MONITORING IN OZONE TRANSPORT CORRIDORS

Interim Report: Task 1 - Feasibility and Design of the Monitoring Network

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ABSTRACT

A review of the data from the 1981 ARB field study in the Southeast Desert Air Basin was carried out in order to contribute to the design of a proposed eight-station ozone monitoring network in 1995. The review concentrated on the existence of layers aloft, mixing heights and transport wind patterns.

Ozone layers aloft were found on six of seven days when aircraft soundings were made in the Mojave Desert or in the passes leading from the South Coast Air Basin. The lowest base elevation observed for the ozone layers was 1400 m-msl with tops near 3000 m-msl. The elevated layers are attributed to flow along the southern slopes of the San Gabriel Mountains and San Bernardino Mountains.

Another type of ozone layer aloft develops at night from the decoupling of the surface layer from the air aloft due to the formation of surface temperature inversions. Under the 1981 study conditions, this type of layer appeared to involve relatively low concentrations of ozone.

Mixing heights observed by the aircraft and estimated from pibal wind observations showed maximum heights of 1500 m-msl except where local, high terrain existed. Under these conditions only a small portion of the observed ozone layers aloft would be expected to be mixed downward to the surface. If the 1981 study conditions are representative, any decoupled layers within the maximum mixed layer depth should have a greater influence on surface concentrations. Synoptic conditions during the 1981 study did not include the important case of low pressure gradients with warm temperatures aloft. Decoupled layers may be of much greater importance under these conditions.

The search for potential monitoring sites included towers and mountaintop installations of microwave and repeater stations. Tower elevations were limited in height to 300 ft. or less and were not considered adequate to observe significant layers aloft. Some of the microwave and repeater sites tend to be at higher elevations, near the top of the afternoon mixed layer but may be useful for evaluating the depth of the ozone layer during afternoon transport conditions.

A total of four elevated and four surface ozone sites are recommended for the proposed monitoring program.

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1.0 INTRODUCTION

Transport of ozone and precursors from the South Coast Air Basin (SCAB) into adjacent air basins is a frequent occurrence, particularly into the Southeast Desert Air Basin (SEDAB). Transport occurs primarily through passes in the mountains surrounding the South Coast and, in the case of the San Diego Air Basin, through inland valleys or along offshore routes. Much of the transport takes place in the surface layers but the possibility exists for layers of pollutants to be transported aloft and subsequently mixed downward to the surface. An eight-station ozone/meteorological monitoring network is planned for the summer of 1995 to obtain more data on these transport issues. Because of the size and scope of the area involved, a judicious selection of sites is essential. In order to facilitate this, a review of some of the existing information has been undertaken, particularly as it applies to transport into the SEDAB. Subsequently, a field survey was carried out to evaluate potential monitoring sites.

Given the overall objectives of the proposed program (to monitor aloft as well as at the surface), ozone soundings in the passes and within the desert itself were one of the most valuable sources of data available. A variety of such soundings were made during the Air Resources Board's SE Desert Study in 1981 (Smith et al, 1983). While the magnitude of the ozone concentrations observed is likely to be different today, the vertical structure of the ozone concentrations has provided very useful information. A large number of pibal observations were also made during the 1981 study both in the passes and in the desert. Mixing heights were derived primarily from the aircraft sounding data. Specific trajectories into the desert were obtained from several tracer releases. Additional trajectory information has come from tracer analyses in Reible, Ouimette and Shair, 1982 and Lehrman, Smith, Knuth and Dorman, 1994.

During this review, major attention was focussed on the characteristics of transport into the SE Desert. A program for 1995 has already been designed by the San Diego Basin Air Quality Management District for the offshore route into the San Diego Air Basin. Observations along the potential route through Temecula and Escondido were not considered as important as establishing the best possible network in the SE Desert.

2.0 LAYERS ALOFT

During the 1981 study there was one aircraft sampling day in and near the Soledad Canyon transport route. An ozone layer aloft was present at Acton at 1627 Pacific Daylight Time (PDT) extending from 1500 meters-mean sea level (m-msl) (700 meters-above ground level (m-agl)) to about 3200 m-msl with a peak of 20 parts per hundred million (pphm) at 2500 m-msl. Winds within the ozone layer aloft were from the south-southwest (SSW) turning to SE above 2500 m-msl.

At 1740 PDT an aircraft sounding about 2 miles east of Palmdale indicated an ozone layer aloft from 1300 m-msl (500 m-agl) to 3200 m-msl. The peak ozone concentration was 17 pphm. A later sounding (1903 PDT) at Adelanto (about 40 miles east of Palmdale) showed an ozone layer aloft beginning at 1300 m-msl (400 m-agl) and continuing at least to the top of the sounding at 2000 m-msl.

Horizontal traverses by the air quality aircraft indicated that the centerline of the plume from Soledad Canyon passed slightly to the north of Adelanto. The upper air winds associated with the ozone layer at Acton suggest the origin of the layer aloft to be the slopes of the San Gabriel Mountains at the eastern end of the San Fernando Valley. The evidence from the Palmdale/Adelanto soundings point to a slight subsidence of the layer within the desert as the Soledad Canyon flow spread horizontally.

There were six days during the 1981 study when aircraft sampling flights were made within or slightly downwind of Cajon Pass. On five of these days ozone layers aloft were apparent with bases ranging from 1400 m-msl to 2000 m-msl and with tops generally near 3000 m-msl. Two examples for July 18, 1981 are shown in Figs. 1 and 2. Figure 1 shows a sounding at Cajon Junction at 1549 PDT with an elevated ozone layer from about 1800 m-msl (900 m-agl) to about 3100 m-msl. The surface ozone layer was about 600 m deep with a peak concentration of about 15 pphm. The winds aloft at Cajon Junction at 1605 PDT were from the southwest in the lower portion of the ozone layer turning to westerly above the altitude of the peak concentration.

Fig. 2 is a sounding made at Victorville at 1810 PDT. An elevated ozone layer existed from 1500 m-msl to about 3000 m-msl. The peak ozone concentration occurred from 2300-2400 m-msl. The surface ozone layer was about 300 m deep with a peak value of about 14 pphm. The winds at Victorville at 1757 PDT were generally west to northwest in the ozone layer aloft with velocities of 3-5 meters per second (m/s). However, the winds in the layer at 1405 PDT were from the south-southwest, shifting toward the west by 1603 PDT. The observations at Victorville point to the widespread (east to west) nature of the layer aloft in view of the inability of the west to northwest winds to clear out the layer within the four-hour period.

