Air Quality Element

TECHNICAL APPENDIX

The technical appendix serves as an important informational resource base for meteorology and baseline air quality data.

ENVIRONMENTAL SETTING-CHARACTERISTICS OF THE OJAI VALLEY AIRSHED

Regional Location and Topography

Ventura County is comprised of coastal mountain ranges, the coastal shore, the coastal plain, and several inland valleys. The northern half of the County (Los Padres National Forest) is extremely mountainous with altitudes up to 8,000 feet.

The Ojai Valley is bounded by the Santa Ynez Mountains and the Los Padres National Forest to the north, and Sulpher Mountain to the south. Access to the valley is from the Santa Paula Road (Highway 150) from the east and the Ventura River Valley from the south, the Maricopa Highway (33) from the north and Casitas Pass Road (Highway 150) from the west (STA Inc. 1991).

The City of Ojai is located in the southern half of Ventura County, 15 miles inland from the Pacific Ocean and directly north of the City of San Buenaventura, the County seat.

Climate

Lying in the semipermanent high pressure system of the eastern Pacific, the region's climate is mild and tempered by cool sea breezes. The normally mild climatological pattern is occasionally interrupted by periods of hot weather, winter storms, or Santa Ana winds. Winds in excess of 50 miles per hour, and humidity levels as low as five percent have been recorded during Santa Ana wind episodes (VCAPCD, 1991).

The local meteorology of the area depends on the interaction of large-scale weather systems with coastal breezes, all modified by the complexity of local mountains and valleys. When large-scale weather systems provide moderately strong winds (greater than 25 miles per hour) aloft (above 5,000 feet), they tend to dominate the wind flow pattern in the area. This is primarily the case in the winter and spring when frontal systems or Santa Ana winds control wind flow. Occasionally, stagnant high pressure systems move in, creating warm, sunny weather during winter and spring. The coastal strip is characterized by sparse rainfall, most of which occurs in the winter season, and hot, dry summers tempered by cooling sea breezes. Summertime weather is dominated by the movement and intensity of the semi-permanent subtropical high pressure system. Daytime westerly onshore winds predominate with reverse evening offshore breezes occurring during the early night time and morning. In spring, summer, and fall, the climate is dominated by marine air. During this time, light synoptic scale winds in the region allow the marine air influence to dominate temperatures and air flow.

The climate of the Ojai Valley is characterized as Mediterranean or dry subtropical and has two distinct seasons: from May through October an extended hot dry period, and from November through April a moist and mild period. Annual temperature differences range from an average minimum of 44°F in January, to an average maximum of 72°F in September. Rainfall occurs primarily between November and April with mean annual precipitation averaging between 12 to 14 inches (VCAPCD, 1991).

Air Pollution Potential

All air pollutants emitted by point and distributed sources are transported, dispersed, or concentrated by meteorologic and topographic conditions. Air pollutants accumulate on days when three factors occur simultaneously: low inversions, low maximum mixing heights, and low wind speeds.

The potential for high contaminant values varies seasonally for many contaminants. During the late spring, summer and early fall, light winds, low mixing heights and brilliant sunshine combine to produce conditions favorable for the maximum production of oxidants, mainly ozone. The smog season is less pronounced from October through March when northeasterly wind of a higher speed is common. This wind pattern functions to disperse the pollutants rather than entrapping them in an inversion layer. During the spring and summer, when fairly deep marine layers are frequently found in the basin, sulfate concentrations achieve yearly peak concentrations. When strong surface inversions are formed on winter nights, especially during the hours before sunrise, and are coupled with near calm winds, carbon monoxide becomes highly concentrated. The highest yearly carbon monoxide values are measured during November, December, and January.

Similarly, nitrogen oxides and nitrate concentrations are highest during the late fall and winter.

The transport of air pollutants into the Ojai Valley Airshed occurs as a result of regional wind patterns. Outside sources of air pollutants have been identified as Los Angeles County, Santa Barbara County, and Outer Continental Shelf oil production and exploration activity. The daytime westerly onshore winds during the months of April through October blow air pollutants inland from the Outer Continental Shelf and Santa Barbara Channel petroleum industry operations, and from the coastal Los Angeles area. A light easterly wind flows through the Santa Susana Pass transporting pollutants from the San Fernando Valley in Los Angeles County into Simi Valley. Figures 1 and 2 illustrate wind patterns that contribute to elevated levels of pollutants occurring in the inland areas. These pollutants are carried offshore by the night time drainage breezes, however, the same pollutants can be transported back into the basin on succeeding days.

The vertical dispersion of air pollutants in Ventura County is limited by the presence of persistent temperature inversions. An inversion occurs when air temperature increases with height, which is a reversal of the normal atmospheric state. Inversions can exist at the surface or at any height above the ground. The height of the base of the inversion is known as the "mixing height" and is the level to which pollutants can mix vertically. In Ventura County, inversions occur at 800 to 1000 feet above sea level during the smog season with occasional inversion layers as low as 200 feet above sea level.

There are two principal types of inversions that occur in Ventura County: radiation inversions and subsidence inversions. Thermal radiation or surface inversions are formed when the ground becomes cooler than the air above it at night. As the earth's surface cools after sunset, the air directly above it also cools, while the air above it remains warm. These surface inversions gradually breakup as the rising sun warms the ground. However, sometimes the inversions are so strong that they do not breakup. The most intense radiation inversions, and therefore the most limited mixing, occur during calm, clear conditions. Approximately 60 percent of all inversions measured at Point Mugu are surface-based, and mostly present in the morning hours.

Summer weather is dominated by the movement and intensity of the semipermanent subtropical high pressure system call the "Pacific High." This system provides clear skies over southern California due to descending air. The descending air is warmer than the marine layer, resulting in an elevated subsidence inversion. As with the radiation inversion, the upward escape of pollutants emitted near the ground is inhibited. Subsidence inversions are less effected by diurnal heating cycles, and can lead to a build-up of pollutants when air flow is restricted by topographic features. Subsidence inversions are a common cause of the smoggy conditions frequently observed in the Los Angeles basin.

Inversions can become multi-layered over several days if daily heating is not sufficient to cause breakup. These inversions can be a combination of radiation and subsidence inversions. Multi-layered inversions are the most difficult to dispel and result in the greatest build-up of pollution.

Ambient Air Quality

The U.S. Environmental Protection Agency (EPA) and the State of California have adopted the ambient air quality standards shown on Table 1. The National Ambient Air Quality Standards (NAAQS) address six pollutants, while the State Ambient Air Quality Standards (SAAQS) address ten. In general, California's standards are more stringent than EPA standards. California has set standards for sulfates, hydrogen sulfide, and vinyl chloride, chemicals that are not regulated under federal law.

Currently, the federal air quality standards for ozone are exceeded in the Ojai Valley on a regular basis. Ojai Valley is second only to Simi Valley in the frequency of first stage smog alerts recorded in the County.

Tables 2 and 3 illustrate the maximum concentrations and the number of days during 1980-89 that the state and federal ozone standards were exceeded in the Ojai Valley Airshed. Currently, Ventura County has nonattainment status for ozone and PM-10. There is one station in the Ojai Valley, as shown in Figure 3. Figure 3 shows the two prior monitoring stations in the Valley.

The following pollutant discussion pertains to only those pollutants and their precursors that do not meet the federal or state attainment requirements for Ventura County and the Ojai Valley Airshed. Please note that specific health effects are discussed here with respect to each of the pollutants. Further health effects are discussed in the following section.

Ozone. Ozone (O_3) is a highly reactive gas formed in the lower atmosphere by a complex series of chemical and photochemical reactions involving reactive organic gases (ROG), nitrogen oxides (NO_x), and sunlight. These pollutants, except sunlight, are described as precursors to the formation of ozone. However, without sunlight the formation of ozone would not occur. Mobile and industrial sources contribute to the concentrations of precursor gases in nearly equal amounts. Ozone formation is a result of strong solar radiation that generates photochemical reactions. Thus, peak concentrations occur at times of maximum sunlight intensity, generally near the middle of the day and during summer months. The highest levels of ozone are typically found in the inland valleys rather than in coastal areas, since the prevailing sea breeze transports the pollutants inland during the time it takes ozone to form. In addition, the inland areas are warmer, facilitating greater ozone production for each pollutant.

Ozone concentrations reaching the Stage 1 episode level (one-hour average ozone greater than or equal to 0.20 parts per million [ppm]) are considered unhealthful, sufficient to cause increased asthma attacks and a decline in lung function in sensitive people. When ozone levels are high, children, the elderly, and people with respiratory problems are advised to remain indoors. Outdoor exercise is discouraged because strenuous activity may cause shortness of breath and chest pains. Ozone is a strong irritant that attacks the respiratory system, causing damage to lung tissue. Asthma bronchitis, and other respiratory ailments, as well as cardiovascular disease, are aggravated by exposure to ozone. A healthy person exposed to high concentrations may become nauseated or dizzy, may develop a headache or cough, or may experience a burning sensation in the chest. Table 3 shows that there have been up to two Stage 1 episodes per year in Ventura County.

The adverse health effects of ozone were discovered by research sponsored by the ARB and conducted at the University of Southern California. Results of the study illustrated that exposure to ozone damages the aveoli, the individual air sacs in the lung where the exchange of oxygen and carbon dioxide between the air and blood takes place. Other oxidizing components of smog may also pose a threat to health; however, their effects are poorly understood at this time.

Researchers in 1987 were investigating the possibility that ozone can damage deep lung tissue during prolonged heavy exercise. In a study supported by the ARB, researchers at the University of California, Irvine, studied the effects of ozone on laboratory rats exercising on a treadmill. The researchers found that exercise combined with ozone exposure dramatically increases severe lung injury, leading to the filling of the lungs with liquid. At lower ozone levels, small lesions (tiny scarred areas) were found in the lungs. This suggests that the same type of damage could occur in athletes who strenuously exercise outdoors when ozone levels are high.

The average ozone concentration for the Ventura area for the years of 1980-1989 were between 5.4 and 10.5 parts per hundred million (pphm), with a high of 10.5 pphm in 1988 in Simi Valley. Table 4 illustrates these concentrations. The number of days exceeding the NAAQS for ozone in the Ojai area for the period of 1980-1989 were less than 25 days per year. For the SAAQS for ozone, less than

75 days per year were measured in exceedance. Figures 4 and 5 illustrate exceedances.

Reactive Organic Gases (ROG). Reactive organic gases are often referred to as hydrocarbons, consisting of hydrogen and carbon in various combinations. Many hydrocarbon compounds are photochemically reactive and play an important role in ozone formation. NOx and ROG are the principal constituents of photochemical reactions producing ozone. ROGs are emitted from both mobile and stationary sources including, but not limited to, motor vehicles, organic solvents, petroleum recovery operations, pesticides and herbicides, and organic solvents.

Levels of hydrocarbons currently measured in urban areas are not known to cause adverse effects on humans. However, certain members of the hydrocarbon group are important components (precursors) in the reactions which produce photochemical smog.

The federal ambient standard for hydrocarbons was revoked by the EPA in 1983. However, in 1987, a new hydrocarbon measurement program was begun by the VCAPCD to focus on the type of hydrocarbons which contribute to photochemical smog. These are the reactive members of the hydrocarbon group called non-methane hydrocarbons. Very high non-methane hydrocarbons have been measured in the southern portion of the Ventura County airshed.

Nitrogen Dioxide. Nitrogen dioxide (NO_2) is a brown gas with a bleach-like odor that is formed in the atmosphere by the oxidation of nitric oxide (NO). These two compounds are collectively referred to as nitrogen oxides (NO_x) and are emitted by mobile and stationary sources.

The national standard for nitrogen dioxide (annual average of all hours is 0.53 ppm) has never been exceeded in Ventura County. The highest annual average from 1987 to 1989 was 0.27 ppm in Simi Valley in 1989. The highest hourly concentration during this period (1987), was also in Simi Valley and was 0.15 ppm. This is less than the California hourly standard of 0.25 ppm.

Particulates. Total suspended particulates (TSP) is the name given to the solid matter suspended in the atmosphere, which includes natural and man-made materials such as soil particles, biological materials, sulfates, nitrates, sea salts, organic compounds, and lead.

Airborne particles, including dust and smoke, may also contain sulfur, nitrogen, carbon, and various materials. Large amounts of very small particles are either emitted directly or are by-products of smog. Although the nose and throat are able to stop most large particles, very small ones easily bypass this natural filtering system and can lodge deep in the lungs. Inhaled particles can directly irritate the respiratory tract, constrict air passageways, and interfere with the mucous lining of the air passageways. Particulate matter may also be a carrier of toxic materials, allowing them to enter the lungs where they can be absorbed into the blood and circulated to other parts of the body. The detailed mechanism of this process and its effect on human health requires further study.

A large portion of particulate matter suspended in the atmosphere have aerodynamic diameters less than 10 microns (one micron is one millionth of a meter) and are referred to as PM-10. PM-10 consists of both directly emitted particles and particles that are formed in the atmosphere from gases, such as reactive organic gases, oxides of nitrogen, and oxides of sulfur.

In 1983, the ARB replaced the state TSP standard with a standard for PM-10. The development of the PM-10 standard was prompted by acute and chronic health effects data, suggesting that it is this class of particles that are deposited in the respiratory tract and are sometimes responsible for respiratory diseases. PM-10 is considered a greater health risk than larger particles due to its ability to be inhaled deep into the lungs. PM-10 particles often are never removed from the lungs by exhaling, and may be carriers of toxic materials which can be absorbed by the blood and carried to other parts of the body. Nearly all pollution-induced visibility reduction is due to constituents of TSP.

The National Ambient Air Quality Standards for the 24-hour and annual means have not been exceeded since 1986. This exceedance was measured during high winds at the Piru station and was 176 $\mu g/m^3$. The one exceedance does not affect the national PM-10 attainment status of the county. However, numerous exceedances of the state 24-hour and annual standards have been recorded at each monitoring site.

Oxides of Sulfur. Sulfur dioxide (SO_x) is a colorless gas with a sharp, irritating odor that is emitted directly into the atmosphere by stationary sources such as power plants, petroleum refineries and chemical plants. It is also produced from burning diesel oil and other fuels in motor vehicles, railroad trains, and ships (SCAQMD, 1991). SO_2 can contribute to acid deposition and visibility impairment after reacting in the atmosphere to form sulfuric acid and sulfates, and as such is a precursor to PM-10.

Healthy individuals also experience sore throats, coughing, and breathing difficulties when exposed to high levels of SO_2. Subjects exposed to SO_2 during exercise have experienced increased difficulty breathing. This response has not been observed when the subjects breathe clean filtered air. People with asthma who inhale SO_2 have symptoms that include shortness of breath. People with emphysema and chronic bronchitis are also adversely affected by exposure to SO_2. Children exposed to SO_2 experience increased respiratory tract infections. Healthy individuals also experience sore throats, coughing, and breathing difficulties when exposed to high levels of SO_2. Subjects exposed to SO_2 during exercise have experienced increased difficulty breathing. This response has not been observed when the subjects breathe clean filtered air.
The national standard for SO_2 is an annual average of 0.03 ppm. This standard has never been exceeded in Ventura County. The state standard is 0.25 ppm.

Carbon Monoxide. Carbon monoxide (CO) is a colorless, odorless gas produced by incomplete combustion of carbon-containing fuels, such as gasoline. Most of the CO in ventura County's atmosphere is emitted directly from motor vehicles, causing concentrations to be higher in the vicinity and downwind of areas with heavy traffic. CO levels tend to be highest in the winter and during the late night and early morning hours, nearly opposite to the ozone concentration peaks.

CO binds tightly to the hemoglobin, the oxygen-carrying protein in the blood, reducing the amount of oxygen that reaches the heart, brain, and other body tissues. Exposure to CO particularly endangers individuals with coronary artery disease, due to an already limited supply of blood and oxygen reaching their heart. Even healthy individuals who are exposed to low levels of CO can experience headaches, fatigue, and slow reflexes from lack of oxygen. Health damage caused by CO is of greater concern at high elevations, where the air is thin and where many individuals may already suffer from inadequate oxygen supply.

CO is not monitored in the Ojai Valley. From 1987-1989 the maximum hourly concentration measured in Ventura County was 12 ppm in Simi Valley, well below the air quality standards.

