4. MEASUREMENT APPROACH

This section specifies study design principles, measurement periods, the study domain, and the locations and purposes of sites for the different networks and study periods. Sections 5, 6, and 7 elaborate on the specific measurements to be taken within these networks during the long-term, winter, and fall experiments.

4.1 Study Design Principles

The selection of measurement locations, observables, averaging times, and frequencies is guided by the following principles:

- PM_{10} is driven by $PM_{2.5}$ during winter. Solving the wintertime $PM_{2.5}$ problem also solves the wintertime PM_{10} problem. The wintertime study therefore focuses on $PM_{2.5}$ measurements.

- PM_{10} is driven by both the $PM_{2.5}$ and coarse fractions during fall in the central to southern San Joaquin Valley. The fall study focuses on the coarse fraction that is predominantly suspended dust.

- Excessive PM_{10} and $PM_{2.5}$ situations due to nearby activities and windblown dust are relatively rare, random occurrences that are often of short duration and cannot be predicted. These situations can only be captured by very frequent sampling throughout the year.

- The statistical nature of the PM_{10} and $PM_{2.5}$ NAAQS minimizes the influence of a few high concentrations and requires three years of data to determine compliance status. Although elevated PM concentrations are sought during winter and fall, these are only of value to the extent that they can be extrapolated to similar occurrences during the three-year period needed to determine $PM_{2.5}$ and PM_{10} standard compliance.

- $PM_{2.5}$ standards are most likely to be exceeded in Fresno and Bakersfield. PM_{10} standards are most likely to be exceeded in the Corcoran/Hanford region. These areas will be more intensively examined than other parts of central California.

- Wintertime secondary ammonium nitrate, ammonium sulfate, and organic aerosol result from regional-scale transport and mixing of emissions from urban and non-urban areas.

- Wintertime transport of secondary $PM_{2.5}$ and its precursors occurs above the surface, often at night or early morning, and reaches the ground-level during afternoon mixing. Measurements to verify this hypothesis and to determine the nature of this transport and mixing are emphasized in the winter study.

- Existing or previously used measurement sites are preferred. When they serve the purpose, measurement sites from compliance networks, IMS95, VAQS, and

SJVAQS/AUSPEX are selected. These have been surveyed and documented before. Several have existing infrastructure and trained technicians available. Previously used or existing sites offer an opportunity to contrast new measurements with those acquired in other studies.

- More detailed and costly measurements at a smaller number of anchor locations are complemented by less detailed and costly measurements at many satellite locations. Satellite measurements are used to understand the zone of representation, and changes that occur, between a few well-instrumented anchor sites with high time resolution for a number of observables.

- More frequent and more complete aerosol chemistry is preferable to a larger number of locations with only mass concentrations. Without the chemical composition, elevated mass concentrations cannot be explained and remain anomalies.

- The Fresno First Street and Bakersfield California sites represent community exposure for those urban areas. Large numbers of micro-scale and middle-scale saturation studies around those sites are not needed.

- Detailed understanding of one or two urban areas can be translated to other urban areas that are not as intensively monitored. The sources are similar, although not identical, in most central California urban areas, and there is evidence of only small transport of primary particles between them. The exceptions are Bakersfield and the eastern Bay area, where several large sulfur dioxide emitters are located.

- Sulfate concentrations are much lower than other $PM_{2.5}$ components; its sources are well identified and probably the most accurate in the emissions inventory. Understanding ammonium nitrate formation and sources or precursors takes precedence over understanding ammonium sulfate formation and sources. The ammonium/nitrate/sulfate chemical system is inter-related, so sulfate is not ignored.

4.2 Study Periods

The long-term average study will take place from 12/1/1999 to 1/31/2001. This period is intended to achieve at least one representative of each conceptual model at one or more of the measurement sites. This requires daily continuous aerosol sampling and meteorological measurements at some of the sites, especially to capture the high wind situation. Annual average measurements continue through the shorter winter and fall studies. The annual study period includes two complete wintertime periods, with the detailed measurements made during the final winter. This schedule allows the ARB backbone network to attain full operational capability and permits further evaluation and testing of new measurement systems that will be deployed.