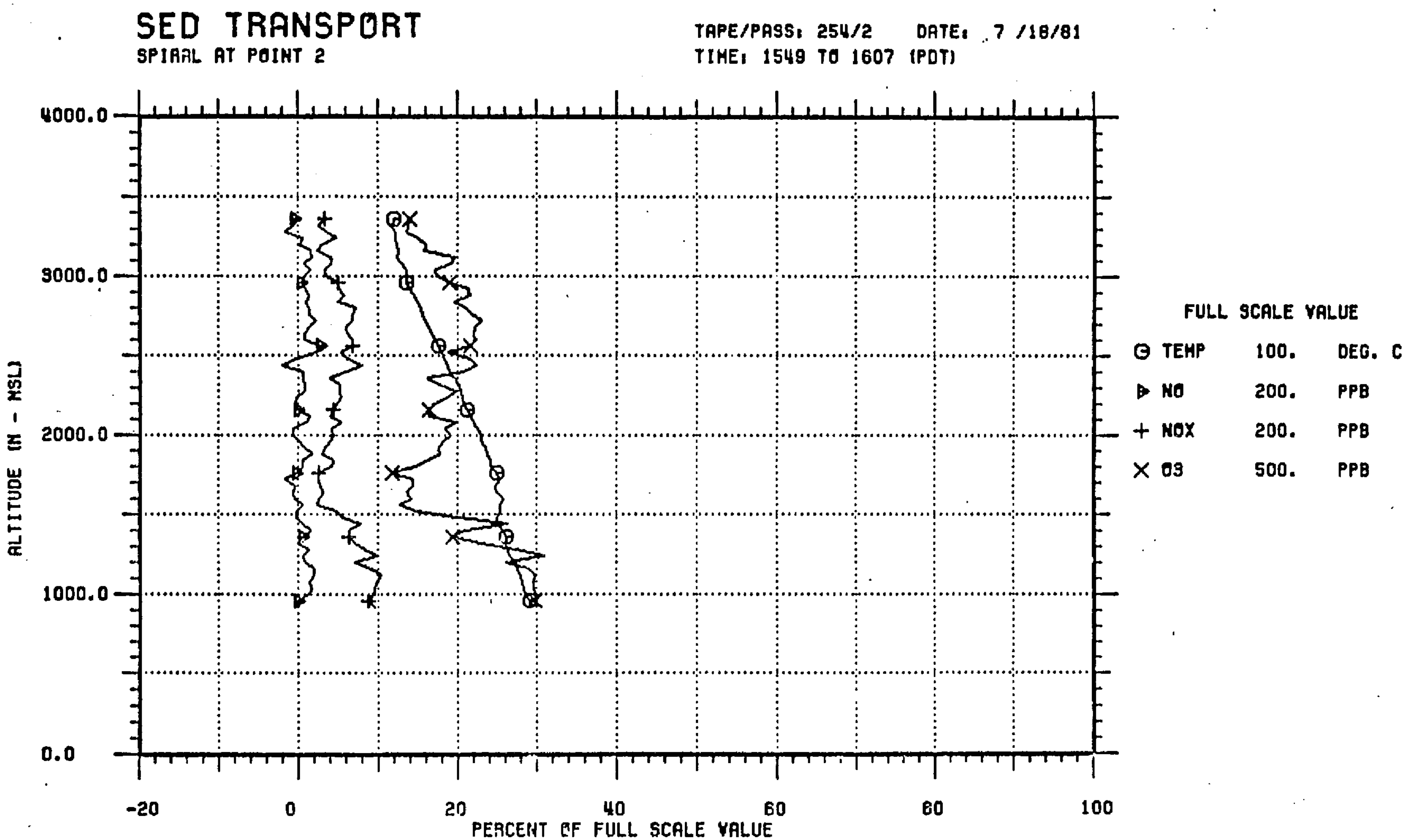

Fig. 1 AIRCRAFT SOUNDING AT CAJON JUNCTION - July 18,1981

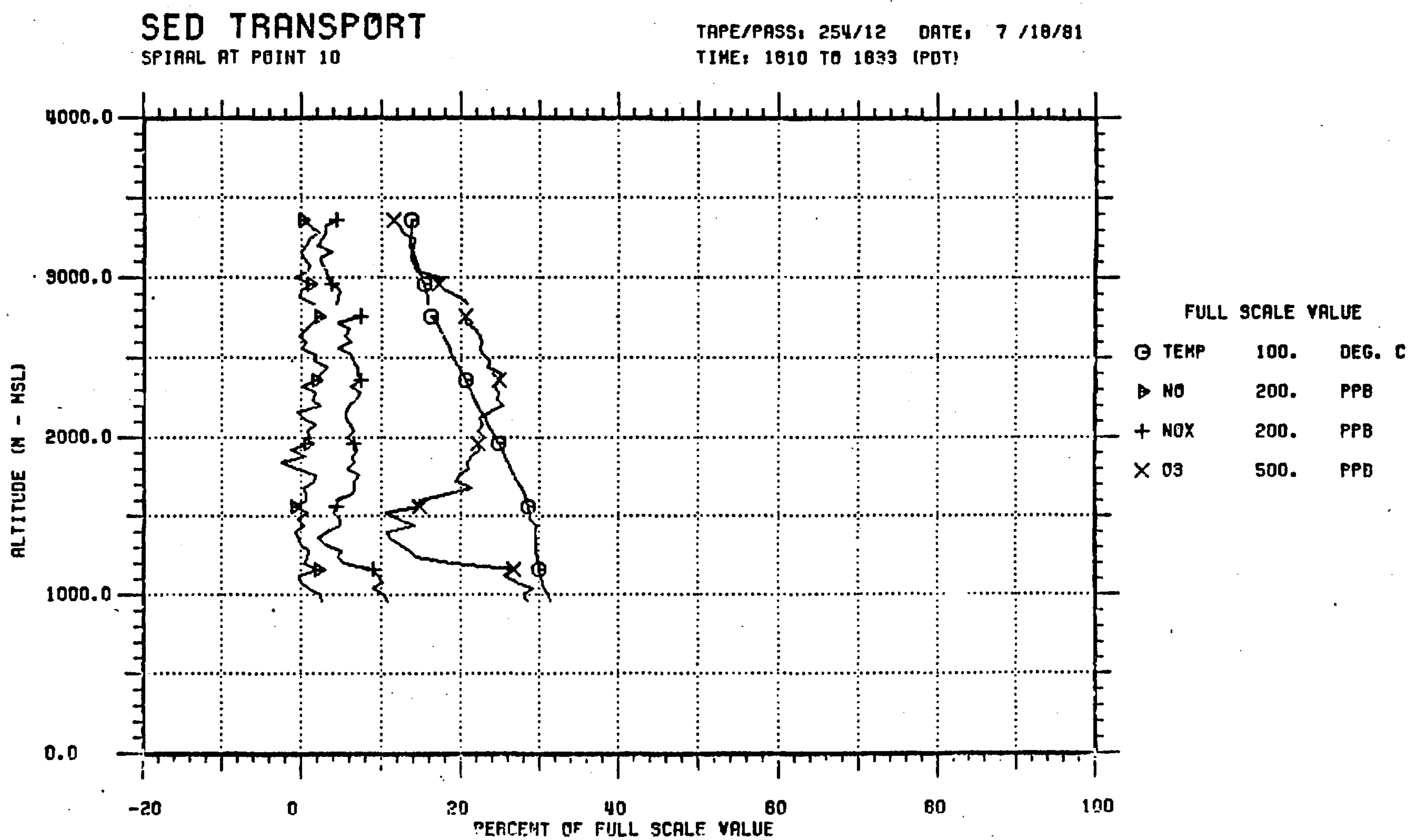

Fig. 2 AIRCRAFT SOUNDING AT VICTORVILLE - July 18,1981

Fig. 3 is an aircraft sounding made at Rialto on July 22, 1981 at 1635 PDT. The sounding shows a strong elevated ozone layer from 1800 m-msl to about 3100 m-msl with a peak of 20 pphm at 2800 m-msl. Winds in the ozone layer as measured at Fontana at 1704 PDT were from the west-northwest. The origin of the layer consequently can be traced back to the slopes of the San Gabriel Mountains where the surface ozone concentration at the Mt. Baldy monitoring station was 25 pphm at 1500 and 1600 PDT.

The data suggest that on many days (not July 22) the winds aloft at mountain-top height are from the southwest. Ozone generated within the South Coast Air Basin is carried upslope as far as the level of the highest ridges (about 3000 m-msl). The layer thus generated is transported on most days into the desert with an elevated base and a top which is influenced strongly by the highest terrain in the area. Comparable observations of high altitude ozone layers are very limited or not available. However, a report by Taylor and Graham (1980) includes an August sounding at Lucerne Valley (1700 PDT) with an elevated ozone layer based at 1500 m-msl. Also shown is an August sounding at Blythe (1100 PDT) with an elevated bscat/ozone layer based at 1400 m-msl and extending above 2200 m-msl. Wakimoto and McElroy (1986) documented ozone layers generated by the slopes of the San Gabriel Mountains but at much lower elevations.

Morning aircraft soundings were made at Barstow, Victorville, Lucerne Valley, Yucca Valley and near Palmdale on three days during the 1981 Study. With the exception of the Palmdale sounding all of the morning soundings showed a low level temperature inversion with ozone layers imbedded within the inversion which could be mixed downward during the day. However, the highest concentration observed on any day was 11 pphm. These layers result from the decoupling of the surface layer through increased low-level stability and destruction of ozone near the surface.

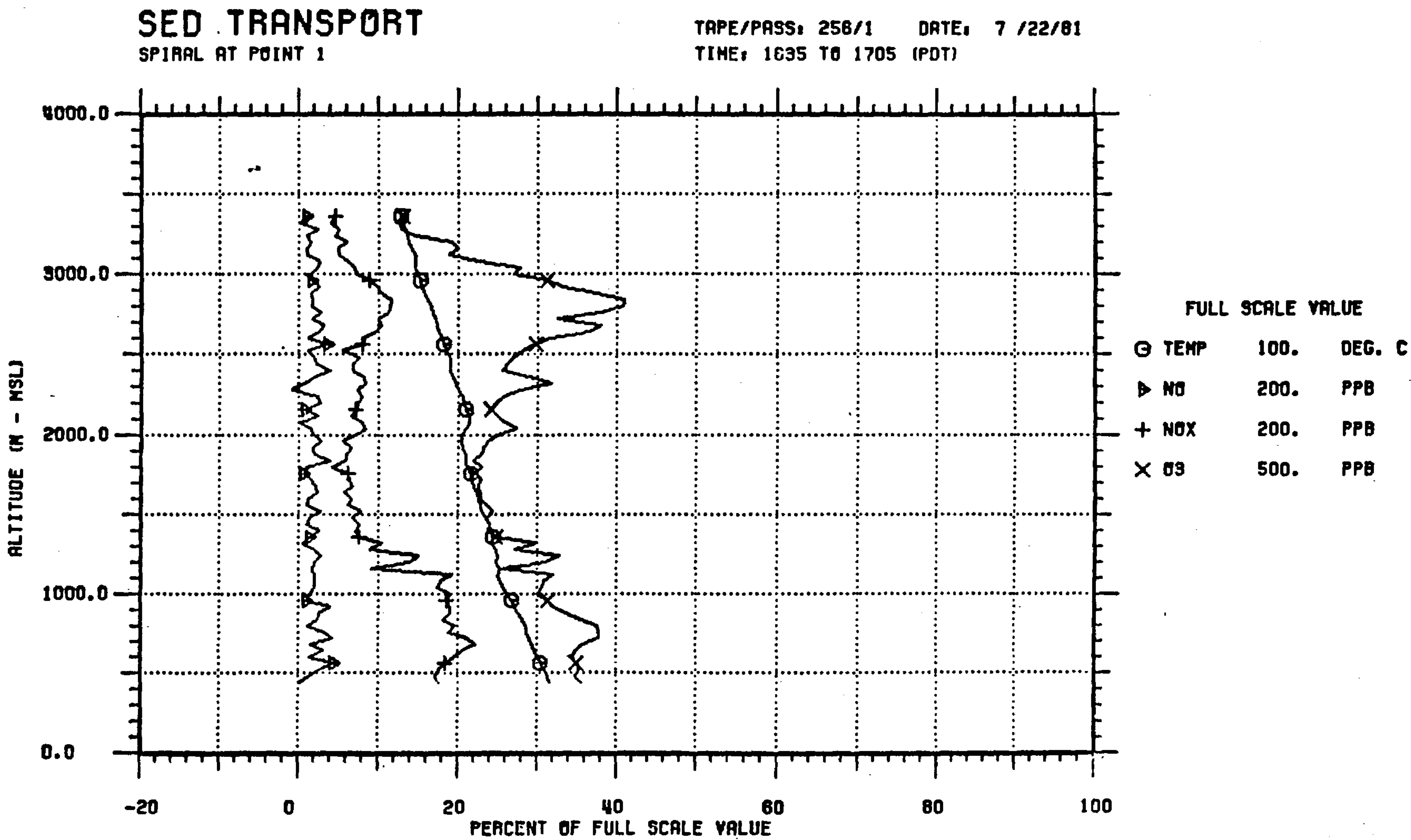

Fig. 3 AIRCRAFT SOUNDING AT RIALTO AIRPORT - July 22,1981

3.0 MIXING HEIGHTS

Mixing heights during the 1981 study were estimated primarily from aircraft soundings. An estimate was also obtained from radiosonde observations at Edwards Air Force Base together with a maximum surface temperature. Table 1 gives a list of the aircraft sounding estimates in terms of msl values as well as height above ground.

The estimates of mixing height from Edwards radiosonde observations averaged several hundred meters higher than observed by the aircraft and are not considered as representative as the aircraft data. Most of the aircraft data were obtained between 1600 and 1800 PDT. Maximum surface temperatures in the Edwards and Victorville areas generally occur between 1500 and 1600 PDT and between 1600 and 1700 PDT at Daggett. The aircraft sounding data were therefore usually obtained within 1-2 hours of the time of surface maximum temperature.

Table 1. Afternoon Mixing Heights (1981)

	Location	m-agl	m-msl	Time (PDT)
July 9	Lake Gregory	400	1800	1602
	E of Hesperia	500	1400	1615
	Hesperia Intsct	200	1400	1648
	NW of Cajon Pass	500	1800	1713
	E of Hesperia	300	1200	1854
July 14	Acton	700	1500	1627
	2 mi E Palmdale	600	1300	1740
	Adelanto	500	1300	1903
July 18	Cajon Jct.	600	1500	1549
	Hesperia Airport	450	1450	1622
	NW of Cajon Pass	800	2000	1652
	Victorville	300	1200	1810
July 22	Lake Gregory	300	1700	1711
	Cajon Jct.	300	1300	1742
July 27	Lake Gregory	200	1600	1639
	Victorville	600	1500	1712
July 30	Hesperia	500	1500	1532
Aug. 3	2 mi S of Cajon Jct.	600	1400	1640

Table 2 lists mixing heights observed by aircraft during morning flights in the desert.