Economic Effects

Air pollution causes economic loss by reducing crop yields, and by facilitating the aging of buildings, clothing, tires, and metals. The ARB completed a study which analyzed the effect of air quality on crop yields. The study concluded that ozone causes more than $300 million worth of annual crop losses in California. Ozone reduced harvests for 15 commercial crops via damaging the cellular structure of plants, reducing photosynthesis, stunting growth, and scars produce which reduces the aesthetic value and, in turn, the selling value of the product. In addition, ozone makes some plants more vulnerable to disease by weakening the plants defense system.

A recent study by the Public Affairs Committee quantified the cost of improving, replacing, or repairing buildings, clothing, tires, and/or metals. The results of the study indicated that the average family spends $2,000 per year to pay for the damage air pollution has caused.

MONITORING ANALYSIS

On July 28, 1991, a train derailment occurred along the Rincon coastal strip, north of Ventura, along Highway 101. The train derailment included the release of hazardous materials which resulted in closing the highway for five days. Caltrans rerouted the traffic from July 28 to August 2 through the Ojai Valley via Highway 33 to Highway 150. Increased traffic volumes were expected to induce greater pollutant levels from automobile exhaust. However, a review of the monitoring data showed no substantial increase of nitric oxide or nitrogen dioxides, which are by-products of automobile exhaust, or of ozone over the normal levels.

The monitoring data raised questions about the adequacy of air monitoring in the Ojai Valley. This incident also resurfaced earlier questions which had arisen when the site was relocated in 1982. After relocation, the number of days that the ozone standard was exceeded appeared to substantially decrease. Although these questions were investigated by the VCAPCD, the City of Ojai requested that they be analyzed further to ensure that the monitoring data was accurate to protect the public health and to support the City's planning efforts.

Three site locations in the Ojai Valley were audited: the current Ventura County regional monitoring site located at 1768 Maricopa Highway; a site at Nordhoff High School (the location prior to 1982); and a site at Signal Street, near Libby Park (the location prior to 1981).

Siting Audit

In order to investigate whether the site relocation had affected the representativeness of the data, a siting audit was performed by conducting an inspection of the site and interviewing the station operator to assess the monitoring site's compliance with the established regulations that govern the collection of ambient and meteorological data. The subjects addressed by the site audit were:

- monitoring and site design
- physical inspection of the site
- probe and instrument siting

Siting Objectives

The Code of Federal Regulations, Title 40, Section 58 (40 CFR 58), is clear concerning the siting of probes and monitoring stations. There are two major subjects related to the siting of an ambient air monitoring station: exposure and spatial scale.

Exposure. Exposure of the probe is very critical and well studied by the EPA. The current monitoring station is located at 1768 Maricopa Highway, which is in a Caltrans storage yard approximately 1.6 kilometers northeast of the northern intersection of Highways 33 and 150. The monitoring station is located behind a large storage shed in the center of the yard. The distance of the air monitoring probe to Highway 33 is 53 meters. The average daily traffic (ADT) is estimated to be approximately 9,500 vehicles per day. The minimum distance that ozone and nitrogen dioxides can be measured from a roadway with less than 10,000 ADT is 10 meters and a minimum of 20 meters from trees. The trees nearest to the probe are 32 meters away. The exposure criteria for roadways and vegetation are met for this monitoring station.

A major problem with this monitoring location is traffic from truck movement and heavy equipment housed in the yard. After examining the ambient pollutant data at the site, it can be determined that the trucks and heavy equipment operation are influencing the oxides of nitrogen analyzer. Spikes were observed in the trace during the early morning and late evening. The effect of the trucks and heavy equipment appears to be temporary and should not affect the overall readings. Additionally, a local source of nitrogen oxide can serve to decrease ozone levels due to the complex photochemical reaction. Overall, the exposure for the nitrogen dioxide and ozone sensors meet the EPA criteria.

The monitoring station was previously located at Nordhoff High School on Highway 33. This site is approximately 0.8 kilometers from the northern intersection of Highways 33 and 150. The ozone analyzer was located in an empty room near the administration office. The distance of the air monitoring probe to

Highway 33 was 60 meters. Currently, the ADT is approximately 9,500 vehicles per day. The nearest trees to the probe were four meters away. The exposure criteria for roadways was acceptable, but exposure to vegetation was not. The major problem with this monitoring station location was the large and numerous trees in the vicinity of the probe. Trees are located 4 meters to the west, 9 meters to the east, and 51 meters to the north. Trees can also destroy ozone through adsorption by their leaves. Thus, this monitoring station was not well sited for ozone monitoring.

The Signal Street monitoring site was located 0.8 kilometers south of the intersection of Signal Street and Highway 150. This monitoring station housed an ozone monitor in a small one story building. The monitoring site is located at the end of a residential cul-de-sac. It is expected that the ADT would be well below 10,000 vehicles per day. The exposure to the roadway is 17 meters, which is acceptable. The nearest trees to the probe were seven meters; therefore, exposure to vegetation at this location was not acceptable. The major problem with this monitoring location was the large and numerous trees in the vicinity of the probe. The nearby trees are located 21 meters to the north, 17 meters to the northwest, and 8 meters to the southwest.

Spatial Scale. 40 CFR 58 defines spatial scale and distances for those scales concerning stationary and mobile sources.

> "The goal in siting monitoring stations is to correctly match the spatial scale represented by the sample of monitoring air with the spatial scale most appropriate for the monitoring objective of this station. Thus, spatial scale of representativeness is described in terms of the physical dimensions of the air parcel nearest to a monitoring station throughout which actual pollutant concentrations are reasonably similar."

The VCAPCD and the California Air Resources Board (ARB) classify this site as neighborhood scale for nitrogen dioxide and urban scale for ozone. Neighborhood scale defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometer range. With regards to this scale, the monitoring objective is to sample air which represents the City of Ojai, Meiners Oaks, and Mira Monte. 40 CFR 58 also states, "For neighborhood or urban scales, the emphasis in site selection will be in finding those areas where long-term averages are expected to the the highest."

The drop in the number of exceedances observed shortly after the monitoring

station was moved to its present location, was most likely due to a drop in overall ozone values, combined with a small drop associated with the local NO emissions sources (i.e., the trucks in the yard). Although Ojai exceeds the ozone air quality standards, it typically only exceeds them by a small amount, e.g., 128 parts per billion (ppb) versus the standard of 120 ppb. Therefore, a small decrease in ozone values can have a substantial effect on the number of days when an exceedance is observed.
Another consideration in siting is the probable longevity and stability of the site. Longevity is important in order to be able to track air quality trends on a consistent basis. As seen above, the comparison of data is strongly compromised when a site is relocated. County public maintenance yards can offer a good "home" for an air quality site. Although they often have some local emissions, the site can usually be expected to remain for a long time and have adequate security, access and power supply.

Although not perfect, the current site does meet the requirements and objectives of a regional ozone monitoring site. In addition, it has been at its present location for ten years and provides a good basis for the analysis of air quality trends in the area. Given the constraints and costs of air quality monitoring, this site is acceptable.

System Audit

The system audit was performed by conducting an inspection of the site and interviewing the station operator to assess the monitoring site's compliance with the established regulations that govern the collection of ambient and meteorological data. Upon auditing of the site, the following was concluded:

- auxiliary equipment (i.e., meteorological equipment, data logger, transfer standards, chart recorders) were also of good quality and acceptable

- log entries and recordkeeping of the monitoring site was reviewed and found to be up to date with respect to calibration of all instruments, including ozone transfer standards, cylinder certifications, and mass flow and meteorological instrument calibrations

- data handling via the electronic data logger was accurate and was found to be backed up daily by the VCAPCD office which calls the station daily via modem and downloads the data to the central computer

Overall, the operation of the monitoring station is being performed within EPA guidelines, is well maintained, and the instruments are in good working order.

Ambient Air Monitoring Comparison

The VCAPCD has reviewed the accuracy and representativeness of the Ojai station monitoring data in light of the concerns raised by the train derailment. Figures 6 and 7 are wind roses indicating direction and strength of windflow. Figure 6 illustrates ozone frequency measured at the 1768 Maricopa Highway Monitoring Station. Their review included an assessment of both the data quality during that time and whether the site was properly located to meet the regional monitoring objectives. The results of this review show that the site was properly located to meet the regional monitoring objectives(VCAPCD, 1992 Draft Monitoring Plan). These results were supported by the EPA (letter from David L. Calkins, Chief, Air Planning Branch, U.S. EPA Region IX, to Richard H. Baldwin, VCAPCD, dated December 3, 1991).

For their review, VCAPCD compared the Ojai data to another site in Ventura County located near Lake Casitas off of Highway 150 and operated by the ARB. To obtain further objectivity, this comparison was expanded to two additional sites in Santa Barbara County, one near Carpinteria and one in the mountains north of Santa Barbara on Paradise Road (see Figures 8-13). A plot of the hourly ozone values from July 26 to August 4 shown on Figure 10 shows that all four sites exhibit the same diurnal distribution, with a very strong correspondence of the concentrations at Ojai with Paradise Road and Carpinteria with West Casitas site. These results show that during this period the ozone values were mostly related to the distance from the coastline and had little to do with proximity to the traffic route, as the Paradise Road site was well away from the problem area. July 30 is the only day when the peak ozone value at Ojai did not compare closely to Paradise Road, and instead was closer to the peak value measured at the other two sites. It should be noted that elevation was not an important factor during this period since the Paradise Road site (547 m) is closest to the West Casitas site (319 m), while Ojai (230 m) is closer to Carpinteria (137 m) in elevation.

The hourly NO_2 data at these four sites during these ten days were also compared. The plot of these data is shown in Figure 14-16. These data are much more difficult to compare since the Ventura County data is only reported to the nearest parts per hundred million (pphm), while the Santa Barbara data were available at the ppb level. However, it can be concluded from this information that while all of the NO_2 values are quite low, that Paradise Road which was furthest from the traffic emissions has the lowest levels. Ojai and West Casitas has the highest concentrations, and appear to have been somewhat higher during the period when traffic was rerouted.

Similar to VCAPCD's assessment, this data comparison confirms that ozone and NO_2 data collected at Ojai are most likely valid. Although not significantly above normal levels, ozone concentrations in Ojai on July 31 were elevated, which could account for some of the health problems experienced by the public during this time. It is also quite likely that some of the discomfort could have been caused by CO air pollution, which is most directly affected by a slowdown by and proximity to motorized traffic. However, since CO levels are thought to be well within the standards in this area, it is not monitored at any of these four sites.

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards[1]		National Standards[2]		
		Concentration[3]	Method[4]	Primary[3,5]	Secondary[3,6]	Method[4,7]
Ozone	1 Hour	0.09 ppm (180 μg/m³)	Ultraviolet Photometry	0.12 ppm (235 μg/m³)	Same as Primary Std.	Ethylene Chemiluminescence
Carbon Monoxide	8 Hour	9.0 ppm (10 mg/m³)	Non-dispersive Infrared Spectroscopy (NDIR)	9.0 ppm (10 mg/m³)	Same as Primary Stds.	Non-dispersive Infrared Spectroscopy (NDIR)
	1 Hour	20 ppm (23 mg/m³)		35 ppm (40 mg/m³)		
Nitrogen Dioxide	Annual Average	-	Gas Phase Chemiluminescence	0.053 ppm (100 μg/m³)	Same as Primary Std.	Gas Phase Chemiluminescence
	1 Hour	0.25 ppm (470 μg/m³)		-		
Sulfur Dioxide	Annual Average	-	Ultraviolet Fluorescence	80 μg/m³ (0.03 ppm)	-	Pararosoaniline
	24 Hour	0.05 ppm[8] (131 μg/m³)		365 μg/m³ (0.14 ppm)	-	
	3 Hour	-		-	1300 μg/m³ (0.5 ppm)	
	1 Hour	0.25 ppm (655 μg/m³)		-	-	
Suspended Particulate Matter (PM_{10})	Annual Geometric Mean	30 μg/m³	Size Selective Inlet High Volume Sampler and Gravimetric Analysis	-	-	-
	24 Hour	50 μg/m³		150 μg/m³	Same as Primary Stds.	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	-	-	50 μg/m³		
Sulfates	24 Hour	25 μg/m³	Turbidimetric Barium Sulfate	-	-	-
Lead	30 Day Average	1.5 μg/m³	Atomic Absorption	-	-	Atomic Absorption
	Calendar Quarter	-		1.5 μg/m³	Same as Primary Std.	
Hydrogen Sulfide	1 Hour	0.03 ppm (42 μg/m³)	Cadmium Hydroxide STRactan	-	-	-
Vinyl Chloride (chloroethene)	24 Hour	0.010 ppm (26 μg/m³)	Tedlar Bag Collection, Gas Chromatography	-	-	-
Visibility Reducing Particles	1 Observation	In sufficient amount to reduce the prevailing visibility[9] to less than 10 miles when the relative humidity is less than 70%		-	-	-

TABLE AQE-1.

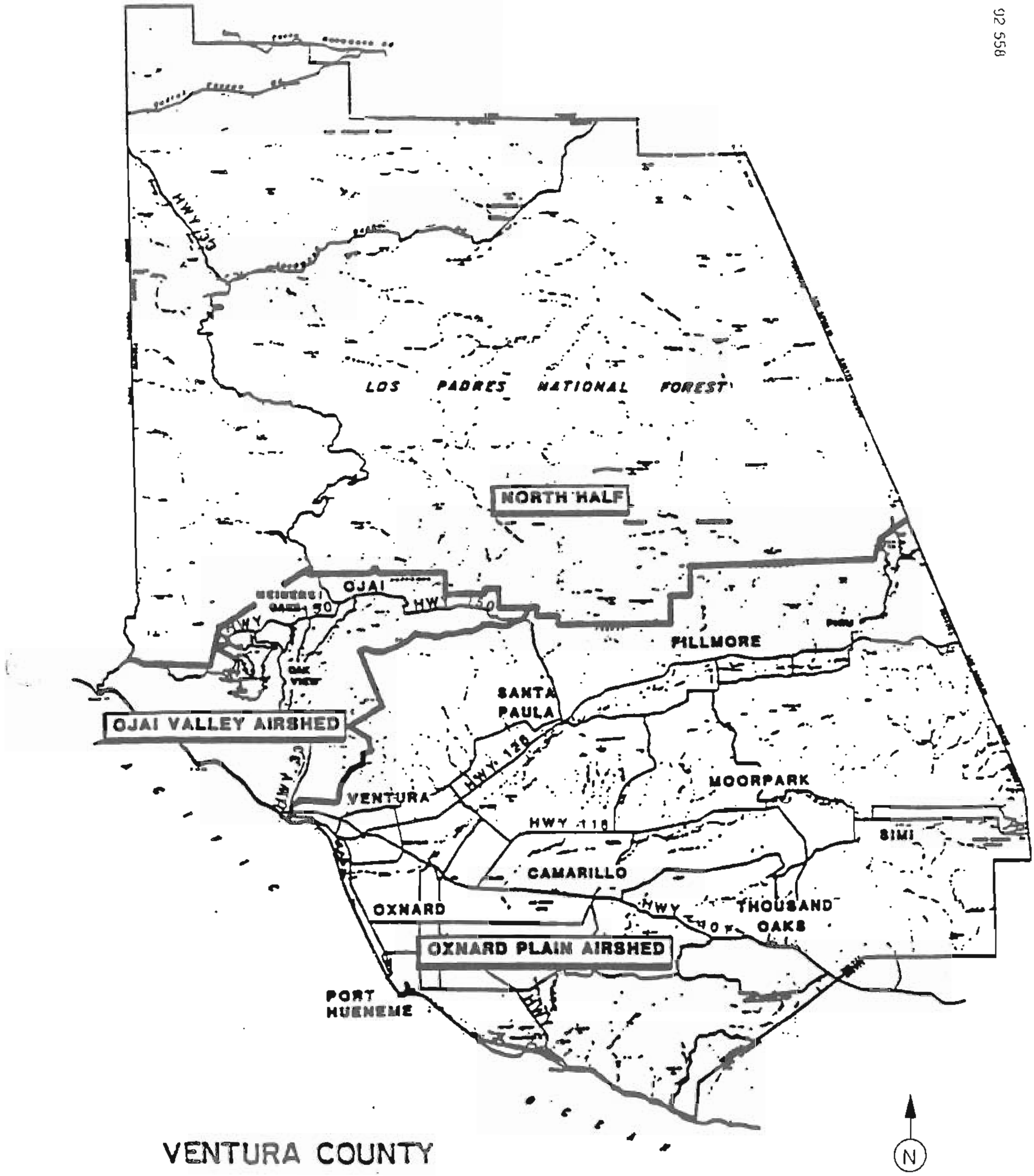

FIGURE AQE-1 . Ventura County airshed designations.