The winter study takes place over a 60-day period between 11/16/2000 and 1/31/2001. The beginning date between 11/16/2000 and 12/1/2000 will be selected based on long-term weather forecasts. Three to eight day episodes, for a total of 15 episode days, will be selected by forecast within this period for enhanced measurements. Episodes will be forecast by meteorologists based on satellite photos that indicate at least four-days between Pacific storms and on NGM model forecasts of a Great Basin high pressure system that is conducive to PM buildup. A forecast team has been established to create a forecast protocol and practice it during winters of 1998/1999 and 1999/2000.

The fall study will occur on 60 consecutive days between 9/1/2000 and 10/31/2000, corresponding to harvesting and land preparation in the Corcoran area in the central San Joaquin Valley. Special measurements taken during the summer will occur between 7/1/2000 and 8/31/2000.

4.3 Study Domain and Long-Term Measurement Locations

The study domain includes all of central California, as shown Figure 4.3-1. The meteorological and air quality modeling domain is regional (lat/lon coordinates [33.8788,-124.2708] [33,8203,-117.1484] [39.7733,-116.7238] [39.8385, -124.5415]). The northern boundary extends through Chico and provides a sufficient representation of areas upwind of Sacramento. The western boundary extends approximately 200 km west of San Francisco and allows the meteorological model to use mid-oceanic values for boundary conditions. The southern boundary extends below Santa Barbara and into the South Coast Air Basin. The eastern boundary extends past Barstow and includes a large part of the Mojave Desert and all of the southern Sierra Nevada.

This large domain is represented for aerosol measurements by the ARB "backbone" monitoring network also shown by the small dots in Figure 4.3-1. This is a large network that will be operated for years to come and will provide the measurements used to determine compliance with the 24-hour and annual standards. Each of these locations operates a Federal Reference Method (FRM) monitor that acquires $PM_{2.5}$ deposited on a 47 mm Teflon membrane filter that is submitted to gravimetric analysis; with appropriate handling and storage these filters can also be used for elemental and ionic analyses. Several of the backbone compliance sites are also designated in Figure 4.3-1 as chemical speciation sites that will acquire elemental, ionic, and carbon concentrations every sixth day during the annual study period.

Figure 4.3-2 shows the current sampling frequency at each of the backbone network sites, ranging from every day to every sixth day sampling. These frequencies will be enhanced during the 15 episodic days of the winter study to acquire samples everyday within the winter measurement domain.

Figure 4.3-3 shows the ARB backbone PM_{10} network, much of which has been operated since 1987 within central California. This network has provided most of the information concerning suspended particle concentrations and chemical compositions that resulted in the conceptual models presented in Section 3. Many of these are collocated with the $PM_{2.5}$ sites identified in Figure 4.3-3. Existing PM_{10} sites substantially outnumber proposed $PM_{2.5}$ compliance sites. The small domain indicated in Figure 4.3-3 shows where the fall PM_{10} study will be conducted.

4.4 PM_{10} and $PM_{2.5}$ Measurement Network Enhancements

The long-term PM_{10} and $PM_{2.5}$ networks will be enhanced during the CRPAQS field study with respect to variables measured, sampling frequency and averaging time, and spatial distribution. Sampling sites are classified as follows:

- **Community exposure (COmmunity REpresentative, CORE):** CORE sites are intended to represent $PM_{2.5}$ concentrations experienced by large populations that live, work, and play within 5 to 10 km surrounding the site. These sites are most affected by regional and urban scale contributions with relatively small neighborhood scale source contributions to $PM_{2.5}$.

- **Background**: Background sites intend to measure concentrations that are not influenced by central California emissions. There is no location in central California that is completely uninfluenced by manmade emissions in the state. Several sites along the west coast, in the Sierra Nevadas, and in the southeast desert and Owens Valley may best represent atmospheric concentrations and composition much of the time. The concentrations and compositions measured at these sites, coupled with examination of concurrent meteorology, will be examined to determine the extent to which samples at these sites can be used to represent global and continental scale concentrations.

