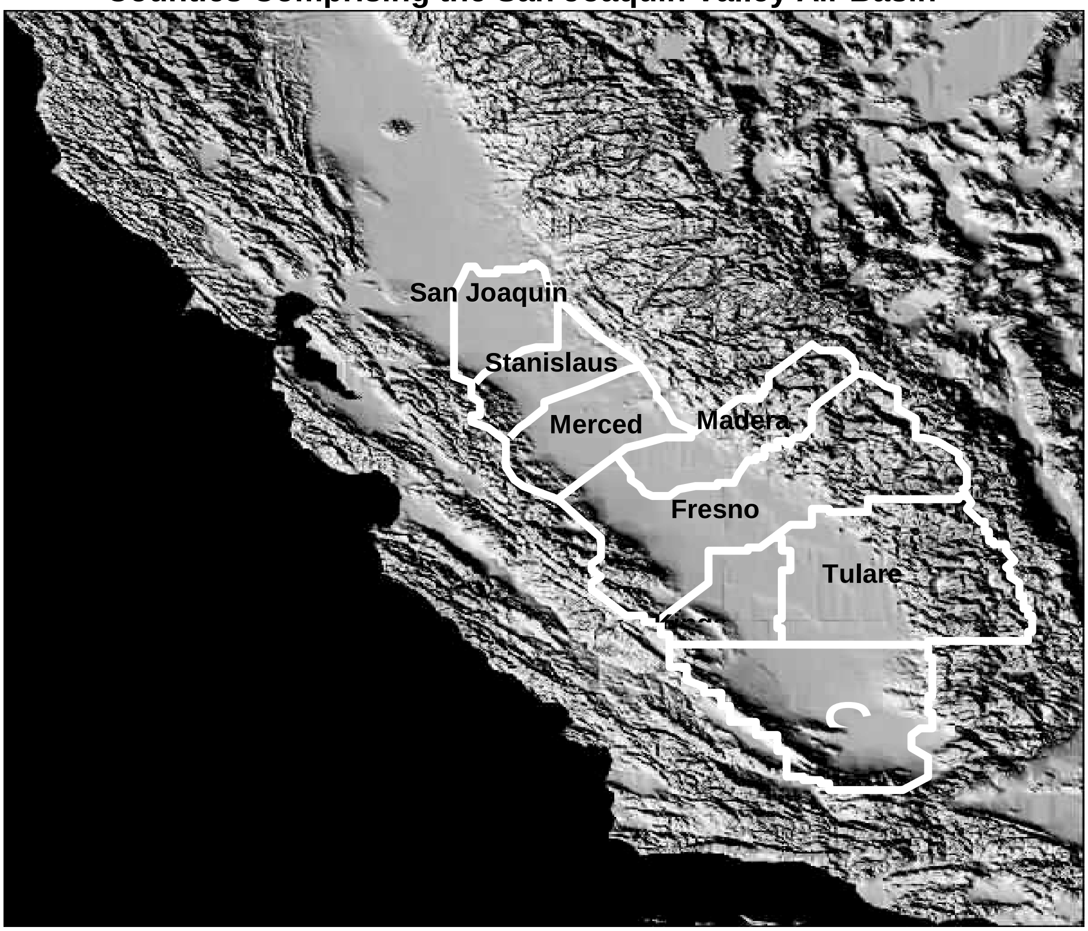
Chapter 2 – San Joaquin Valley Air Quality

2 SAN JOAQUIN VALLEY AIR QUALITY

2.1 INTRODUCTION

The SJVAB consists of eight counties: Fresno, Kern (western and central), Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare (see Figure 2-1). Cumulatively, these counties represent approximately 16 percent of California's geographic area, making the SJVAB the second largest air quality basin (based on area) as delineated by ARB. The current population within the SJVAB is approximately 3.4 million people. Based on California State Department of Finance projections, the population in the SJVAB is expected to grow to 3.6 million by 2005, to 4 million by 2010 and to 4.9 million by 2020.

FIGURE 2-1
Counties Comprising the San Joaquin Valley Air Basin



2.2 AIR QUALITY DETERMINANTS IN SJVAB

2.2.1 General

Air pollution in the SJVAB can be attributed to human-related (anthropogenic) activities that produce emissions. Air pollution from significant anthropogenic activities in the SJVAB includes a variety of industrial-based sources as well as on- and off-road mobile sources. Activities that tend to increase mobile activity include increases in population, increases in general traffic activity (including automobiles, trucks, aircraft, and rail), urban sprawl (which will increase commuter driving distances), and general local land management practices as they pertain to modes of commuter transportation. These sources, coupled with geographical and meteorological conditions unique to the area, stimulate the formation of unhealthy air. The geography of mountainous areas to the east, west and south, in combination with long summers and relatively short winters, contributes to local climate episodes that prevent the dispersion of pollutants. Transport, as affected by wind flows and inversions, also plays a role in the creation of air pollution. These conditions are described in the following sections.

2.2.2 Geography and Topography

California is divided into regional air basins according to topographic air drainage features. The SJVAB consists of a continuous intermountain valley approximately 250 miles long and averaging 80 miles wide (Figure 2-1). On the western edge of the Valley is the Coast Mountain range, with peaks reaching 5,020 feet, and on the east side is the Sierra Nevada range with some peaks exceeding 14,000 feet. The Tehachapi Mountains form the southern boundary of the Valley. This mountain range includes peaks over 6,000 feet, and contains mountain passes to the Los Angeles basin and the Mojave Desert. The SJVAB floor is only open to the north.

Although marine air generally flows into the basin from the San Joaquin River Delta, the region’s topographic features restrict air movement through and out of the basin. The Coastal Range hinders wind access into the valley from the west, the Tehachapi Mountains prevent southerly passage of airflow, and the high Sierra Nevada range forms a significant barrier to the east. Additionally, most of the surrounding mountains are above the normal height of summer inversion layers (1,500-3,000 feet). These topographic features result in weak airflow. The wind pattern produces conditions that result in poor horizontal dispersion of pollutants. During high-pressure events over the SJVAB, pollutant dispersal is also limited vertically by inversions, as explained in 2.2.3. As a result, the SJVAB is highly susceptible to pollutant accumulation over time.

2.2.3 Climate

Warm, dry summers and cool winters characterize the SJVAB floor. The average mean temperature over a thirty-year period is 65°F. High daily temperature readings in summer average around 95°F. The SJVAB also experiences mild winters, where the average daily low temperature is 45°F. In general, the SJVAB averages 106 days a year with 90°F or hotter, and 40 days a year with 100°F or hotter. The daily summer temperature variation can be as high as 30°F. The SJVAB has an “inland Mediterranean” climate that averages over 260 sunny days per year, primarily because semi-permanent high pressure systems establish themselves over the SJVAB and deflect low-pressure systems that might otherwise bring rain and winds.

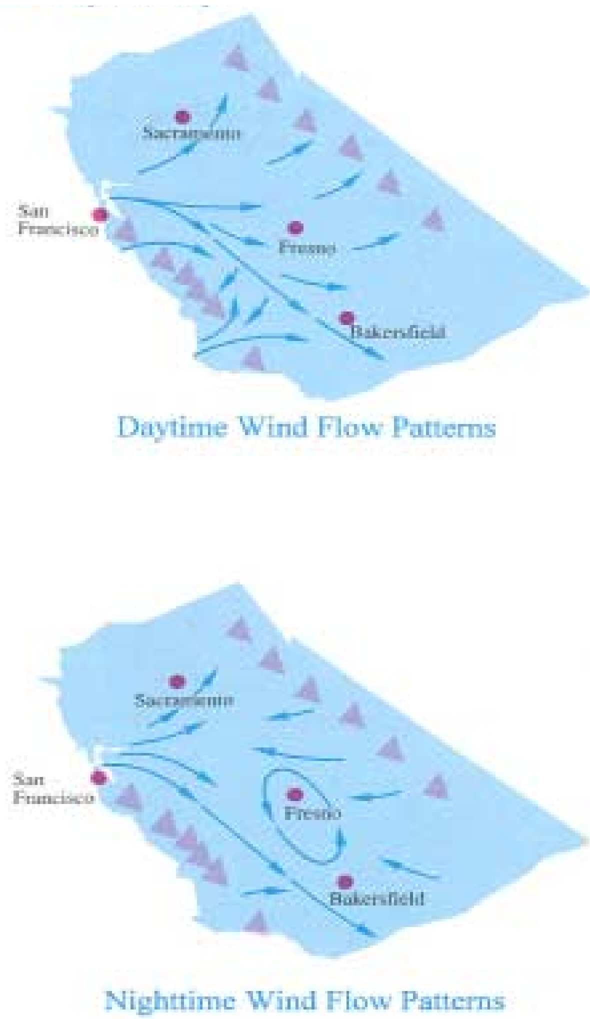
Precipitation in the SJVAB is confined primarily to the winter months with some usually occurring in late summer and fall. Average annual rainfall for the valley floor of the SJVAB is 9.25 inches, but varies from over 20 inches in the north part of the Valley to less than 5 inches in the south.

