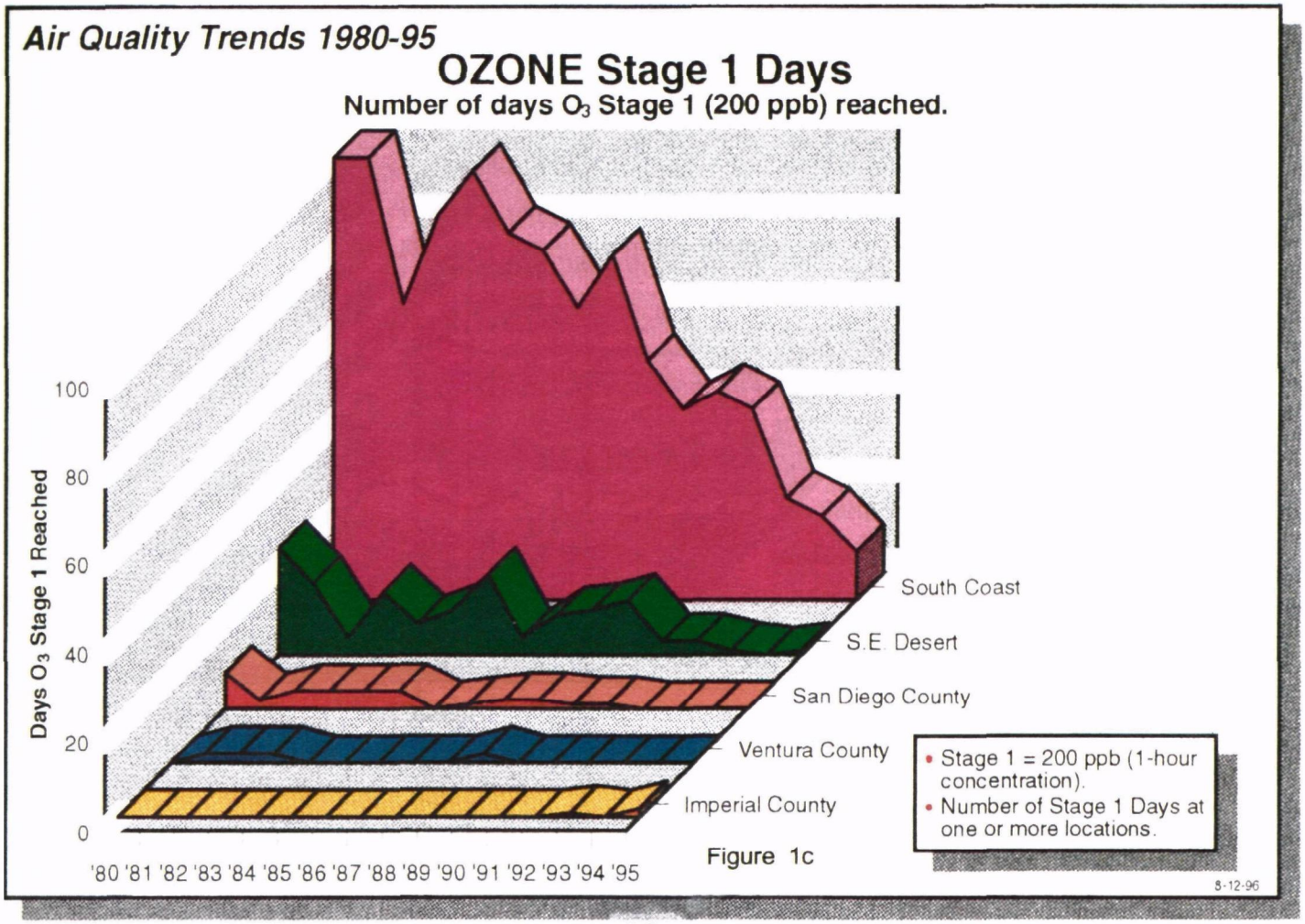
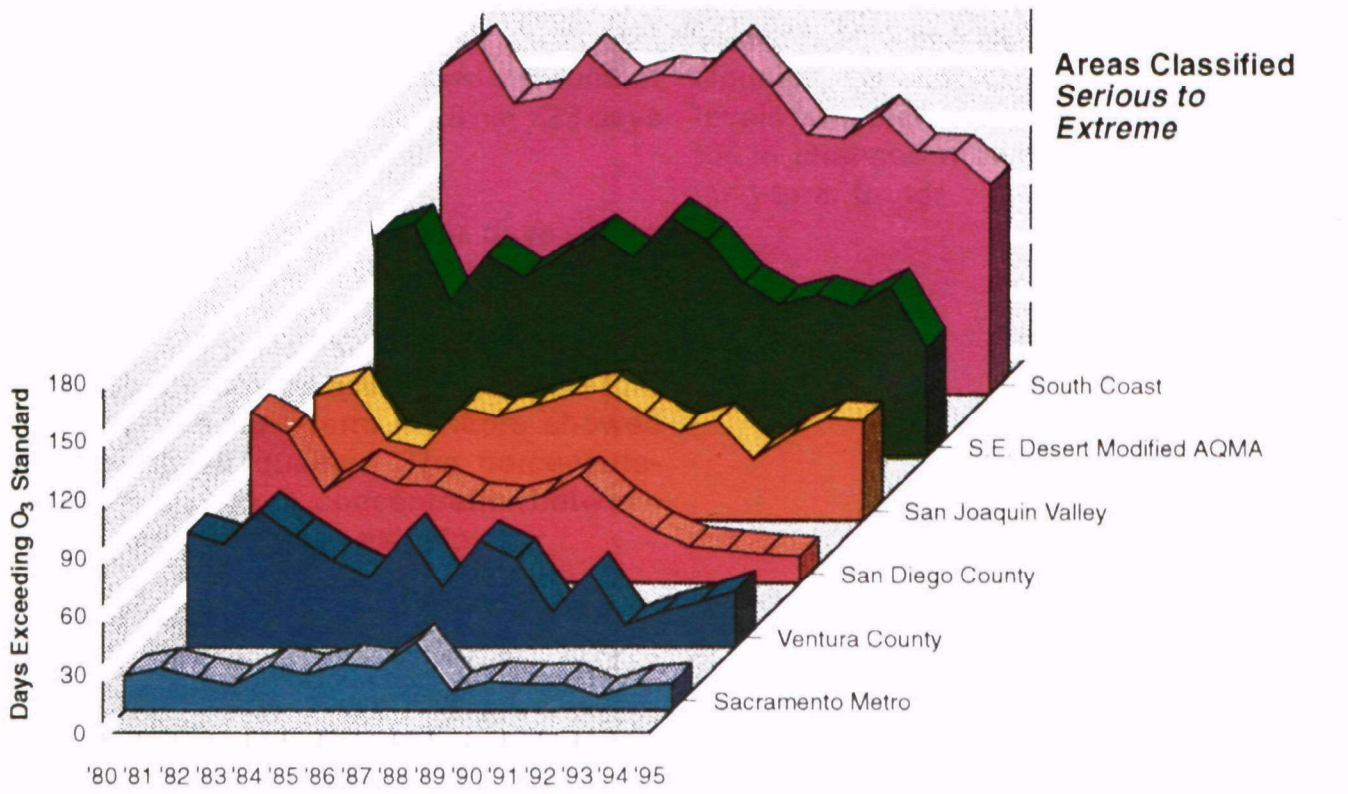
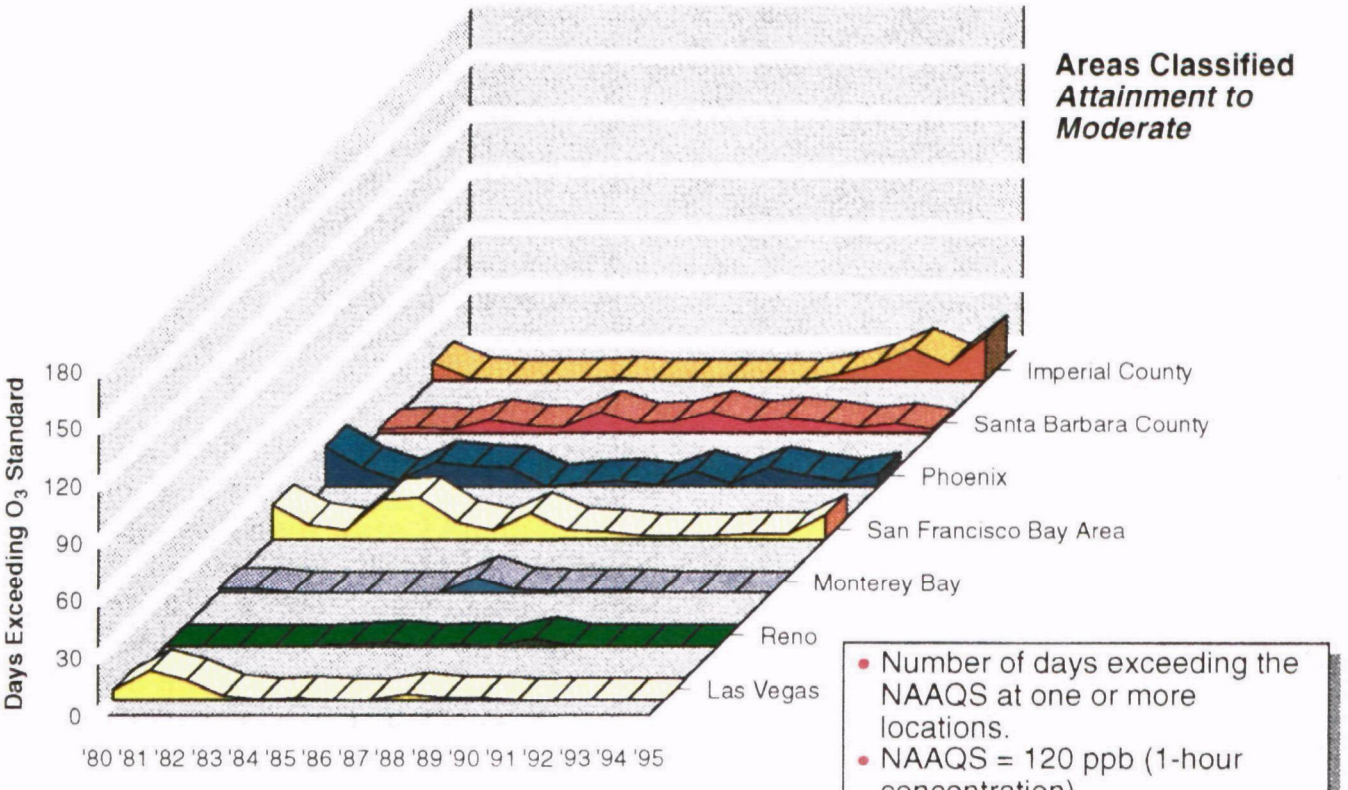


Figure 1c

OZONE Exceedances

Number of days exceeding the O_3 NAAQS.