- **Interbasin transport:** These sites are intended to evaluate concentrations along established or potential transport pathways between the Bay Area, the south central coast, the SJV, the South Coast Air Basin, and the Mojave desert. Interbasin transport sites are typically at mountain passes. During winter, these may also double as background sites, as they will sometimes be above and sometimes be below the valleywide mixed layer.

- **Intrabasin gradient:** These sites are located in non-urban areas between backbone network sites. They are intended to evaluate the extent to which one urban area affects PM concentrations in another urban area, as well as the extent to which urban contributions arrive at non-urban locations. These sites are also located in areas that may be affected by nearby dust emissions raised by undocumented activities or wind erosion.

- **Vertical gradient:** These sites are located at higher elevations on tall towers or hillsides to evaluate vertical mixing by comparison with ground-level measurements.

- **Source:** Source sites are located right next to, and downwind of, representative and identifiable emitters. Where practical, these are located within 1 km of gradient or CORE sites to further evaluate the zone of influence of these source emissions on measurements at those sites. Source sites are intended to quantify near-maximum contributions from individual emitters and, when coupled with measurements from nearby sites, estimate the zone of influence of these emitters.

- **Receptor zone of representation:** Receptor sites are intended to examine medium or neighborhood scale spatial variability around CORE sites. Their data are used to determine the extent to which the CORE site represents community exposure at increasing distances from the CORE site.

- **Visibility:** Visibility sites are intended to estimate the amount of light scattering or light extinction, and sometimes the contributions of atmospheric constituents to scattering and extinction. Many of the sites located for other purposes can serve these purposes, but a few sites are located specifically for these purposes, especially during the summer in and near the Mojave desert.

Sites meeting these classifications are distributed among three different networks:

- **ARB backbone network:** ARB, in collaboration with the California air quality management districts, is establishing the $PM_{2.5}$ monitoring sites shown in Figure 4.3-1. The IMPROVE visibility sites in National Parks are also backbone site. This network acquires samples with the frequencies shown in Figure 4.3-2. The PM_{10} network shown in Figure 4.3-3 acquires filter samples every sixth day. Several of the PM_{10} sites have continuous monitors that measure hourly PM_{10} everyday. Most of these $PM_{2.5}$ and PM_{10} sites have been selected to be community representative and will be used for determining compliance with the $PM_{2.5}$ and PM_{10} NAAQS. These monitors will operate for many years, well beyond the duration of the CRPAQS field study. Additional measurements are made at these backbone sites, as well as at other locations that represent the classifications described above.

- **CRPAQS anchor network:** Anchor sites are more highly instrumented than other sites, especially with monitors that acquire mass and chemical measurements continuously at high time resolution. Five sites are collocated with $PM_{2.5}$ backbone network sites for the annual program: Bakersfield-California Street (BAC), Fresno-First Street (FSF), Sacramento Del Paso Street (SDP), and San Jose-Fourth Street (SJ4). An additional non-urban anchor site operates all year at Angiola (ANGI). The Edwards Air Force Base (EDW) is an anchor site during the summer to evaluate the properties of visibility-reducing atmospheric constituents in the Mojave Desert. The anchor network is substantially augmented during the winter with additional measurement locations at Bethel Island (BTI), Dublin (DUB1), Modesto-I Street (MIS), Pt. Arena (PARN), Sierra Nevada Foothills (SNFH), and Walnut Grove Tower (WAG) sites. Both surface and elevated monitors are located on the Angiola (ANGT) and Walnut Grove (WAGT) towers to evaluate vertical gradients.

- **CRPAQS satellite network:** The satellite network consists of portable filter-based and continuous light scattering measurement systems that do not require power or complicated infrastructure. This type of network offers substantial flexibility with respect to site selection and site type. Most of the interbasin transport and intrabasin gradient sites are in this category. Most of the satellite sites use $PM_{2.5}$ inlets on the sampling systems owing to the relatively low number of backbone $PM_{2.5}$ sites compared to PM_{10} sites. Seven satellite sites at which historically high PM_{10} concentrations have been measured are collocated with backbone sites at the Bakersfield-Golden State (BGS), Corcoran-Patterson (COP), Fresno-Drummond (FSD), Hanford-Irwin (HAN), Modesto-24 Street (M14), Oildale-Manor (OLD), and Visalia-Church Street (VCS) sites. These PM_{10} satellite sites will be operated every six days, but three days behind the regular six-day schedule applied to PM_{10} and $PM_{2.5}$ sampling at these sites.