For the purposes of transport, wind flows and inversion layers will be discussed. Wind speed and direction play an important role in the dispersion and transport of air pollutants. Wind moves ozone precursors and ozone downwind from source areas of emissions or areas where ozone is formed. Figure 2-2 depicts typical wind flow patterns for day and night during the ozone season in the SJVAB. As can be seen, the dominant wind flow pattern (day or night) in the SJVAB is from the northwest to the southeast, along the axis of the Valley.

During the daytime, surface winds enter the SJVAB primarily from the north through the San Francisco Bay area; they also enter at other locations through passes in the coastal range. The air picks up ozone precursors emitted in the Bay Area and transports them down the valley where they eventually form ozone in the SJVAB. Precursor emissions from SJVAB source areas (Stockton, Modesto, Merced, etc.) are also transported down the valley where they are converted to ozone. This general transport moves air near the surface south from Stockton to Bakersfield. The effect of the transport is seen to the southeast of Fresno and Bakersfield. The city of Parlier (near the city of Fresno), and the communities of Edison and Arvin near Bakersfield, often experience the highest ozone levels in the SJVAB. Air leaves the southern end of the Valley during the day by flowing over the Tehachapi Mountains (southeast of Bakersfield) into the Mojave Desert, thereby transporting ozone and other pollutants out of the SJVAB. Also during the daytime, heated air rises into the mountains and transports ozone and other pollutants up the Sierra Nevada and coastal mountains.

FIGURE 2-2

San Joaquin Valley Wind Patterns During Ozone Season



Source: SJVAQSPC 1996

At night, the same general wind flow pattern continues, with some important exceptions. First, the air is no longer able to exit the southern end of the SJVAB because it encounters cooler drainage winds from the surrounding mountains. Consequently, it is forced back north to set up a circular flow pattern (Figure 2-2) known as the Fresno eddy. The eddy circulates pollutants in a counterclockwise pattern, and returns polluted air to urban areas where more precursors are added the next day. Another important difference about the nighttime winds in the SJVAB is that they typically are caused by a jet stream of fast moving air at an altitude of about 1000 ft and a speed of up to 30 mph. Lastly, some of the pollutants transported to higher altitudes from daytime heating return to the valley at night because of drainage winds from the mountains.

Inversions affect air pollutant transport by limiting vertical dispersion of pollutants. An inversion occurs in the atmosphere when air temperature increases with height rather than decreases. Pollutants emitted to the atmosphere will rise and disperse as long as they are warmer than the surrounding air. When pollutants encounter air that is the same temperature or that is warmer, they are no longer able to rise and thus they remain at the elevation of the warmed air. Inversions limit vertical movement of air because displacement of air up or down in an inversion results in the air returning to its original level. This is called a stable atmosphere and results in little vertical air movement and therefore poor vertical pollutant dispersion. The inversion thus acts like a lid on the atmosphere. The SJVAB experiences two common types of inversions: radiation and subsidence inversions.

Nocturnal cooling of an air layer near the earth’s surface is the principal cause of radiation inversions. The radiation inversion extends upward several hundred feet from the ground and occurs during the evening and early morning hours. During a radiation inversion, little vertical mixing occurs, which minimizes pollutant dispersal. At daybreak, the sun begins to heat the ground, which in turn heats the lower layers of air and eventually lifts and breaks the inversion, thereby facilitating pollutant dispersal. During summer months, daytime heat from the sun lifts the inversion to heights anywhere from 2,000 to over 5,000 feet (even higher over mountain ranges due to heating of the slopes), which helps disperse pollutants and lowers their concentrations. However, these same summer daytime conditions also increase ozone production, which can neutralize or offset the effects of enhanced vertical dispersion. Studies have shown that radiation inversions tend to persist longer into daylight hours in the southern part of the SJVAB due to a lack of marine air intrusion and associated atmospheric mixing. On the worst dispersion days the inversion may remain only a few hundred feet above the surface of the SJVAB.

Subsidence inversions are caused by downward motion (subsidence) high in the atmosphere, typically in association with a high-pressure area positioned along the coast of California. As air descends under the influence of the high pressure system, it compresses and heats up, and as a result becomes warmer than the air beneath it. This limits vertical mixing, as the warm air aloft restricts air movement from below.

During inversion events, air pollutant emissions build up in the atmosphere below the inversion; ozone precursors then react to form ozone, and levels increase from day to day. One-hour concentrations of ozone that exceed federal standards generally occur in the SJVAB during strong inversions. During many high ozone level events, the SJVAB is likely experiencing a combination of radiation and subsidence inversions.

2.2.4 Ozone Transport

Ozone transport refers to the movement of ozone and ozone precursors from other basins to the SJVAB, from the SJVAB to other air basins, and within the SJVAB. Transport can occur at ground level and also at higher altitudes (e.g., movement of polluted air up mountain slopes during the day). Although improvements have been made in the SJVAB's ozone air quality over the last decade, the basin continues to violate the federal 1-hour ozone standard on numerous days. Furthermore, in recent years, the location of the highest measured ozone levels has changed from northern Kern County to southeastern Fresno County. ARB's 2001 assessment of ozone transport found that pollutants transported from other air basins affect the SJVAB's ozone air quality, but the magnitude of the effect declines from north to south (ARB 2001). Local emissions are thought to be primarily responsible for the SJVAB's worst ozone air quality. Attaining the federal 1-hour ozone standard by 2010 will require implementation of emission control measures in other basins, as governed by ARB's Ozone Transport Mitigation Regulations, as well as reductions in the SJVAB's precursor emissions.

Transport of pollutants within the SJVAB plays a significant role in violations of the federal 1-hour ozone standard in the SJVAB. As discussed above, prevailing winds blow from the northern part of the SJVAB to the south, and can carry pollutants from San Joaquin, Stanislaus, and Merced counties to the Fresno area. Pollutants transported from the San Francisco Bay Area south to Fresno and Bakersfield must pass through the northern SJVAB, so transport from the San Francisco Bay Area to Fresno is combined with a northern SJVAB contribution. Further south, eddy currents can carry pollutants along the east side of the SJVAB from Tulare County and northern Kern County to the Fresno area.

Ozone and precursors are transported from other basins to the SJVAB. On some days, according to the ARB study referenced above, pollutants transported from the San Francisco Bay Area affect ozone air quality in the northern SJVAB, mixing with local emissions to contribute to violations of the federal 1-hour ozone standard. On other days, violations of the standard are due entirely to local emissions. The effect of Bay Area transport diminishes with distance so that the ozone air quality in Fresno and Bakersfield is affected less. Overall, ARB rates the Bay Area's impact on SJVAB ozone air quality as ranging from inconsequential to overwhelming (by itself can cause violations of the state standard) depending on meteorological conditions occurring at the time of transport evaluation and in the receptor area. ARB also identifies the broader Sacramento area as a source of ozone and precursor transport to the SJVAB, but the effect only ranges from significant (contributes to a violation of the standard when combined with local emissions) to inconsequential.

The SJVAB is also a source area for pollutants transported to other air basins. According to the ARB, the SJVAB can be a source area affecting ozone air quality in the broader Sacramento area, the Great Basin valleys, the mountain counties, the Mojave Desert, and the north central and south central coasts, depending on meteorological conditions. ARB rates the SJVAB's contributions as ranging from inconsequential to overwhelming, depending on the receptor area.

The above discussion is based upon a somewhat dated transport assessment that was limited in scope and limited by information on ozone behavior in the atmosphere. Work continues under CCOS to update our understanding of transport using improved emissions inventories, improved databases on meteorological behavior and atmospheric chemistry, and improved grid-based photochemical models. Consequently, findings and conclusions regarding transport may change from those presented above. Future development of CCOS episodes and modeling tools will provide updated and improved information to evaluate transport. Future plans addressing state or federal ozone standard attainment will incorporate significant advances in knowledge regarding transport.

2.2.5 Population

The SJVAB is a major geographic, population, and agricultural sub-region of California. Agriculture and agriculture-related businesses have thrived as a result of the Valley's climate, excellent soil, extensive irrigation network, and its location between the San Francisco Bay Area and Southern California markets.

The SJVAB represents approximately 16 percent of the geographic area of California. It extends from the northern boundary of SJVAB south through the Valley to the SJVAB portion of Kern County (not including Eastern Kern County). From east to west, the SJVAB extends from the crest of the Sierra Nevada Mountains including the entire San Joaquin River watershed, down across the valley floor and up to the crest of the Coast Range Mountains.

The SJVAB is California's second largest air basin in land area. It has a population of approximately 3.4 million persons with expected growth projections of nearly 30 percent in a period of twenty years. As a result of this population growth, activities associated with an increased population base, particularly the major population centers within the SJVAB represent a significant contributor to the high levels of pollutants in the area.

Increased population growth, in itself, is a source of ozone precursors. New residents emit ozone precursors from activities such as driving, recreation, home maintenance, hot water heating, industrial and agricultural activities, etc. Chapter 3 presents information on the ozone precursor emission rates for various categories of sources. Table 2-1 shows the most recent published estimates of population levels and projections within the SJVAB.