- Number of days exceeding the NAAQS at one or more locations.
- NAAQS = 120 ppb (1-hour concentration).
- NAAQS = National Ambient Air Quality Standard.

Figure 1d

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Coast Air Basin. The standard was exceeded in the Basin on 184 days at its worst in 1981. In 1995, it was exceeded on 107 days. The second-largest improvement occurred in the California Southeast Desert area, where the number of exceedances decreased from 123 days in 1988 to 56 days in 1995.

The trend toward fewer days above the O_3 NAAQS and Stage 1 smog alert level has been accompanied by a trend in lower O_3 concentrations. Peak O_3 concentrations in most areas of Region 9 that had several long-term monitors showed improving air quality. The percent decreases in peak O_3 concentration between 1986 and 1995 were as follows:

% Decrease In Peak *Concentration*	*Area*
-28%	San Diego County
-27%	South Coast
-20%	Southeast Desert, CA
18%	Ventura County
16%	Monterey Bay
13%	Sacramento Metro
13%	Santa Barbara Co.
8%	San Joaquin Valley
4%	San Francisco Bay
+11%	Phoenix

The South Coast Air Basin had the second largest decrease in peak O_3 concentrations. There were 27 long-term O_3 monitors in the South Coast and the average (second highest daily 1-hour) concentration at those sites decreased from 227 ppb in 1986 to 164 ppb in 1995.

Although Figure 1d shows overall improvement for ozone, some areas have shown recent degradation, such as Phoenix, San Francisco Bay Area, San Joaquin Valley, Imperial County, and Ventura County. It is important to note that ozone levels can fluctuate from year to year and these changes may not be indicative of long-term trends.

PARTICULATE MATTER

BACKGROUND and HEALTH EFFECTS

Air pollutants called "particulate matter" include dust, dirt, soot, smoke, and liquid droplets directly emitted into the air by sources such as factories, power plants, transportation sources, construction activity, fires, and windblown dust. Particulates are also formed in the atmosphere by condensation or transformation of emitted gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds into tiny droplets.

Based on studies of human populations exposed to high concentrations of particles (often in the presence of sulfur dioxide) and on laboratory studies of animals and humans, the major concerns for human health include effects on breathing and respiratory functions, aggravation of existing respiratory and cardiovascular disease, alterations in the body's defense systems against foreign materials, damage to lung tissue, carcinogenesis and premature death. The major subgroups of the populations that appear likely to be most sensitive to the effects of particulate matter include individuals with chronic obstructive pulmonary cardiovascular disease, individuals with influenza, asthmatics, the elderly, and children. Particulate matter may injure crops, trees and shrubs, and may cause damage to metal surfaces, fabrics, etc. Fine particulates also impair visibility by scattering light and reducing the visual range in urban, rural, and wilderness areas. The haze caused by fine particles can diminish crop yields by reducing sunlight.

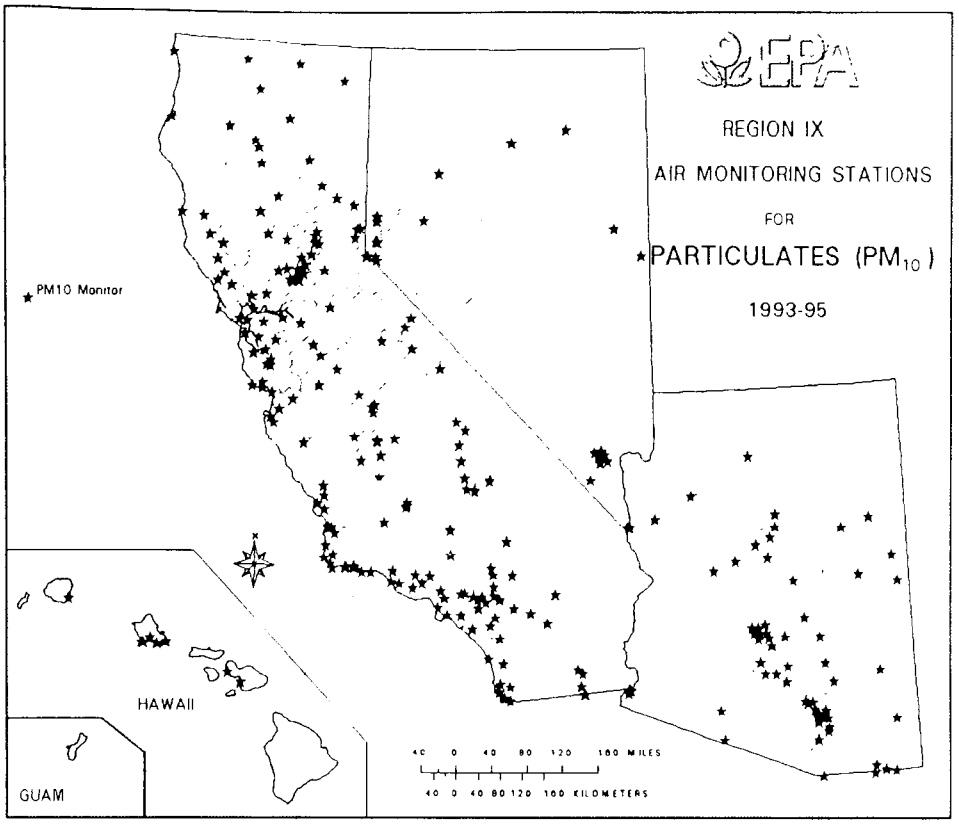
The current NAAQS for particulate matter was established in 1987 The particulate size measurement used, known as PM_{10}, includes particles with an aerodynamic diameter of less than 10 microns. These smaller particles are most likely responsible for the adverse health effects on humans, because particles so small can reach the thoracic or lower regions of the respiratory tract. The PM_{10} annual mean standard is 50 micrograms per cubic meter of air ($\mu g/m^3$). The 24-hour standard is attained when the expected number of days per calendar year above 150 $\mu g/m^3$ is no more than one. EPA is currently reviewing recent health effects studies on fine particulates, and may revise the PM_{10} NAAQS to focus on particles smaller than ten microns, possibly at 2.5 microns. In addition, EPA is considering standards for visibility impairment and regional haze, which may be part of the revised PM NAAQS or separate standards. A proposal is expected in November 1996 with final promulgation in June 1997

RECENT PM_{10} AIR QUALITY IN REGION 9

For the three-year period 1993-95, PM_{10} was monitored at 298 sites in Region 9. Figure 2a shows the geographic distribution of PM_{10} monitors throughout the Region.

The 42 PM_{10} sites that violated the NAAQS during 1993-95 are shown on the map in Figure 2b. The "spikes" represent monitors with PM_{10} levels in violation of the annual standard, and the height of each spike shows the annual mean concentration for the site. The triangles on the map show monitors that attained the annual standard but exceeded the 24-hour standard. The more serious PM_{10} problem areas in Region 9 are in the South

Figure 2a



Coast Air Basin (Los Angeles area), San Joaquin Valley, Southeast Desert, and Great Basin Valley of California, in addition to Reno, Las Vegas, Phoenix, and areas near the Mexican border.

LONG-TERM PM_{10} TRENDS

PM_{10} is the newest NAAQS pollutant to be measured, with data going back only to 1988 in most areas. Overall, PM_{10} annual mean concentrations have decreased by 26% in Region 9, based on 156 monitoring sites operating from 1988 through 1995. This compares to a 20% decrease at 748 sites nationwide.

Figure 2c shows the PM_{10} trends for 22 areas in Region 9 from 1988 through 1995. For most of the areas, the number of days with high particulate pollution has decreased over time. For example, the number of days with excess pollution in the San Joaquin Valley decreased from 14 days in 1990 to 3 days in 1995. Likewise, Paul Spur, a town in Arizona, improved from 11 days above the standard in 1989 to none in 1995. Although Figure 2c shows general improvement in particulate trends, some areas have shown more bad-air days in 1995. It is important to note that daily particulate levels can fluctuate and these increases may not be indicative of longer term trends.

Figure 2d shows the trend in annual PM_{10} concentrations since 1988. For all areas, the trend is positive -- the annual mean particulate concentration has decreased. The nonattainment areas (with several long-term monitors) that had the largest percentage reduction in their annual mean concentration are:

% Decrease in Concentration	Area
-49%	Sacramento County
-36%	Coachella Valley, CA
-34%	South Coast
-33%	San Joaquin Valley
-28%	Las Vegas
-24%	Reno
-23%	Searles Valley, CA
-14%	Phoenix

California's South Coast Air Basin has the largest long-term PM_{10} monitoring network, with 14 sites, and has shown an overall 34% reduction in annual mean concentrations between 1988 and 1995.