Table 2. Morning Mixing Heights (1981)

	Location	m-agl	m-msl	Time (PDT)
July 15	2 mi E Palmdale	500	1200	0906
	Barstow	100	750	0959
July 19	Victorville	200	1100	0732
	Lucerne Valley	100	900	0758
	Barstow	200	800	0827
July 23	Yucca Valley	500	1400	0743

The height of the observed mixing layer in Table 1 does not exceed 1500 m (msl) except over the higher terrain near Lake Gregory and in the area northwest of Cajon Pass along the Pearblossom Highway (surface elevation 1200 m). Even if allowance is made for a slightly higher mixing height at the time of maximum surface temperature, there appears to be little opportunity for ozone layers above 1500 m-msl to mix downward to the surface to any significant degree. It should be noted that the Barstow exceedances of possible local origin occur near midday, prior to the time of maximum surface temperature. If the material is being mixed downward, it is therefore likely to have originated from a level below 1500 m-msl.

In view of the interest in the Barstow area and the absence of afternoon aircraft soundings, the wind profiles at Barstow were examined for indications of mixing height depth. At 1400 and 1600 PDT there was clear evidence from directional wind shears of mixing heights of 1000-1100 m-msl at 1400 PDT and 1200-1400 m-msl at 1600 PDT. These values are in agreement with aircraft soundings available from other portions of the desert.

The data in Table 2 indicate the existence of surface inversions in the desert with the exception of the sounding 2 mi E of Palmdale. In this area it would appear that constricted flow may increase the mixing height in a local region. This, in turn, might contribute to a layer aloft within the desert after the surface inversion has become established farther downwind.

Available mixing height data from the limited data sample in July 1981 indicate that the surface mixing layer within the desert extends upward approximately to the base of the elevated ozone layer discussed previously. The upper layer should therefore provide a very limited contribution to surface ozone concentrations under the overall synoptic conditions encountered during July 1981.

4.0 WIND FLOW PATTERNS

Pibal wind observations were made at a number of locations in and near the Mojave Desert during the 1981 Study. Although the number of observational days at any given location is very limited, the consistency of the wind field permits a meaningful, composite picture of diurnal flow patterns.

Figs. 4-6 show composite wind vectors for the available locations at 1500 m-msl. Throughout most of the desert itself, this altitude represents about 600-900 m above the terrain and near the top of the afternoon mixing layer. It also generally represents the base of the ozone layers aloft as described earlier. The three figures cover the times of 1600, 2200 and 0400 PDT and illustrate the period of greatest interest for transport within the desert.

Fig. 4 (1600 PDT) indicates southerly flow in the area from Barstow to Cajon Pass with highest velocities at Cajon and Lake Gregory. Wind directions in the western part of the desert were from the west-southwest. By 2200 PDT (Fig. 5) the flow over Cajon Pass and Lake Gregory remained southerly but with reduced velocity. Victorville and Barstow winds became more westerly. The major development at 2200 PDT was the increased wind speeds at Barstow and in the western portion of the desert. Particularly in the Barstow area this constitutes the formation of a low-level, nocturnal jet and is discussed further in a later paragraph. By 0400 PDT the flow at Victorville and Lake Gregory was from the south while the western and northern portions of the area indicated west-southwest to west winds. The velocity at Barstow was considerably reduced from the value at 2200 PDT.

Fig. 7 is a plot of changes in the westerly component of the wind at Barstow on a diurnal basis. Data for elevations of 1000 m-msl and 1500 m-msl are included in the figure. Terrain elevation at Barstow is about 600 m. It is apparent that the westerly flow reaches a peak at 1000 m-msl between 2000 PDT and 0200 PDT as a manifestation of the development of the low-level, nocturnal jet in the northern part of the desert. Except for the period near 2200 PDT, the velocity components at 1500 m-msl were consistently lower than at 1000 m-msl during the jet development. Examination of the individual wind profiles indicates that the peak of the jet occurred at about 300-400 m above the terrain with a tendency to rise during the early morning hours.

The wind flow patterns indicate that, within the limited data available, the Barstow area may receive transported pollutants from the south (or southwest) during the late afternoon but that moderate winds during the night are likely to clear out the transported material. It should be noted that no data are available for the case of low or negative pressure gradients when the development of the nocturnal jet may not occur.

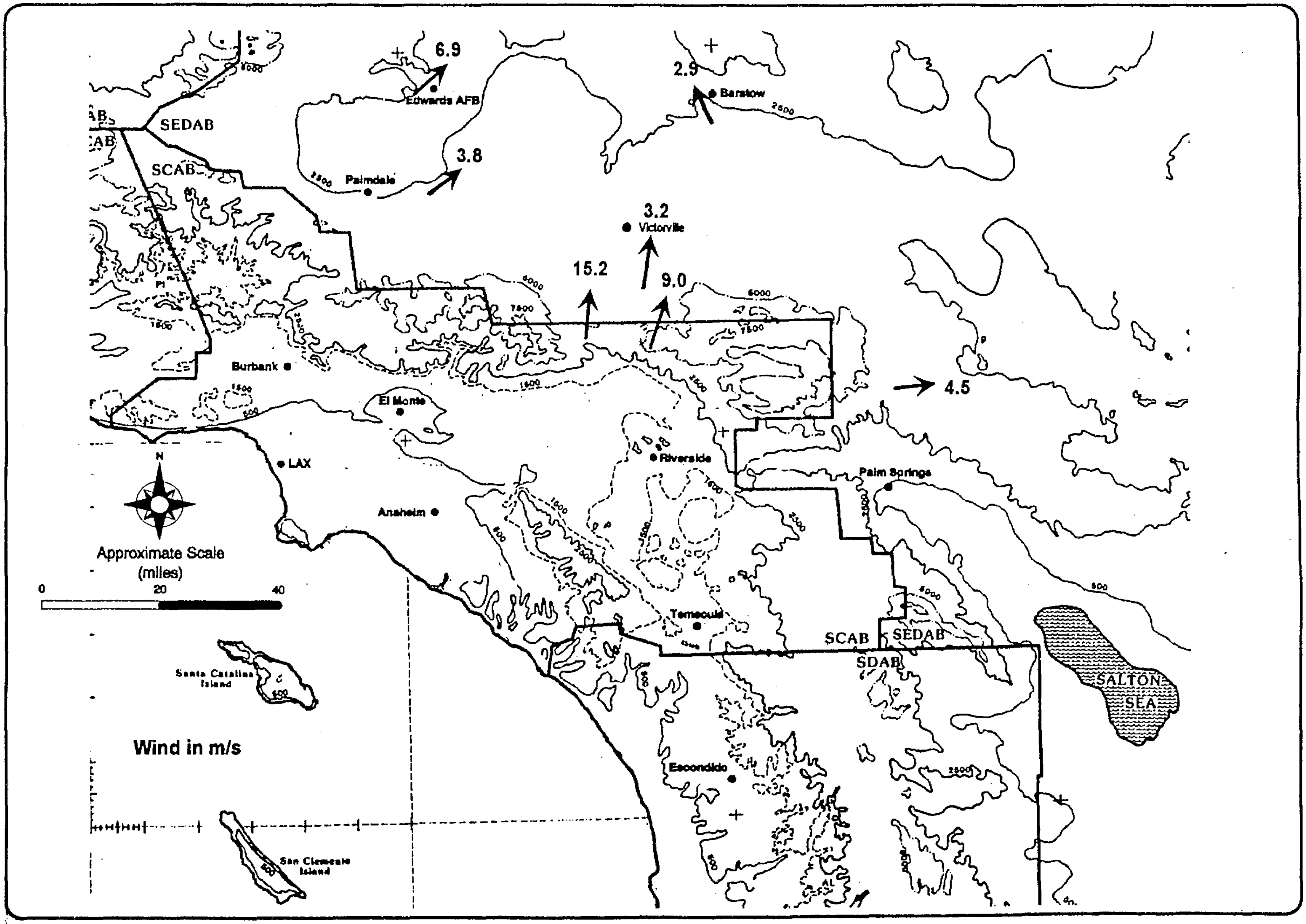

Fig. 4 Composite Wind Vectors at 1500 m-msl (16 PDT)

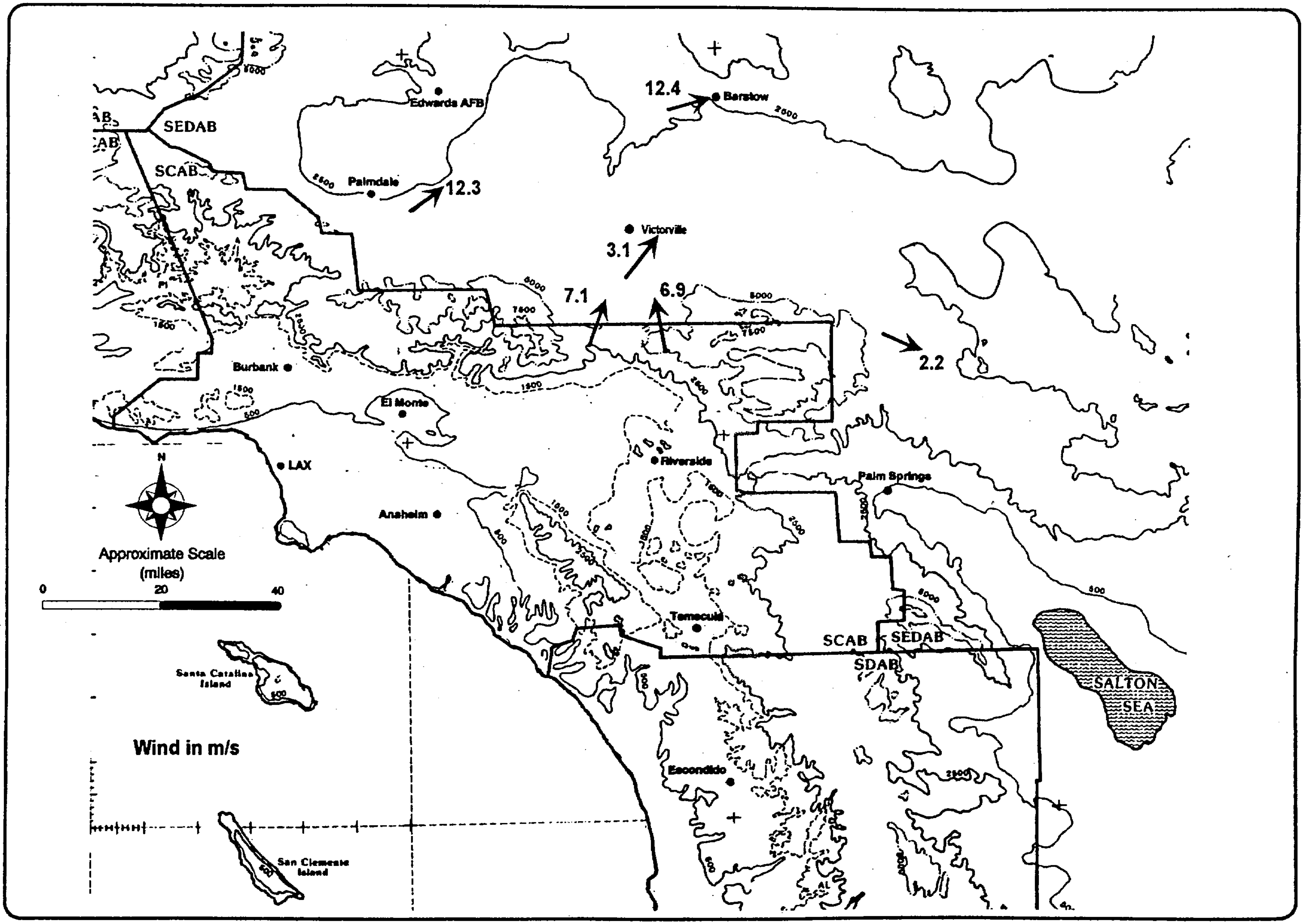

Fig. 5 Composite Wind Vectors at 1500 m-msl (22 PDT)