Table 2-1
SJVAB Population and Land Area

County	1990[1]	2000[1]	2010[1]	2020[1]	Land Area[2]
Fresno	**667,490**	**803,401**	**949,961**	**1,114,654**	5,963
Kern[3]	**446884**	**545049**	**663223**	**779091.84**	4,355
Kings	**101,469**	**129,823**	**156,334**	**184,751**	1,391
Madera	**88,090**	**124,372**	**150,278**	**183,966**	2,136
Merced	**178,403**	**210,876**	**277,715**	**360,831**	1,929
San Joaquin	**480,628**	**567,798**	**747,149**	**989,462**	1,399
Stanislaus	**370,522**	**449,777**	**559,051**	**653,841**	1,494
Tulare	**311,921**	**369,355**	**447,315**	**543,749**	4,824
Total	**2,645,407**	**3,200,451**	**3,951,026**	**4,810,346**	23,490

[1] As of May 2004. State of California, Department of Finance, Intercensal Estimates of the Population of California Counties, updated revised report 90-00.
[2] Area in square miles. Air Resources Board, The 2004 California Almanac of EMISSIONS & AIR QUALITY, California Environmental Protection Agency, Sacramento, 2004. The surface areas shown reflect land portions of air basins only and exclude water bodies.
[3] Kern County has portions located outside of the San Joaquin Valley Air Basin. Populations are adjusted based upon a 17% total population reduction to account for the portion of Kern County outside of the air basin.

The Valley is the home of the nation's most productive agriculture industry. According to the California Department of Food and Agriculture (CDFA 2002), eight of the top ten agricultural producing counties in the United States are located in California and six of California's top ten counties are located in the SJVAB. The top two counties, Tulare and Fresno, produced over $6.7 billion in commodities in 2001. Over 27,000 farms are located in the region. Harvested acreage exceeds 5.1 million acres per year. Another 5.4 million acres is used as rangeland and irrigated pasture. Although farmland is being reduced by urbanization, agriculture will continue to play a key role in the region's economy.

2.2.6 Development Patterns

Population growth can affect ozone air quality, but the effect can be exacerbated by development patterns and the technology used by the population to support its economic activities. For example, sprawl development increases commute distances; if the vehicles used for these commutes contain an increased percentage of high emission vehicles, emissions could increase. The jobs/housing imbalance can contribute to longer commutes and increased emissions; for example, increasing numbers of workers in the Bay Area are moving to the SJVAB for affordable housing, yet keep their jobs in the Bay Area and commute longer distances. For these reasons, control measures developed and studied by local governments are increasingly important, because local governments have land use authority to effect changes, whereas the District, ARB, and EPA do not.

2.3 OZONE

2.3.1 Background

Ozone is a highly reactive gas molecule comprised of three oxygen atoms (O_3); it has a light blue color at very high concentrations. Ozone occurs naturally at altitudes high in the stratosphere (35,000 to 65,000 feet, depending on latitude and season) where it shields life on earth from harmful ultraviolet radiation. Depletion of stratospheric ozone by chemical reactions involving anthropogenic chemicals (principally chlorofluorocarbons) allows this radiation to reach the earth's surface, thereby endangering the biosphere. For this reason, the FCAA (Title VI) addresses protection of the stratospheric ozone layer to maintain the crucial function of ultraviolet radiation filter. Ozone is also present in the first few hundred feet of elevation above ground level (in the troposphere) due to chemical reactions between hydrocarbons and nitrogen oxides from natural and anthropogenic sources in the presence of sunlight. Because of its reactivity, tropospheric ozone present in high enough concentrations as an air pollutant adversely affects human health and damages crops and materials (see Section 2.3.2). Consequently, Title I, Part D of the FCAA addresses the control of emissions to reduce tropospheric ozone concentrations to safe levels. This plan focuses only on tropospheric ozone and does not address protection of the stratospheric ozone layer. All references to "ozone" in this plan refer to tropospheric ozone.

2.3.2 Adverse Effects

Ozone is a major component of "smog", and it affects human health, vegetation/crops, and materials. In humans, ozone can irritate and inflame the respiratory tract, particularly during heavy physical activity, which results in heavy coughing, throat irritation, and breathing difficulty. Ozone damages vegetation and agricultural crops by interfering with the photosynthesis process. Studies have shown reductions of up to 20 percent in yields of grapes, cotton, oranges, alfalfa, and tomatoes. The ARB estimates that the SJVAB's agricultural crop losses exceed $150 million due to exposure to ozone. According to the National Park Service, up to half the Ponderosa and Jeffrey Pine in the Sierra Nevada Mountains show ozone injury. Ozone also damages a number of materials widely used in commerce such as rubber, cotton, nylon, polyester, dyes, paints and coatings. Exposure to ozone is of principal interest due to its health effects, as described in the following paragraphs.

Over the years, research studies of ozone in animal laboratories, human clinical studies and epidemiological studies have produced a multitude of evidence that correlates exposure to ozone and adverse health effects (ALA 2002). Ozone, acting as a strong oxidizer, has proved to significantly harm the respiratory system, thereby leading to the permanent damage of lung tissues. These damaged lung tissues result in decreased lung capacity. Chronic exposure to high levels of ozone have also been established to negatively impact the immune system, making people more susceptible to respiratory illnesses, including bronchitis and pneumonia (Burnett 2001). Ozone also accelerates aging, and increases susceptibility to other infections (EPA 1999). Furthermore, ozone exposure exacerbates pre-existing asthma and bronchitis conditions, and in areas of high concentrations can lead to the development of asthma among active children (Gent 2003).

Recent research continues to highlight the extent and severity that ozone exposure poses to human health. Exposure to ozone begins to adversely impact human health even before birth. Studies have shown that ozone exposure may be potentially related to cardiac birth defects during vulnerable pregnancy periods (Ritz 2002). Children are one of the groups most sensitive to ozone. They are more vulnerable than adults because of their size and physical immaturity and their tendency to be more active and to spend more time outdoors (where ozone levels are higher). Children also breathe in more air per pound of body weight than adults, thus exposing them even more to ozone toxicity (EPA 1997). Children who grow up in environments with high levels of ozone may also be expected to show diminished lung growth and capacity, making ozone a risk factor for premature respiratory morbidity later in life (ALA 2002). In areas of elevated summertime ambient concentrations of ozone, a positive association with increases in emergency or urgent hospital admissions for respiratory problems in children less than 2 years of age was detected (McConnell). Asthmatic children using maintenance medication are especially vulnerable to ozone, even at levels below the EPA standards (Gent 2003).

Asthma severity as measured by symptoms, medication use, restrictions in activity, or use of medical services, has been discovered to be affected by ozone exposure. With over 20 million Americans suffering from asthma, and only 60% of those Americans having it under control, ozone exposure has the possibility to affect many people (NHI 2003). Between 1980 and 1995, the percentage of children in the United States with asthma doubled, from 3.6 percent in 1980 to 7.5 percent in 1995. The percentage dropped in 1996 to about 6 percent, but by 2001 it had risen again, this time to 8.7 percent (6.3 million children) (CNN 2003). Hospital admissions for all respiratory causes including asthma show a consistent increase as ambient ozone, sulfate, or sulfur dioxide levels increase in a community (SCAQMD 2003). Fourteen Americans die every day from asthma, a rate three times greater than just 20 years ago (EPA 1997). Ozone greatly aggravates asthma by making asthma sufferers more sensitive to allergens, which are the most common triggers for asthma attacks. In addition, those suffering from asthma are more severely affected by the decreased lung capacity and irritation that ozone provokes upon the respiratory system (EPA 1999). Recent studies have also begun to demonstrate a causal link between ozone exposure and asthma. Results show that playing multiple team sports in a high ozone environment is associated with the development of physician-diagnosed asthma. The results were consistent with a large increased risk both for new-onset asthma and for the exacerbation of previously undiagnosed asthma (McConnell). These findings suggest that new incidences of asthma diagnoses can be associated with heavy exercise in communities with high concentrations of ozone. Children who participate in three or more outdoor sports and live in high ozone environments have a risk 3.3 times greater of developing asthma than those who did not play sports (McConnell).

Another potentially significant finding is that animals in ozone studies have demonstrated possible chronic effects from ozone exposure, including permanent functional and structural changes of the lung (Burnett 2001). Repeated inflammation associated with ozone exposure over a lifetime may result in sufficient damage to lung tissues that individuals would then experience lower quality of life in terms of respiratory function and activity level (SCAQMD 2004). In fact, living in an area of high levels of ozone and related co-pollutants for four or more years is associated with diminished lung function and more frequent reports of respiratory symptoms (Galizia 1999).