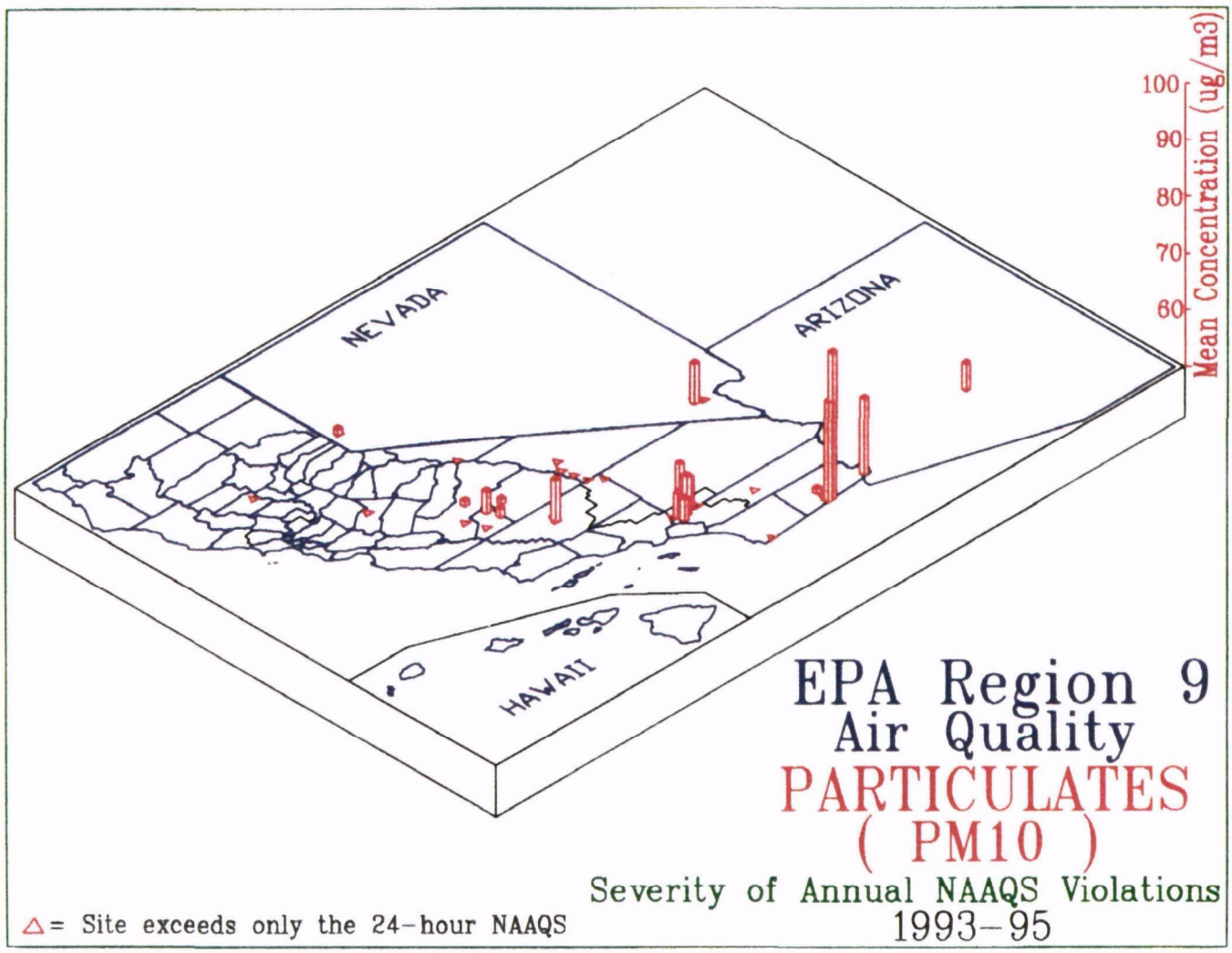

NEVADA
ARIZONA
HAWAII
100
90
80
70
60
Mean Concentration (ug/m3)
EPA Region 9
Air Quality
PARTICULATES
(PM10)
Severity of Annual NAAQS Violations
1993–95
△= Site exceeds only the 24-hour NAAQS

Figure 2b

PARTICULATE MATTER (PM_{10}) Exceedances

Number of days exceeding the 24-hour PM_{10} NAAQS.

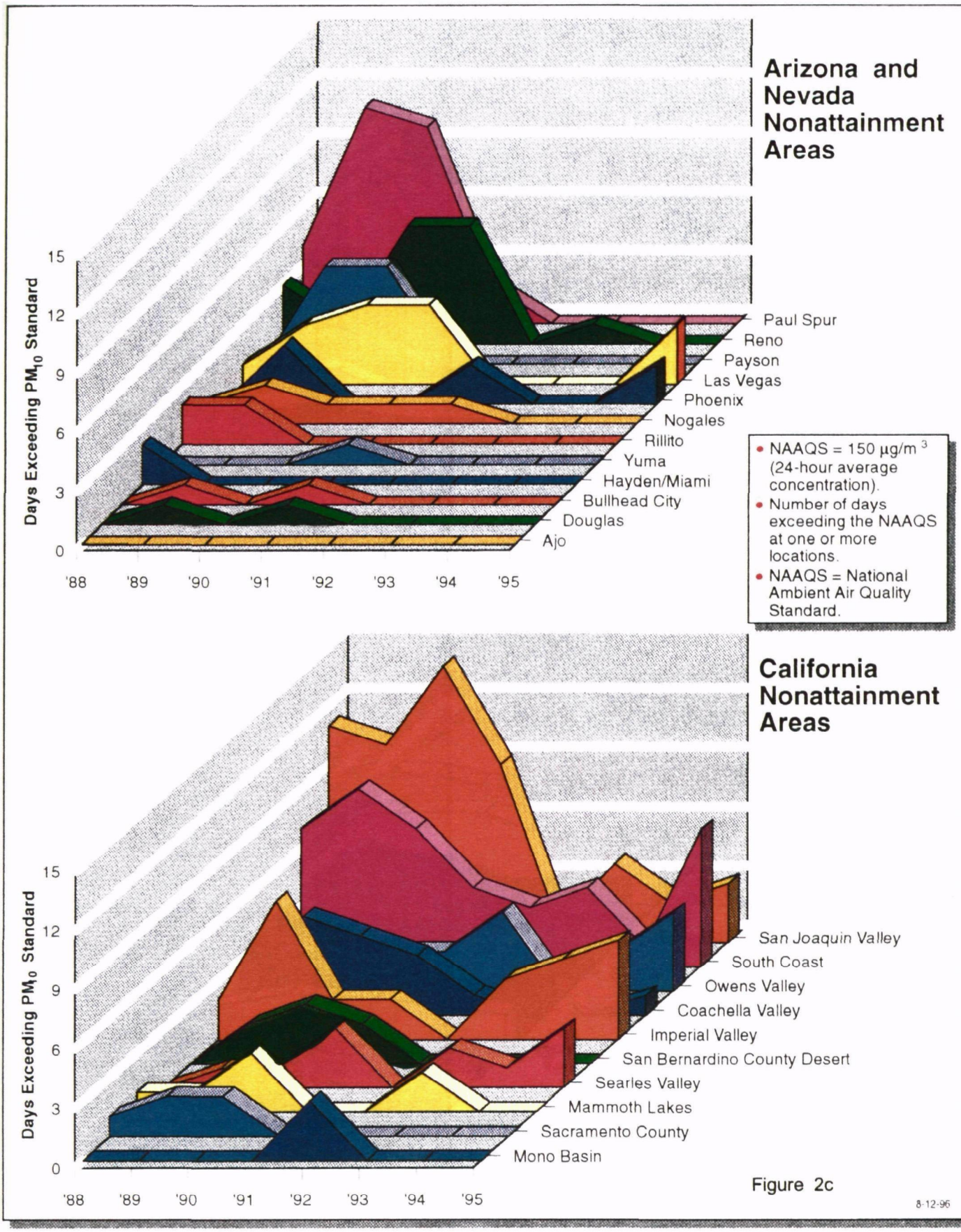


Figure 2c

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PARTICULATE MATTER (PM_{10}) Concentrations

Composite annual mean concentrations.

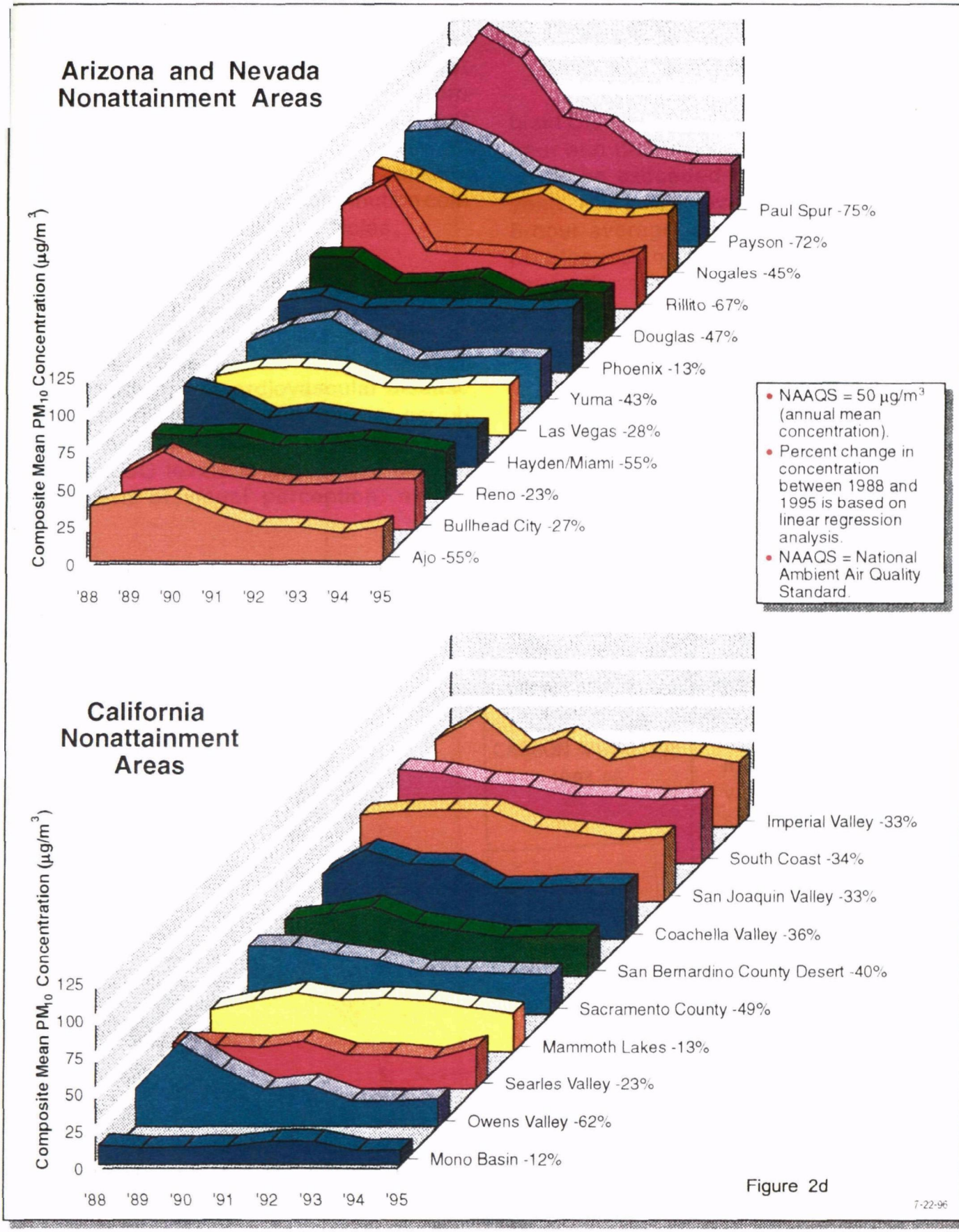

Figure 2d

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CARBON MONOXIDE

BACKGROUND and HEALTH EFFECTS

Carbon monoxide (CO) is a colorless, odorless, and poisonous gas produced by incomplete combustion of carbon in fuels. Two-thirds of the nationwide CO emissions are from transportation sources, with the largest contribution coming from highway motor vehicles.

Carbon monoxide enters the bloodstream and reduces the delivery of oxygen to the body's organs and tissues. The health threat is most serious for those who suffer from cardiovascular disease, particularly those with angina or peripheral vascular disease. Exposure to elevated CO levels is associated with impairment of visual perception, manual dexterity, learning ability, and performance of complex tasks.