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NOTES:

1. California standards for ozone, carbon monoxide, sulfur dioxide (1 hour), nitrogen dioxide and particulate matter - PM_{10}, are values that are not to be exceeded. The sulfates, lead, hydrogen sulfide, vinyl chloride, and visibility reducing particles standards are not to be equaled or exceeded.

2. National standards, other than ozone and those based on annual averages or annual arithmetic means, are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parenthesis are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the implementation plan is approved by the EPA.

7. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.

8. At locations where the state standards for ozone and/or suspended particulate matter are violated. National standards apply elsewhere.

9. Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

TABLE AQE-1 (cont.).

TABLE AQE-2

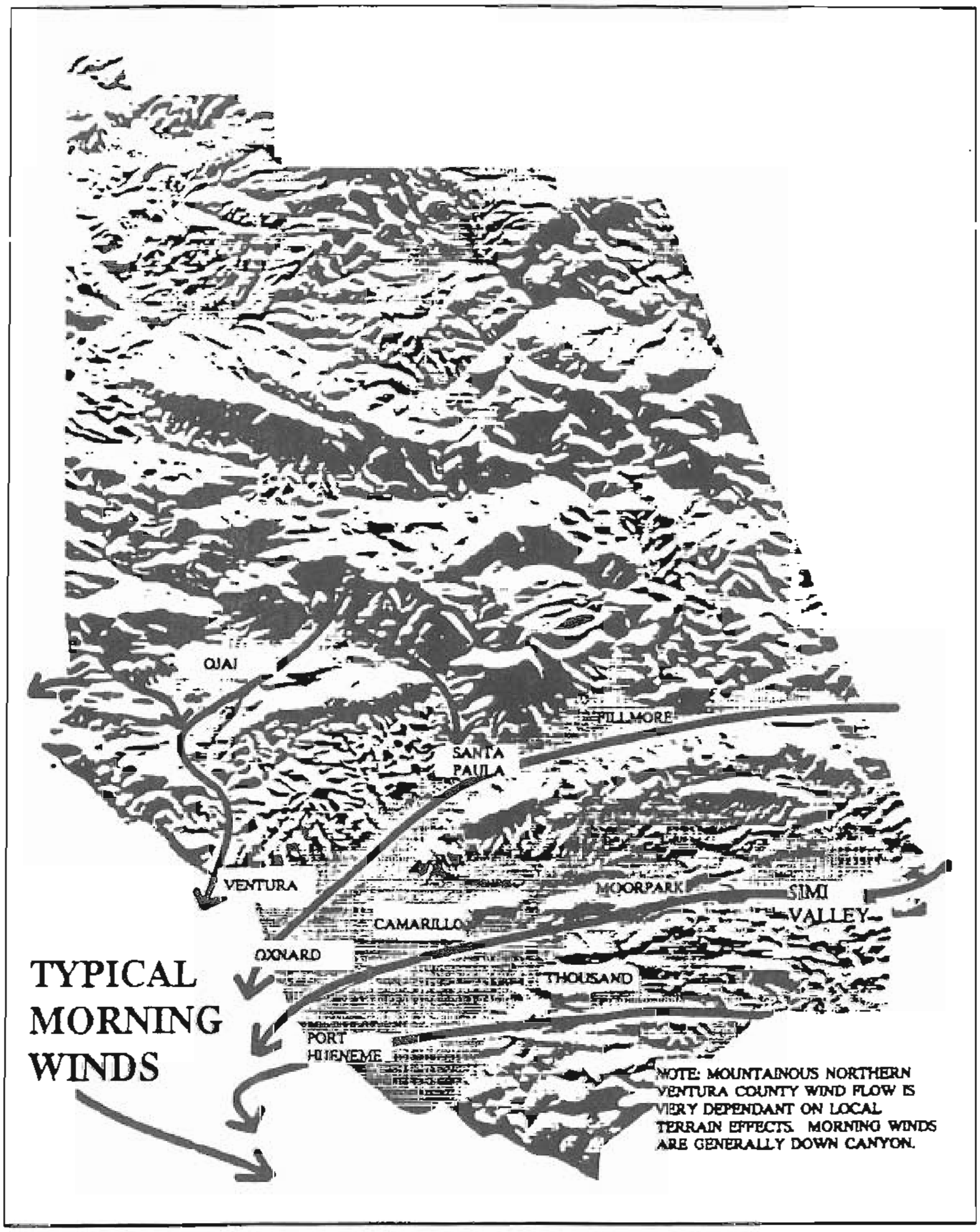
SIZE OF COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL PROJECTS NECESSARY TO EXCEED VARIOUS POUNDS PER DAY THRESHOLDS

Land Use	Size Facility 5 lbs/day
General Aviation Airport	90 flights/day
General Light Industrial	31,250 sq ft
General Heavy Industrial	119,048 sq ft
Industrial Park	31,250 sq ft
Manufacturing	48,077 sq ft
Warehousing	40,000 sq ft
Mini-Warehouse	1000 units
Hotel	33 rooms
Motel	29 rooms
Resort Hotel	16 rooms
Marina	92 berths
Golf Course	36 acres
Movie Theater w/o matinee	2 screens
Movie Theater w/ matinee	1 screen
Racquet Club	455 members
Elementary School	278 students
High School	218 students
College	193 students
University	125 students
Church/Synagogue/Temple	39,371 sq ft
Day Care Center	9 employees
Library	6,623 sq ft
Hospital	23 beds
Nursing home	90 beds
Clinic	11,468 sq ft
Medical Office	8,475 sq ft
Government Office	4,106 sq ft
State Motor Vehicles Dept.	17,066 sq ft
U.S. Post Office	3,471 sq ft
Civic Center	11,313 sq ft
Office Park	21,835 sq ft
Research Center	35,715 sq ft
Business Park	37,175 sq ft
Discount Store	4,231 sq ft
Nursery (Garden Center)	14 employees
Quality Restaurant	3,149 sq ft
High Turnover Restaurant	1,499 sq ft
Fast Food w/o Drive-Through	391 sq ft
Fast Food w/ Drive-Through	481 sq ft
New Car Sales	6,238 sq ft
Service Station	3 pumps
Supermarket	2,400 sq ft
Convenience Store	340 sq ft
Video Arcade	10,823 sq ft
Walk-in Bank	1,586 sq ft
Drive-in Bank	1,035 sq ft
Walk-in Savings & Loan	4,936 sq ft
Drive-in Savings & Loan	4,062 sq ft

TABLE AQE-3

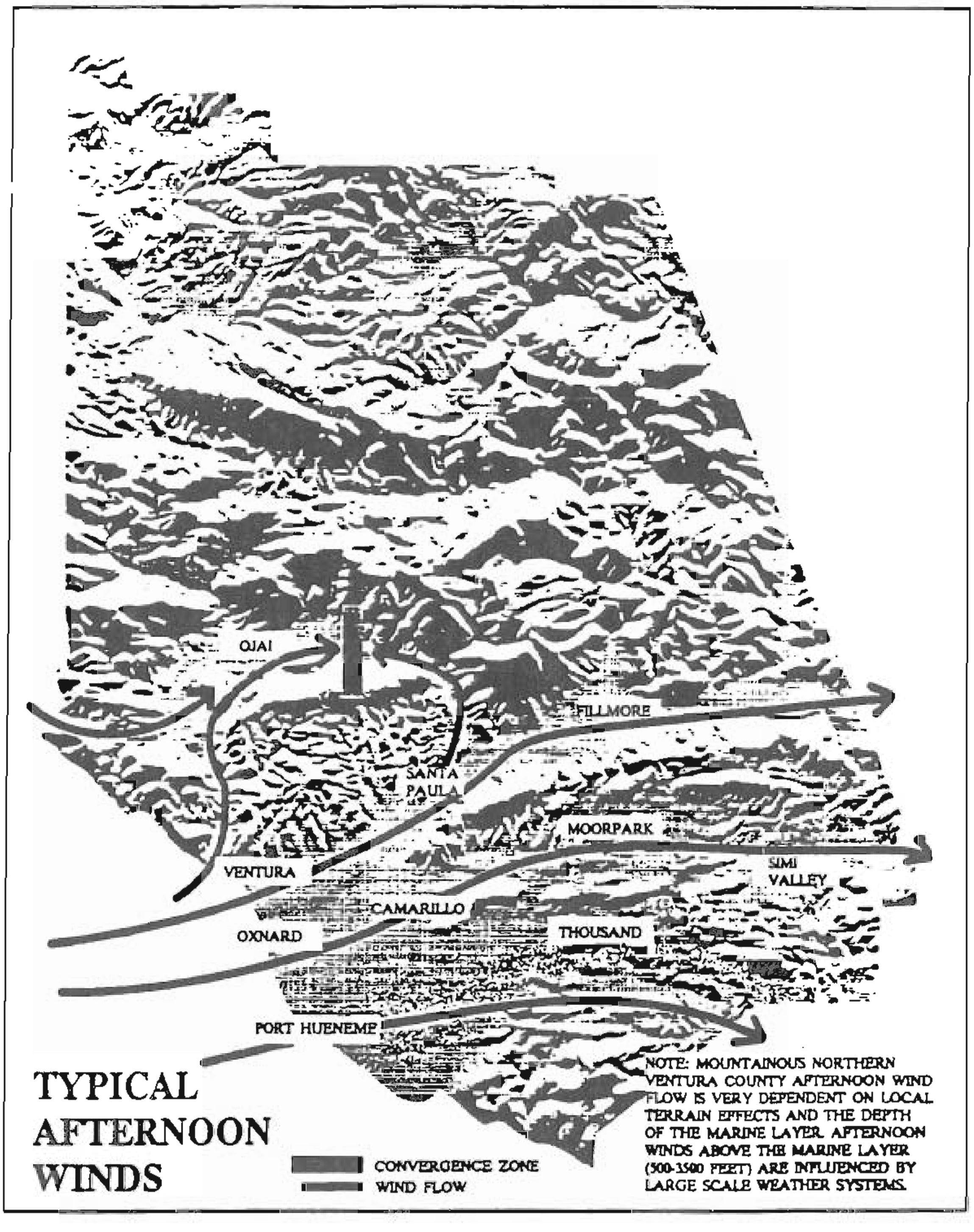
NUMBER OF RESIDENTIAL DWELLING UNITS NECESSARY TO EXCEED VARIOUS POUNDS PER DAY THRESHOLDS

Land Use	Number of Units 5 lbs/day
Single Family Housing	22
Apartment	32
Condominium	32
Mobile Home	37
Retirement Community	46



SOURCE: VCAPCD, 1991

FIGURE 2. Ventura County morning wind flow.



SOURCE: VCAPCD, 1991

FIGURE 2. Ventura County afternoon wind flow.

92.559A

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards [1]		National Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [4,7]
Ozone	1 Hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet Photometry	0.12 ppm (235 $\mu g/m^3$)	Same as Primary Std.	Ethylene Chemiluminescence
Carbon Monoxide	8 Hour	9.0 ppm (10 mg/m^3)	Non-dispersive Infrared Spectroscopy (NDIR)	9.0 ppm (10 mg/m^3)	Same as Primary Stds.	Non-dispersive Infrared Spectroscopy (NDIR)
	1 Hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
Nitrogen Dioxide	Annual Average	-	Gas Phase Chemiluminescence	0.053 ppm (100 $\mu g/m^3$)	Same as Primary Std.	Gas Phase Chemiluminescence
	1 Hour	0.25 ppm (470 $\mu g/m^3$)		-		
Sulfur Dioxide	Annual Average	-	Ultraviolet Fluorescence	80 $\mu g/m^3$ (0.03 ppm)	-	Pararosoaniline
	24 Hour	0.05 ppm[8] (131 $\mu g/m^3$)		365 $\mu g/m^3$ (0.14 ppm)	-	
	3 Hour	-		-	1300 $\mu g/m^3$ (0.5 ppm)	
	1 Hour	0.25 ppm (655 $\mu g/m^3$)		-	-	
Suspended Particulate Matter (PM_{10})	Annual Geometric Mean	30 $\mu g/m^3$	Size Selective Inlet High Volume Sampler and Gravimetric Analysis	-	-	-
	24 Hour	50 $\mu g/m^3$		150 $\mu g/m^3$	Same as Primary Stds.	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	-	-	50 $\mu g/m^3$		
Sulfates	24 Hour	25 $\mu g/m^3$	Turbidimetric Barium Sulfate	-	-	-
Lead	30 Day Average	1.5 $\mu g/m^3$	Atomic Absorption	-	-	Atomic Absorption
	Calendar Quarter	-		1.5 $\mu g/m^3$	Same as Primary Std.	
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)	Cadmiun Hydroxide STRactan	-	-	-
Vinyl Chloride (chloroethene)	24 Hour	0.010 ppm (26 $\mu g/m^3$)	Tedlar Bag Collection, Gas Chromatography	-	-	-
Visibility Reducing Particles	1 Observation	In sufficient amount to reduce the prevailing visibility[9] to less than 10 miles when the relative humidity is less than 70%		-	-	-

TABLE 1.

NOTES:

1. California standards for ozone, carbon monoxide, sulfur dioxide (1 hour), nitrogen dioxide and particulate matter - PM_{10}, are values that are not to be exceeded. The sulfates, lead, hydrogen sulfide, vinyl chloride, and visibility reducing particles standards are not to be equaled or exceeded.

2. National standards, other than ozone and those based on annual averages or annual arithmetic means, are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parenthesis are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the implementation plan is approved by the EPA.

7. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.

8. At locations where the state standards for ozone and/or suspended particulate matter are violated. National standards apply elsewhere.

9. Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

TABLE 1 (cont.).