Active children are considered to be most at risk from ozone exposure. Those children spend a significant part of their time outdoors, engaged in physical activity. Children are also more likely to have asthma or other respiratory illnesses. Asthma is the most chronic common disease for children (McConnell). Active adults are also at a significant risk. Healthy adults of all ages who exercise or work strenuously outdoors are considered a “sensitive group” because they have a higher level of exposure to ozone than less physically active people (EPA 1999) Individuals with respiratory diseases such as asthma are also considered at risk because ozone aggravates their condition. Asthma and other chronic respiratory diseases make an individual’s lungs more vulnerable to the effects of ozone. These individuals will suffer the effects of ozone at lower levels than sensitive people. Others are unusually susceptible to ozone. Scientists have yet to explain why certain people are more sensitive to ozone than others. Finally, elderly people will be at higher risk from ozone exposure if they already suffer from respiratory disease, are active outdoors, or are one of those unusually susceptible to ozone exposure.

2.3.3 Precursors and Formation

Ozone is the product of a series of chemical reactions involving sunlight, reactive organic gases [also called volatile organic compounds (VOCs)] and nitrogen oxides (NOx). VOCs and NOx are “ozone precursors” and are considered primary pollutants because they are emitted directly into the atmosphere. ARB originally expressed the December 5, 2001 hydrocarbon emissions data as reactive organic gases (ROG) rather than the currently used volatile organic compounds (VOC). Since ARB now considers the terms to be synonymous, “ROG” has been renamed as “VOC” in this plan. VOC emissions are a subset of ROG emissions. ROG is composed of hydrocarbon compounds that may contribute to the formation of smog by their involvement in atmospheric chemical reactions. Ozone is considered a secondary pollutant because it is formed in the atmosphere from primary pollutants via photochemical reactions.

Because solar energy is required to form ozone and the chemical reactions are not instantaneous, the greatest concentrations of ozone are usually downwind of urban centers and usually occur on summer afternoons when sunlight is most intense. In summer, as weather systems move through the area, a cycle of stable and less-stable air masses over the valley results in alternating periods of higher and lower ozone concentrations. During the winter months, a number of factors contribute to reduced ozone concentrations: clouds and fog block the required solar radiation at ground level, the sun angle is lower, the days are shorter, wintertime storms produce good dispersion conditions that inhibit the buildup of pollutants, and temperatures are not high enough to produce ozone in great quantities.

2.3.4 Design Value Determinations from Ozone Levels

Section 1.2.1 described the term "design value" for the federal 1-hour ozone standard. In general, the design value is the pollutant concentration in the atmosphere at which healthy air exists. Ambient air quality standards for which attainment is defined in terms of the number of instances in which a numeric value is exceeded in a given time frame are called "exceedance-based" standards. For standards such as these, which includes the federal 1-hour ozone standard, the design value must therefore be calculated.[1] The design value is currently calculated for the federal 1-hour ozone standard by taking the fourth highest[2] daily maximum 1-hour ozone concentration at a given monitoring station during the three-year compliance period. The design value for a geographic area with more than one monitor, such as an air basin or county, is the same as the highest monitoring station's design value.

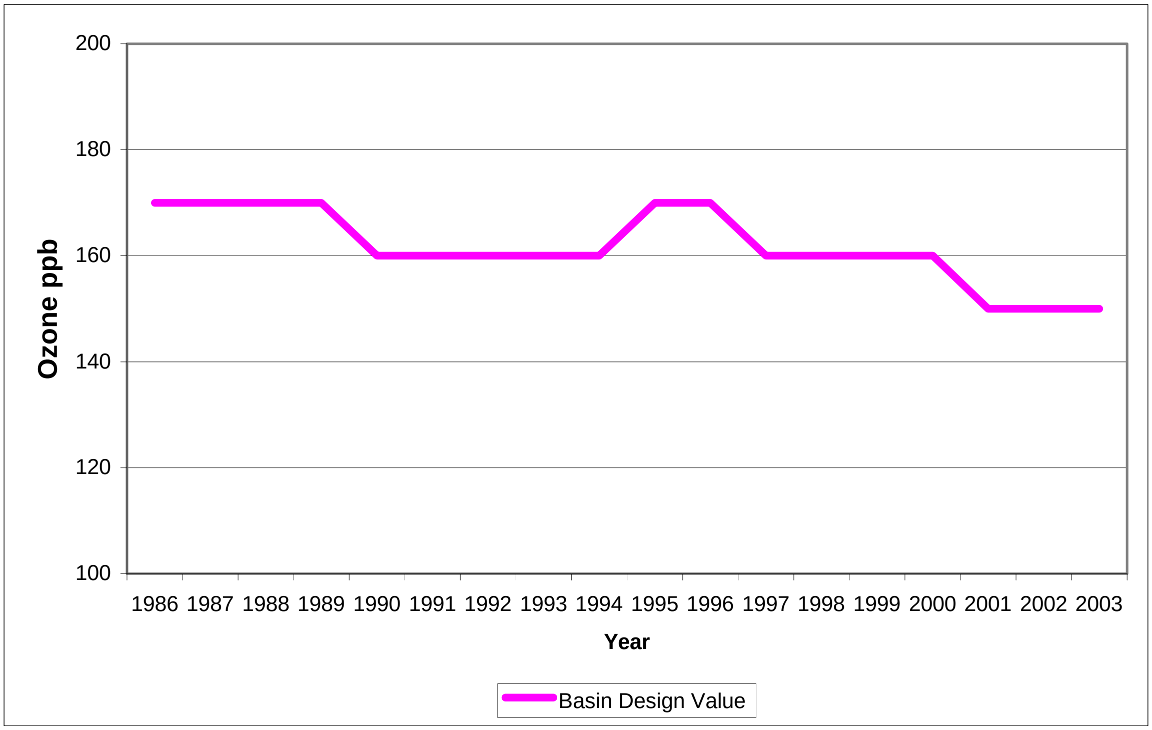
The design value for the SJVAB in 1994 (when the previous OADP was prepared) was 0.160 ppm (160 ppb). The SJVAB's current design value, based on 2003 air quality monitoring data, has dropped to 0.151 ppm (151 ppb). Figure 2-3 illustrates the SJVAB's trend in 1-hour design value.

[1] The calculation is needed to "translate" the exceedance-based information (e.g., number of times pollutant levels are higher than the numeric value of a standard) to a concentration (because design values are concentrations). In contrast to the federal 1-hour ozone standard, the federal 8-hour ozone standard is concentration-based, not exceedance-based, such that the design value is the same as the standard.

[2] Since an area can be in attainment with three exceedances of the federal 1-hour ozone standard in three years, the fourth highest value is of interest for the design value.

Figure 2-3

Basin 1-Hour Design Value for 1986 - 2003



2.3.5 Area Classification for the One (1)-Hour Ozone Standard

Attainment for the one-hour ozone standard requires that the concentration of 0.12 ppm by volume not be exceeded, on average, more than one day per year at any one monitoring station over any three-year period. If there are four or more exceedance days at a single monitor during a three-year period, the average number of exceedance days per year exceeds one and the air basin has not attained the standard. The EPA's finding (November 2001) that the SJVAB did not attain the 1-hour ozone standard on schedule was based on the area's design value (it is greater than 0.12 ppm) and the average number of exceedance days per year during the 1997 to 1999 period.

2.3.6 One (1)-Hour Ozone Exceedance Trends

Figure 2-4 shows the long-term trends in the SJVAB for the number of days over the federal 1-hour ozone standard, by region in the SJVAB (northern, central, southern), as well as by the basin as a whole. The Northern Region consists of San Joaquin, Stanislaus, and Merced counties. The Central Region consists of Madera, Fresno and Kings counties. The Southern Region consists of the western part of Kern County as well as Tulare County. As can be seen, the number of days over the standard overall has decreased basinwide from a peak of over 70 in the late 1980's to a level of 37 in 2003. However, short-term trends show an increase in the number of days over the standard basinwide: from below 30 days in 1999 to 37 in 2003. A similar trend is observed for the Southern Region. Northern and Central Regions show a downward trend in this time frame. Trends in other ozone statistics primarily with respect to the State Ozone Standard are shown in Section 8.