The national health standard for ambient CO specifies upper limits for both 1-hour and 8-hour average levels that are not to be exceeded more than once per year. The 1-hour level is 35 ppm, and the 8-hour average level is 9 ppm. This report focuses on the 8-hour standard because the 1-hour standard is rarely exceeded.

RECENT CARBON MONOXIDE AIR QUALITY IN REGION 9

For the two-year period 1994-95, CO was monitored at 141 sites in Region 9. Figure 3a shows the geographic distributions of CO monitors throughout the Region. In general, more monitors are located in or near urban areas than in rural areas.

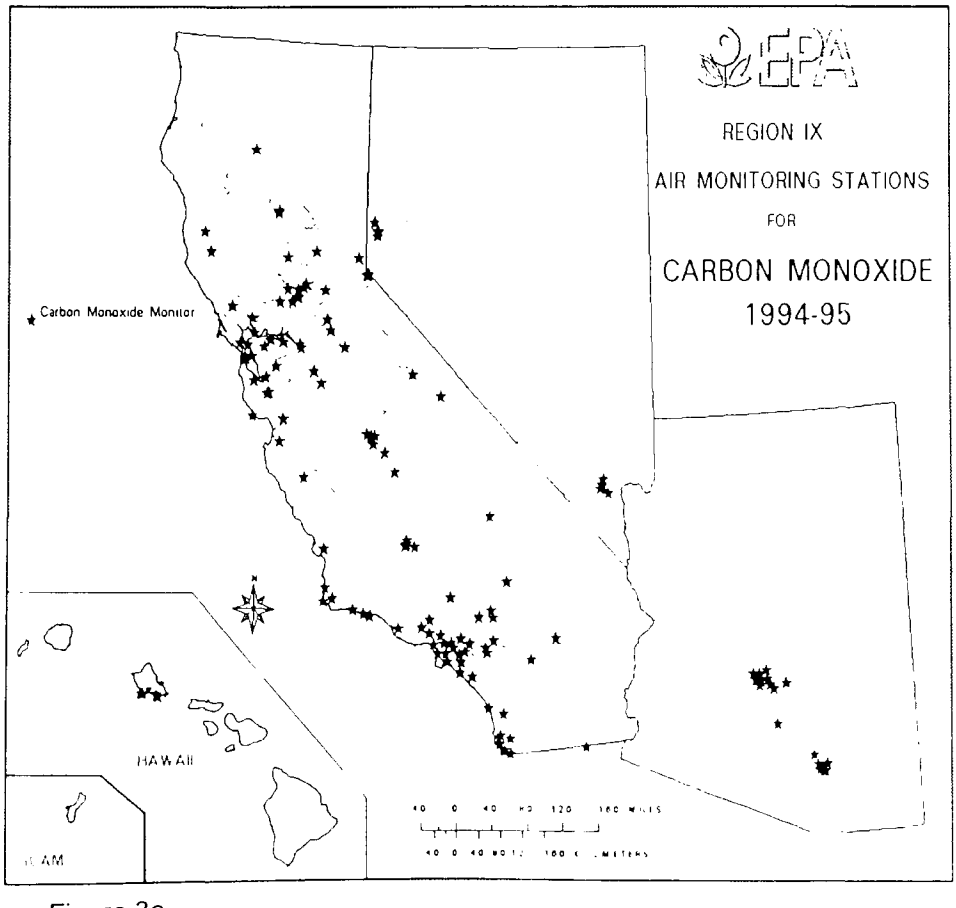


Figure 3a

The eight CO monitoring sites that violated the health standard during 1994-95 are shown on the map in Figure 3b. The vertical "spikes" represent CO monitors in violation, and the height of each spike shows the number of violations. The four areas with violations were the South Coast Air Basin (Los Angeles

area), Phoenix, Las Vegas, and Calexico.

LONG-TERM CO TRENDS

Air quality with respect to carbon monoxide has greatly improved over the last ten years in all areas of Region 9. Overall, CO concentrations (second high 8-hour average) have decreased by 35% in the Region, based on 84 sites operating from 1986 through 1995. This compares to a 28% decrease at 328 sites nationwide. Much of the CO air quality improvement can be attributed to newer, cleaner-burning vehicles and fuels, and state smog check programs.

Figure 3c shows the number of days with CO pollution above the standard since 1980 for 14 areas of the Region. Note that the number of days over the health standard is a composite from all CO monitors in an air basin. It represents the number of days during the year that the CO standard was exceeded at one or more monitors.

Several areas have shown remarkable reductions in CO exceedances since 1980. The CO exceedances in Phoenix decreased from 99 days in 1984 to seven days in 1995. The South Coast decreased from 93 days in 1980 to 17 days in 1995. Las Vegas decreased from 76 days to four. Lake Tahoe decreased from 55 days in 1982 to none.

Peak CO concentrations (8-hour average) have also decreased substantially during the last ten years in seven areas that have several long-term monitors. The percent decreases in CO concentrations between 1986 and 1995 were as follows:

% Decrease in Peak Concentration	Area
-54%	Lake Tahoe
-39%	S.F Bay Area
-39%	Phoenix
-35%	Tucson
-33%	Sacramento
-32%	San Diego
-27%	South Coast

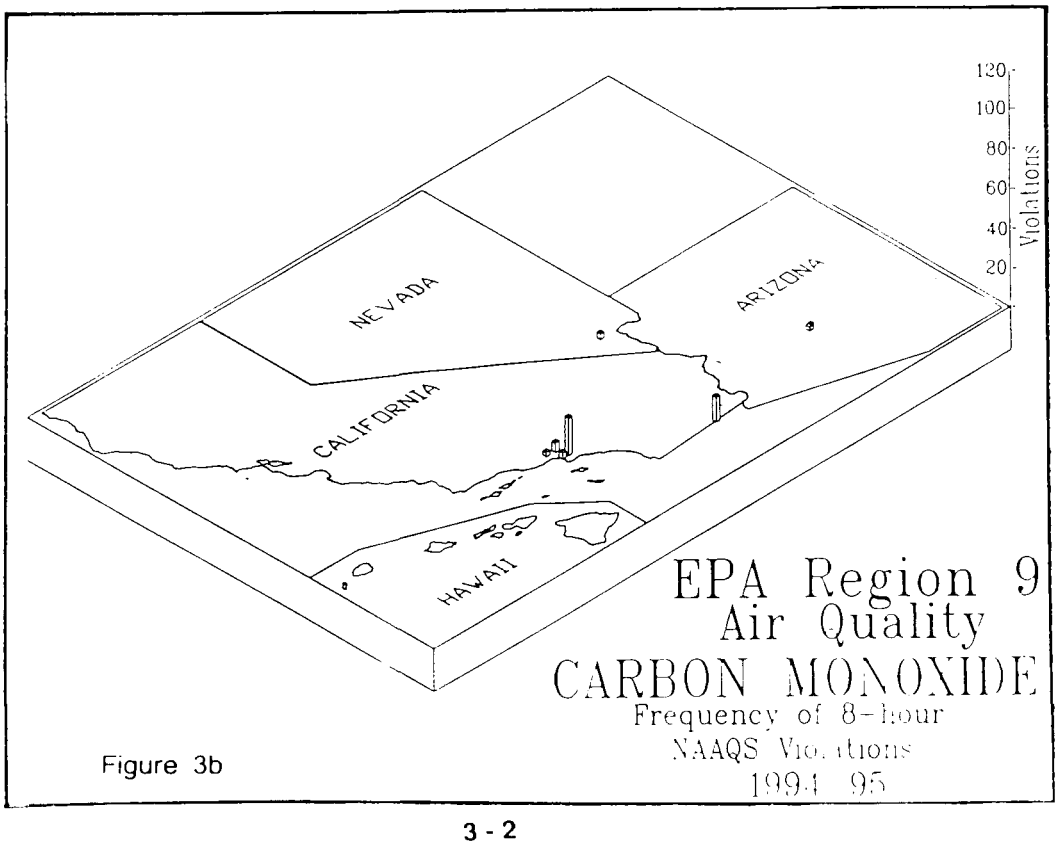
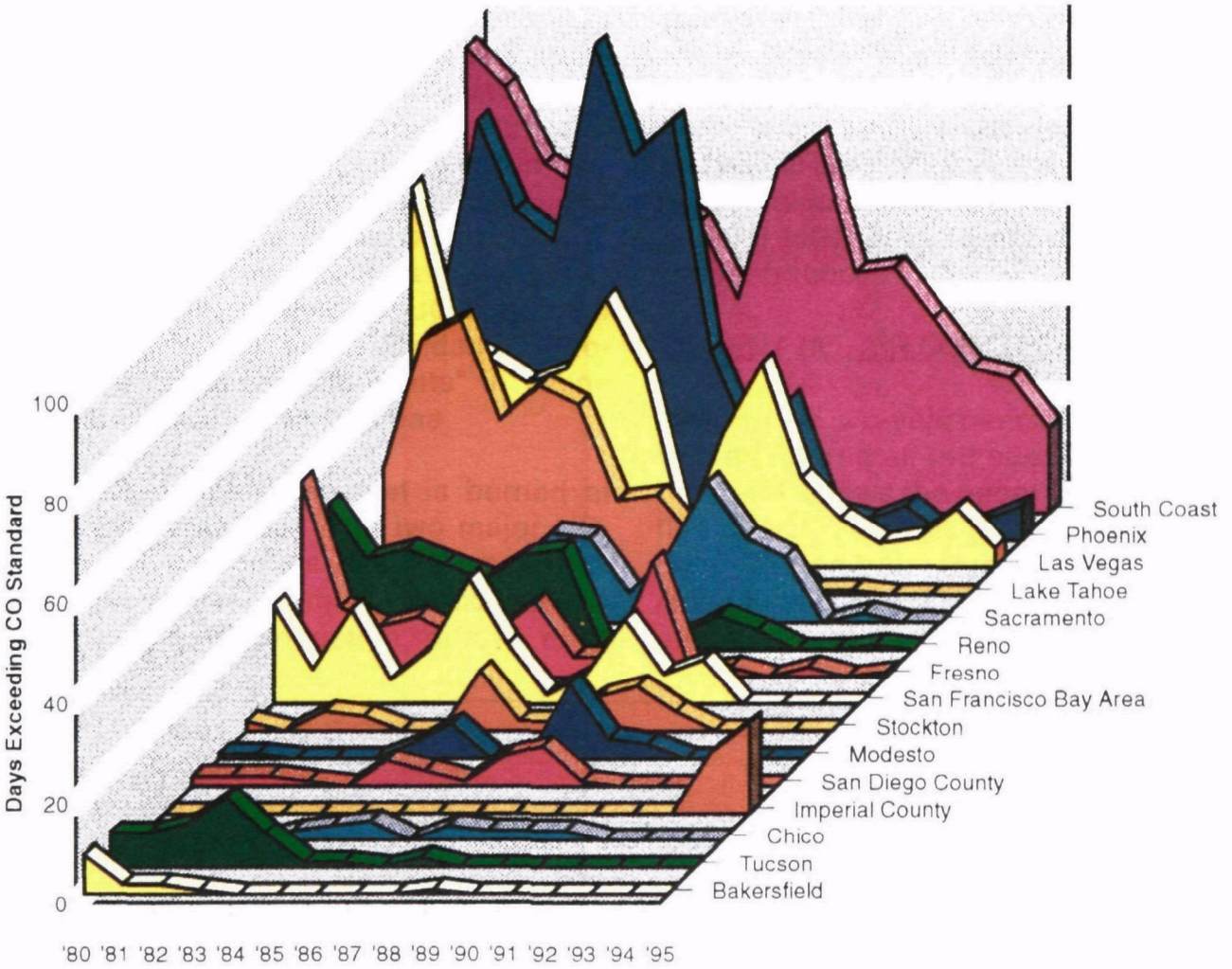


Figure 3b

CARBON MONOXIDE Exceedances

Number of days exceeding the 8-hour CO NAAQS.