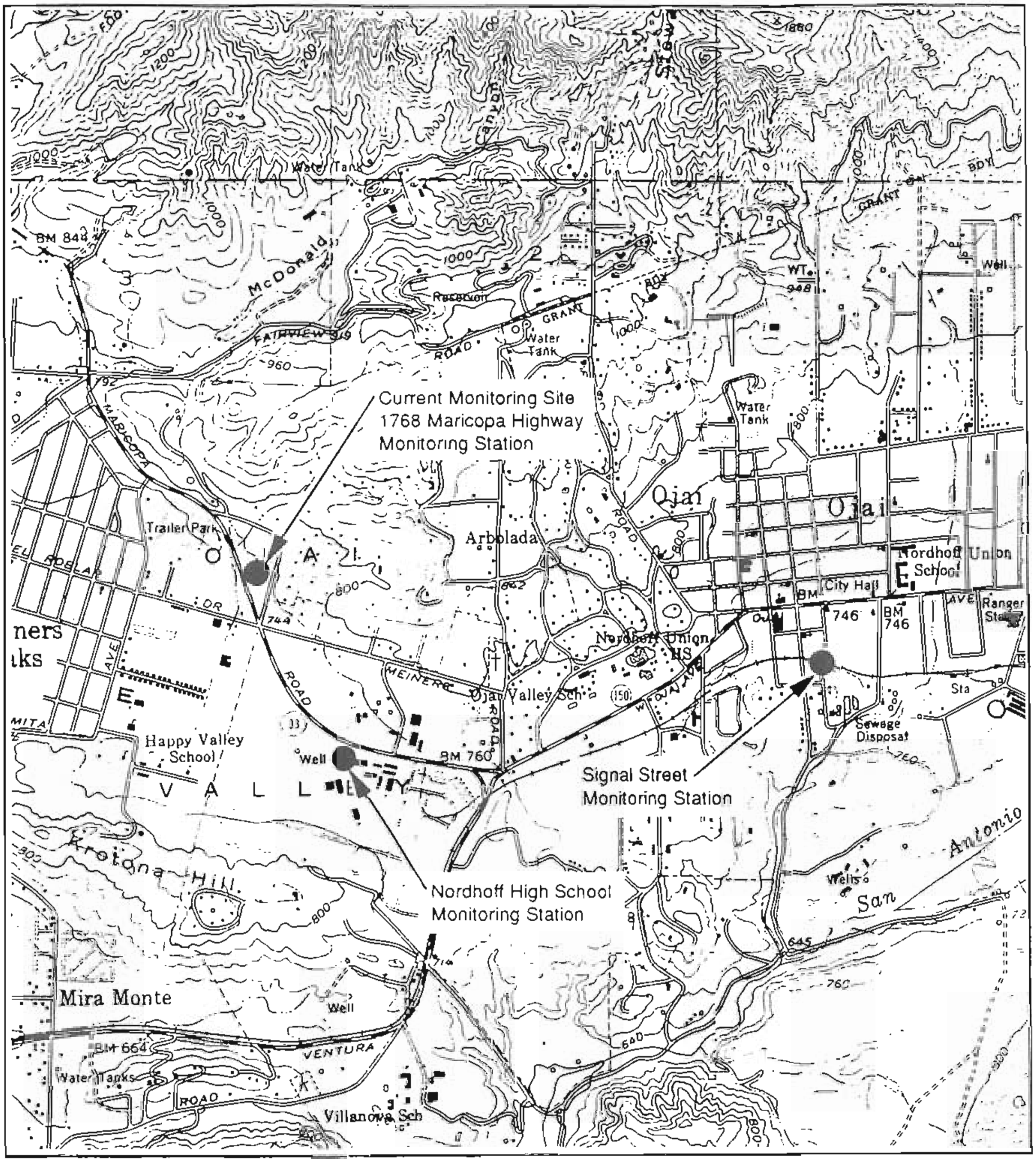
TABLE 2
NUMBER OF DAYS EXCEEDING THE OZONE STANDARDS*
NAAQS (12 PPHM)/CAAQS (9 PPHM)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
El Rio	3/30	8/29	3/23	7/20	1/12	3/28	5/25	5/33	3/25	2/18
Ventura	3/18	3/19	3/13	7/28	3/13	3/10	1/18	5/20	3/9	2/14
Simi	29/82	38/110	61/113	49/111	34/123	35/127	50/134	22/90	52/120	40/101
Piru	—	—	13/66	16/68	4/37	7/42	9/72	5/63	8/45	4/42
Ojai	33/75	27/101	25/80	10/77	3/30	6/34	10/58	3/45	3/51	5/57
T. Oaks	26/73	—	12/66	13/70	5/46	10/40	12/56	2/31	9/44	11/49
County-wide	61/139	85/149	70/142	58/125	45/130	44/136	59/149	31/123	55/135	46/116

* Smog Season (May - October)

TABLE 3
NUMBER OF CALIFORNIA FIRST-STAGE EPISODES

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
El Rio	0	0	0	0	0	0	0	0	0	0
Ventura	0	0	0	0	0	0	0	0	0	1
Simi Valley	0	2	2	2	0	0	0	0	0	1
Piru	1	1	0	0	0	0	0	0	0	0
Ojai	0	1	0	0	0	0	0	0	0	0
Thousand Oaks	0	—	0	0	0	0	0	0	0	0
Total Countywide "Alert Days"	1	2	2	2	0	0	0	0	0	2



SOURCE: U.S. Geological Survey, 1988

SCALE 1:24000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

N

FIGURE 3. Monitoring site locations.

AeroVironment Inc.

TABLE 4
AVERAGE OZONE CONCENTRATIONS FOR 1980 - 1989 (PPHM) SMOG SEASON**

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
El Rio	6.6	7.1	6.4	6.5	5.7	6.7	6.8	6.6	6.5	6.4
Ventura	5.9	6.3	6.0	7.4	6.4	6.1	6.3	6.0	5.4	6.0
Simi Valley	9.0*	10.5	10.3	10.1	9.8	9.8	10.2	9.1	10.5	9.3
Piru	—	—	8.3	8.1	7.6	7.8	8.4	6.5	6.3	7.4
Ojai	9.2	9.4	9.1	8.7	7.5	7.8	8.3	6.3	6.6	8.0
Thousand Oaks	8.6	—	8.0	8.5	7.7	7.7	8.0	6.0	6.3	7.4
Inland Valleys	8.9	—	9.4	9.6	8.3	8.4	9.4	8.3	10.5	8.6
Coastal Areas	6.5	7.0	6.5	7.2	6.3	6.7	6.8	7.3	7.2	6.4

* Does not meet criteria for representativeness.

** May - October

92-566

FIGURE 4

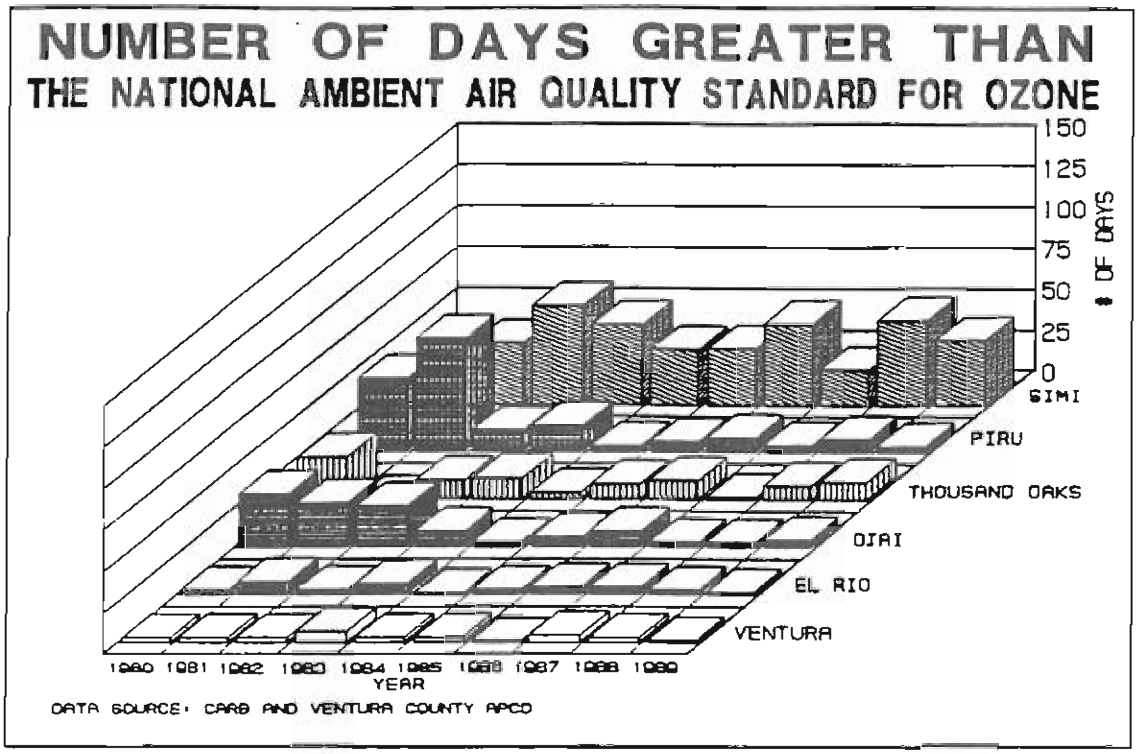
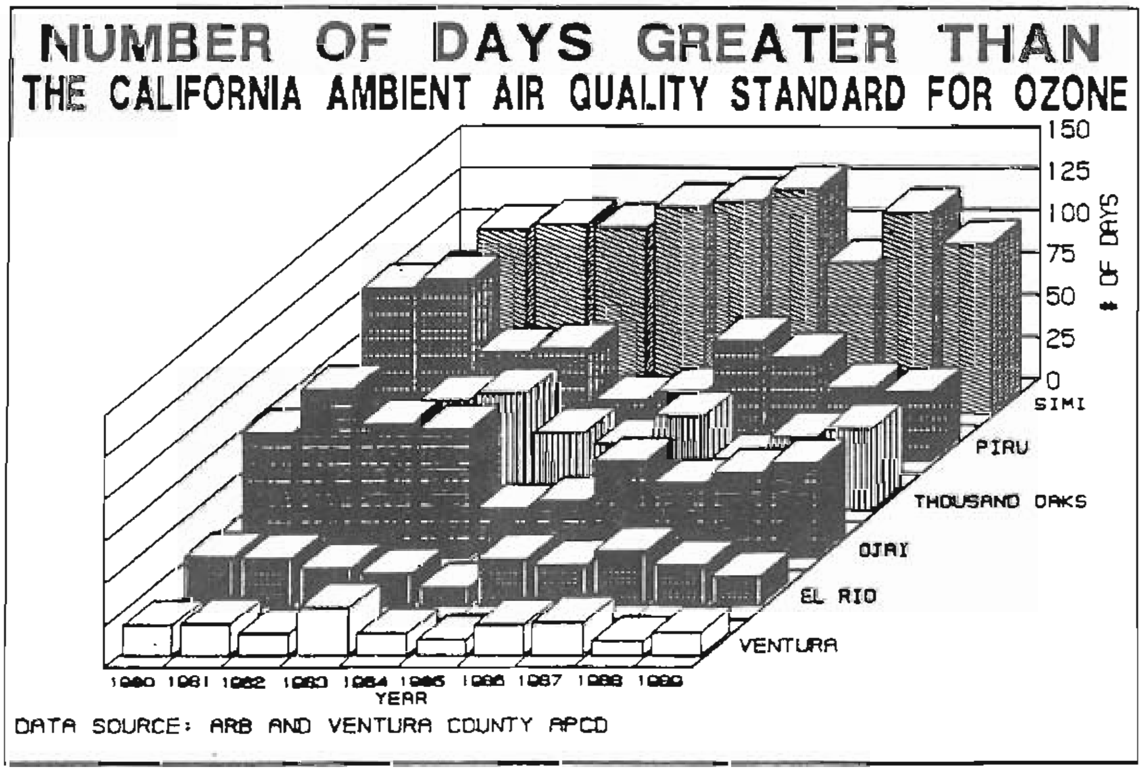


FIGURE 5



SOURCE: VCAPCD, 1991

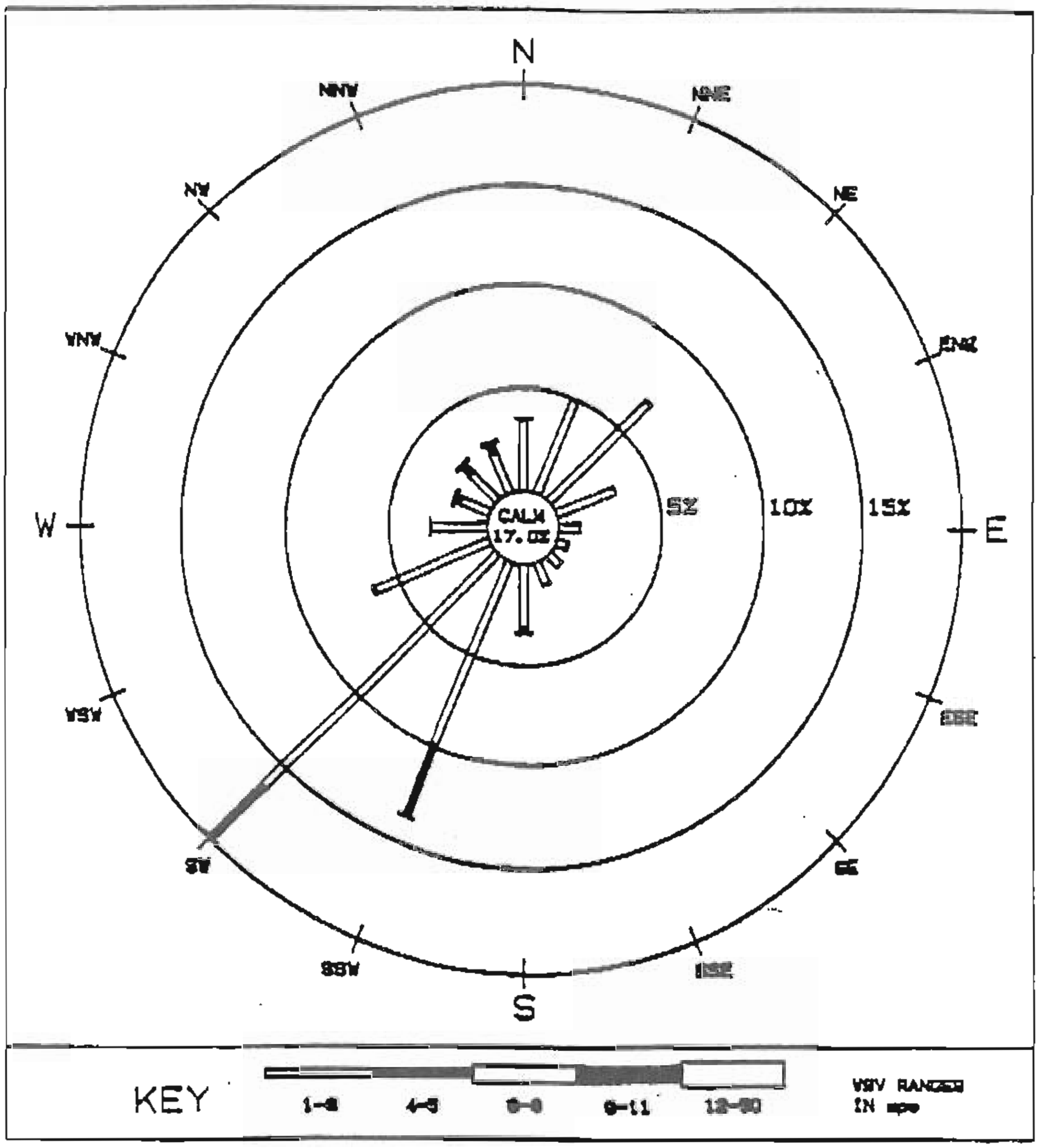


TABLE M-31 OJAI WIND SPEED FREQUENCY AT SPECIFIED WIND DIRECTIONS

Wind Speed MPH	N 349 TO 011	NNE 012 TO 033	NE 034 TO 056	ENE 057 TO 078	E 079 TO 101	ESE 102 TO 123	SE 124 TO 146	SSE 147 TO 168	S 169 TO 191	SSW 192 TO 213	SW 214 TO 236	WSW 237 TO 258	W 259 TO 281	WNW 282 TO 303	NW 304 TO 326	NNW 327 TO 348	Total	Total Observations	CUM %
0 TO 0.4	2.9	4.1	4.6	2.6	1.5	0.8	0.6	0.5	0.7	0.7	0.7	0.6	0.7	0.7	1.3	1.7	24.6	3539	100
0.5 TO 3	3.4	4.9	6.9	3.1	1.0	0.4	0.7	1.1	3.0	8.8	18.4	6.3	2.8	1.5	1.9	2.1	65.4	9430	76
4 TO 5	0.1	0.0	0.0		0.0	0.0		0.0	0.3	3.9	3.5	0.1	0.1	0.2	0.9	0.5	9.3	1358	10
6 TO 8	0.0								0.0	0.0	0.0		0.0	0.1	0.1	0.1	0.3	70	1
9 TO 11																0.0	0.0	2	0
12 TO 50																	0	0	0
Number of Hours	729	1158	1440	718	293	169	163	218	669	2043	2659	673	499	347	487	646	13307	14389	calms 1082
Mean Wind Speed	1	1	1	1	1	1	1	1	2	3	2	1	1	2	2	2	.	1	.

FIGURE 6. Ojai wind rose - January 1988 - December 1989.