Figure 2-4

Number of Days Over the Federal 1-hour Ozone Standard in the San Joaquin Valley Air Basin by Region

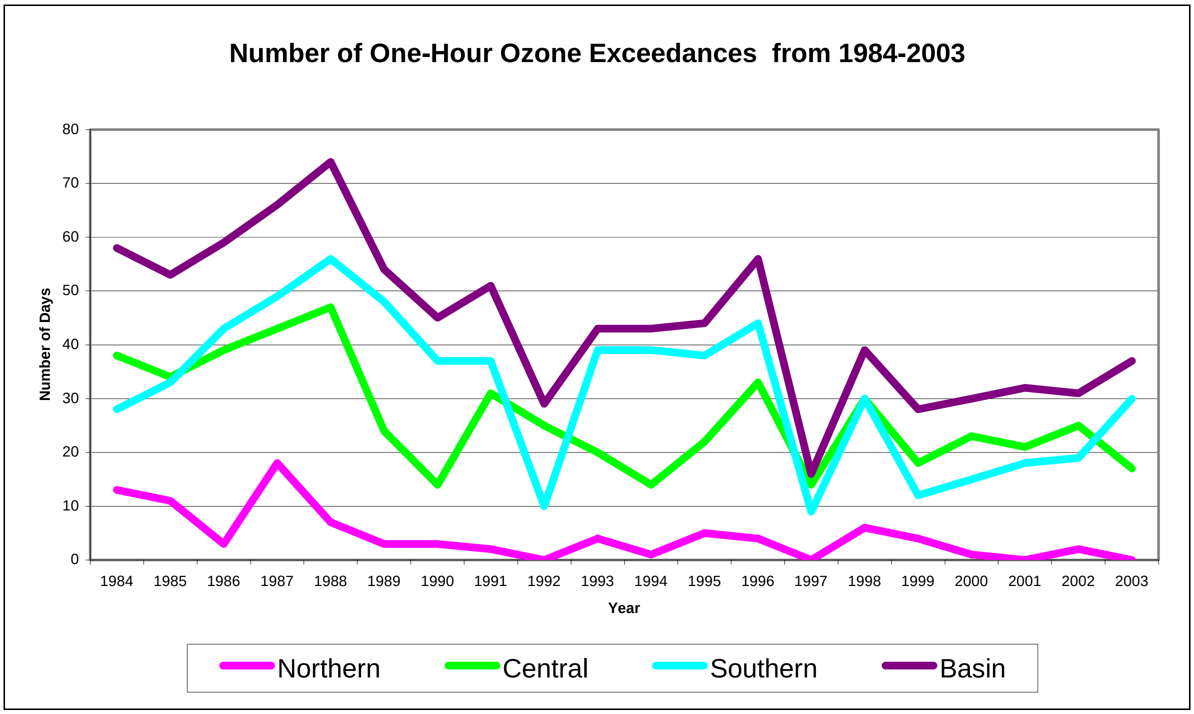
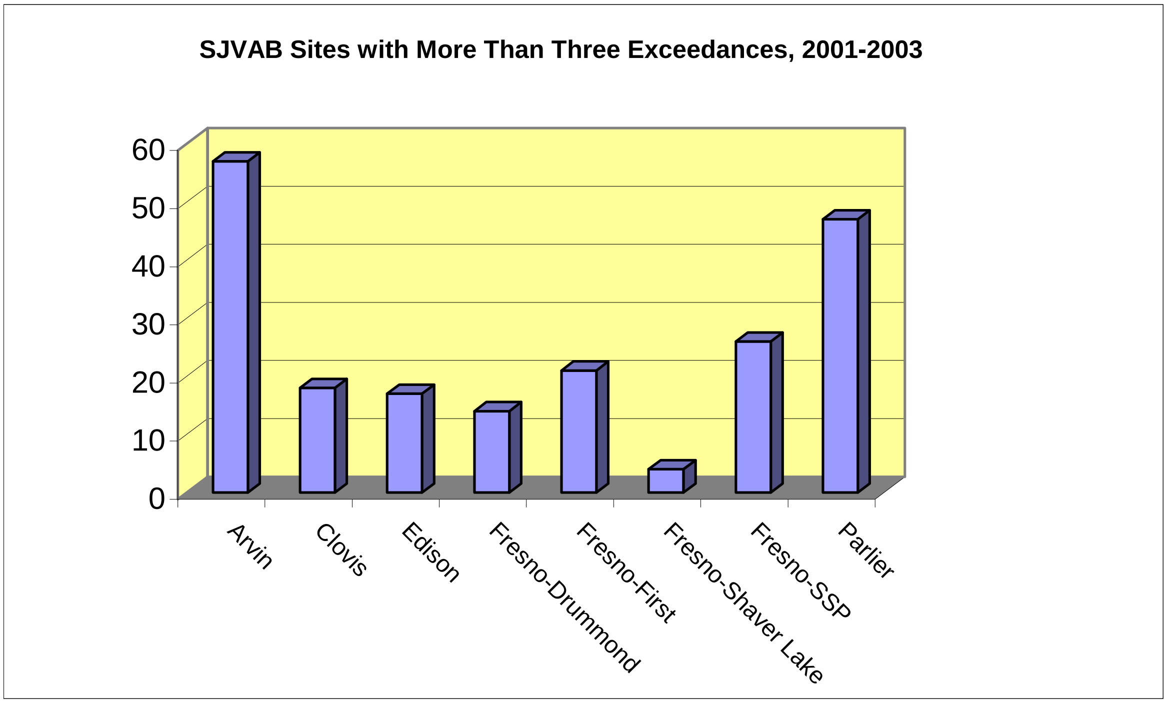


Figure 2-5 summarizes the SJVAB monitoring sites with more than three exceedances during 2001-2003. Compliance is achieved when this number is three or less for a three year period. As shown in Figure 2-5, eight monitoring sites experienced more than three exceedances, with one site (Arvin) experiencing more than 50 exceedances and another (Parlier) more than 40 exceedances. These data reflect the pervasiveness of the SJVAB's 1-hour ozone nonattainment problem.

Figure 2-5
SJV Ozone Exceedances



2.3.7 Status of Federal 8-Hour Ozone Standard

The federal 8-hour ozone standards adopted by EPA in 1997 (0.08 ppm by volume for primary and secondary standards) were overturned in the US Circuit Court of Appeals for the District of Columbia in 1999 on the grounds that the agency had overstepped its authority and unlawfully usurped Congress' legislative power. However, the EPA appealed the case to the US Supreme Court. In February 2000, the Supreme Court found that that EPA had not overstepped its authority and had not unlawfully usurped Congress' legislative power; however, the Court did find that the implementation policy was unlawful. The Court confirmed that the Clean Air Act does not bar EPA from implementing the ozone standard. On November 13, 2002, the American Lung Association and eight other public interest groups filed a complaint alleging that EPA failed to designate areas for the 8-hour ozone standard. In response to this complaint, EPA published a proposed consent decree establishing April 15, 2004 as the date for promulgating attainment designations for the 8-hr ozone standard (67 *FR* 70070). EPA issued these designations on April 15, 2004. In addition, EPA also issued the Phase I of the implementation rule for the 8-hour standard on April 15, 2004, which includes provisions on revocation of the 1-hour standard, anti-backsliding, and area classifications. The effective date of the 8-hour ozone designation is June 15, 2004. EPA designated the SJVAB as nonattainment for the federal 8-hour ozone standard, and classified the SJVAB, based on its 2001-

2003 design value, as serious nonattainment. As such, the SJVAB's attainment date for the federal 8-hour ozone standard is June 15, 2013. EPA will require submittal of the 8-hour OADP for the SJVAB in 2007.

Phase I of the Final Rule also gives the District the option of preparing an early 8-hour ozone increment of progress report or an early 8-hour OADP in lieu of submitting this *Extreme OADP* for the 1-hour ozone standards. Because EPA has found the 1-hour ozone standard is not necessary to protect public health, EPA has instructed states to focus resources on planning and implementation of the 8-hour ozone standard. (69 *FR* 23858)

2.4 OZONE MONITORING

2.4.1 Monitoring Network

EPA requires ARB and the District to measure the ambient levels of air pollution to determine compliance with the NAAQS. To comply with this mandate, the District and the ARB operate an ambient monitoring network that consists of 28 sites located throughout the SJVAB (see Figure 2-6). Not all stations monitor the same air quality or meteorological parameters, as indicated. Stations identified by a "G" designation in Figure 2-6 measure levels of ozone in the SJVAB's atmosphere.

Federal regulations require State and Local Air Monitoring System (SLAMS) networks to meet four basic monitoring objectives:

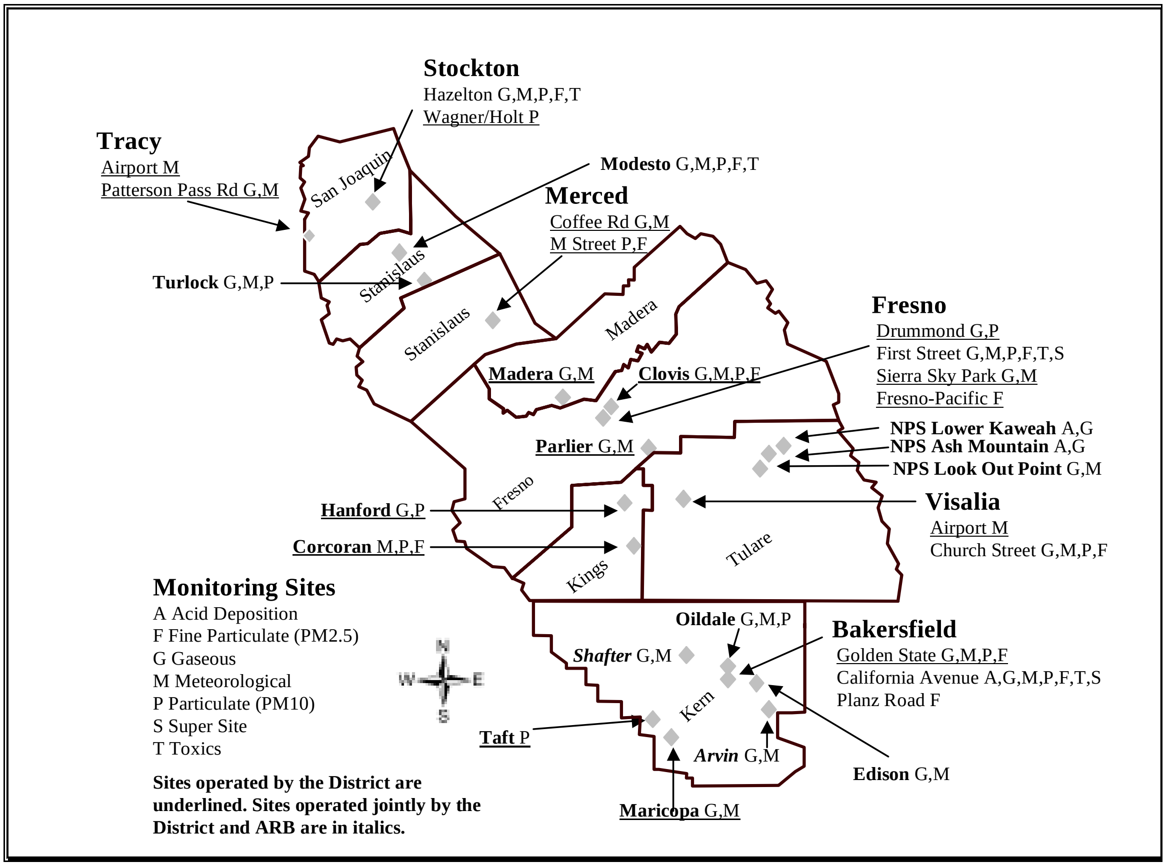
- monitoring the highest concentration of a pollutant
- monitoring representative concentrations in areas of high population density
- monitoring the impact of major pollutant sources, and
- monitoring pollutant background concentrations.

Each monitor must be capable of representing a spatial scale consistent with its monitoring objective. Categories of spatial scale are:

1) *Microscale* - An area of uniform pollutant concentrations with a radius ranging from several meters up to 100 meters.
2) *Middle Scale* - Uniform pollutant concentrations in an area with a radius of approximately 100 meters to 0.5 kilometers.
3) *Neighborhood Scale* - Uniform pollutant concentrations in an area with a radius of approximately 0.5 to 4.0 kilometers.
4) *Urban Scale* - Citywide pollutant concentrations in an area with a radius ranging from 4 to 50 kilometers.
5) *Regional Scale* - Uniform pollutant concentrations that would be characteristic of a very large (for example, rural) area that has a radius from tens to hundreds of kilometers.

Locations for the physical siting of air quality monitors are selected based on the objectives of the monitoring. All ozone monitoring in the Valley is directed toward measuring representative population exposures and maximum concentrations. As a result, most ozone monitors in the Valley are scaled for either neighborhood or urban scale measurements.

FIGURE 2-6
San Joaquin Valley Air Basin Air Quality Monitoring Network



The SJVAB has 23 ozone monitoring stations, with eleven operated by District personnel, three by the National Park Service, and nine by ARB. All ozone monitors are continuous analyzers and operated on the principle of ultraviolet absorption (40 CFR Part 50). Table 2-2 lists all ozone monitoring sites in the SJVAB.

As indicated by Table 2-2, all ozone monitoring in the Valley is directed toward measuring representative population exposures and maximum concentrations. As a result of these monitoring objectives, most ozone monitors in the Valley are scaled for either neighborhood or urban scale measurements.

The four major metropolitan areas within the SJVAB, (Stockton, Modesto, Fresno, and Bakersfield), each have ozone monitors to better characterize the ozone distribution in the metropolitan area. The Fresno and Bakersfield areas each have ozone monitors to measure upwind transport (Madera-Pump Yard and Shafter-Walker Street), middle-city concentrations (Fresno-First, Bakersfield-California, and Bakersfield-Golden State), downwind city-edge concentrations (Fresno-Drummond and Edison-Johnson Ranch), and downwind maximum concentrations (Parlier and Arvin). The upwind transport and middle-city ozone monitors measure representative concentrations while the downwind city-edge and downwind maximum monitors measure maximum concentrations. The Clovis-Villa and Oildale-Manor ozone monitors, located in the northeast quadrant of the Fresno and Bakersfield metropolitan areas, respectively, are sited for maximum concentrations. The remaining ozone monitors are located in smaller urban areas and several remote locations. These monitors are located for representative concentrations (with the exception of the Merced-Coffee Avenue station) since the areas where they are located are not capable of producing high concentrations of ozone.

2.4.2 Other ozone monitoring

In addition to the permanent monitoring network described above, the District has participated in a number of special studies directed at ozone monitoring in the SJVAB.

2.4.2.1 Fresno oxidant study

In the period from June through November, 1976, ARB conducted a saturation study to determine ozone concentrations within the Fresno metropolitan area and produced a report entitled "*The Areal Representativeness of Air Monitoring Stations - Fresno Study Phase I (Oxidant)*". Questions posed for the study included whether the Fresno-Olive site measurements represented average population exposure, the extent which ozone concentrations vary along an upwind to downwind traverse of the city, where the highest concentrations occurred, and how many stations were necessary to assure that the highest population exposures were measured.

The monitoring for this study was performed with mobile vans as well as fixed monitoring stations. Parameters measured include O_3, NO_X, CO, CH_4, THC (total hydrocarbons), and meteorological parameters including wind speed and direction, temperature, and relative humidity. The stations were placed in an approximate line from the northwest to southeast edge of Fresno to document pollutant concentrations along an upwind-downwind traverse of the city.

Table 2-2
Ozone Monitoring Stations in the San Joaquin Valley Air Basin

Site Name	Sampling Interval/Frequency	Scale	Monitoring Objective	Type	Agency
Arvin	1 Hour/Continuous	Urban	Representative Conc.	PAMS[1]/NAMS[2]	ARB[3]
Bakersfield-California	1 Hour/Continuous	Neighborhood	Representative Conc.	SLAMS[4]	ARB
Bakersfield-Golden State	1 Hour/Continuous	Neighborhood	Representative Conc.	PAMS/SLAMS	SJVUAPCD[5]
Clovis-Villa	1 Hour/Continuous	Neighborhood	High Concentration	PAMS/NAMS	SJVUAPCD
Edison-Johnson Ranch	1 Hour/Continuous	Urban	High Concentration	SLAMS	ARB
Fresno-Drummond	1 Hour/Continuous	Neighborhood	High Concentration	SLAMS	SJVUAPCD
Fresno-First Street	1 Hour/Continuous	Neighborhood	Representative Conc.	SLAMS	ARB
Fresno-Sky Park	1 Hour/Continuous	Urban	Representative Conc.	SLAMS	SJVUAPCD
Hanford-Irwin	1 Hour/Continuous	Neighborhood	Representative Conc.	SLAMS	SJVUAPCD
Madera-Pump Yard	1 Hour/Continuous	Urban	Representative Conc.	PAMS/SLAMS	SJVUAPCD

[1] PAMS- Photochemical Assessment Monitoring Systems
[2] NAMS-National Air Monitoring Systems
[3] ARB – California Air Resources Board
[4] SLAMS- State and Local Air Monitoring Systems
[5] SJVUAPCD- San Joaquin Valley Unified Air Pollution Control District

Table 2-2
Ozone Monitoring Stations in the San Joaquin Valley Air Basin (cont.)

Site Name	Sampling Interval/Frequency	Scale	Monitoring Objective	Type	Agency
Maricopa-Stanislaus	1 Hour/Continuous	Urban	High Concentration	SLAMS	SJVUAPCD
Merced-Coffee Avenue	1 Hour/Continuous	Urban	High Concentration	SLAMS	SJVUAPCD
Modesto-14th Street	1 Hour/Continuous	Neighborhood	Representative Conc.	SLAMS	ARB
Oildale-Manor	1 Hour/Continuous	Urban	High Concentration	NAMS	ARB
Parlier	1 Hour/Continuous	Urban	High Concentration	PAMS/NAMS	SJVUAPCD
Sequoia Nat'l. Park-Ash Mtn.	1 Hour/Continuous	Regional	Representative Conc.	SPM[6]	NPS[7]
Sequoia Nat'l. Park-Lookout Point	1 Hour/Continuous	Regional	Representative Conc.	SPM	NPS
Sequoia Nat'l. Park-Lower Kaweah	1 Hour/Continuous	Regional	Representative Conc.	SPM	NPS
Shafter-Walker Street	1 Hour/Continuous	Urban	Representative Conc.	PAMS/SLAMS	ARB
Stockton-Hazelton	1 Hour/Continuous	Neighborhood	Representative Conc.	SLAMS	ARB
Tracy-Patterson Pass	1 Hour/Continuous	Urban	Representative Conc.	SLAMS	SJVUAPCD
Turlock-Minaret	1 Hour/Continuous	Neighborhood	Representative Conc.	SLAMS	SJVUAPCD
Visalia-Church Street	1 Hour/Continuous	Neighborhood	Representative Conc.	SLAMS	ARB

[6] SPM- Special Purpose Monitoring Stations
[7] NPS- National Park Service

Conclusions drawn from this study include:

1 Meteorology plays a major role in ozone formation in the Valley. Long, hot, dry summer days with morning subsidence inversions and light winds are ideal conditions for ozone formation.
2 Under normal meteorological conditions, the ozone concentrations recorded at Fresno-Olive are representative of average population exposure. Under adverse conditions, the concentrations at the downwind edge of the city are much higher than at Fresno-Olive. A new station located at the downwind edge of the city was recommended. This site is Fresno-Drummond.
3 The incremental increase in ozone concentration per mile downwind across the city on an average day is much greater than the increase per mile downwind from the city. A measure of this "city effect" is the amount of increase in the max-hour concentration downwind along the resultant wind direction line. Max-hour oxidant concentrations increased, on the average, approximately forty percent across the city from air entering the city to the northwest.
4 Under the most adverse meteorological conditions, the max-hour concentrations at the downwind edge of the city were approximately 15 pphm greater than at the upwind edge.