- NAAQS = 9 ppm (8-hour average concentration).
- Number of days exceeding the NAAQS at one or more locations.
- NAAQS = National Ambient Air Quality Standard.

Figure 3c

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NITROGEN DIOXIDE

BACKGROUND and HEALTH EFFECTS

Nitrogen dioxide (NO_2) is a brownish, highly reactive gas which is present in urban atmospheres. NO_2 is formed in the atmosphere from emissions of oxides of nitrogen (NO_x). NO_x plays a major role, together with volatile organic compounds, in the atmospheric reactions that produce ozone. Although NO_x actually scavenges ozone at close range, it is a precursor pollutant to ozone formation when it reacts with other compounds in the atmosphere in the presence of sunlight, over longer periods of time. Oxides of nitrogen are "transport pollutants" in ozone formation in downwind areas.

NO_x forms when fuel is burned at high temperatures. The two major NO_x emission categories are transportation sources (primarily motor vehicles) and stationary fuel combustion sources, such as electric utilities and industrial boilers.

The NAAQS is based on nitrogen dioxide (NO_2) because it is known to be highly toxic to humans. Nitrogen dioxide can irritate the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections. Nitrogen oxides are an important precursor to both ozone and acidic precipitation, which harm both terrestrial and aquatic ecosystems. The NAAQS for NO_2 is 53 ppb annual mean concentration.

RECENT NO_2 AIR QUALITY IN REGION 9

For the two-year period 1994-95, NO_2 was monitored at 143 sites in Region 9. Figure 4a shows the geographic distribution of NO_2 monitors throughout the Region. In general, more monitors are located in or near urban areas than in rural areas.

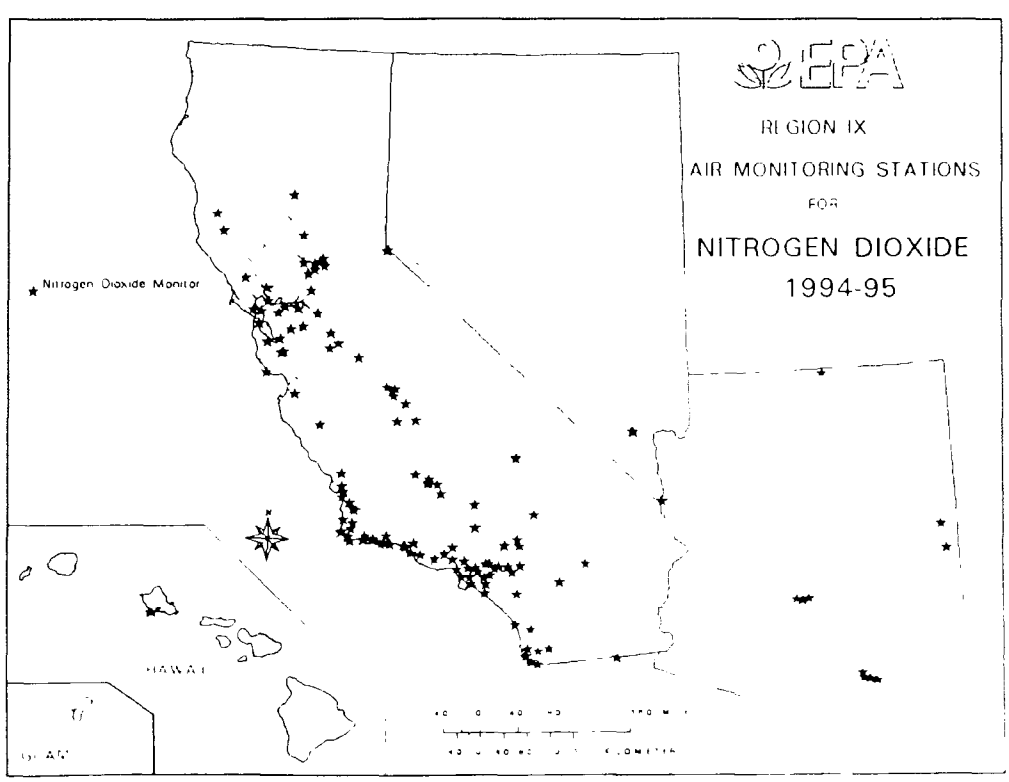

Figure 4a

There were no sites that violated the NO_2 NAAQS in 1994 or 1995. In fact, there were no violations anywhere in the United States during this period. The most recent violation occurred in the South Coast Air Basin (Los Angeles area) in 1991.

LONG-TERM NO_2 TRENDS

Air quality with respect to nitrogen dioxide has improved over the last ten years in Region 9. Even with dramatic increases in vehicle growth during this period, the overall air quality improvement has been largely due to newer, cleaner-burning vehicles and stationary source controls.

For the Region as a whole, there were 81 long-term monitors that operated for the 10-year period. These monitors, as a group, showed a 15% decrease in their annual mean NO_2 concentrations between 1986 and 1995. This compares to a 9% decrease at 205 sites nationwide.

Figure 4b shows the change in annual mean concentration for five areas since 1980. The values are a composite of the annual mean concentrations of all long-term NO_2 monitors in each area. Note that all areas have been well below the standard, except for the South Coast Air Basin, which has shown the most improvement, with a 19% drop in NO_2 concentrations from its peak in 1980.

Air Quality Trends 1980-95

NITROGEN DIOXIDE (NO_2) Concentrations

Annual mean concentrations.

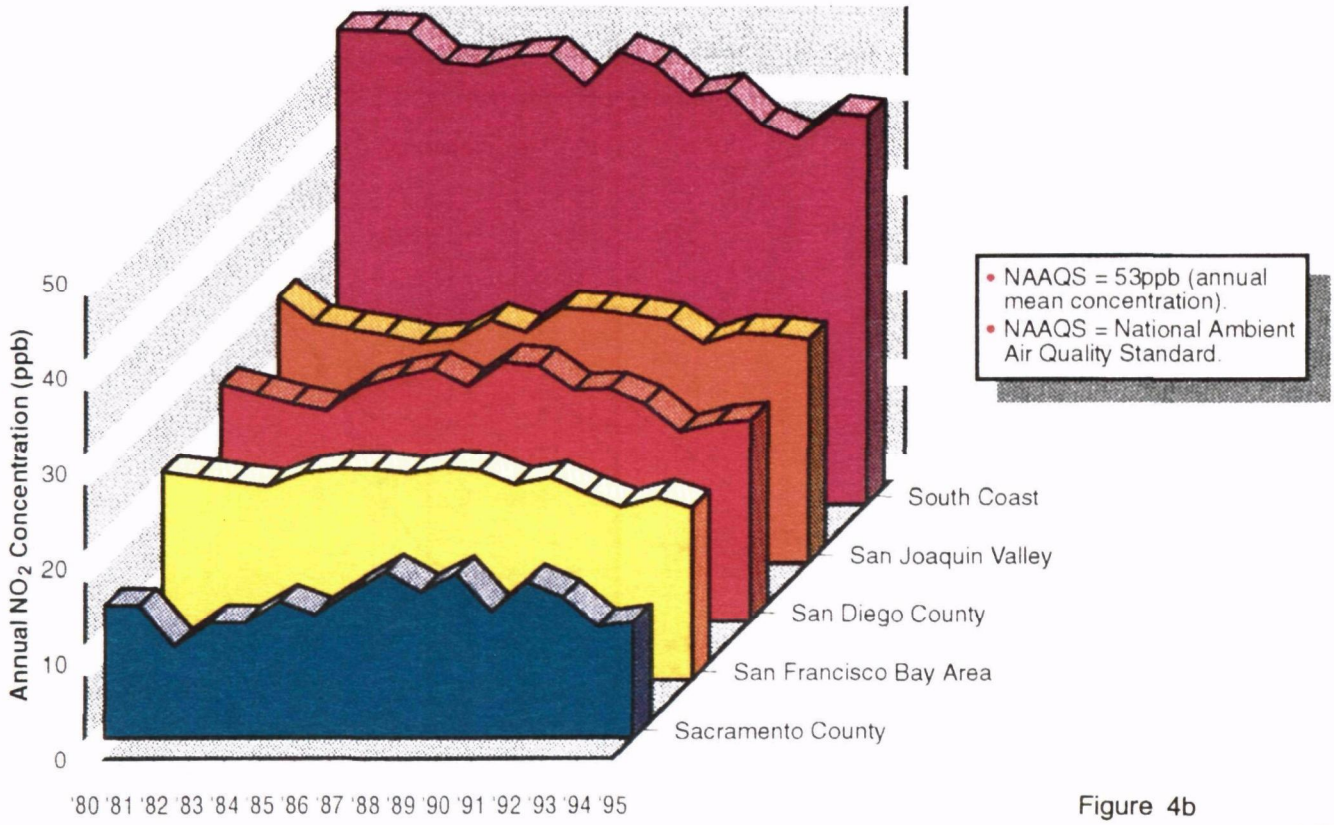

Figure 4b

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SULFUR DIOXIDE

BACKGROUND and HEALTH EFFECTS

Ambient sulfur dioxide (SO_2) results largely from stationary sources that burn coal and oil, refineries, pulp and paper mills, and from nonferrous metal smelters.

High concentrations of SO_2 affect breathing and may aggravate existing respiratory and cardiovascular disease. Sensitive populations include asthmatics, individuals with bronchitis or emphysema, children, and the elderly. SO_2 also produces leaf damage to trees and agricultural crops.

Sulfur dioxide and other oxides of sulfur combine with oxygen to form sulfates and with water vapor to form aerosols of sulfurous and sulfuric acid. These acid mists can irritate the respiratory systems of humans and animals and injure plants. Particulate sulfates also reduce visibility.