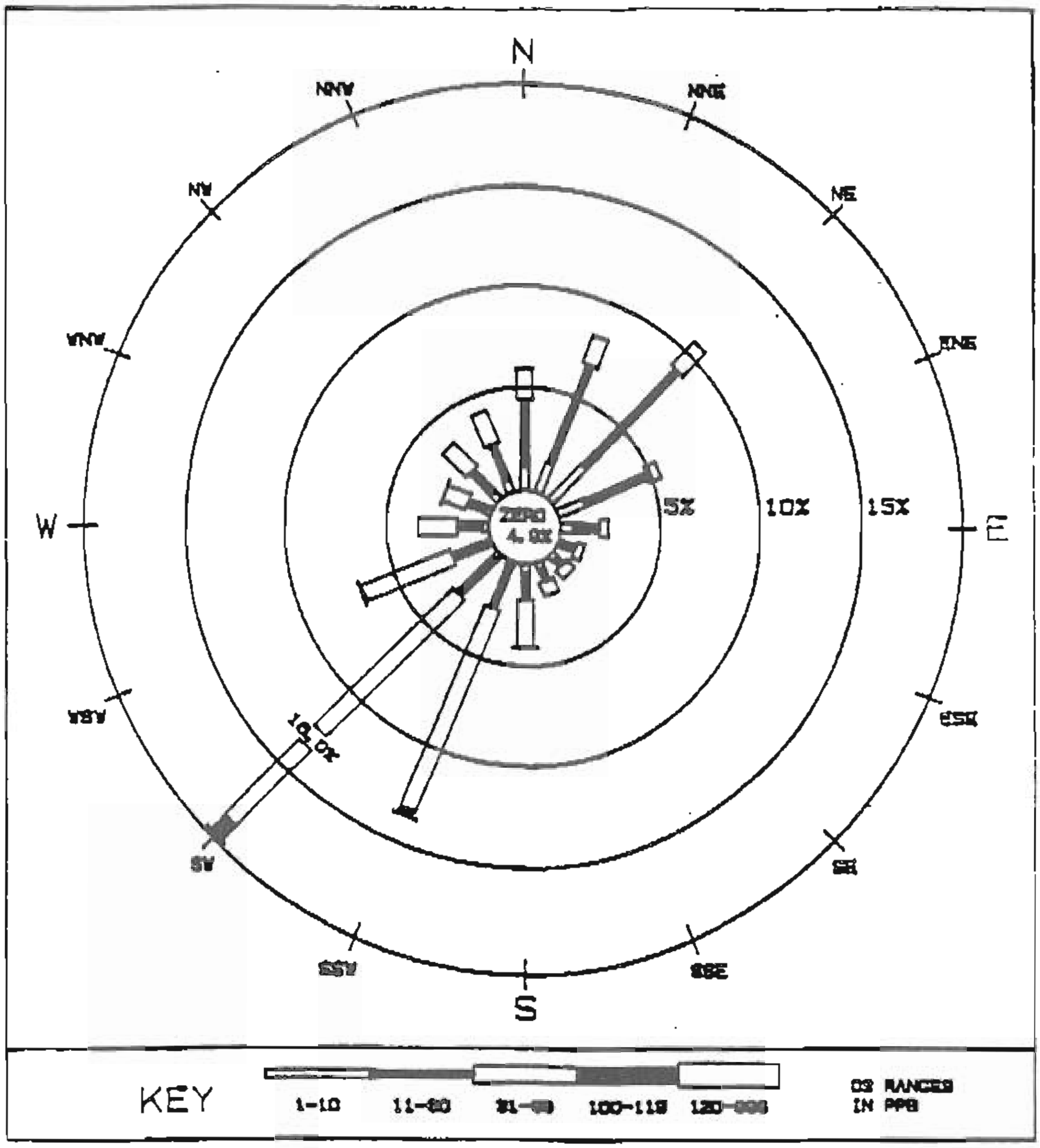
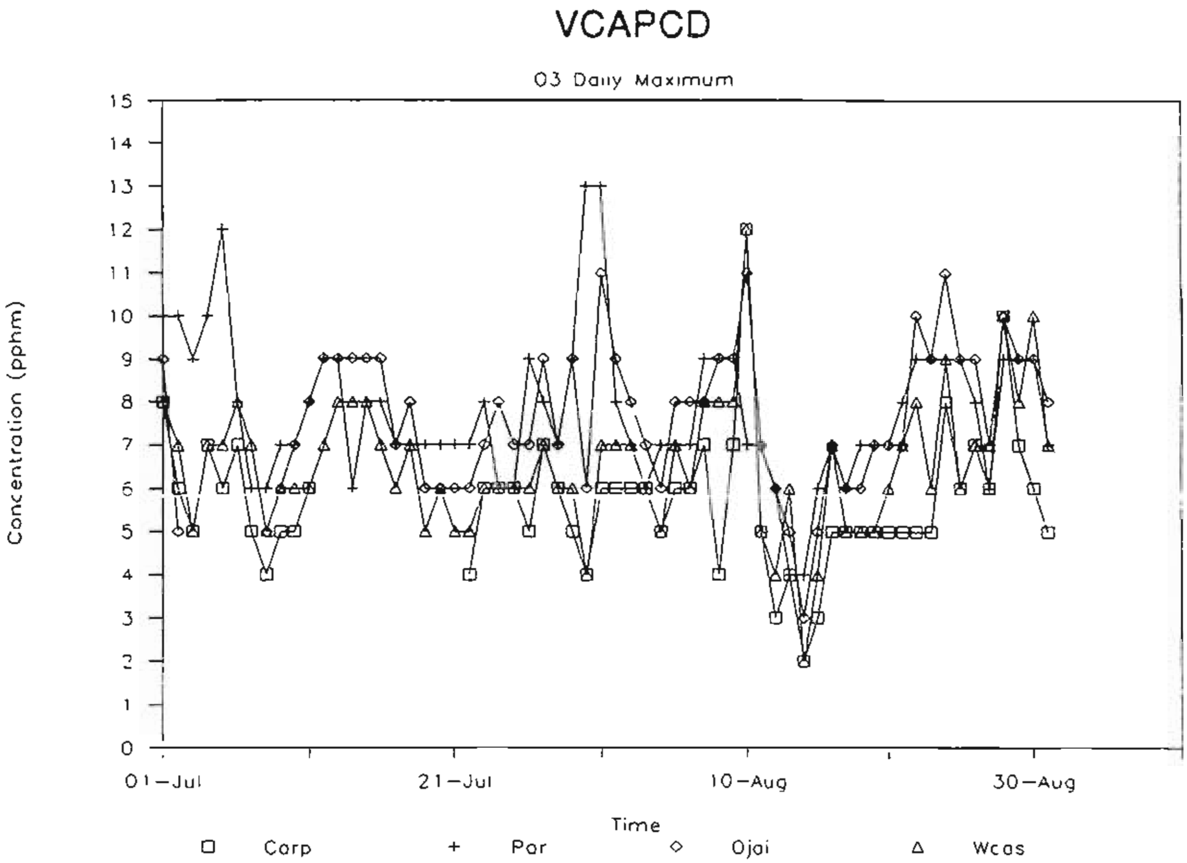


TABLE M-32 OJAI OZONE FREQUENCY AT SPECIFIED WIND DIRECTIONS

Concentration ppb	N 349 TO 011	NNE 012 TO 033	NE 034 TO 056	ENE 057 TO 078	E 079 TO 101	ESE 102 TO 123	SE 124 TO 146	SSE 147 TO 168	S 169 TO 191	SSW 192 TO 213	SW 214 TO 236	WSW 237 TO 258	W 259 TO 281	WNW 282 TO 303	NW 304 TO 326	NNW 327 TO 348	Total	Total Observations	Cum %
0 TO 0.4	0.2	0.4	0.4	0.1	0.1	0.0	0.0	0.1	0.2	1.2	1.1	0.4	0.2	0.1	0.1	0.2	4.9	652	100
0.5 TO 10	1.1	1.5	2.4	1.4	0.6	0.2	0.3	0.3	0.4	0.2	0.3	0.2	0.3	0.3	0.4	0.8	10.6	1421	95
11 TO 30	3.3	5.2	6.6	3.4	1.3	0.7	0.5	0.7	1.3	2.2	2.8	1.9	1.3	1.0	1.6	1.9	35.3	4704	84
31 TO 99	1.5	1.5	1.6	0.7	0.5	0.4	0.5	0.7	2.3	10.9	16.0	4.7	1.9	1.2	1.8	1.7	47.7	6342	49
100 TO 119	0.0		0.0							0.2	1.0	0.1	0.0				1.4	196	2
120 TO 999									0.0	0.0	0.2	0.0		0.0			0.2	38	0
Number of Hours	522	1462	1477	747	324	180	179	228	567	1999	2826	669	466	340	464	576	13353	13353	.
Mean Concentration	23	21	20	19	20	24	20	28	34	49	56	43	32	30	28	27	-	30	.

FIGURE 7. Ojai ozone rose - January 1988 - December 1989.



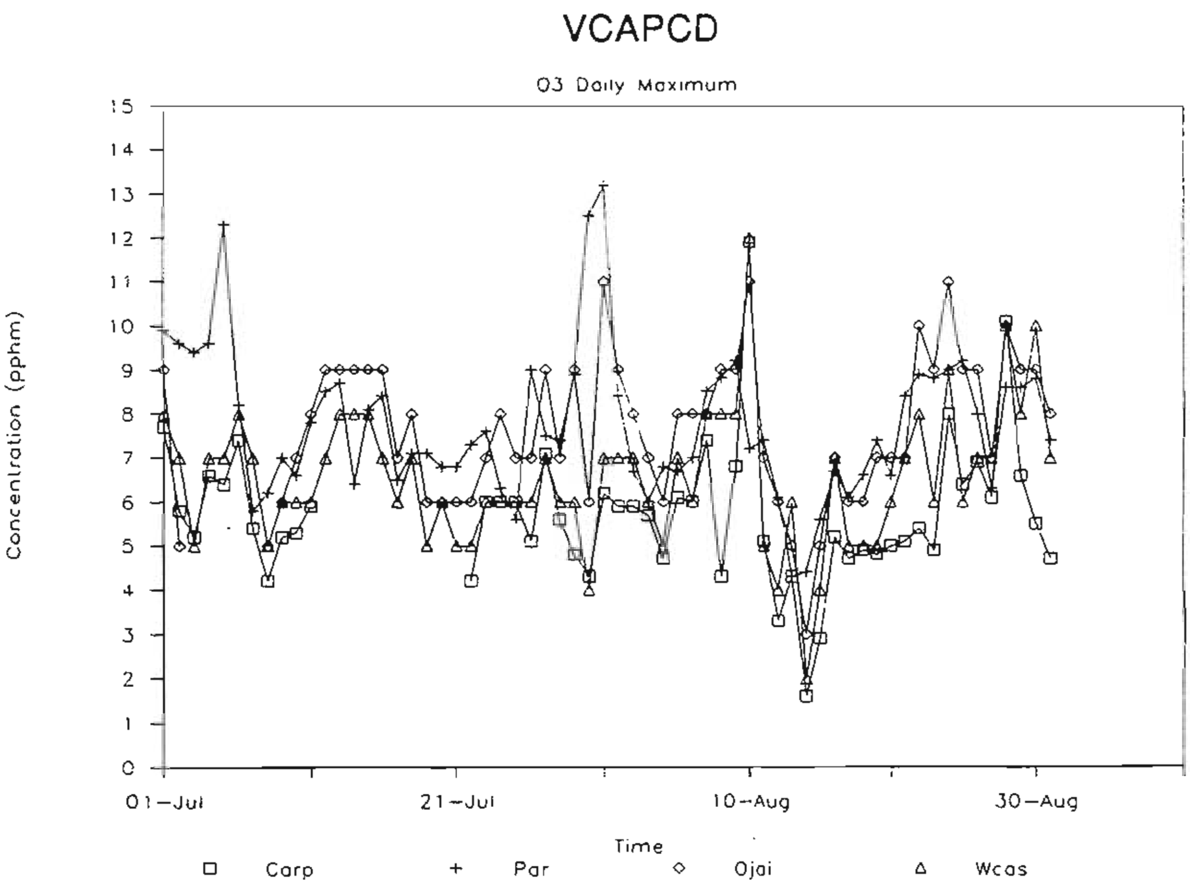
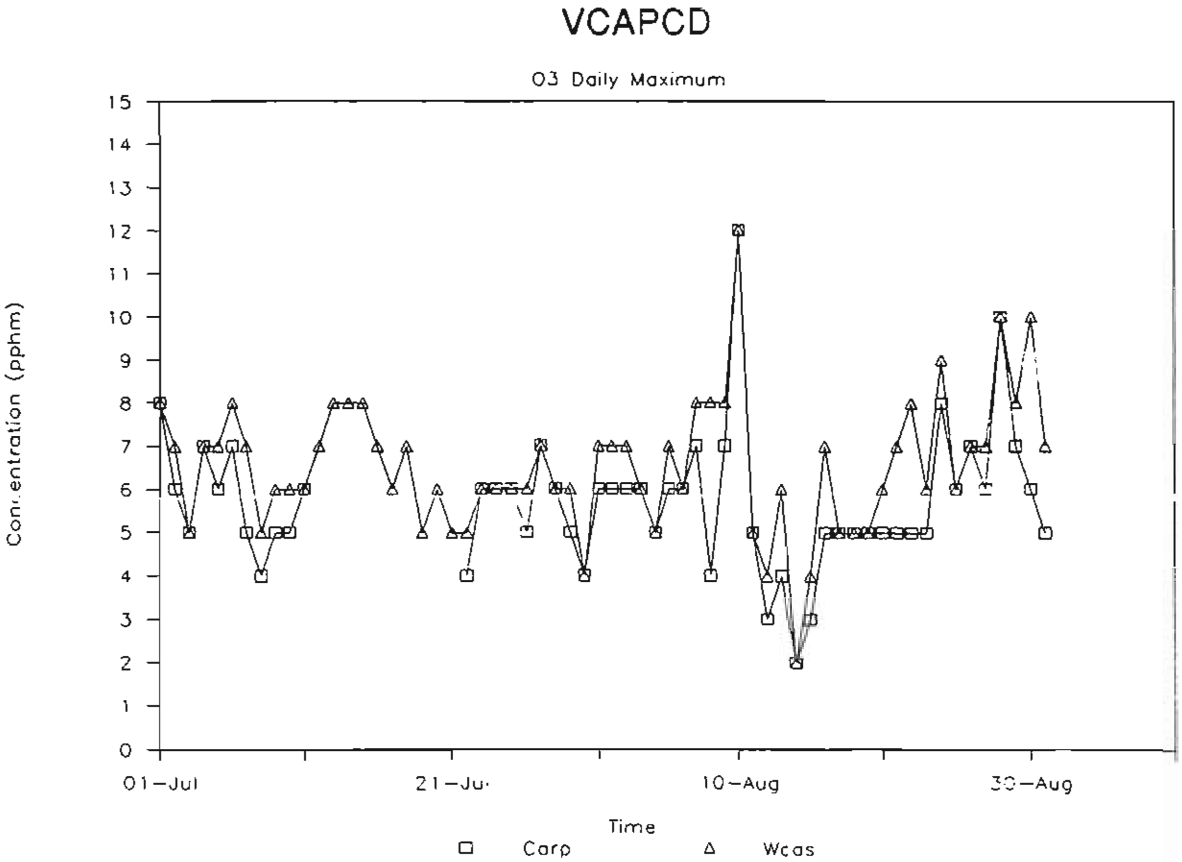


FIGURE 8. Siting study.