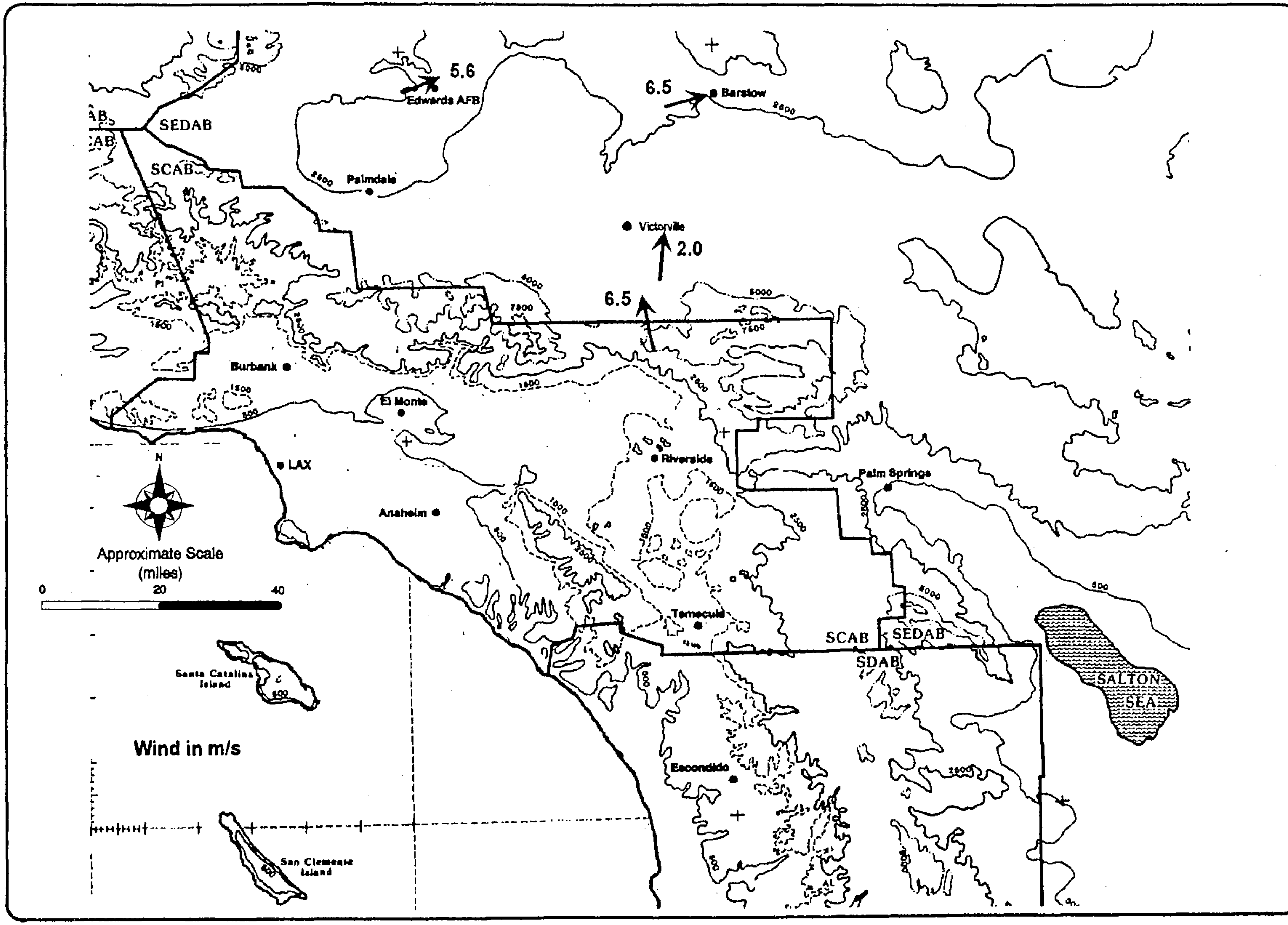

Fig. 6 Composite Wind Vectors at 1500 m-msl (04 PDT)

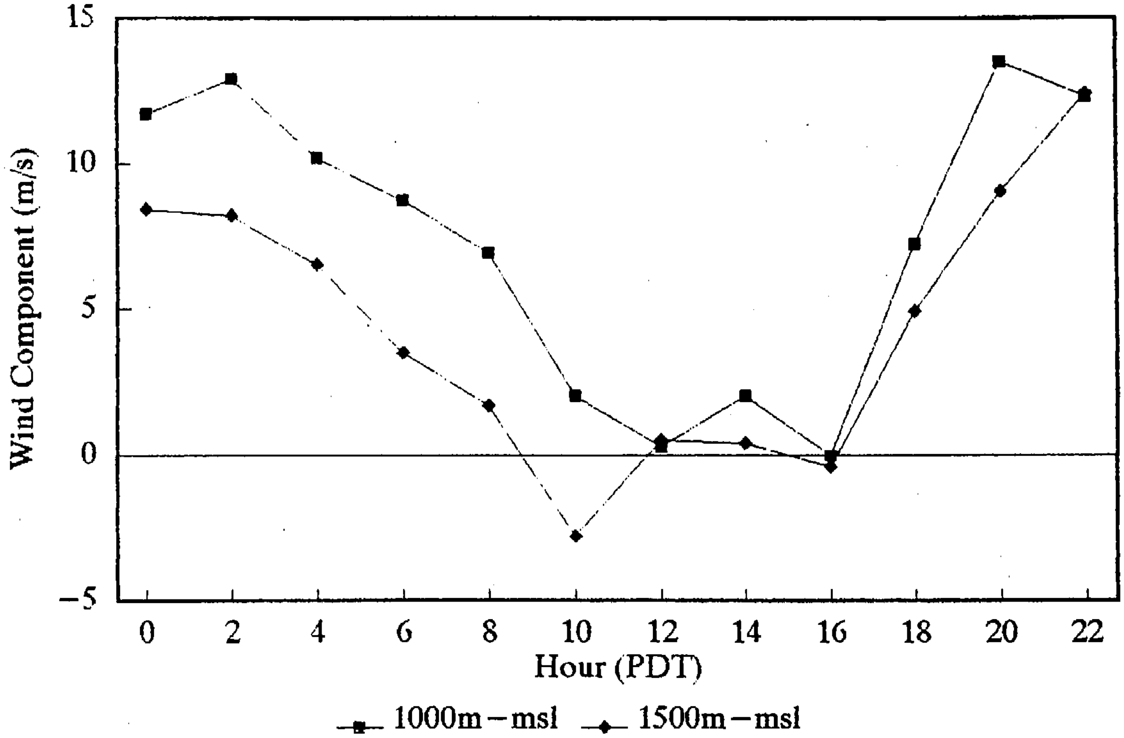

Fig. 7. Westerly Wind Component at Barstow, July 14-15, July 18-19, 1981

5.0 TRACER TRAJECTORIES

There were three tracer releases during the 1981 Study which provide useful information on typical transport routes within the desert. Two of these releases entered the desert through Soledad Canyon. The third release was made from Cajon Pass.

The two trajectories from Soledad Canyon were directed toward the northeast. Both resulted in tracer gas concentrations at Barstow in the late afternoon. One of the releases resulted in a relatively narrow plume in the direction of Barstow. The plume from the other release was more widespread with some tracer material appearing at Victorville as well as Edwards AFB. No significant amounts of tracer material were found in the desert in either case on the following day after extensive auto traverses.

The Cajon Pass tracer release lasted for four hours (1300-1700 PDT) during which winds in the pass and downwind changed in direction. Initially, the center of the plume from Cajon Pass moved to the west of Victorville and thence slightly to the west of Barstow, curving northeast thereafter. During the late afternoon, the direction of the plume after leaving the release location gradually shifted. By the end of the release period, the plume headed north and the northeast, finally reaching Lucerne Valley by 2000 PDT. The shift resulted from a general change in wind directions as indicated in Fig. 5.

The trajectories of all three releases conform to the flow patterns shown in Figs. 4-6.

Additional tracer information is available from Reible, Ouimette and Shair (1982). A tracer release from the San Fernando Valley moved into the western Mojave Desert centered near Palmdale with a crosswind dimension of about 10 miles. A release from Oildale in the San Joaquin Valley took two different routes into the Mojave Desert. One route was to the east-northeast over Lake Isabella and the other was over the Tehachapi Pass into Mojave and then northward.

During the 1990 San Joaquin Valley Study (Lehrman, Smith, Knuth and Dorman, 1994) tracers released at Pittsburg (1600-2000 PDT) reached the southern end of the Valley in the early afternoon of the following day and were observed at Edwards AFB in the late afternoon. Some residual tracer material remained in the Edwards area throughout the night. Further concentrations were observed at Edwards on the second day after release, apparently from material stored overnight in the southern part of the Valley.

The limited information available from the tracer data suggests that the trajectories from the South Coast Air Basin into the

Mojave Desert may follow more consistent flow patterns than those from the San Joaquin Valley.

6.0 DISCUSSION

Analysis of the data from the 1981 SE Desert Study indicates the frequent presence of ozone layers aloft during the late afternoons in and downwind of the passes leading from the South Coast Air Basin. In the 1981 data the upper ozone layers were based at 1400 m-msl or higher. Tops of the layers were generally at 3000 m-msl. The presence of the upper layers was documented as far east as Adelanto from Soledad Canyon and as far north as Victorville from Cajon Pass. No information was available beyond these locations. The upper layers are attributed primarily to upslope motion along the southern slopes of the San Gabriel Mountains and San Bernardino Mountains.

Another type of ozone layer aloft develops from a nocturnal decoupling of surface layers due to strong stabilization and restricted mixing near the surface. Evidence for these layers was present in morning soundings in the desert but the peak concentration observed was 11 pphm at Lucerne Valley. Transport from the South Coast Air Basin on the previous day may contribute to these layers but some local contributions may be present.