Figure 4.4-1 shows the combined backbone, anchor, and satellite site network for $PM_{2.5}$ by site type, while Figure 4.4-2 shows the types of measurements that are to be acquired at each site, both as part of long-term monitoring and as part of CRPAQS.

Table 4.4-1 describes the proposed $PM_{2.5}$ network that is to be installed during 1998 and 1999. This table summarizes the location, purpose, measurement frequency, and routine chemical characterization that is currently envisioned for these sites. Most of these sites are intended to be CORE sites. Background sites will be operated at Pt. Arena and Pt. Arguello and a transport site will be operated at Altamont Pass. $PM_{2.5\ b}$ackbone network sites are to be equipped with Federal Reference Method (FRM) samplers that acquire $PM_{2.5}$ mass deposits on Teflon membrane filters that can be analyzed for mass and elemental concentrations. Table 4.4-1 and Figure 4.3-1 identify those sites that will be equipped with chemical speciation monitors that obtain samples on Teflon and quartz filters. As part of long-term monitoring, the speciation monitors are intended to operate every twelfth day and will undergo chemical characterization for elements, ions, and carbon. The Ridgecrest (RGI) site is not currently planned for backbone network speciation, but it will be upgraded for this purpose during CRPAQS monitoring to better characterize the chemical characteristics of $PM_{2.5}$ in the Mojave Desert. CRPAQS will also increase the frequency of chemical speciation sampling at analysis at these sites to every six days during the annual measurement program.

Table 4.4-2 identifies and describes the PM_{10} backbone network sites that correspond to those located in Figure 4.3-2. This table also shows which are collocated with $PM_{2.5}$ backbone network sites and those that only have PM_{10} measurements. Other air quality variables measured at each site are identified in this table and are plotted in Figure 4.3-3. Table 4.4-3 presents a similar summary for meteorological monitors that currently operate at the backbone $PM_{2.5}$ and PM_{10} samplings sites. Definitions for column headings in Tables 4.4-1 through 4.4-3 are presented in Table 4.4-4. These existing measurements serve as a starting point for the addition of CRPAQS measurements. Tables 4.4-5 and 4.4-6 describe the aerosol measurements that will be acquired at each site and the methods and averaging time to be applied to those measurements. As noted in Table 4.4-5, some of these measurements will be specific for summer, fall, and winter periods while many of them will operate throughout the 14-month annual monitoring period.

For the most part, the backbone network sites follow the summertime transport pathway from the Bay Area, through the SJV, and out into the Mojave Desert. The SJV backbone sites are primarily located on the eastern side of the valley, along SR 99, within population centers. The exception is the Corcoran site, which is in a rural area that has registered elevated PM_{10} in the past and has served as a design location for the PM_{10} State Implementation Plan. The larger urban areas have more than one $PM_{2.5}$ monitor, as indicated in Table 4.4-1, so that $PM_{2.5}$ spatial homogeneity can be determined and spatial averages can be calculated. These sites have undergone substantial scrutiny and they pass the tests for urban-scale, community exposure site described by Watson et al., (1997) and summarized in Section 8.

Most of the anchor sites are a subset of the backbone network. For annual monitoring, these sites have been carefully considered to represent the following characteristics:

- **Fresno First Street CORE site (FSF):** This long-term site in a residential/commercial area receives a broad mixture of neighborhood, urban, and regional scale $PM_{2.5}$ contributions. Although it is near neighborhoods where wood is burned during winter, it is not overly influenced by this local source.

- **Bakersfield California Street CORE site (BAC):** This site is also in a residential/commercial area with a broad mixture of sources from various scales that is not overly influenced by microscale sources. Refineries and oilfield operations provide an increment of sulfur emissions from well-defined directions that are above those found at other CORE sites in the SJV.