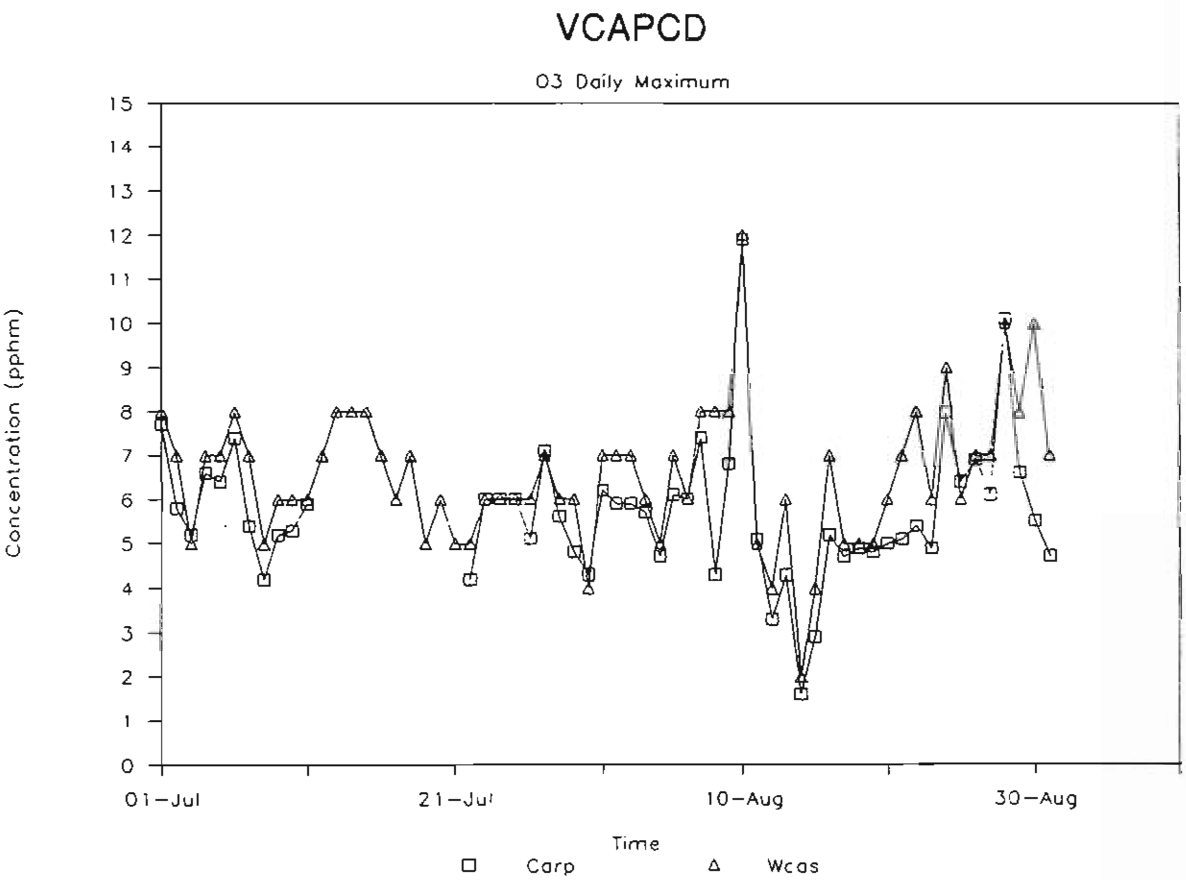
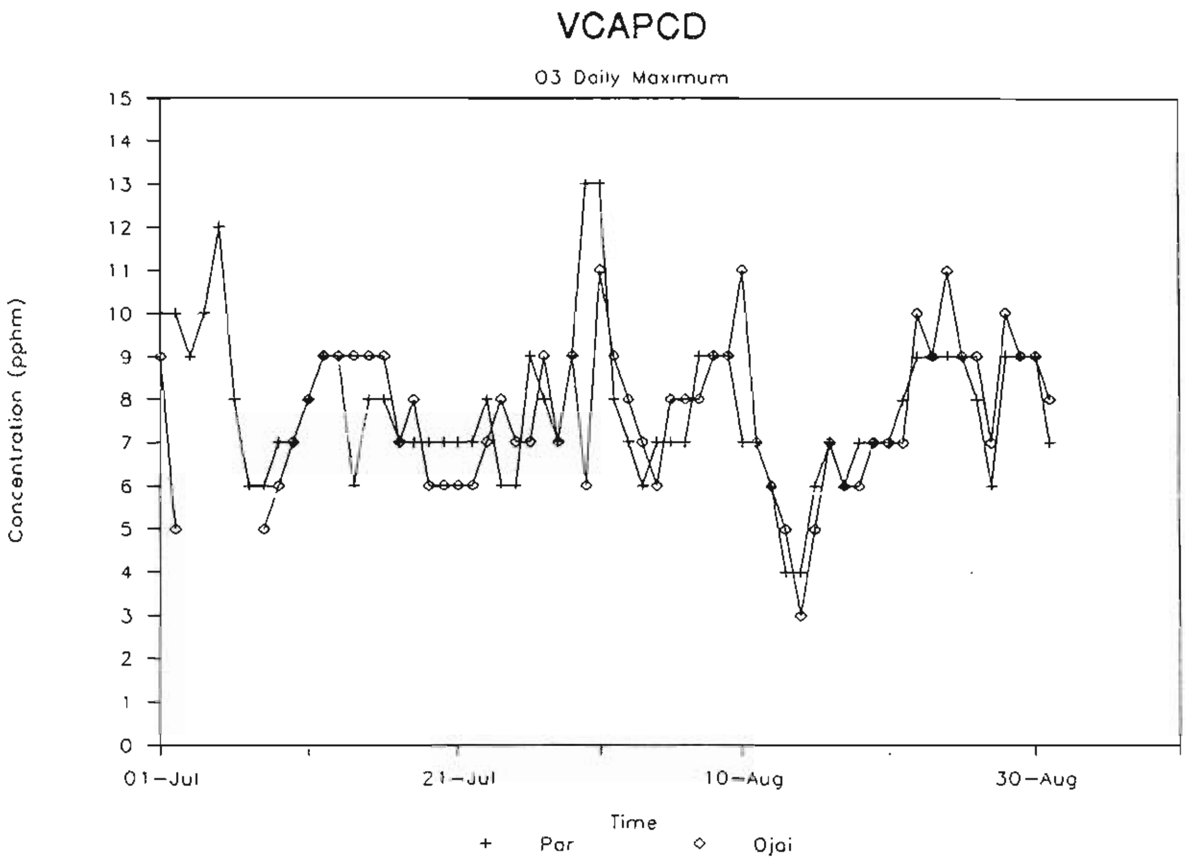


FIGURE 9. Siting study.



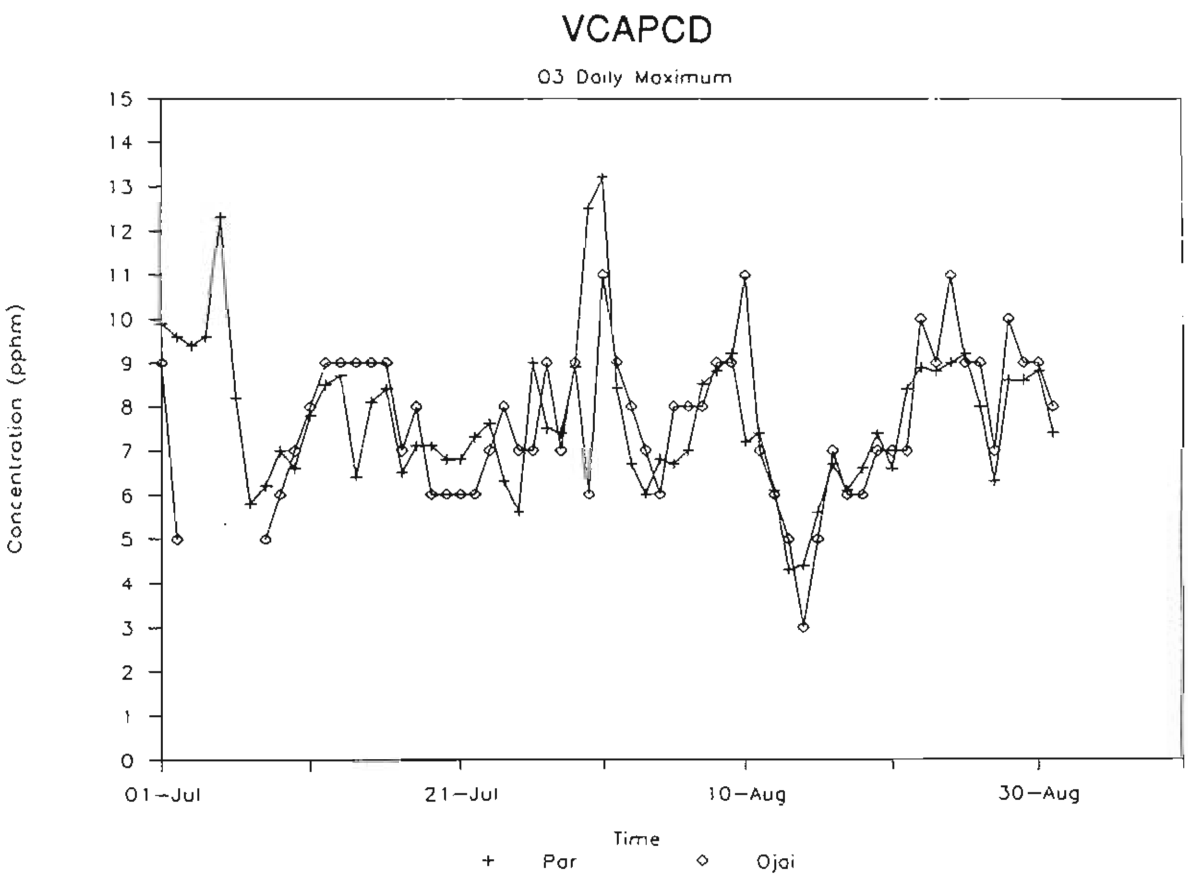
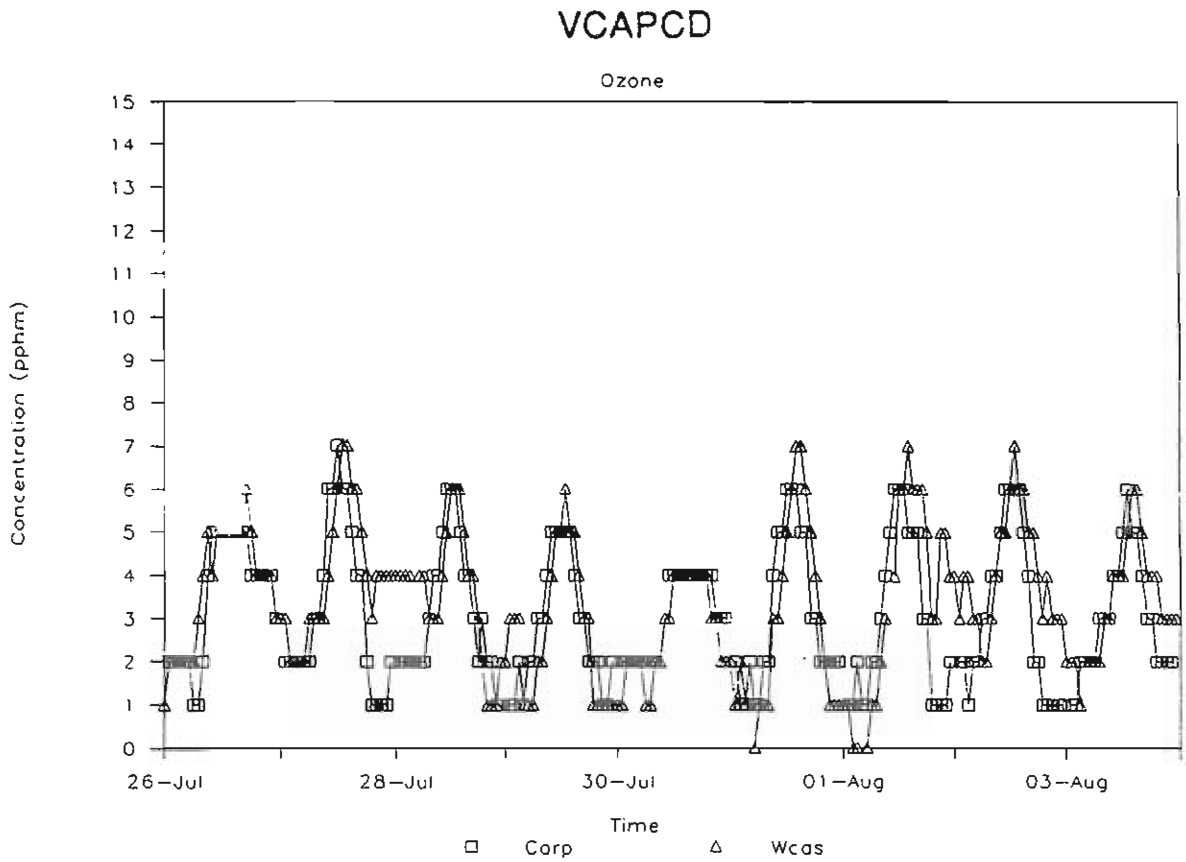


FIGURE 10. Siting study.



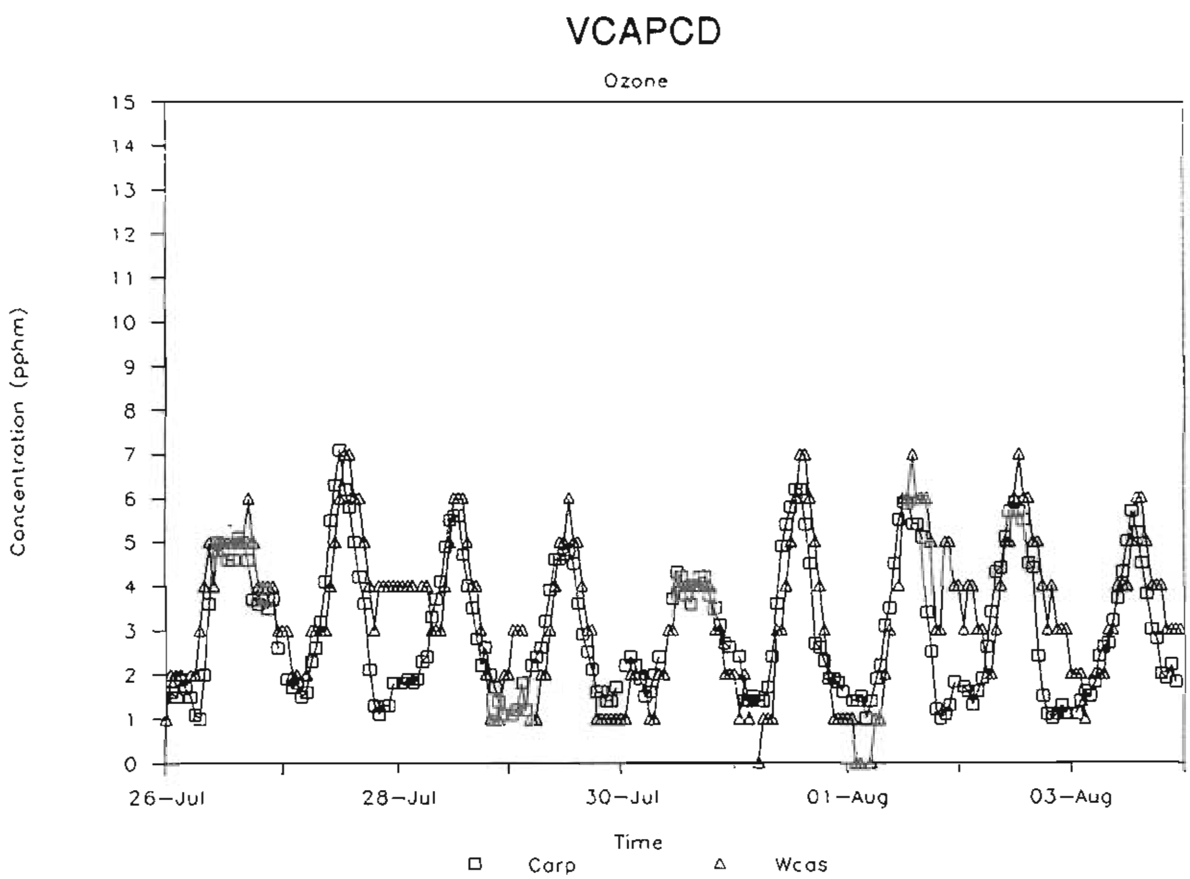
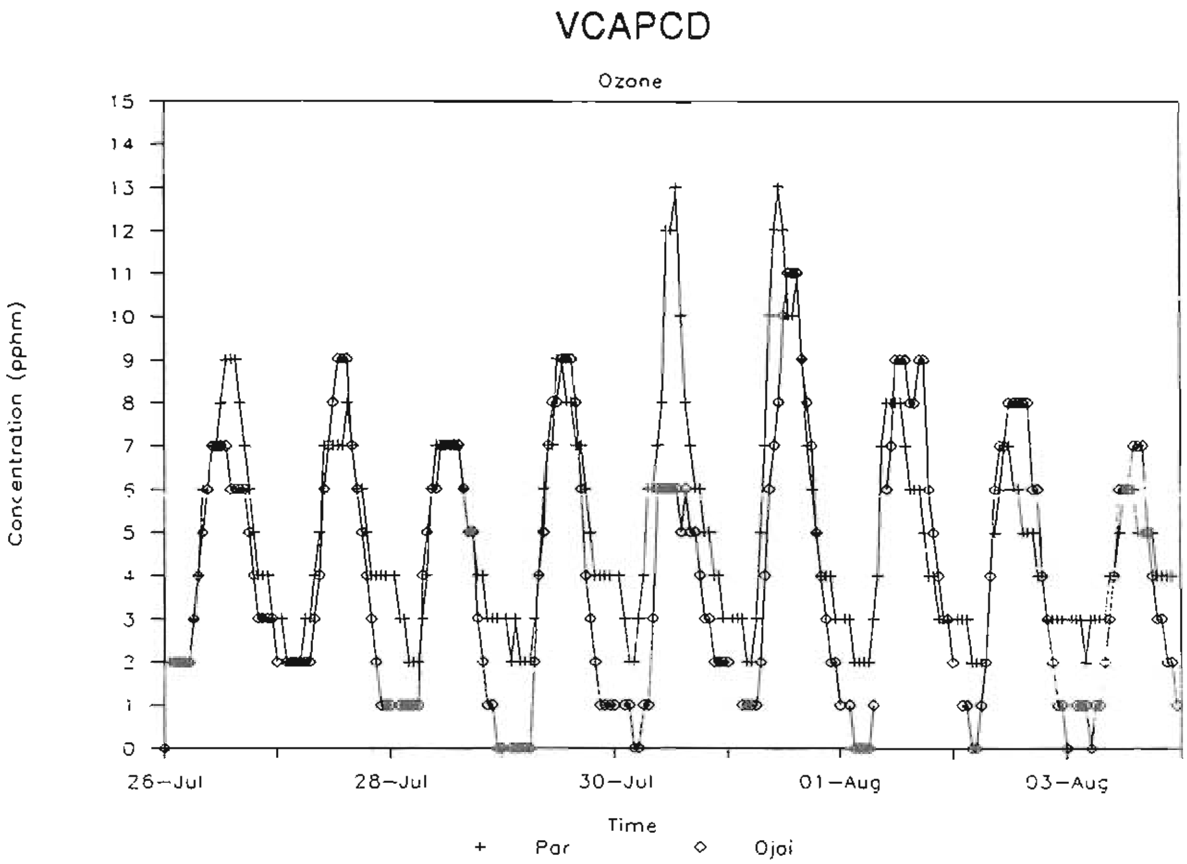