Though these statements may not be totally accurate today because of better emissions control, the results of this study are included to demonstrate the general characteristics of ozone formation in the Fresno metropolitan area.

2.4.2.2 San Joaquin Valley Air Quality Study

Air pollution control officials, local elected officials, and industry representatives agreed in late 1986 to undertake a cooperative air quality study. The policy makers' ultimate goal was to identify and adapt well-founded, cost-effective ways to reduce air pollution in the San Joaquin Valley. The San Joaquin Valley Air Quality Study was initiated to provide technical tools to enable decision makers to develop and evaluate control strategies. The Study's original charter describes the challenges:

- To provide an improved understanding of the conditions that lead to high ozone levels in the Valley.
- To provide policy makers with the necessary tools and information to develop sound regional plans for equitable and effective emission controls to reduce ozone levels to meet state and federal ambient air quality standards.

Field Measurements

An extensive field measurement program was carried out during the summer of 1990 with some additional fieldwork in 1991. The field program collected data on air pollutant concentration and weather conditions from July 1 through August 31. During the period continuous measurements were taken at 339 surface sites, which collected upper air data.

The data from these monitors were transmitted to the Study headquarters on a real time basis. This allowed the Study to know immediately whether all sites were operational. It also provided the Study with the ability to forecast the onset of high ozone conditions.

During these high ozone periods, of which there were 14 days comprising five episodes, additional special monitoring was conducted to enhance both the spatial and temporal density of measurements. This included over 1,000 hours of data recorded over the Valley by nine research aircraft; weather patterns aloft; and the collection of speciated hydrocarbon measurements.

Several tracer studies were also conducted during the summer of 1990. In these studies, a tracer gas is released at a fixed location in known amounts. The movement of the tracer gas is then tracked to provide information on air movement and the rate of dilution by the air.

Emission Inventory

Emission data were also collected to characterize the magnitude and location of emissions occurring during each ozone episode day. This was particularly important as a number of ozone episodes occurred on weekends, a time when emission patterns are often significantly different than during weekdays. Studies were also conducted to develop estimates of emissions from natural and cultivated vegetation, assess motor vehicle traffic patterns, and update estimates from several categories of emission sources believed to be represented by outdated or inaccurate estimates.

Data Analysis

Team members assembled a comprehensive archive of the air quality and weather data collected during the field program for distribution to project scientists for analysis. The data analyses included: 1) an examination of the spatial and temporal distribution of ozone and ozone causing chemicals, 2) an assessment of the specific weather conditions associated with high ozone concentrations, and 3) an evaluation of air pollution concentrations aloft from the data collected via aircraft. These analyses provided an improved understanding of ozone patterns in the Valley as well as provided information crucial for understanding the performance of the air quality and weather models.

Findings

Ozone concentrations were found to be highest in and around the major urban areas of Fresno and Bakersfield, and in the Stockton/Modesto area. Monitors detected peak ozone concentrations of 0.15 ppm at Fresno and Edison (south east of Bakersfield) during the August 3-6, 1990, ozone episode; these levels exceed the national ozone standard of 0.12 ppm. Much of the remainder of the San Joaquin Valley experienced ozone concentrations at or above the more restrictive California state standard, but did not exceed the federal standard.

The general weather conditions that led to high ozone levels in the Valley included large-scale high pressure systems that developed over the Western United States, low wind speeds and high temperatures. Theses conditions occur frequently in the Valley between May and September, and may persist for several days. The dominant wind flow pattern is from the northwest to the southeast along the axis of the Valley. Air leaves the southern end of Valley during the daytime by flowing over the Tehachapi Mountains (southeast of Bakersfield) into the Mojave Desert. Pollutants on the Valley floor are also transported up the Sierra Nevada and Coastal Mountains as heated air raises into the mountains during the daytime. Some pollutants may also be returned as cooler air sinks into the Valley during the nighttime.

At night, a jet stream (of fast moving air) forms at an altitude of about 1,000 feet, with winds coming from the northwest at speeds of up to 30 mph. Because of nighttime stability conditions, air transported by this jet stream can't exit the Valley and is partially forced back northward along the eastern edge of the Valley, resulting in a counterclockwise flow known as the "Fresno eddy." The Fresno eddy circulates pollutants within the Valley, returning polluted air to urban areas where additional emissions are added to it. Polluted air that is trapped in the upper atmosphere at night can also contribute to the high ozone levels on subsequent days.

The August 3-6, 1990 ozone episode (which occurred over a weekend) is representative of the weather conditions associated with historical high ozone periods. August 3 and 4 were favorable for moderate ozone concentrations; August 5 and 6 were favorable for the occurrence of high ozone concentrations. These days had weather patterns characteristic of some of the highest ozone periods recorded in the 1980's.

2.4.2.3 Central California Ozone Study (CCOS)

The purpose of the Central California Ozone Study (CCOS) is to guide efforts to comply with the health based air quality standards for ozone by improving our understanding of the dynamics of ozone formation in urban and regional-scale ozone episodes in central and northern California. The CCOS effort began with a summer 2000 field research effort to collect observations related to formation of ozone at the surface and aloft for a large area of central California, with supporting collection of activity and emissions data. Additional work is ongoing to complete the project with analysis and modeling of the collected information, to improve the performance of modeling, and to guide actions to improve air quality for an extensive geographic region. The direct benefits will affect the future health of millions of citizens and extensive areas of sensitive agricultural production and federally protected forests and national parks.

The CCOS area of study (domain) includes most of northern California and all of central California. The northern boundary extends through Redding and allows representation of the entire Central Valley of California. The eastern boundary extends past Barstow and includes a large part of the Mojave Desert and all of the southern Sierra Nevada. The southern boundary extends below Santa Barbara and into the South Coast Air Basin. The western boundary extends approximately 200 kilometers west of San Francisco, because measurements were needed along the western boundary to characterize the temporal and spatial distributions of ambient background levels of ozone and precursors in the air flowing into California.

The CCOS field measurement program was conducted during a four-month period from 6/1/2000 to 9/30/2000, a study period corresponding to the time of year the majority of the high ozone level episodes occurred in northern and central California during previous years. CCOS field staff collected continuous surface air quality measurements and surface and upper-air meteorological measurements throughout the study period to provide sufficient data to model any day of the study period. They also collected data during ozone episodes to better understand the dynamics and chemistry of the formation of high ozone concentrations, and the contribution of transport to exceedances of federal and state ozone standards in downwind areas. CCOS field staff collected additional continuous surface air quality measurements at sites downwind of the San Francisco Bay Area, Sacramento, and Fresno to characterize ozone formation, carbon and nitrogen chemistry variations by time, day, and pollutant transport pattern. Data analysis is ongoing and results will be reported at a future date. This plan includes CCOS episodes to evaluate control strategies needed to attain the federal 1-hour ozone standard by November 15, 2010.

District and ARB staff examined several CCOS episodes for use in this *Extreme OADP*. As discussed in Section 5, modeling staff ultimately selected the CCOS episode from July 30 through August 2, 2000 for the plan. A typical Great Basin high-pressure system occurred during this episode, with a strong ridge that brought moderately high ozone levels to the SJVAB. The high-pressure system persisted for four days, before a trough off the Pacific Northwest coast moved the high-pressure system eastward, leaving approximately zonal flow over most of the SJVAB by August 3, 2000 (DRI 2003). The Bay Area and Sacramento Area also recorded moderately high ozone levels during this episode, with each experiencing 1-hour ozone levels slightly above the standard.

Staff members from the District, ARB, other northern/central California districts, and consultants to the CCOS study agency will continue to analyze CCOS episodes to improve model performance for use in future revisions to SIPs for the 1-hour ozone standard (if appropriate) and for use in future SIPs for the federal 8-hour ozone standard.