There are three national health standard for SO_2: an annual arithmetic mean of 80 micrograms per cubic meter of air ($\mu g/m^3$), a 24-hour level of 365 $\mu g/m^3$ and a 3-hour level of 1300 $\mu g/m^3$ The first two standards are primary (health-related) standards, while the 3-hour NAAQS is a secondary (welfare-related) standard. For an air basin to be classified as having attained the SO_2 standard, the annual mean standard is not to be exceeded, while the short-term standards are not to be exceeded more than once per year.

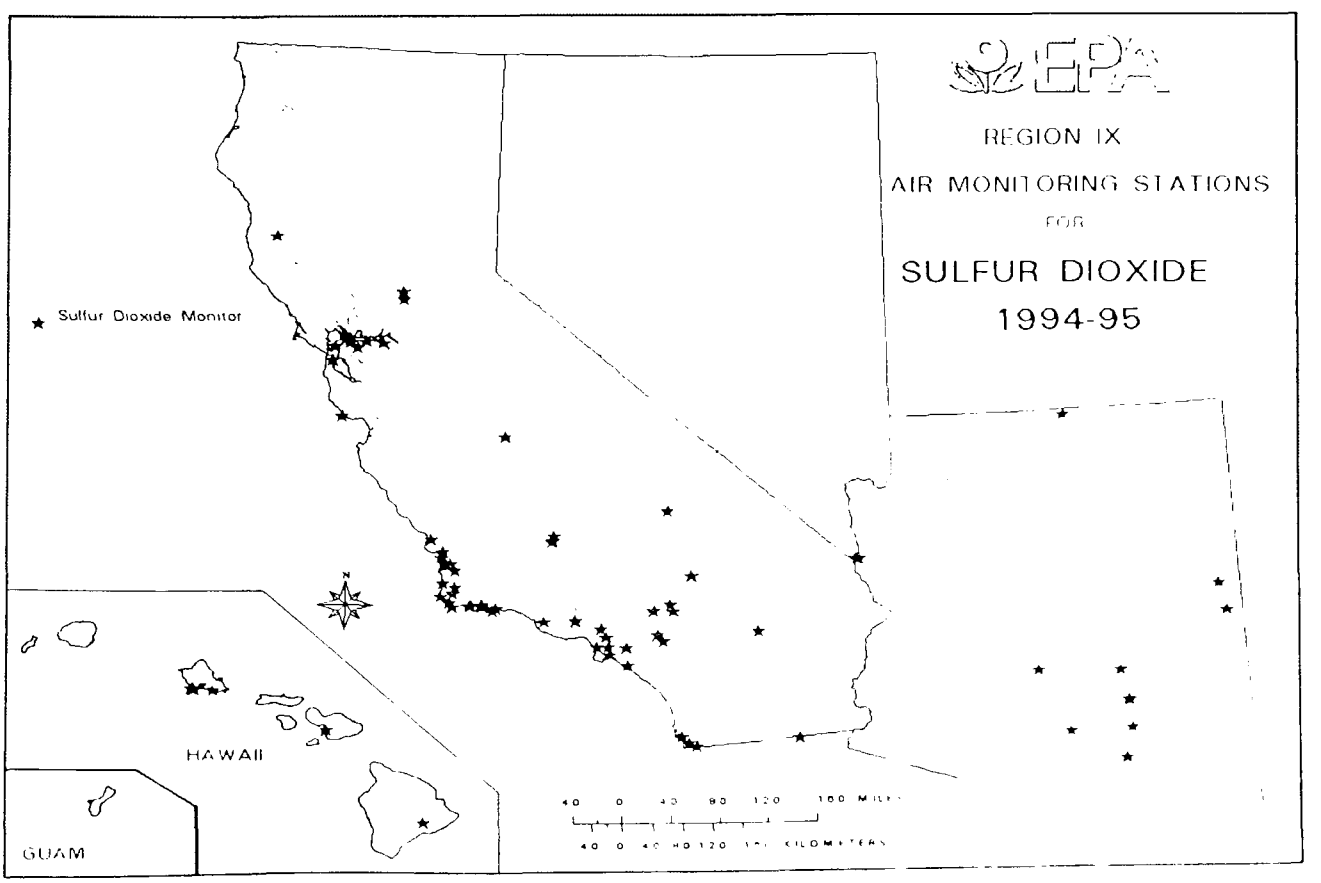


Figure 5a

RECENT SO_2 AIR QUALITY IN REGION 9

For the two-year period 1994-95, SO_2 was monitored at 81 sites in Region 9. Figure 5a shows the geographic distribution of SO_2 monitors throughout the Region. The only site in Region 9 which violated the NAAQS during this period was one monitor at Hawaii Volcanoes National Park, which exceeded both the 24-hour and 3-hour standards. The exceedances were due to natural SO_2 emissions from volcanoes. The annual standard was not violated at any monitoring site although the National Park site in Hawaii came close.

LONG-TERM SO_2 TRENDS

There have been no exceedances of the annual SO_2 standard in Region 9 since 1984, and the trend in SO_2 concentrations has been downward since 1980. For the Region as a whole, there were 41 long-term monitors during the ten year period from 1986 to 1995. These monitors, as a group, showed a 21% decrease in annual SO_2 concentrations over ten years. This compares to a 25% decrease at 475 sites nationwide.

Until the mid-1980's, the SO_2 NAAQS was exceeded at sites near nonferrous metal smelters in Arizona. See Figure 5b for the trends since 1980 for both the 24-hour and 3-hour standards. During the last ten years, several smelters have ceased operations. The currently operating smelters near the towns of Hayden, Miami, and San Manuel have substantially reduced their SO_2 emissions, and consequently the number of NAAQS violations has declined. For example, the Miami area went from 22 exceedances of the 24-hour standard in 1982 to none in recent years. Likewise for the 3-hour standard, Miami went from 48 exceedances in 1982 to none in recent years.

SULFUR DIOXIDE Exceedances

Number of exceedances of the SO_2 NAAQS.

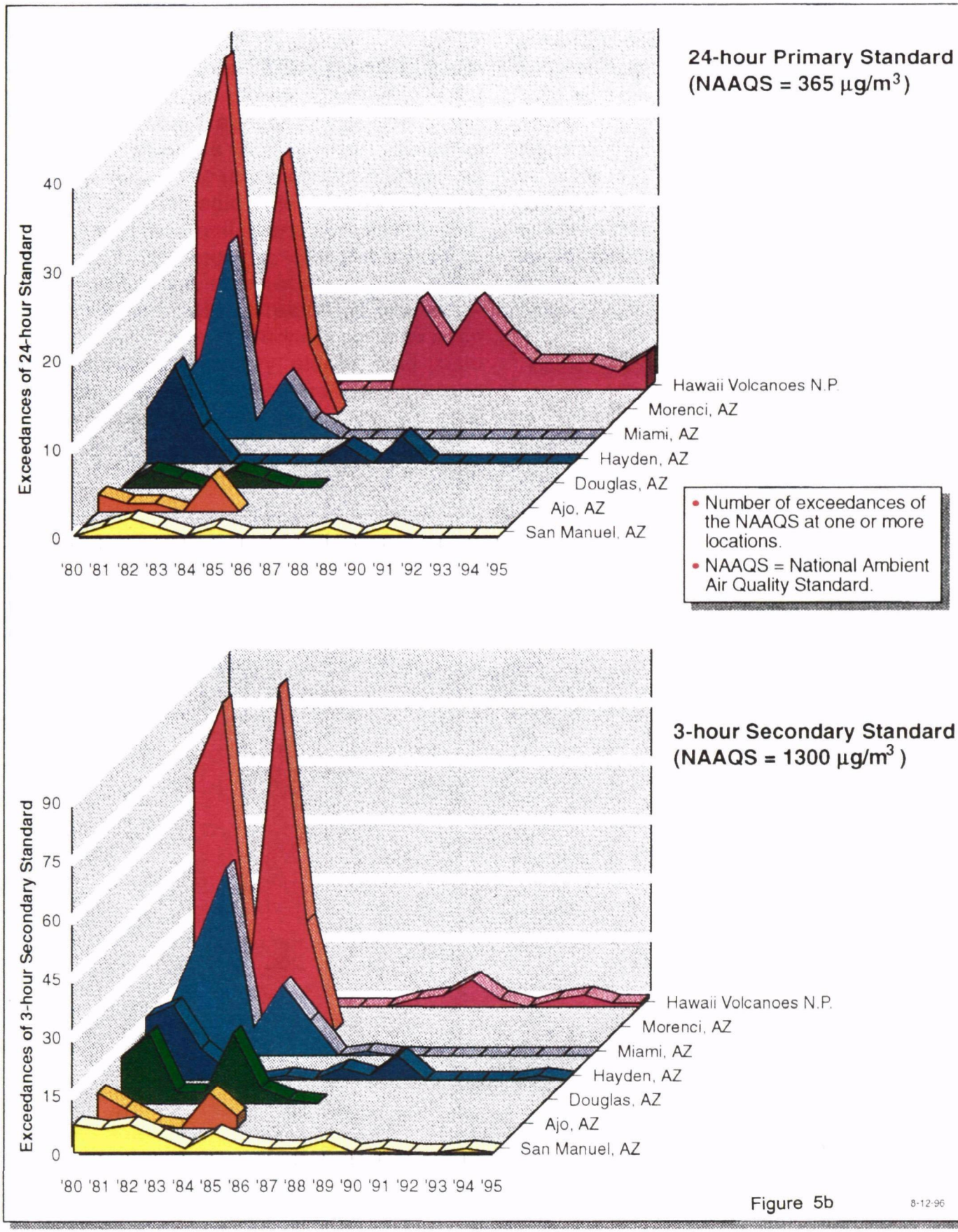


Figure 5b

8-12-96

LEAD

BACKGROUND and HEALTH EFFECTS

Since the mid-1970's, lead (Pb) emissions have been reduced over 95% -- the most dramatic success thus far in the nation's struggle for cleaner air. This has been mainly the result of eliminating lead from gasoline sold in the U.S. The elimination of lead emissions from transportation sources has changed the nature of the ambient lead problem in the United States from vehicle-related to one associated with point stationary sources such as smelters, battery plants, and solid waste disposal. There are few such lead point sources in Region 9.

Exposure to lead can occur through multiple pathways, including inhalation of air and ingestion of lead in food, water, soil, or dust. Excessive lead exposure can cause seizures, mental retardation, and/or behavioral disorders. Fetuses, infants, and children are especially susceptible to low doses of lead, resulting in central nervous system damage. The national health standard for lead is 1.5 micrograms per cubic meter of air ($\mu g/m^3$) average concentration over a three-month period.