Observed mixing heights in the desert did not exceed 1500 m-msl except over higher terrain such as Lake Gregory and immediately northwest of Cajon Pass. Most of the observations were made within an hour or two of the time of maximum surface temperature.

Composite wind vectors at 1500 m-msl for the 1981 study period show southerly winds from Cajon Pass to Barstow in the late afternoon shifting to southwest at 2200 PDT and returning to southerly by 0400 PDT. Wind directions in the western part of the desert were consistently from the southwest for these time periods. These directions conform to the trajectories of the tracer releases which affected the Mojave Desert. A nocturnal jet developed along the northern edge of the area (Barstow) starting at 1800 PDT and peaking from 2000 to 0200 PDT. The jet was centered at about 300-400 m-agl with peak velocities of 13-15 m/s. The strong flow along the northern edge of the area serves to clear out much of the ozone which had been transported into Barstow during the day.

From the standpoint of potential impact on surface ozone concentrations, the maximum mixing layer depth during the afternoon does not seem to be sufficient to incorporate a significant portion of the upper ozone layer into the mixed layer. More likely sources of surface ozone impact from mixing during the day are the decoupled layers below 1500 m-msl which are formed during the night. Under the synoptic conditions of the 1981 study, however, significant layers of this type are likely to be transported out of the area of interest by winds during the night.

It is important to note that the 1981 study test days were selected to involve transport from the South Coast Air Basin under exceedance conditions to the SEDAB. Within this requirement ranges of 850 millibars (mb) temperatures from 19 to 24 degrees Celsius and LAX-Daggett pressure gradients from 1.1 to 4.4 mbs were encountered. These are representative conditions for significant transport into the desert. All but one of seven test days showed elevated ozone layers moving into the desert with considerable consistency as to the elevations involved. Missing from the 1981 test conditions is the very important case of weak or reversed pressure gradients together with warm temperatures aloft. In this case, some transport through the passes may still occur but may not be removed during the night by wind transport. Recirculation within the desert is a likely event. The ozone layer aloft, however, may well be transported away from the desert if offshore winds prevail above the mountain tops. The importance of decoupled layers mixing downward during the day should increase in this scenario.

7.0 FIELD SURVEY

7.1 Identification of Potential Sites

An initial search for potential monitoring sites concentrated on the Mojave Desert and the passes between that area and the South Coast Air Basin. Previous monitoring experience on Catalina Island precluded the need for an extensive investigation of potential sites there.

Identification of potential elevated monitoring sites provided the most difficult siting problems. A survey of aircraft sectional charts, USGS Quadrangle maps, highway maps, and other demographic information identified a very limited number of high towers which could be suitable as elevated sites. Even when appropriately located, most of the candidate towers extended only to heights in the range of 200-300 feet above the terrain, with none above 300 feet. From the analysis and discussion presented earlier, it was determined that such elevations would be in the lower part of the local mixing layers and therefore would likely experience ozone concentrations similar to those found at the surface during the day and might be within the surface inversions at night.

In order to overcome the disadvantages of the high tower candidates, a second set of potential sites was developed by searching for existing facilities on high terrain located in the corridors that the ARB has expressed the greatest interest. The extensive network of microwave repeaters, cellular installations and other communication facilities on hills and mountains in the area provided opportunities for such sites. These candidate locations usually have existing shelter and towers that can be used for mounting meteorological sensors, along with power, telephones and security. Moreover, these sites provide monitoring platforms higher above the mean terrain than do the high-tower candidates.

A third set of potential monitoring sites was produced to fill in the gaps in the existing surface monitoring network on the desert floor. Areas of interest, identified in the above analysis and in discussions with ARB personnel, where additional monitoring was needed became the prime candidate locations for the surface sites.

7.2 Field Aerial Survey

After identifying potential monitoring sites, an aerial survey was made from a light aircraft to assist in evaluating these sites and to identify additional sites. The survey focused on the Mojave desert beginning in the Soledad Canyon, extending east to the Cady Mountains, and south to the Cajon Pass. Eight potential elevated sites from the prearranged list were surveyed, as well as the general area for additional candidates.

It was determined that seven elevated sites looked acceptable from the air, and that the terrain at those sites were in strategic locations and provided good exposure for wind and ozone measurements. These candidate facilities were Hauser Mountain, Ten-High Mountain, Shadow Mountain, Flash II Mountain, Elephant Mountain, Quartzite Mountain, and Baily Peak.

Four potential elevated sites were determined to be unsuitable for monitoring. A microwave site in the Cady Mountains was located in a saddle between two peaks and was not elevated enough above the mean terrain. Also judged as not adequate was a fire lookout at Cajon Summit which had served as a site in previous studies. The site is located immediately adjacent to and just 100 ft. above I-15 where it is exposed to traffic emissions. No elevated facilities were observed in the Newberry Springs area where a microwave/repeater site was supposed to be located. In addition, a 300 ft. tower which was indicated on aircraft sectional maps in the Palmdale Lake area could not be sighted.

An additional potential elevated site at Bell Mountain, east of I-15 near Apple Valley airport, was identified during the aerial survey.

It was noted from the airplane that the main flow out of Soledad Canyon likely enters the Antelope Valley along a line from Lake Palmdale eastward. That area was decided the best location for surface monitoring. Possible surface sites were also noted in the vicinity of I-40 to the east of Newberry Springs, and around Baldy Mesa just north of the Cajon Pass Summit.

7.3 Field Ground Survey

The aerial survey was followed by a ground survey to further determine the suitability of the candidate sites from a both science and logistics point of view. Facilities and access roads were further evaluated, and, if ownership was not known, identified from posted signs. Responsible personnel for the facilities that had not been identified prior to the site visits were contacted about the site specifics and availability. Both the Mojave Desert region and Catalina Island were included in this task.

Sites or locations inspected during the ground survey were:

- Ten-High Mountain
- Hauser Mountain
- Shadow Mountain

- Flash II Mountain (NW of Barstow)
- Quartzite Mountain
- Bell Mountain
- Cajon Summit
- Baldy Mesa which extends from Cajon summit north to the I-15/395 intersection
- Palmdale
- White's Landing, Fox Cove, Toyon Bay (Catalina Island)

The airport on Catalina Island, which is considered an elevated site, was inaccessible due to roadwork in progress. Travel, except for essential services, was restricted and expected to remain so until approximately May 1. Fortunately, Ogden has installed and operated a site there in 1989, and is familiar with that facility and required logistics.

The first five sites on the above list are communications facilities on top of isolated mountain tops, and all have power, inside air-conditioned space, and good security. With the exception of Shadow Mountain, all have land-based telephone service. The operators/owners of those facilities all expressed a willingness to enter a lease arrangement. All have antenna structures which could be used to mount anemometers. It should be noted that typically there are a cluster of towers and antennas at this type of installation. All the towers are of the open-grid type and, hence, should not significantly distort the wind flow.

Bell Mountain, located several miles west of the Apple Valley airport, had no existing facilities either on top or near its base. Power would have to be brought in from some distance if a monitoring site were to be established there.

No adequate sites were found at the summit of Cajon Pass. The previously used forest service facility was too close to I-15, as was a California Department of Forestry (CDF) fire station at Oak Hills road. A microwave and communication facility on Baily Mountain several miles east of I-15 was determine to be at too high an elevation (5300 ft msl) and too far south to measure transported ozone in Cajon Pass. A suitable surface site location was determined, however, in the Baldy Mesa area just to the north-northwest of Cajon Summit. This area is at or just slightly lower than the summit and has excellent exposure to flow and transport from the pass. No existing buildings or towers are available, but land space for lease with accessible power and phone are available. Emissions from I-15, which is 1.5 miles to the east and approximately 3.0 miles upwind, are an undetermined problem.

The area from Lake Palmdale east is the southern edge of Palmdale, and contains newly developed residential housing and services. Several locations there could serve as a surface sites. One facility that provides security, and has a communications tower and adjacent building was judged to be a suitable candidate site.

Avalon was dismissed as a potential surface site due to the expected large source of emissions from boat traffic. Pebbly Beach, southwest of Avalon, was dismissed as a site due to its proximity to a power generating station. Three camps, remote from Avalon, were surveyed by boat. Two were located in narrow coves surrounded by steep terrain. A third, at White's Landing was the best candidate based on terrain features. Equipment could be sited there at a YMCA camp in a storeroom off the dining hall. There is access to the site by either the YMCA boat or road.

A complete list of candidate sites with specifics on location, type of facility, access, and exposure are given in the appendix to this report.

8.0 RECOMMENDATIONS

The proposed monitoring program will include eight locations, at least three of which will be elevated sites. In order to make the most effective use of the available resources, the recommended locations are largely concentrated in and near the Mojave Desert where significant transport issues exist.

The possibilities for suitable elevated site locations are quite limited. Some of the major considerations are the location and elevation of the site, the potential effect of local emission sources, ready access, the availability of power (and possibly phone service), security and the representativeness of the site as a measure of ozone concentrations aloft without undue influence from local terrain effects. A primary source of such sites is the extensive network of microwave tower and repeater installations which are located on mountaintops throughout Southern California and elsewhere. The challenge is to find the proper combination of elevation and location which will best serve the purposes of the program. Another source for elevated sampling platforms are TV or radio towers that are not mountaintop-located. This type of platform was regarded as the first choice, and our initial efforts were directed to identifying such structures. However, a result of our survey was that the sampling height attainable from towers identified is insufficient for the needs of the program.

The information given in previous sections of this report have suggested that ozone layers below about 1500 m-msl may have the opportunity to mix downward to the surface during the afternoon heating cycle. For reference purposes the mid-point of the afternoon mixing layer would lie at about 1100-1200 m-msl (3600-3900 ft.) in the major part of the desert. Ideally, sampling in this elevation range might have the opportunity of observing layers aloft which could be mixed downward subsequently. Unfortunately, many of the microwave and repeater installations are at somewhat higher elevations.

Following is a list of candidate sites with a brief discussion of the rational for monitoring at those locations. They represent possible sites within the expected mixing layer but which are also strategically located along transport routes of interest. The list includes, separately, elevated and surface sites from which a final selection needs to be made. A subsequent list gives the recommended sites which we feel would most effectively contribute to the program. Locations of the recommended eight sites are shown in Fig. 8.