2.4.2.4 PAMS Sampling

The 1990 Federal Clean Air Act Amendments include a provision in Title I, Section 182 requiring States to begin a program of enhanced ozone monitoring. On March 4, 1992, EPA promulgated regulations as revisions to Title 40, Code of Federal Regulations, Part 58 for the establishment and operation of *Photochemical Assessment Monitoring Stations* (PAMS). EPA finalized these regulations on February 12, 1993. The regulations require enhanced monitoring of ozone, ozone precursors including oxides of nitrogen and volatile organic compounds, and meteorological parameters in areas designated as serious, severe, or extreme ozone nonattainment.

The District's PAMS network consists of two smaller networks that are focused on monitoring PAMS parameters in the Bakersfield and Fresno Metropolitan Statistical Areas (MSAs). Each focused network consists of one Type 1 PAMS, one Type 2 PAMS, and one Type 3 PAMS. The Type 1 PAMS is sited to monitor morning upwind ozone and ozone precursor concentrations, the Type 2 PAMS is sited to monitor morning ozone and ozone precursor concentrations at the downwind edge of the central business district, and the Type 3 PAMS is sited to monitor peak afternoon ozone concentration downwind of the MSA.

Currently, all six of the PAMS in the network are operational. The Fresno MSA Type 1 PAMS is located at Madera-Pump Yard, Type 2 is located at Clovis-Villa, and the Type 3 is located at Parlier. The Bakersfield MSA Type 1 is located at Shafter-Walker, Type 2 is located at Bakersfield-Golden State and the Type 3 PAMS is located at Arvin.

The District’s PAMS activities typically consist of collecting VOC and carbonyl (another type of chemical that reacts in the atmosphere to produce ozone) samples on specified schedules. For example, the 2001 PAMS Program for VOC and carbonyl sampling was operated in accordance with the "California Alternative Sampling Schedule" (CAP III), for the July-September period. During these months sampling was scheduled for every 3rd day and called for the collection of at least four (4) three-hour integrated samples per day, plus additional samples surrounding suspected high ozone days (episodes). An episode is defined as a time frame in which a maximum hourly average ozone concentration exceeds the federal one-hour standard of 125 parts per billion. In terms of the number of episode days sampled, the Districts’ CAPIII proposal established a goal of capturing at least 3 episodes during the three-month season.

The PAMS Site Types #1, #2, and #3 are pre-established SLAMS sites. Continuous monitoring for ozone, oxides of nitrogen, and surface meteorology is ongoing at these sites, and the data are routinely submitted to AIRS throughout the year. From July 1 to September 30 the District collects and ships samples related to VOC and carbonyl species for the PAMS season. VOC canisters and carbonyl cartridges are collected and sent to a contracted lab for analysis.

2.4.3 Conclusion

Ozone air quality in the SJVAB is extensively monitored. A permanent monitoring network continuously samples the air at various locations in the SJVAB to measure ozone levels in the atmosphere. During the ozone season, these data are supplemented by special ozone precursor samples collected during episodes of anticipated high ozone levels. In addition, federal, state and local governments have collaborated in the past on a number of special air quality studies, components of which have included measurements of ozone air quality and meteorological and other parameters that affect ozone formation. The most recent and most extensive of these special studies, the Central California Ozone Study, provided data that was used to develop this *Extreme OADP* (see Chapter 5).

2.5 OTHER POLLUTANTS OF CONCERN IN THE SAN JOAQUIN VALLEY AIR BASIN

2.5.1 Particulate Matter

PM10 is composed of very small particulate matter measuring less than 10 microns (one one-millionth of a meter) in diameter. These small particles are comprised of finely divided solids or liquids such as dust, soot, aerosols, fumes, and mists. The PM10 problem in the SJVAB is partially caused by the same compounds that produce ozone: VOCs and NOx. These compounds react in the atmosphere to form aerosols, which make up a significant fraction of PM10 in the SJVAB. Particulate matter is also directly emitted by society’s activities, including agricultural operations, industrial processes, fossil fuel combustion, agricultural and prescribed fires, construction and demolition, and entrainment of road dust into the air. PM10 is also derived from natural sources, including windblown dust and wildfires.

Community studies of air pollution effects on health have linked particulate matter, alone or in combination with other air pollutants, with a number of significant respiratory and cardiovascular-related effects. These effects include increased mortality and aggravation of existing respiratory and cardiovascular diseases as evidenced by increased hospitalization, school absences, and increased work loss days. Populations at general risk for suffering adverse health effects from exposures to particulate matter include children, asthmatics, the elderly, individuals with influenza, and individuals with chronic obstructive pulmonary cardiovascular disease. Particulate matter can also alter the body's immune system and affect removal of foreign materials from the lung, and in children this can result in decreased lung capacity.

The federal standards for PM10 are 50 micrograms per cubic meter for the annual average (primary and secondary standards) and 150 micrograms per cubic meter for the 24-hour average (primary and secondary standards). Exceedances of the 24-hour standard usually occur between October and February in the SJVAB.

EPA originally classified the SJVAB as moderate non-attainment, but bumped it up to serious non-attainment in 1993 because the District was not able to demonstrate attainment by 1994 in its Moderate Area Plan.

On August 19, 2003 California submitted a serious nonattainment area plan for PM10 to EPA (the 2003 *PM10 Plan*). After an initial review, EPA determined that amending the plan in a few key areas would facilitate its ultimate approval; consequently, the District and ARB amended the 2003 PM10 Plan. In December 2003, the District Governing Board adopted the Amended 2003 *PM10 Plan*. On December 30, 2003, California submitted the Amended 2003 *PM10 Plan* to EPA. On January 9, 2004, EPA found the 2003 *PM10 Plan Amendments* to be complete. On February 4, 2004, EPA proposed approval of the 2003 *PM10 Plan* as amended and issued a final rule approving the plan on April 28, 2004. This rule was published in the *Federal Register* on May 26, 2004, with an effective date of June 25, 2004 (69 *FR* 30006). All references to 2003 *PM10 Plan* in this *Extreme OADP* refer to the amended plan approved by EPA effective June 25, 2004.

Air quality data show an overall improvement for the SJVAB's PM10 nonattainment problem. The peak 24-hour PM10 exceedance value was 439 $\mu g/m^3$ in 1990 and 150 $\mu g/m^3$ in 2003 (150 $\mu g/m^3$ is the standard). The estimated number of days exceeding the 24-hour PM10 standard has decreased from 56 days in 1990 to 0 days in 2003. Lastly, the three year annual average PM10 level at the peak station was 78 $\mu g/m^3$ in 1991 but dropped to 56 $\mu g/m^3$ in 2003 (50 $\mu g/m^3$ is the federal PM10 annual average NAAQS). The SJVAB is still nonattainment for PM10, but substantial progress has been made.

2.5.2 Carbon Monoxide

CO is an odorless, tasteless, and colorless gaseous air pollutant. It is a directly emitted byproduct of incomplete fuel combustion. The largest portion of CO emissions comes from gasoline-fueled motor vehicles. Other contributors are fires (forest, residential, and agricultural), industrial processes, solid waste disposal, and fuel combustion at stationary sources. Most occurrences of unhealthful levels of CO are found in major urban areas in conjunction with high traffic levels and limited dispersion.

Inhaled CO has no direct toxic effect on the human lungs; however, once it enters the human bloodstream through gas exchange in the lungs, it readily combines with hemoglobin, which is the substance that carries oxygen to cells in the body (the CO/hemoglobin affinity is about two hundred times stronger than the oxygen/hemoglobin affinity). Consequently, the hemoglobin becomes tied up with CO and is not available to transport oxygen to the body. Effects include dizziness, nausea, lack of coordination, headaches, impaired perception, and weakened heart functions; prolonged exposures to high levels can lead to death. People especially sensitive to CO include children (and the human fetus), the elderly, those with respiratory and heart illnesses, those with anemia, and smokers.

Carbon monoxide usually does not persist in the atmosphere and is depleted and diluted through chemical reactions and dispersion. Exceedances of the federal standard are most likely to occur in the winter, due to lowered inversion levels (that trap this pollutant and cause elevated concentrations), increased fuel combustion for heating, and reduced atmospheric chemical reactivity due to low temperatures. Since CO is somewhat soluble in water, normal winter precipitation removes the pollutant from the atmosphere. Carbon monoxide also participates in the overall photochemical reaction mechanism leading to the production of ozone and smog.

The federal standard for CO is 9 ppm for the 8-hour average and 35 ppm for the 1-hour average (primary standard only). In the past, four urbanized areas in the SJVAB were designated as nonattainment for the carbon monoxide (CO) standards. The last of the four areas were redesignated to attainment in 1998 for both Federal and state standards. In June 2004, ARB published a draft CO Maintenance Plan for the attainment areas.

2.5.3 Toxic Air Pollutants

Other ozone precursors include various VOCs, some of which may also be considered toxic air contaminants (TAC). The FCAA required the District to re-evaluate its existing TAC regulatory program alongside the technology-based standards for 189 hazardous air pollutants identified by the EPA. The federal TAC standards [Maximum Achievable Control Technology (MACT) standards] affect over 170 source categories nationwide, many of which are already subject to state regulation. The District has ensured that only appropriate source categories in the SJVAB are subject to federal enforcement action.

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