FIGURE 11. Siting study.



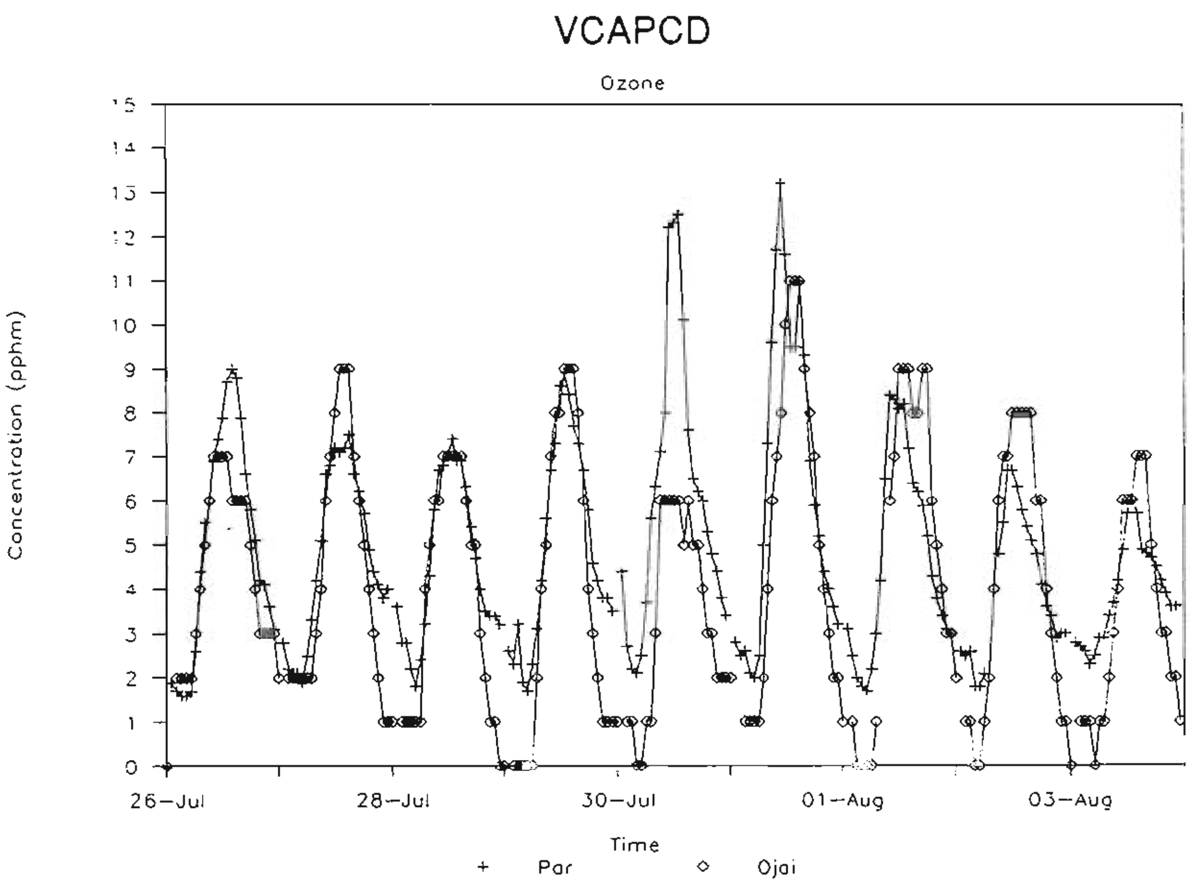
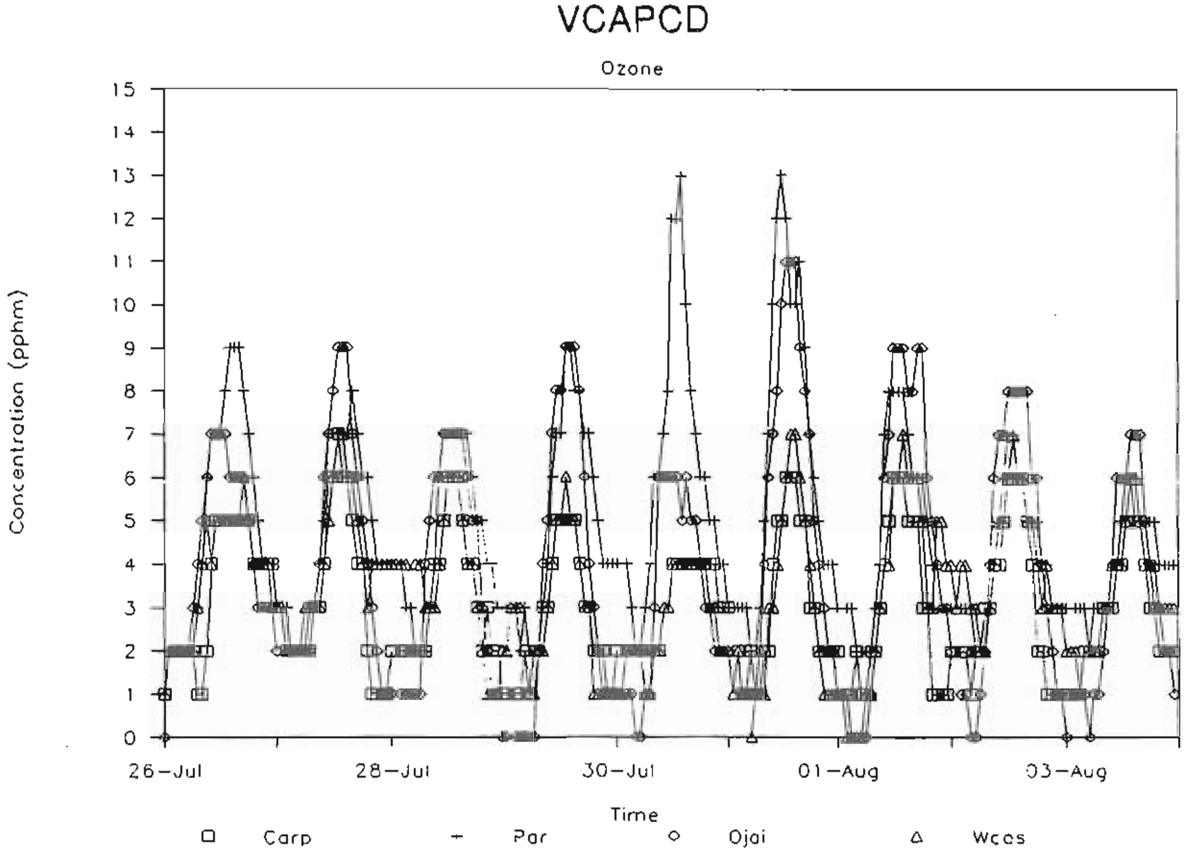


FIGURE 12. Siting study.



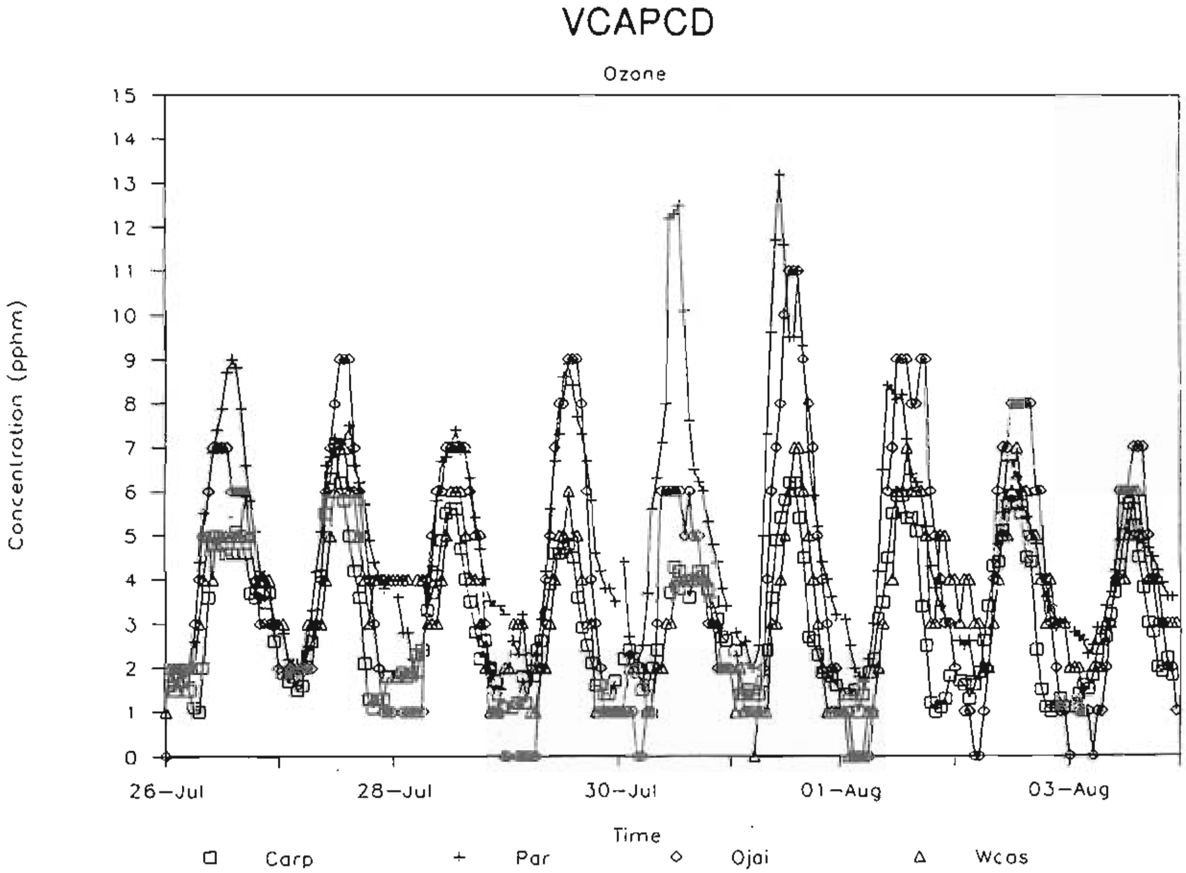
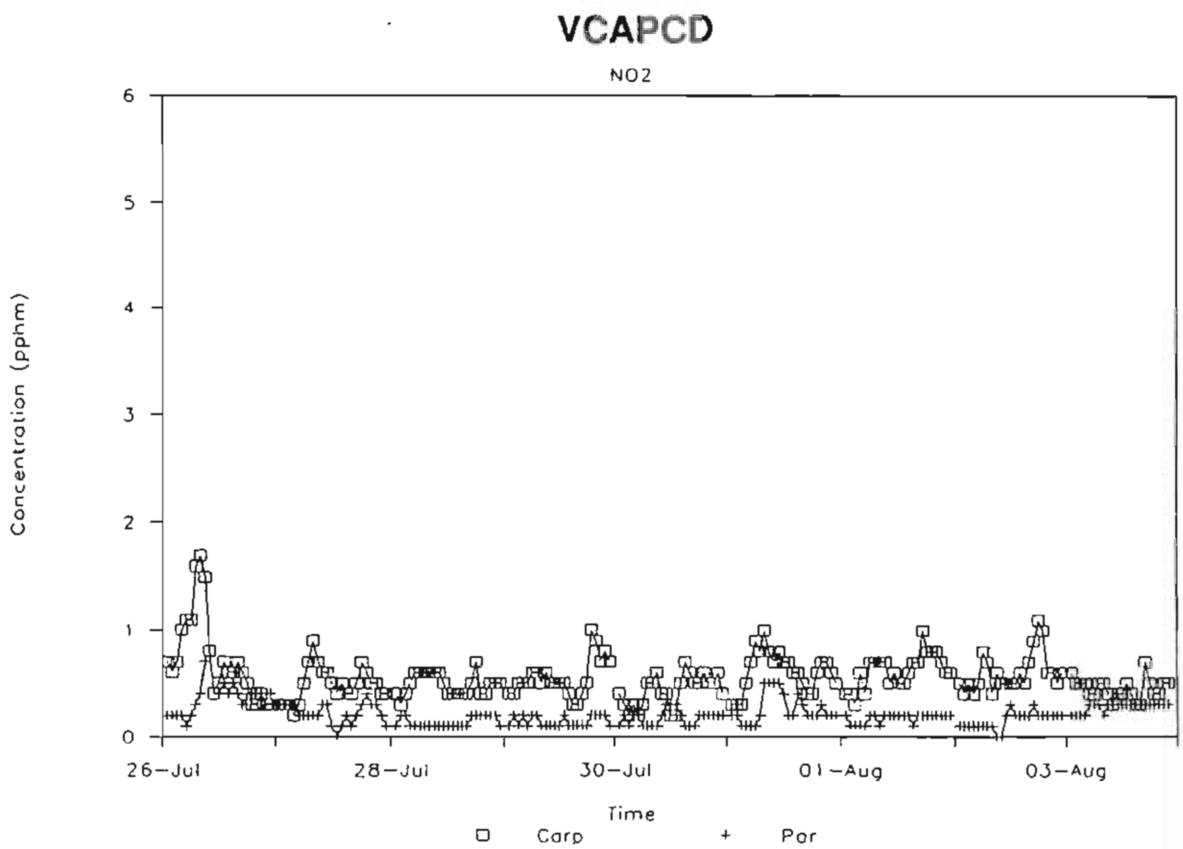


FIGURE 13. Siting study.