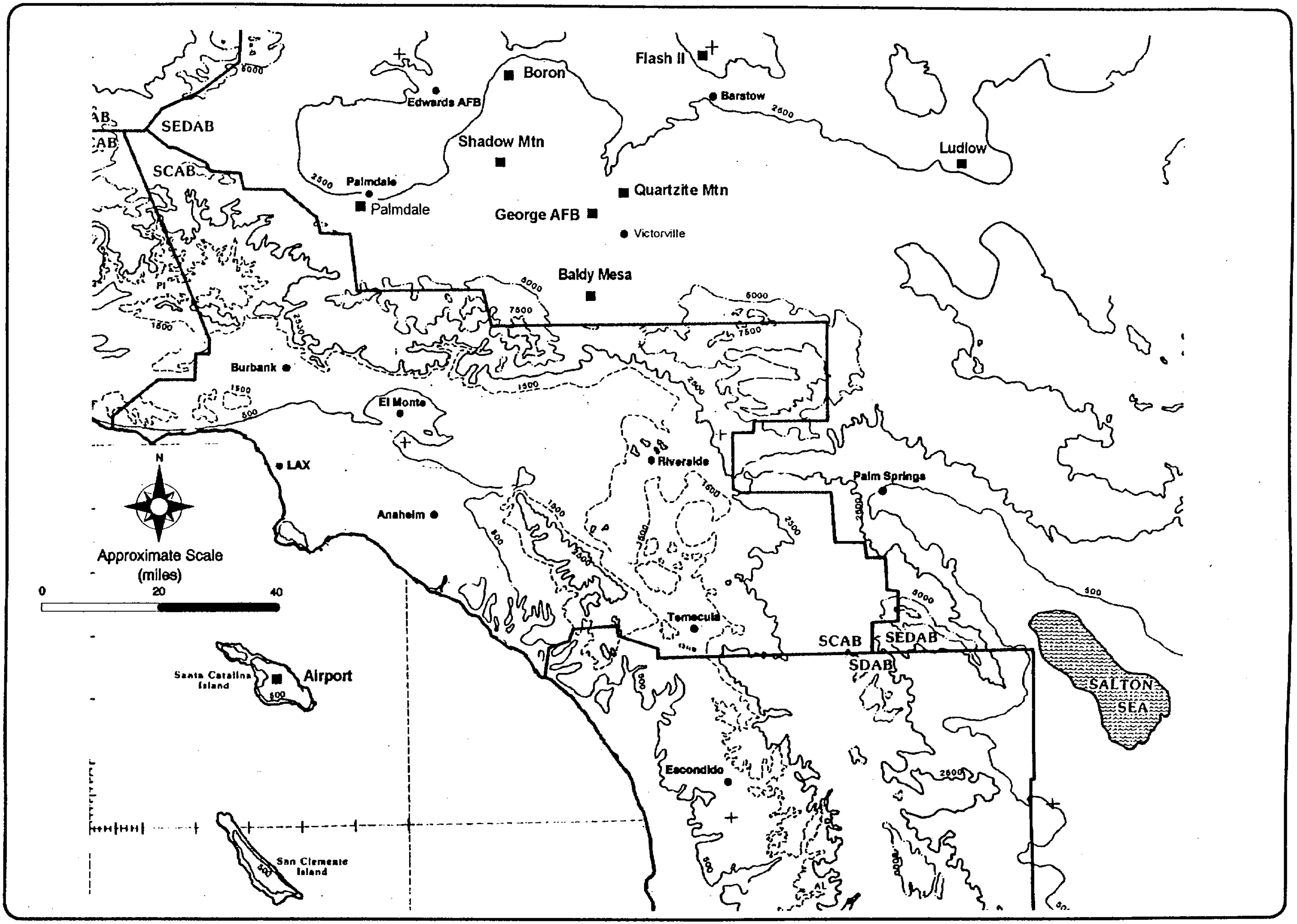

Fig. 8 Locations of Recommended Sites (Shown as Squares)

8.1 Candidate Sites - Elevated

The following locations comprise the short list of potential sites which were closely scrutinized as sites for elevated measurements.

1. Catalina Airport (1602 ft. msl) - Observes offshore transport from LA Basin to San Diego. Previous sampling was successful for this purpose.

2. Quartzite Mountain (4482 ft. msl/1500 ft. agl) - About 4 mi. east of George AFB in the flow from Cajon Pass. Site is at about the same elevation as the Pass. May have local source problems from highways and cement plants.

3. Flash II Mountain, 5 Mi. NNW of Barstow (3325 ft. msl/1300 ft. agl) - Well located to sample layers aloft that are mixed downwind during the day. Possibly in region of upslope flow due to higher mountains to north.

4. Cady Mountains (about 3500 ft. msl/1000 ft. agl) - Located 30 mi. east of Daggett. Would sample eastern part of desert with reference to potential recirculation.

5. Shadow Mountains (4120 ft. msl/1100 ft. agl) - Located 8 mi. north of El Mirage Airport. Would sample extension of flow from Soledad Canyon.

6. Hauser Mountain (5200 ft. msl/2400 ft. agl) - Located about 9 mi. west of Palmdale near the outflow from Soledad Canyon. Although higher than other sites in the list it might observe the upper layer moving out of Soledad Canyon.

7. Ten-High Mountain (4250 ft. msl/1400 ft. agl) - Better situated than item 6 (above). Nearer to Soledad canyon and lower than Hauser Mountain. Would probably measure in the mixed layer.

8. Elephant Mt. (4542 ft. msl/2500 ft. agl) - About 13 mi. northeast of Barstow. Is not situated as well as item 3 (above) to sample potential layers aloft due to its much higher elevation.

9. Baily Peak. (5606 ft. msl/est. 1900 ft. agl) - On east side of Cajon Pass and about midway through the Pass. Is not well situated to sample polluted layer in the Pass due to its high elevation and probable terrain effects.

8.2 Candidate Sites - Surface

The following locations are surface-based potential sites that we considered for inclusion in the monitoring network.

1. White's Landing, Catalina - Not very promising near sea level because of low level stability due to cool surface and warm air aloft. Will be difficult for transported ozone to penetrate to surface.

2. Southeast of Palmdale @ 1030 E Ave. 'S' - Would sample surface outflow from Soledad Canyon.

3. Baldy Flats - Downwind of Cajon Pass but removed from I-15 traffic sources. Would provide surface ozone measurements at the outflow of the Pass.

4. Ludlow - About 50 mi. east-southeast of Barstow. Could sample input from 29 Palms area and potential recirculation from the east.

5. Boron - Would help to distinguish between South Coast and San Joaquin Valley flows.

6. El Mirage - Would provide better understanding of the eastward transport from Soledad Canyon and the El Mirage convergence zone.

8.3 Recommended Sites - Elevated

The following list are the sites that we recommendation for elevated measurements. The four sites are located on mountaintops along the offshore to San Diego County and Cajon Pass to Barstow transport routes. Section 8.5 contains a brief discussion of concerning these measurements and the overall objectives of the study.

1. Catalina Airport - Essential for monitoring offshore transport to San Diego and has been useful previously.

2. Flash II Mountain - Should be the best opportunity available for monitoring the ozone layers aloft at Barstow which might contribute to non-transport influences. Elephant Mt. would sample only top portion of mixing layer.

3. Shadow Mountains - Ability to monitor outflow from Soledad Canyon without the terrain influences near the Canyon exits. Lower elevation above terrain than candidate sites near the exit of Soledad Canyon.

4. Quartzite Mountain - Ideal location for monitoring the flow from Cajon Pass although local sources of emissions may be a problem. Measurements would be within but near the top of the mixed layer.

8.4 Recommended Sites - Ground

The following ground-based locations are our recommendations for monitoring sites to be included in the project network.

1. Southeast of Palmdale - It is important to monitor the flow through Soledad Canyon at a location which may be more representative than Lancaster.

2. Boron - A wider area coverage of surface ozone monitors in the desert is desirable. Boron would supplement the coverage in the western portion and may help distinguish between South Coast and San Joaquin Valley impacts.

3. Ludlow - Would supplement the eastern area coverage and might pick up recirculation or 29 Palms contributions.

4. Baldy Flats/Cajon Pass - It would be useful to monitor the surface ozone flow near the outflow of the Pass.

8.5 Representativeness of the Elevated Measurements

The objective of the monitoring aloft in this project is to measure ozone and winds in situ from an elevated platform that portray the atmosphere at that height above the surrounding terrain. A tall tower in conjunction with long-line sampling was our first choice. However, our survey failed to identify towers of sufficient height that could give any additional information over conventional surface measurements. The next best method for siting, which is recommended herein, is to locate the measurements on top of prominent terrain such as isolated peaks. However, there is a question about how representative data are from such sites.

At night when the atmosphere is stable, air flow is typically laminar and directed around an isolated barrier and, except for roughness effects, there is little upward movement of air. Thus under nighttime conditions, measurements representative of the free atmosphere are expected. However, during the daytime when insolation occurs, the air flow is disturbed by local terrain effects, and air is likely drawn upward. This flow can be extremely complex and is driven by a number of parameters such as slope aspect, albedo, amount of insolation, and atmospheric stability.

A sense of the representativeness of mountaintop measurements can be gained by comparing independent observations from the lidar or from rawinsonde/ozonesondes. From the diurnal trend of differences between the two types of measurements, an assessment of using elevated terrain sites as a surrogate can be made.

It should be noted that similar elevated-terrain measurements made in other studies (e.g., Sutter Buttes and the airport at Catalina Island) have provide useful data.

9.0 OZONE LIDAR/WIND PROFILING SYSTEMS SITING

The objectives of the ozone lidar system and accompanying wind profiler are to 1) demonstrate the lidar's capabilities, 2) to assess the representativeness of long-line or elevated terrain in situ monitoring, and 3) to characterize the flux of ozone within a transport corridor.

The ozone lidar and wind profiler systems have special site requirements which include room for trailers and antennas, electric service providing 200 amps or more, relatively "quiet" acoustic and RF environment, and flat terrain with an unobstructed view for 6 kilometers. Moreover, if a RASS system is used, consideration must be given to locating site where operations will not bother others.

Considering these objectives and siting requirements, our recommendation is to place the systems at George Air Force Base (AFB). George AFB is no longer active except for maintenance operations, and our initial inquires indicate that the facility would be available. This location is the logical choice as it offers the following:

- Provides the power and space requirements.
- Is located in a major transport corridor (Cajon Pass to Barstow).
- Can be used to corroborate the elevated measurements at Quartzite Mountain
- Allows an instrumented aircraft to make the low passes required to validate the lidar's performance.
- Can provide vehicle access within the 3 km operation arc of the lidar which is required for the "reference point" MLD van measurements.
- Provides excellent security.

Even though our site survey failed to identify any candidate long-line sampling towers, it would still be informative to compare measurements at one of the three elevated sites recommended in Section 8. Locating at George AFB will provide the best opportunity for doing so. The Quartzite Mountain and George AFB sites would be approximately 5 miles apart.

Aircraft are normally not permitted to operate at less than 500 ft. altitude over a rural area or at less than 1000 ft. over an urban area unless at an airport. The inactive runways at George AFB will likely permit the instrumented airplane to make low passes as frequent as required down to ground level, and then spiral to altitude above the lidar. In addition, room and airdrome clearance would be available for balloon-borne rawinsonde/ozonesonde soundings.