RECENT Pb AIR QUALITY IN REGION 9

For the two-year period 1994-95, lead was monitored at 60 sites in Region 9. Figure 6a shows the geographic distribu-

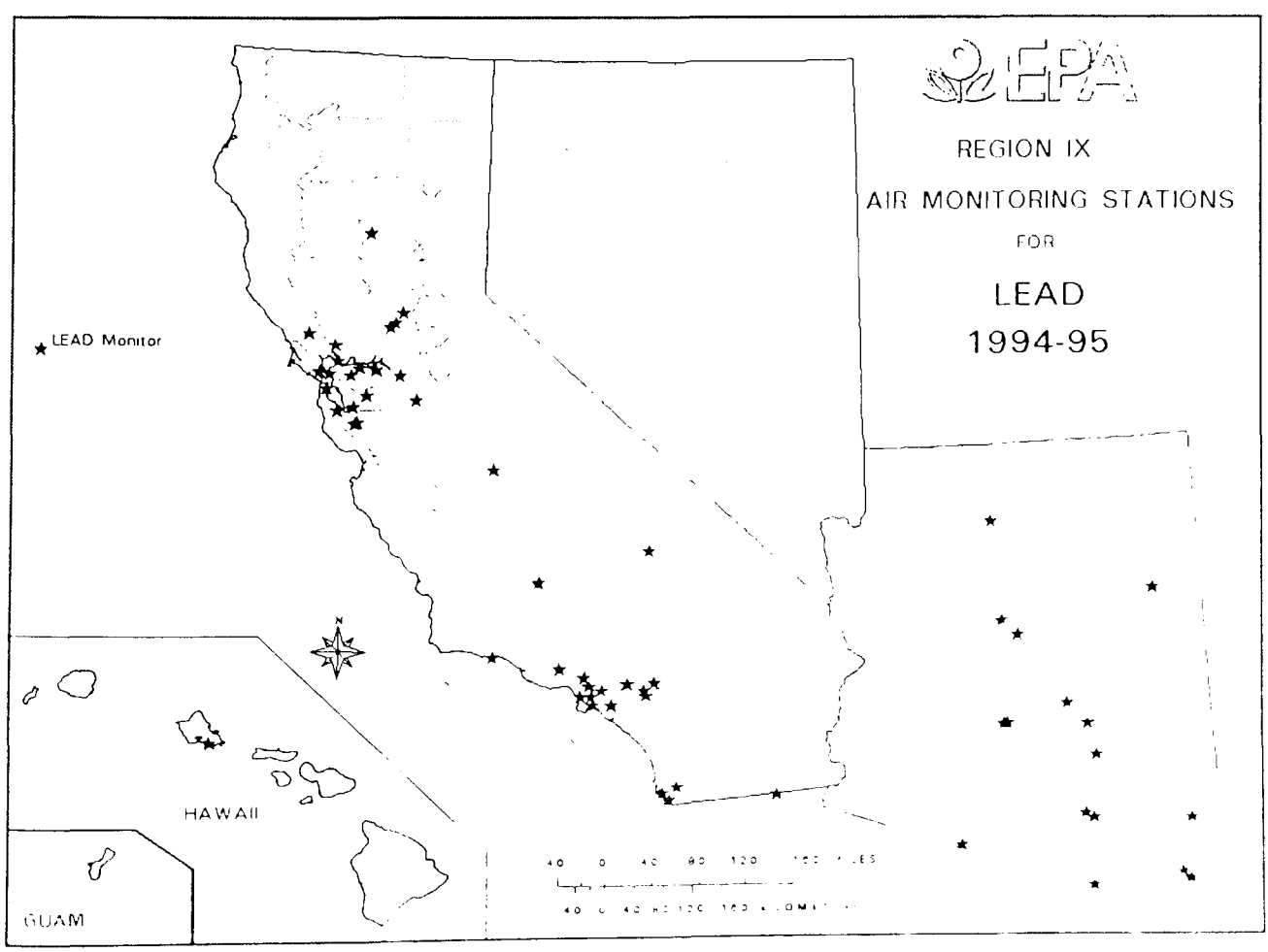


Figure 6a

tion of the lead monitors throughout the Region.

There were no violations of the national health standard at any sites during 1994-95. Lead concentrations are now typically 5% of the Federal standard or less. The only lead violation in the last ten years was measured at a special purpose monitor in 1991. The monitor is sited near a lead smelter in Commerce, located in the South Coast Air Basin. Anti-pollution measures were subsequently put into place at this source, and emissions were greatly reduced.

LONG-TERM LEAD TRENDS

For the Region as a whole, there were 24 long-term monitors that operated for the past ten years. These monitors, as a group, showed an astounding 86% decrease in maximum quarterly mean Pb concentrations between 1986 and 1995. This compares to an equally notable 86% decrease at 197 sites nationwide.

Figure 6b shows the change in lead concentrations for five areas of Region 9 since 1980. All five areas had a dramatic 96% to 97% reduction in lead concentrations since 1980.

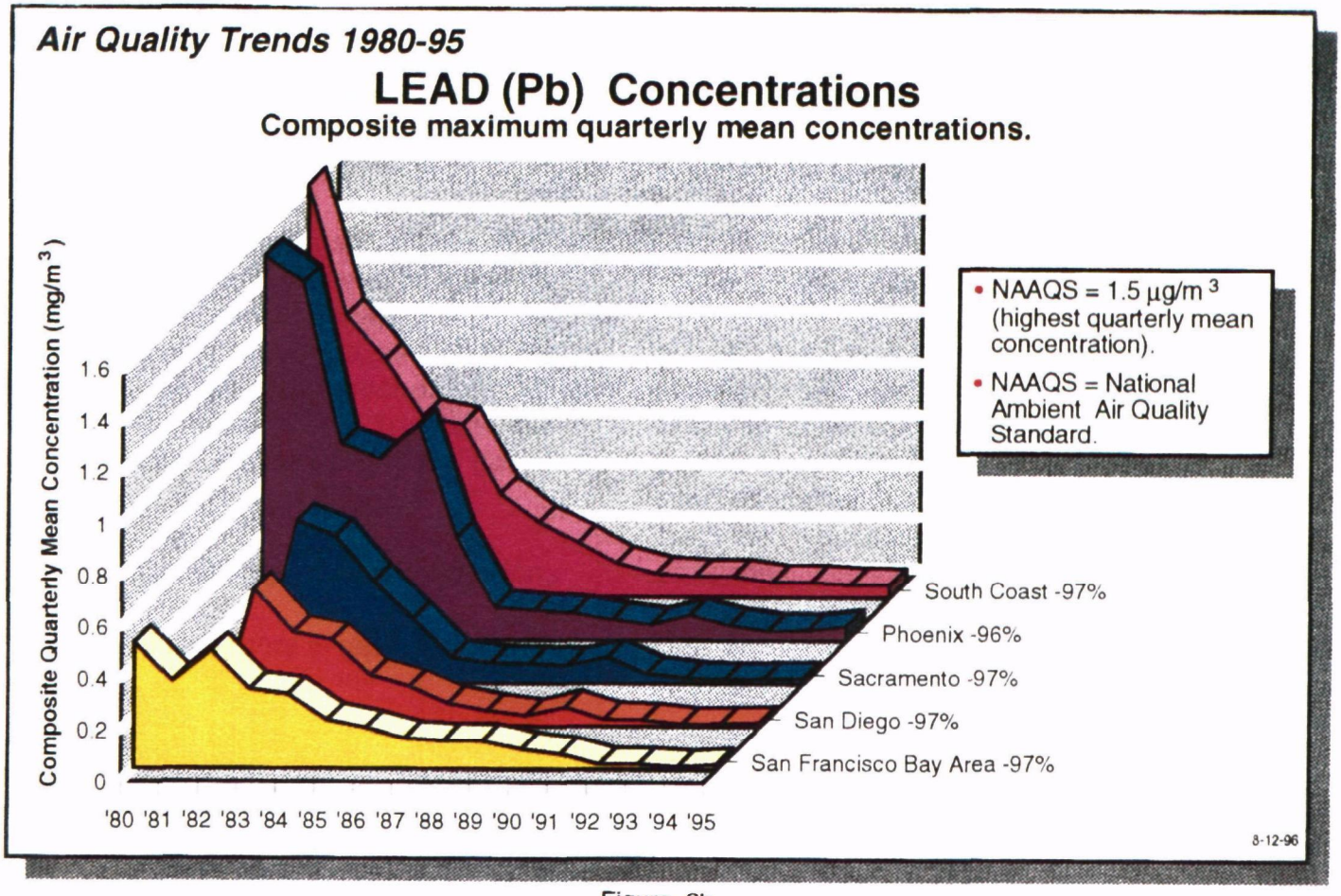


Figure 6b

AIR EMISSIONS SOURCES

Air Pollution Emissions

Human activity is responsible for most air pollution. This chapter is a broad overview of the pollution sources that contribute to higher concentrations of carbon monoxide, nitrogen dioxide, particular matter, and ground-level ozone. The emission sources of two other air pollutants, sulfur dioxide and lead, are not included here, since ambient levels are very low throughout our region.

The air pollution emissions in figure 7a are for the South Coast Air Basin (Los Angeles area) for 1993, the most recent year for which emissions have been estimated. The South Coast was selected because it represents an urban area with high ambient concentrations of several air pollutants. Other areas may have a somewhat different emissions mix.

The "pie charts" show emission sources for volatile organic compounds (VOC) and oxides of nitrogen (NO_x), the two ozone-forming pollutants, as well as emission sources for carbon monoxide (CO) and particulate matter (PM_{10}). The three predominant types of emissions are described below.

Mobile Source (Vehicle) Emissions

This category is represented by the magenta and red "pie slices" in figure 7a. It is the largest emission source category for three of the four pollutants presented. Mobile sources include "on-road" motor vehicles and "off-road" vehicles, such as trains and ships. Total mobile sources account for about 63 percent of VOC emissions, 84 percent of NO_x emissions, and 99 percent of CO emissions. The "on-road" portions are 53, 64, and 82 percent, respectively.

Point Source Emissions

Point sources are generally large emitters, such as manufacturing, chemical, and petroleum production facilities, and electric utilities. Point source emission categories include petroleum processing, storage and transfer, fuel combustion, industrial processes, etc. The contribution of point sources to the air pollution problems is significant but smaller than the contribution from mobile sources.