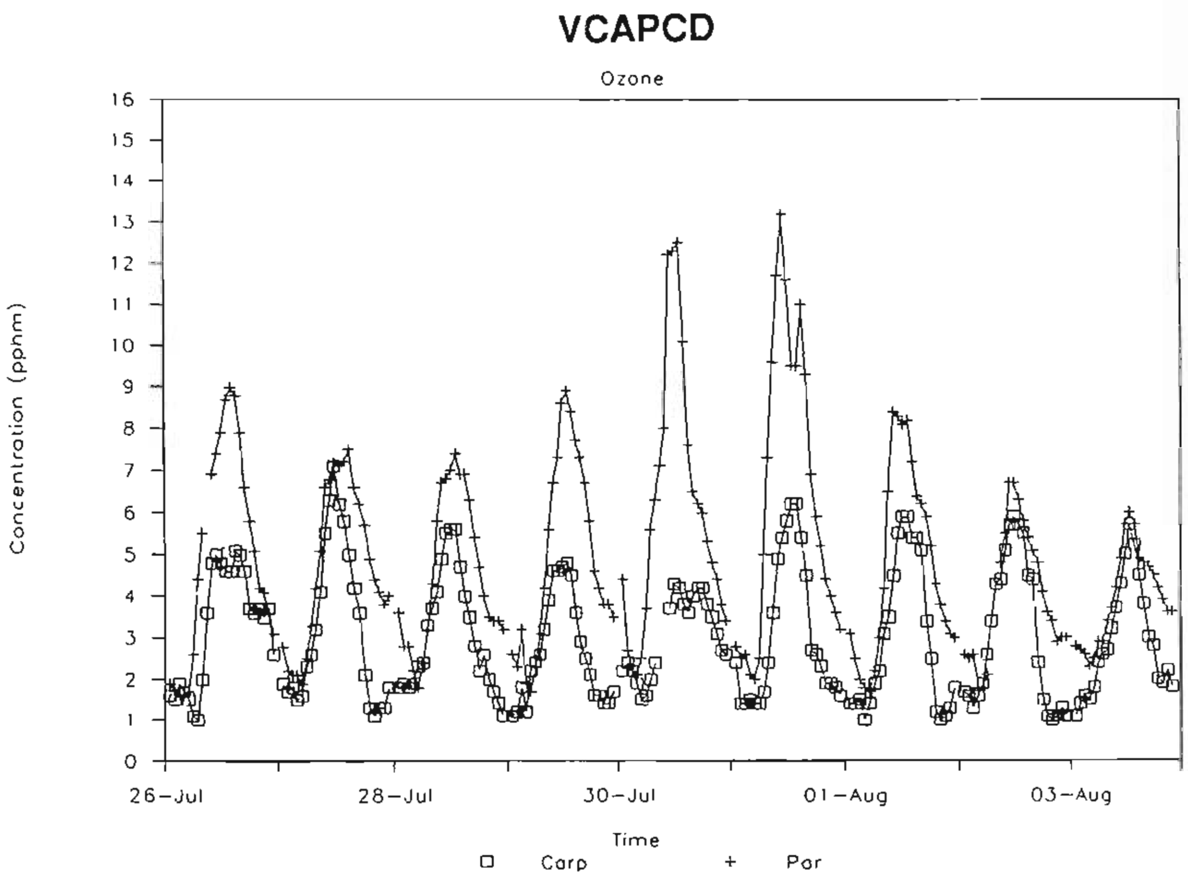
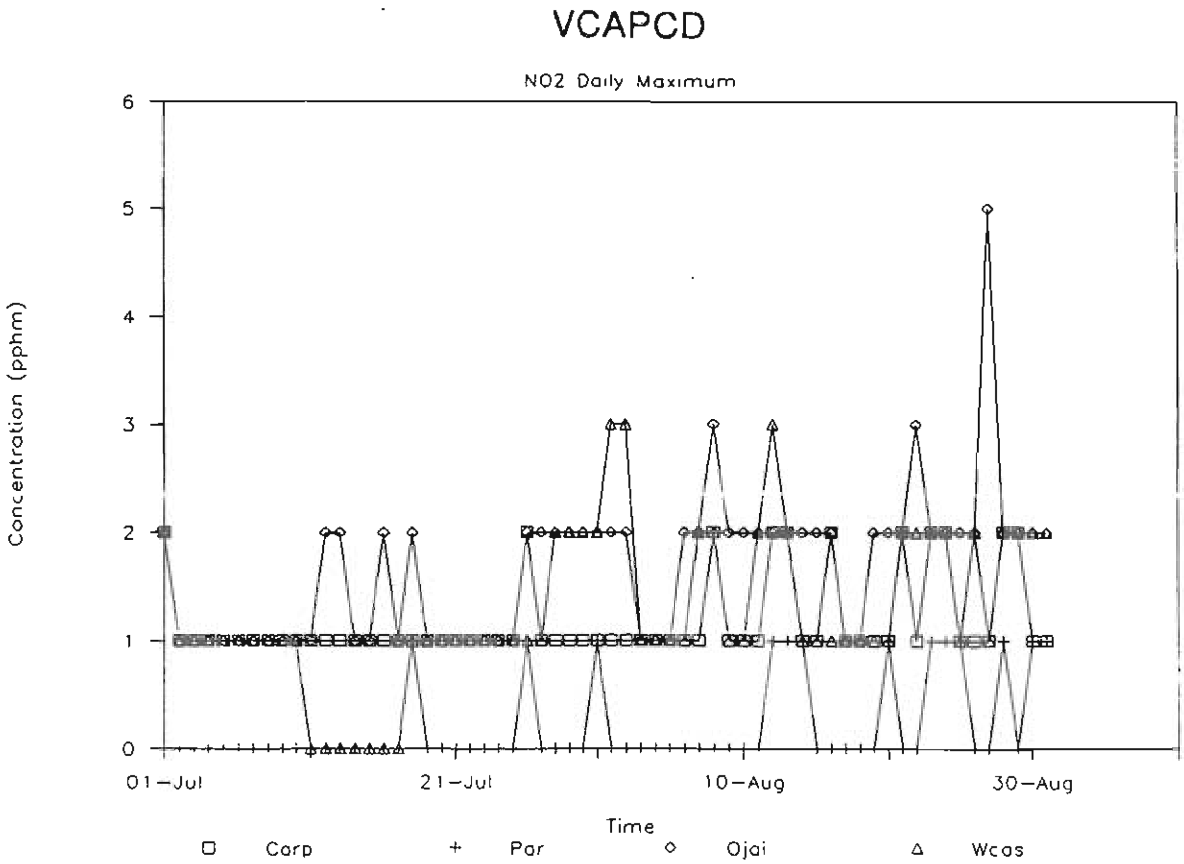


Figure 14. Siting study.



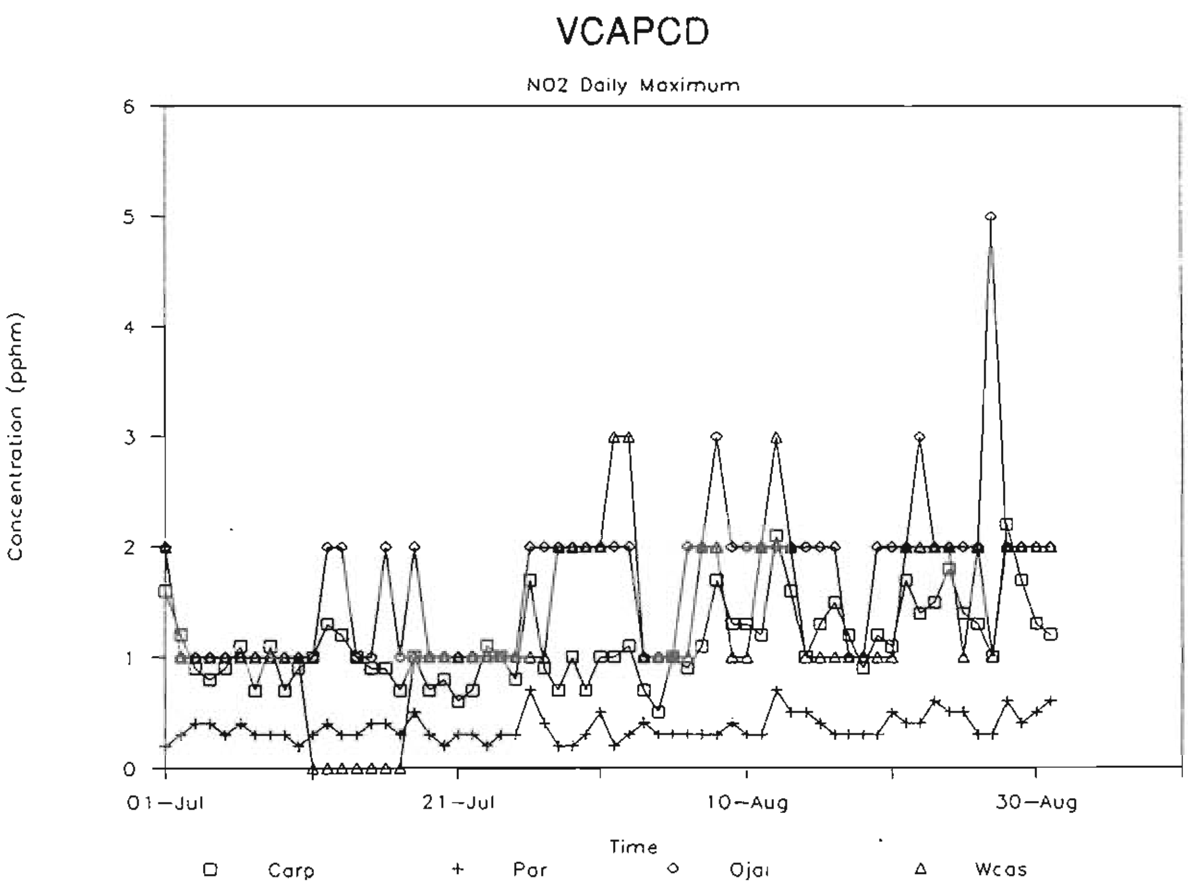
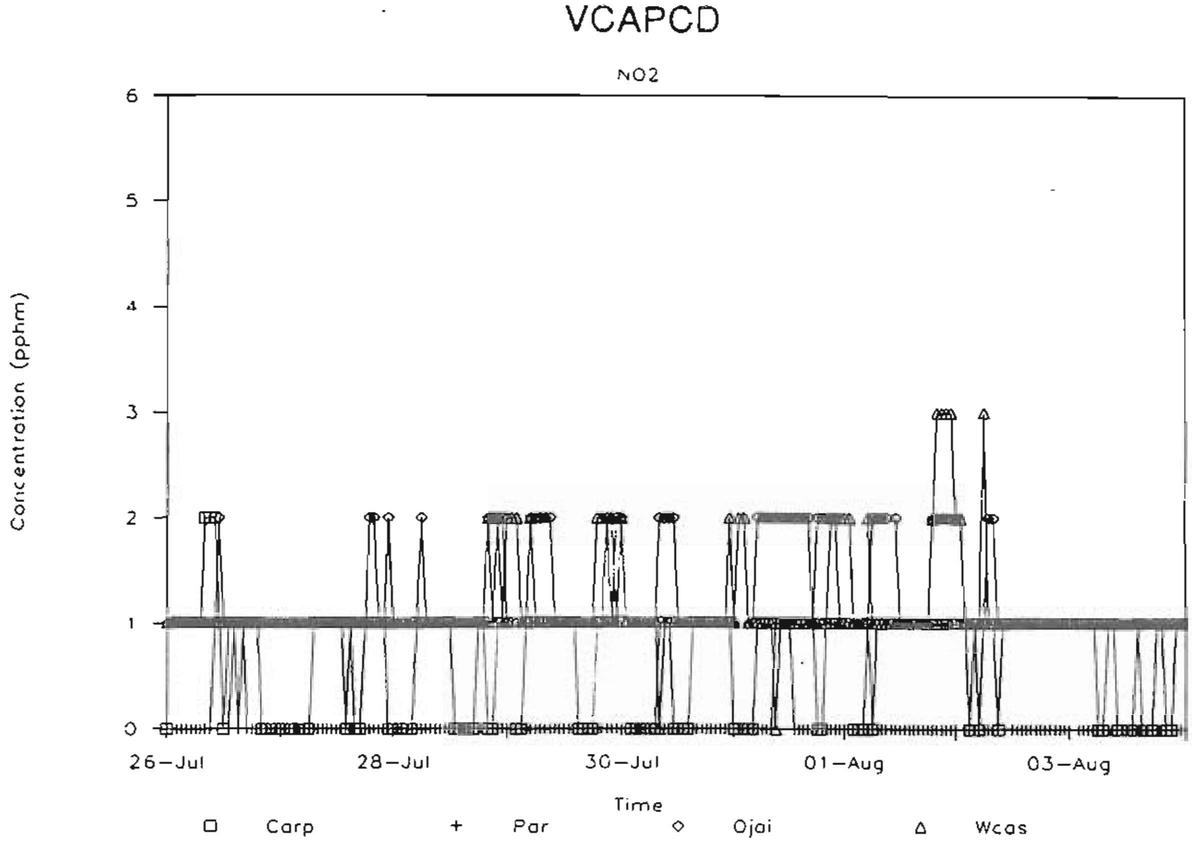


FIGURE 15. Siting study.



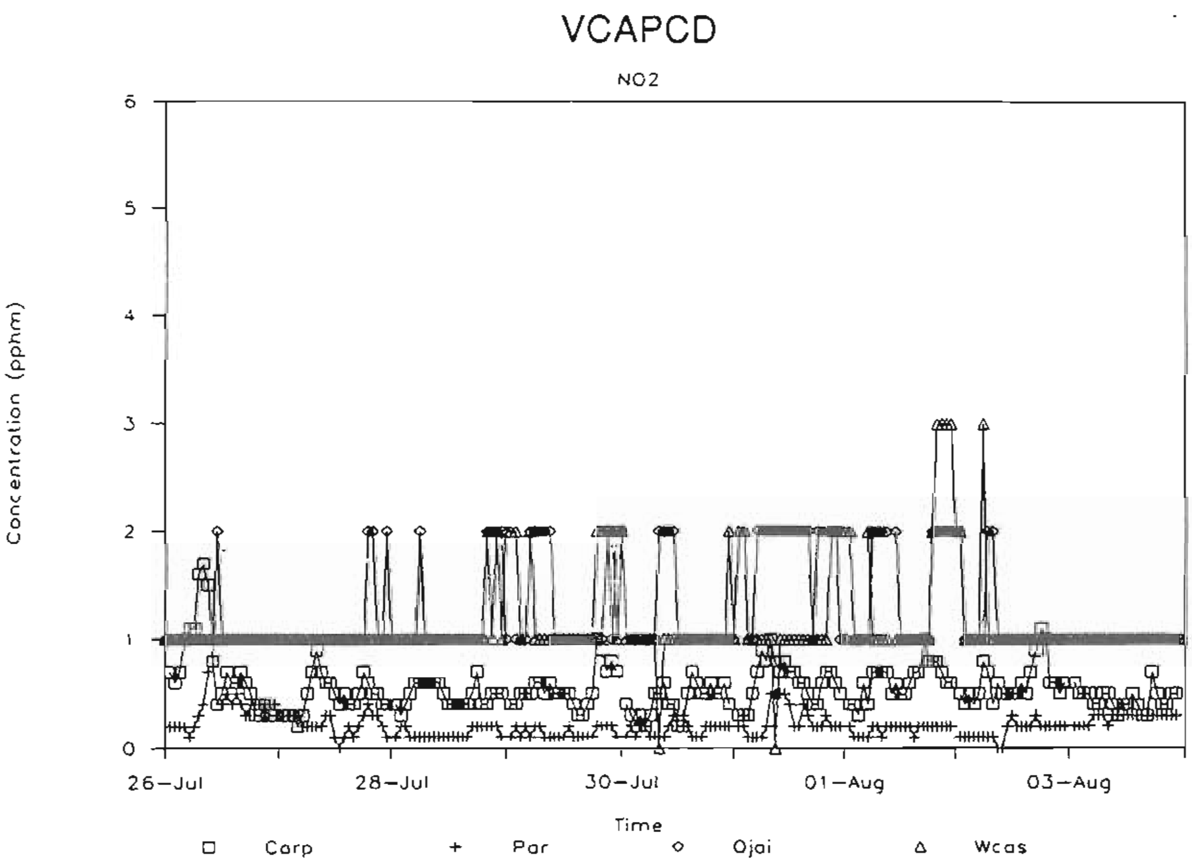


FIGURE 16. Siting study.

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