The inactive base should allow MLD's monitoring van to setup virtually anywhere along the lidar's measuring plane without the usual siting problems.

A number of other potential lidar sites were examined during the field ground survey. These included: the airports at Hesperia and Apple Valley; CDF sites near Cajon Pass summit and at Mountain View Acres; and a water district maintenance facility near I-15 and Highway 395. All these sites are located south of Victorville and are not near any of the proposed elevated ozone monitoring sites.

The two airport sites have commercial power available but may require a special drop for 220 VAC service. Since both facilities are at active airports, aircraft and/or balloon soundings could be run at these locations. A network of roads in the area could be used for MLD's van operations. The main drawback to these sites is their location east of I-15, on the fringe of the main ozone transport corridor.

The CDF and I-15/395 sites are all located along I-15 between Cajon Pass summit and Victorville, within the corridor of optimum ozone transport from Cajon Pass. In addition, there is a substantial road network in the area which will allow MLD's van operations. A possible problem with the three sites is their close proximity to I-15 vehicular emissions. Another drawback is the lack of a nearby airport, or rural airspace, to allow low aircraft sounding operations. Balloon soundings are feasible at all three locations. Commercial power is available at the sites, but a special drop will be required for 220 VAC.

The Cajon Pass summit site is located at a CDF-County fire station near the Oak Hills off ramp on the I-15 parallel road, about 1.5 miles east of the proposed Baldy Mesa surface ozone site. The Mountain View Acres site is a CDF fire station, and adjacent water district facility, in a residential sub-division about two miles southwest of Victorville. The third site is located about a mile northwest of the I-15/highway 395 junction at a water district maintenance facility.

10.0 REFERENCES

Lehrman, D. E., T. B. Smith, W. R. Knuth and C. E. Dorman 1994; Meteorological Analysis of the San Joaquin Valley Air Quality Study, Atmospheric Utilities Signatures, Predictions and Experiments Program (SJVAQS/AUSPEX); T & B Systems Report to Pacific Gas & Elect. Co. and Calif. ARB, 231 pp.

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Appendix

Candidate Site Information Catalogue

<u>Elevated</u>

Baily Peak
Catalina Airport
Elephant Mtn.
Flash II Mtn.
Hauser Mtn.
Quartzite Mtn.
Shadow Mtn.
Ten-High Mtn.

<u>Surface-based</u>

Baldy Mesa
Boron
El Mirage
George Air Force Base
Ludlow
Southeast Palmdale
White's Landing

Site Information - ARB Ozone Transport Corridors Study

Site Name: Baily Peak

Type of Site: Elevated - Ozone, meteorology.

Location: Overlooking Cajon Pass

Coordinates: 34° 15' 19"N, 117° 21' 43"W

Site Elevation (msl): 5606ft
Height above average surrounding terrain: 1600ft

Operator/owner of site facility: Jones Communications
Contact Name: Craig Chase Phone: 805-273-1890

Existing indoor space: Yes; Existing tower: No;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: Unk
Site was not visited but has same facilities as other communications sites listed herein.

Access (1-10*): Unk
As with other similar sites will have 24 hrs./day, 7 days/week access. Distance on or condition of access road are unknown.

Comments:
Viewed site during airplace survey. Located directly over Pass but may be to high to measure pollution layer. Pollution layer in Pass was shown to be quite shallow in 1981 study.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Catalina Airport

Type of Site: Elevated - Ozone, meteorology.

Location: Catalina Airport

Coordinates: 33° 24' 00"N, 118° 24' 30"W

Site Elevation (msl): 1602ft
Height above average surrounding terrain: 1602ft

Operator/owner of site facility: Airport Manager
Contact Name: Paul Moritz Phone: 310-510-0143

Existing indoor space: Yes; Existing tower: No;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 3

In 1989 field program, anemometer was mounted on boom attached to control tower railing, for lack of a better location. Would like to install where exposure was better. Will have to check out facilities prior to installation trip.

Access (1-10*): 2

Site will be serviced by airplane.

Comments:

Site was used successfully in prior field studies. Data gathered provided useful information.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Elephant Mtn.

Type of Site: Elevated - Ozone, meteorology.

Location: 13 miles northeast of Barstow.

Coordinates: 35° 00' 00"N, 116° 50' 00"W

Site Elevation (msl): 4542ft
Height above average surrounding terrain: 2500ft

Operator/owner of site facility: BLM/Yerba-Daggett Community Services District #40
Contact Name: Cregg Duckworth; Phone: (909) 387-5942

Existing indoor space: Yes; Existing tower: Yes;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 3

Existing micro wave tower suitable for wind sensor side arm mount. Existing building has limited indoor space, will require supplying bench space and surge protection for monitoring equipment. Automatic back up power is available during power interruptions. About 50ft extra length of sensor cable will be needed to connect into data logger if inside the building.

Access (1-10*): 6

Access is from Irwin road northeast of Barstow in the Calico Peak area. An unpaved road of unknown quality leads to the site. Some lock gates are present. Access through the gates is unknown. The site area is under the control of the BLM, and is leased to the Services District. Other sub-leases, mostly to television repeater companies, are effective at the site. Some difficulty may be encountered in expediting access agreements due to the multiple layers of control of the area.

Comments:

This may be a desirable site to measure elevated ozone layers due to the high elevation, however it is probably a bit too high to consistently monitor meteorological and air quality parameters in the mixing layer. Exposure is excellent from the east, through the south, to the west. Possible access problems could cause installation delays.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Flash II Mtn.

Type of Site: Elevated - Ozone, meteorology.

Location: Five miles north-northwest of Barstow.

Coordinates: 34° 58' 15"N, 117° 02' 22"W

Site Elevation (msl): 3325ft
Height above average surrounding terrain: 1300ft

Operator/owner of site facility: Jim Doering Communications
Contact Name: Jim Doering; Phone: (818) 308-0398

Existing indoor space: Yes; Existing tower: Yes;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 3
Existing microwave tower suitable for wind sensor side arm mount. Existing building has limited indoor space, will require supplying bench space and surge protection for monitoring equipment. Automatic back up power is available during power interruptions. About 50ft extra length of sensor cable will be needed to connect into data logger if inside the building.

Access (1-10*): 3
Access is along an unpaved road which goes to the site at the peak of Flash II from Irwin road north of the mountain. The road is rough in spots but passable without four-wheel drive. Care should be taken with low clarence vehicles. There are no gates or other restrictions on the road to the site. The existing building is behind a locked cyclone fence. The combination for both the gate and building locks will be available. The junction of the site access road and Irwin road is 3.9 miles north of the junction of Irwin road and highway 58 on the northwest side of Barstow.

Comments:
This is an excellent site to measure layers aloft in the Barstow area. The exposure to the southeast, through the south and southwest, and to the west is excellent. The site elevation is low enough to be well within the mixed layer expected during ozone episodes, and high enough above the surrounding upwind terrain to monitor conditions above the existing surface sites in the area.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Hauser Mtn.

Type of Site: Elevated - Ozone, meteorology.

Location: Near Soledad Canyon

Coordinates: 34° 32' 50"N, 118° 12' 43"W

Site Elevation (msl): 5100ft
Height above average surrounding terrain: 2300ft

Operator/owner of site facility: Meridian Communications
Contact Name: Lee Zanteson; Phone: 818-222-5655

Existing indoor space: Yes; Existing tower: Yes;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 4

There is an existing 80' antenna tower with some heavy duty boom arms at several heights on which a wind sensor could be mounted. In this configuration, an extra length of cable would be required to reach data system. A mast is possible at south end of building but roof is pitched and covered with ceramic tile. Another option is a mast attached to existing fence post. Building has abundance of indoor space available, will require supplying bench or table and surge protection for monitoring equipment. Automatic back up power is available during power interruptions.

Access (1-10*): 2

24 hrs./day, 7 days/week.

Road access from I-14 at Red Rover Mine Rd. exit. About 4 miles from exit but requires written instructions. Access road is well surfaced. Gate along road, and into facility. Keys would be provided to us.

Comments:

Exposure very good except for the presence of another tower immediately to the north. Both towers are of the open-grid type. The site a bit too elevated to measure the polluted layer in Soledad Canyon. Further from the canyon than Ten-High Mtn.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Quartzite Mtn.

Type of Site: Elevated - Ozone, meteorology.

Location: About 3 miles northeast of George AFB

Coordinates: 34° 36' 38"N, 117° 17' 20"W

Site Elevation (msl): 4482ft
Height above average surrounding terrain: 2000ft

Operator/owner of site facility: Jim Doering Communications
Contact Name: Jim Doering; Phone: (818) 308-0398

Existing indoor space: Yes; Existing tower: Yes;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 3

There is an existing 40' unoccupied steel tower suitable for wind sensor top mount. The existing building has limited indoor space, and will require supplying bench space and surge protection for monitoring equipment. Automatic back up power is available during power interruptions. About 100' of extra length cable will be needed to connect ozone monitor inside into data logger which will be mounted on the tower base.

Access (1-10*): 5

Access is from the Riverside Cement company entrance on National Trails Highway near the town of Oro Grande. The plant gate is 5.4 miles NW of the junction of National Trails Highway and I-15. Access road is paved in spots, unpaved in others. Unpaved portions are very rough, but passable without four wheel. Low riding vehicles not recommended. There is one locked gate on the access road. A key will be provided for the gate and building by the sponsor.

Comments:

Good location to investigate elevated transport directly northward from Cajon Pass . The site is on a dominate terrain feature with excellent exposure for both ozone and winds. The elevation is a little above the mean mixing layer, and slightly below possible aloft decoupled ozone layers. Two cement plant operations are located about two miles to the southwest and southeast of the site respectively. The amount of primary emissions from these plants, if any, is unknown. I-15 runs within three miles east of the site, and within five miles south (up wind) of the site, and is 1500ft below.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Shadow Mtn.

Type of Site: Elevated - Ozone, meteorology.

Location: Near Lake Mirage

Coordinates: 34° 44' 15"N, 117° 33' 54"W

Site Elevation (msl): 4120ft
Height above average surrounding terrain: 1000ft

Operator/owner of site facility: Pacific Micronet
Contact Name: Chuck Crawford; Phone: 800-2667483

Existing indoor space: Yes; Existing tower: Yes;
Commercial Power: Yes; A/C: Yes; Land telephone line: No

Difficulty to install(1-10)*: 4

Existing tower which is about 15-20' tall is attached to side of building and is suitable for attaching mast or extending tower length. Existing building has adequate indoor space available, will require supplying bench space and surge protection for monitoring equipment. Automatic back up power is available during power interruptions. Will require cellular phone for remote access, cellular coverage is good.

Access (1-10*): 5

24 hours / 7 days a week.

Road access from either Palmdale area or US Highway 395 from Shadow Mtns. Road (which has good surface although graded). Turn north (uphill) at blue house in Shadow Mountain residence area. About 1 1/2 miles on this access road which gets rough and is not recommended for passenger car. At fork turn left (right fork has a locked gate anyway). No gate on access road to this site.