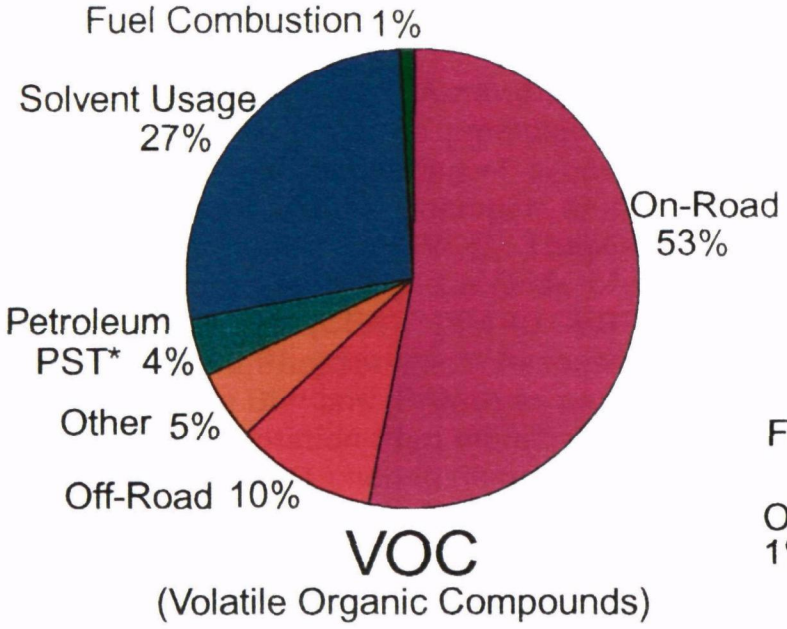
Area Source Emissions

Area sources generally include many small sources, such as residential water heaters, architectural coatings, and travel-related road dust (for PM_{10}), etc. Area sources account for 83% of the PM_{10} emissions and a substantial part of the VOC emissions.

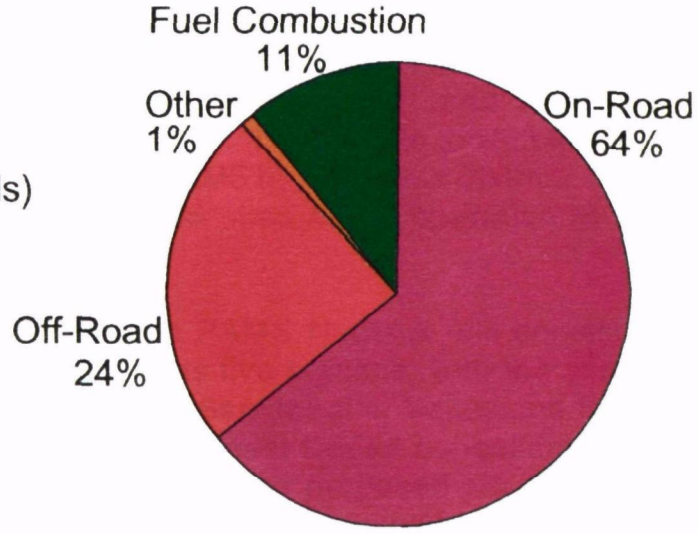
Figure 7a

AIR EMISSIONS ESTIMATES - South Coast Air Basin, CA

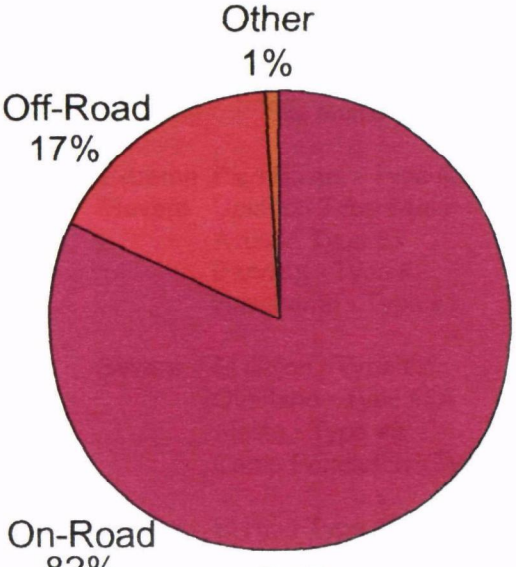
Relative Contribution by Source Category - 1993



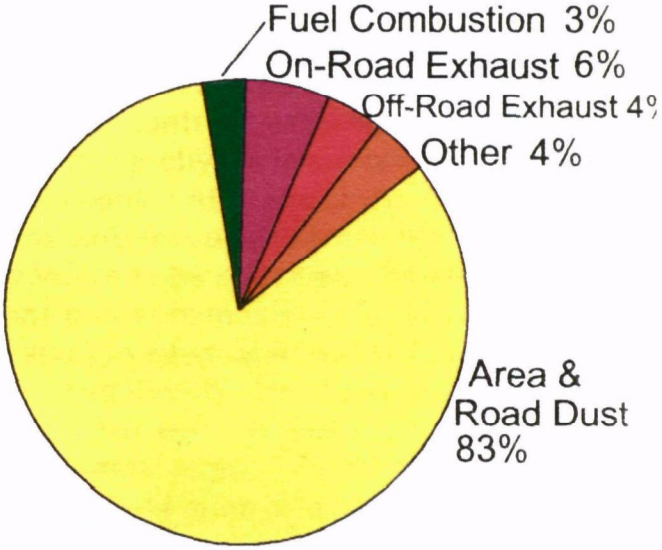
VOC
(Volatile Organic Compounds)



NOx
(Nitrogen Oxides)



CO
(Carbon Monoxide)



PM10
(Particulate Matter)

* PST = Process, Storage & Transfer

Enhanced Ozone Monitoring: PAMS Program in Region 9

REGULATORY BACKGROUND

The Clean Air Act Amendment 182(c)(1) requires States to promulgate rules for enhanced monitoring of ozone and its precursors, oxides of nitrogen, and volatile organic compounds (VOC). These rules are incorporated into the Code of Federal Regulations (CFR). Title 40 CFR Part 58 required Photochemical Assessment Monitoring Stations (PAMS) as part of State Implementation Plan monitoring networks in ozone (O_3) nonattainment areas classified as serious, severe, and extreme. The principal reasons for PAMS are to augment regional air and meteorological monitoring due to nonattainment status of the NAAQS, and to satisfy the need for a comprehensive database for O_3 and precursors.

Region IX PAMS Networks

Area	Class	Site Name
South Coast /Southeast Desert	Extreme /Severe	Pico Rivera Type #2 Upland Type #4/#1 Azusa Type #3 Banning - Type #2 Hawthorne - Type #1
San Diego	Severe	El Cajon - Type #2 Overland - Type #2A Alpine Type #3 Camp Pendleton Type #1
Ventura	Severe	El Rio Type #2 Simi Valley - Type #3 Emma Wood Type #1
Sacramento	Severe	Del Paso - Type #2A Folsom - Type #3 Elk Grove -Type #1
San Joaquin Valley	Serious	Golden State - Type #2 Clovis Type #2 Arvin Type #3 Parlier - Type #3

CALIFORNIA PAMS

For Region 9, PAMS networks exist only in the State of California. The California Air Resources Board (CARB) coordinates the PAMS program in five areas, namely Sacramento Metro, San Joaquin Valley, Ventura County, South Coast/ Southeast Desert, and San Diego. Beginning in 1993, these Districts were required to measure speciated VOCs/carbonyls, O_3, NO_x, and surface and upper air meteorology. The table to the left lists the existing PAMS by California District. Nineteen PAMS sites are in operation at this time.

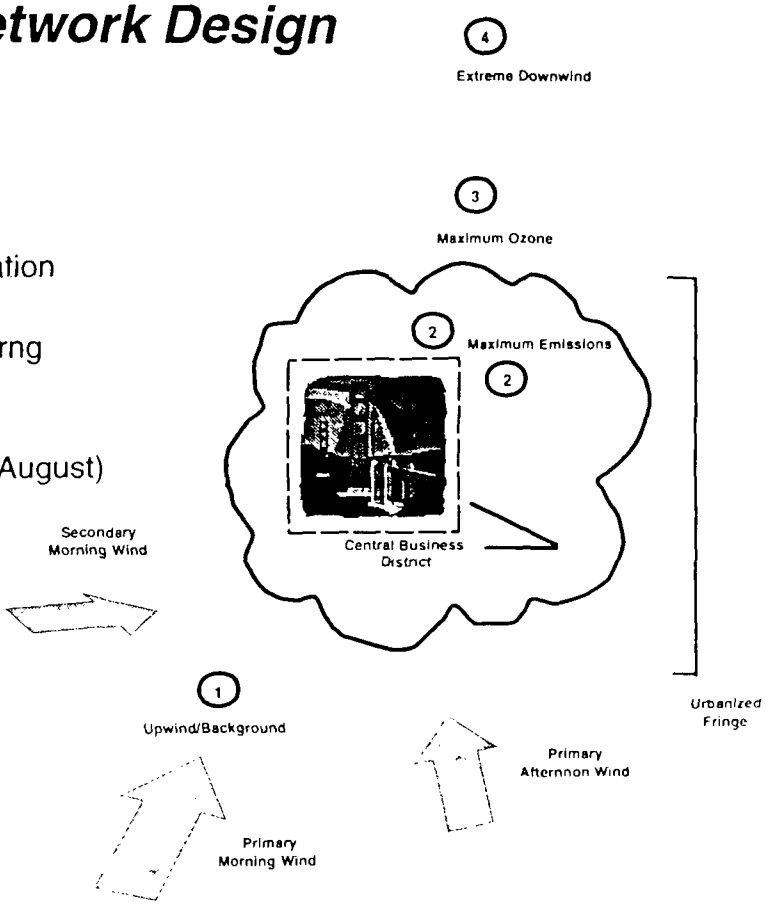
Each PAMS Network will consist of as many as five stations, with the exception of the San Joaquin Valley and South Coast/Southeast Desert consolidated areas which have proposed six PAMS by 1997 and 1998, respectively. Each PAMS network will consist of four kinds of stations, designated as Type #1, #2, #3, and #4, to fulfill specific data collection objectives. The Type #1 site is located upwind of the metropolitan area to measure O_3 and precursors being transported into the area. The Type #2 sites are located downwind of the central business district and their main objective is to collect O_3 precursor emissions. At these sites, 56 hydrocarbons and three carbonyls are the targeted VOCs to be collected. The Type #3 stations measure maximum O_3 concentrations and are sited downwind of the urban area. And finally the Type #4 site is located farther downwind of the nonattainment area. The primary purpose of Type #4 sites is to measure O and

precursor concentrations exiting the area. The figure below identifies general PAMS network design requirements and visually depicts the location of the different PAMS sites.

Analysis of collected PAMS data is a primary focus of the PAMS program. Exploratory analysis is already underway, but comprehensive results will not be available until completed networks are installed by 1998.

PAMS Network Design

- Required only for serious, severe, and extreme areas
- Requirements based on population
- Ozone, NOx, and VOC monitoirng required at each site
- Monitoring season: (June-July-August) (Calif: July-Aug-Sept)
- Five-year phase-in
- Alternative networks allowed
- Meteorological monitoring
  - Surface - each site
  - Upper air - 1 site/area



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