Access road is about 3-4 miles from Highway 395 and, coming from Palmdale side, about 7 miles beyond the end of paved road.

Comments:

Good location to measure the flow from the Soledad Canyon and/or to measure the Lake Mirage convergence zone. A prominent terrain feature with excellent exposure for both ozone and winds.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Ten-High Mtn.

Type of Site: Elevated - Ozone, meteorology.

Location: Near Soledad Canyon

Coordinates: 34° 31' 48"N, 118° 08' 36"W

Site Elevation (msl): 4250ft
Height above average surrounding terrain: 1450ft

Operator/owner of site facility: Jones Communications
Contact Name: Craig Chase Phone: 805-273-1890

Existing indoor space: Yes; Existing tower: Yes;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 3

There is an existing 40' tower on which a wind sensor could be mounted. Possibly need an short extension mast for distance above existing microwave antennas. An extra length of cable would be required to reach data system. Tower abuts with building where ozone analyzer could be located. Building has indoor space available throughout, will require supplying bench or table and surge protection for monitoring equipment. Automatic back up power is available during power interruptions.

Access (1-10*): 2

24 hrs./day, 7 days/week.

Road access take Ave. S exit from I-14. East about 1 mile then left on Tierra Subida. Stay on road through residental development 3.0 miles to top of hill. Last 1.5 miles poorly graded. Three facilities on top.

Comments:

Exposure very good. Towers/antennas from other facilities will not compromise wind measurements. This is the better of the two candidate sites near Soledad because it is nearer to the canyon and lower in elevation.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Baldy Mesa

Type of Site: Surface - Ozone, meteorology.

Location: Near Cajon Pass summit

Coordinates: 34° 23' 20"N, 117° 26' 33"W

Site Elevation (msl): 4250ft

Operator/owner of site facility: Summit Estates
Contact Name: Dane A. Wigington; Phone: (619) 949-5832

Existing indoor space: No; Existing tower: No;
Commercial Power: Yes; A/C: No; Land telephone line: Yes

Difficulty to install(1-10)*: 6

The site is located in a vacant two-acre parcel (#52) in a developing residential sub-division. There are no existing buildings on the lot, but there are houses on the parcels immediately to the west and southwest. Underground power and telephone terminals are in place at the street, but arrangement will have to be made with the local utilities for hook ups. If problems arise with this, arrangements have been made to buy power and telephone service from the neighboring houses. A small portable air conditioned shelter and a temporary 10m tower will be permitted on the site at the expense of the project. The land parcel will also be leased from the owner for a six month minimum at the expense of the project. No special construction, zoning or other permits will be required.

Access (1-10*): 1

Access is from Caliente road, which is a frontage road adjacent and parallel to and just west of I-15. The freeway off ramp is Oak Hills road just north of the summit of Cajon pass. Take Oak Hills road west into the sub-division from the CDF/county fire station on Caliente road. Parcel #52 is on Farmington street in the northwest corner of Summit Estates Phase 1. There are no locked gates or guarded facilities.

Comments:

The parcel #52 location is on a slight knoll in a flat/rolling terrain. Exposure is excellent in all directions with just a few one story buildings and low brush in the vicinity. The site is ideally located in the Cajon Pass transport corridor. There is very light vehicular traffic in the sub-division, but the freeway traffic east of the site is frequently heavy. I-15 is 1.5 miles east of and around 2.5 south-southwest (up wind) of the site.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Boron

Type of Site: Surface - Ozone, meteorology.

Location: Kern County fire station in Boron.

Coordinates: 35° 01' 00"N, 117° 39' 00"W

Site Elevation (msl): 2460ft

Operator/owner of site facility: Kern County Fire District

Contact Name: Battalion Chief; Phone: (805) 822-5555
Fire Station; (619) 762-6167

Existing indoor space: No; Existing tower: Yes;
Commercial Power: Yes; A/C: No; Land telephone line: Yes

Difficulty to install(1-10)*: 5

Monitoring will take place at the Boron fire station where there may be indoor space available including air conditioning. If the space is not available, there will be room on the grounds for a small temporary shelter which can be located near an existing PM10 sampler. The shelter would be leased at project expense. Commercial power and telephone are available to the shelter or the indoor location. Meteorological monitoring will take place on a 40' permanent hose tower situated next to the main building. Wind sensors will be mounted on a side arm. Data logging equipment will be mounted at the tower base unless monitoring space is available in the main building. Less than 50' extra sensor cable will be necessary if the indoor facility is available.

Access (1-10*): 1

The site is located near the Health and Emergency Center in Boron near the intersection of Boron Ave. and highway 58. There are no locked gates, and access to the building will be allowed.

Comments:

Exposure for the wind sensors is adequate on the exiting tower. Some wind deformation may occur at times due to buildings in the area. The site is located in a small urban setting which may produce varying degrees of primary pollutants. Vehicular traffic on local streets and Highway 58 should be the primary sources. The contribution of precursors from the U.S. Borax plant and mining operation, about 4 miles to the northwest, is unknown. Borax emissions, if any, should stay to the north of the site during westerly to southwesterly flow.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: El Mirage

Type of Site: Surface - Ozone, meteorology.

Location: Three miles south of El Mirage Dry Lake.

Coordinates: 34° 36' 12"N, 117° 36' 15"W

Site Elevation (msl): 2865ft

Operator/owner of site facility: CDF/San Bernardino County
Contact Name: Bill Mason; Phone: (619) 868-1747 (chief)
Jim Rismiller (909) 881-6900 (CDF)

Existing indoor space: Yes; Existing tower: Yes;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 3

The fire station building has indoor space available, including air conditioning. The wind sensor can be mounted on a second-story steeple with a small mast. The top of the mast will be 30' above the ground. The ozone monitor and data logger will be mounted inside the station.

Access (1-10*): 3

The site is located at 2925 El Mirage road, near the entrance to the El Mirage sail plane field. The site is a volunteer fire station which is unmanned much of the time. A building key will be provided.

Comments:

The site is located in the convergence zone between flow from Soledad Canyon to the west-southwest and Cajon Pass to the south-southeast. Exposure for both ozone and winds is fairly good for a surface site.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: George Air Force Base

Type of Site: Surface - Ozone Lidar, meteorology.

Location: Victorville

Coordinates:

Site Elevation (msl): 2875ft
Height above average surrounding terrain: 0ft

Operator/owner of site facility: Victor Valley Economic Development Authority
Contact Name: Mike Pextin   Phone: 619-246-6115

Existing indoor space: Yes; Existing tower: No;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*:

Access (1-10*): 1
Site likely available 24 hrs./day, 7 days/week.

Comments:

Should be a quiet environment with a number of possible locations with no terrain or structures that would interfere with measurements.

Should provide excellent access for MDL van siting. Ozone airplane should be able to make low passes over runways.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Ludlow

Type of Site: Surface - Ozone, meteorology.

Location: Fifty miles east-southeast of Barstow on I-40.

Coordinates: 34° 42' 36"N, 116° 09' 15"W

Site Elevation (msl): 1782ft

Operator/owner of site facility: LA Cellular
Contact Name: Rich Armstrong; Phone: (213) 716-5389

Existing indoor space: Yes; Existing tower: No;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 4

Existing building has limited indoor space, will require supplying bench space and surge protection for monitoring equipment. Automatic back up power is available during power interruptions. No large tower is available at the site, cellular antennas are mounted on a small pole next to the building. Wind sensors will have to be mounted on a 30' mast supplied by the project. It may be possible to attach the mast to the pole with the wind sensors above the cellular equipment. It is more likely that the mast will be attached and guyed to the building.

Access (1-10*): 1

Access is from Highway 66, about 0.3 miles east of the Chevron station (which is downtown Ludlow). Highway 66 is about 0.5 miles south of I-40. A key to the building will be provided.

Comments:

Exposure is good for a surface site at this location. There are no large buildings nearby and the vegetation is sparse. This location could provide information on ozone transported from the east at the surface level. I-40 is nearby to the north. Vehicular emissions from the freeway are the only local source of pollutants. The extent of the I-40 influence is unknown.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: Southeast Palmdale

Type of Site: Surface - Ozone, meteorology.

Location: 1030 East Avenue 'S'

Coordinates: 34° 33' 26"N, 118° 06' 46"W

Site Elevation (msl): 2760ft
Height above average surrounding terrain: 0 ft

Operator/owner of site facility: Northgate Communications
Contact Name: Fred Budmier Phone: 310-284-3190

Existing indoor space: Yes; Existing tower: Yes;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 1

There is an existing 55' Rohn-type tower on which a wind sensor could be mounted on a boom at 30'. Tower abuts with building where ozone analyzer could be located. Building has limited indoor space available, will require supplying bench or table and surge protection for monitoring equipment.

Access (1-10*): 1

24 hrs./day, 7 days/week.

Road access take Ave. S exit from I-14. West on Ave. S for 2 mi. to Rolling Hills Estates, 1030 East Ave. S. Site is within a fenced RV storage area.

Comments:

Exposure very good. There should be no significant local emission sources upwind during the prevailing flow. Is well located to measure surface ozone concentrations in the outflow from Soledad Canyon.

* 1 represents least problems/expense; 10 represents greatest.

Site Information - ARB Ozone Transport Corridors Study

Site Name: White's Landing

Type of Site: Surface - Ozone, meteorology.

Location: Catalina Island

Coordinates: 33° 23' 20"N, 118° 22' 15"W

Site Elevation (msl): 10ft
Height above average surrounding terrain: 10ft

Operator/owner of site facility: YMCA - Glendale
Contact Name: Troy Baker Phone: 310-510-0143

Existing indoor space: Yes; Existing tower: No;
Commercial Power: Yes; A/C: Yes; Land telephone line: Yes

Difficulty to install(1-10)*: 4
Logistically it would be difficult to get a tower there so would have to install a mast on dining area roof. Storage room where equipment would have to reside has limited space available. Monitor would rest on existing shelving.

Access (1-10*): 4
Once at Catalina Island the site can be traveled to either by boat or automobile. A phone call to the camp and they would send a boat to Avalon to pick us up in 15 - 30 min.. Not sure if island taxis would travel there.

Comments:
Exposure to offshore basin flow is as good as could be found anywhere on the island. The other coves looked at were narrow and surrounded by steep terrain. Relatively speaking, the cove is wide (approx. 300 yds.) and the terrain slopes uphill rather gently. There are 6-7 tall palm trees within a 50' radius of dining hall/kitchen. Roof vent for kitchen stove approximately 10' from proposed ozone analyzer inlet line.

Located almost directly east of airport.

This is a YMCA camp and will be frequented be campers all summer long, hence this site is not as secure as others.

There are 50+ boat moorings offshore so there will be some local emission sources.

* 1 represents least problems/expense; 10 represents greatest.