- **Sacramento Del Paso Street CORE site (SDP):** This site is in a residential/commercial area with mostly traffic-dominated emissions nearby. This site provides a contrast with the other two sites in the central and lower San Joaquin Valley.

- **San Jose-Fourth Street CORE site (SJ4):** This site is in a residential/commercial area with mostly traffic-dominated emissions nearby. Wood smoke has been found as a significant contributor during winter. This site represents the climate and source mix in the Bay Area Air Quality Management District.

- **Angiola intrabasin gradient site (ANGI):** This new site is located in a non-urban setting to the SE of Corcoran but outside the influence of SR 99 and its population centers. This site needs to be located in a large field with at least a 1 km fetch in all directions and with low vegetation. It should have a high occurrence of fogs during winter. According to landuse maps, a variety of agricultural activities surround this area with cotton and alfalfa being the dominant crops, interspersed with dairies, feedlots, chicken coops, and orchards. Agricultural activity may occur in nearby fields during the fall. This site needs to be well outside of airplane flight paths as it will host a 100 m scaffold tower. This tower will acquire micrometeorological measurements all year and will permit elevated measurements during winter to determine vertical fluxes between the surface and valleywide layer during winter.

During summer an anchor site will be operated at:

- **Edwards Air Force Base (EDW):** This site on the base has long been used to evaluate light extinction and its chemical constituents. The only nearby sources are suspended desert dust and roadway emissions from lightly traveled paved roads within the base.

During winter, the annual anchor sites will be enhanced by measurements at:

- **Bethel Island interbasin transport site (BTI):** This established air quality site in the Sacramento Delta is in a transition zone between the Bay Area and SJV. It is along the summertime transport pathway between the two basins, but during winter it experiences secondary nitrate concentrations that are more typical of the SJV than of other Bay Area PM monitoring sites. It is isolated from local sources, but is directly east of the Benicia/Martinez, Pittsburg, Antioch industrial corridor where much of central California's point source emissions are located.

- **Sierra Foothills background site (SNFH):** This site needs to be located east of Fresno at ~500 m above mean sea level. Candidate locations are the U.S. Forest Service Station at Prather (~500 m MSL, N 37° 02' 09", W 119° 30' 42") and the U.S. Forest Service heliport at Trimmer (~500 MSL, N 36° 55' 14", W 119° 18' 18"). These candidates are being tested during the winter of 1998-99 using portable nephelometers at these elevations as well as sites with lower and higher elevation. These sites are along the potential transport pathways to the Lower Kaweah site in Sequoia National Park that is known to receive substantial transport from the SJV during non-winter months, but is unpolluted during winter. The site finally selected should have minimal terrain obstructions between the selected site and the valley.

- **Pt. Arena background site (PARN):** This site is intended to evaluate the time resolution of materials transported into the study area. Pt. Arena is far enough north of the Bay Area that large amount of urban emissions are not anticipated. Early measurements at Pt. Reyes, further to the south, showed evidence of contamination by urban emissions.

- **Dublin interbasin transport site (DUB1):** This site needs to be established during the winter to evaluate the timing and magnitude of materials leaving the Bay Area through the Livermore Valley en route to Altamont Pass.

- **Walnut Grove interbasin transport and vertical gradient site (WAG and WAGT):** This site will be established during winter to take advantage of the ability to locate instruments at the base of and at an elevated point (200 to 300 m agl) of the Walnut Grove tower. This site is located near the transition point between the Sacramento and San Joaquin Valleys and will evaluate transport between these valleys as well as the vertical evolution of pollutant concentrations.

- **Angiola vertical gradient site (ANGT):** In addition to the ground-based measurements acquired throughout the year, continuous measurements of secondary particles and their precursors will be made at the top (~100 m agl) of the Angiola tower during winter.

- **Modesto-I Street CORE site (MIS):** This is an additional commercial/residential site that will better characterize wintertime exposures in one of the larger metropolitan areas of the study region.

Anchor sites require substantial infrastructure to support the detailed, high time resolution measurements to be acquired both throughout the year and during the intensive monitoring campaigns.

Many of the satellite sites specified in Table 4.4-5 are intrabasin gradient monitors to determine what happens between the backbone sites, especially between the major cities. The Bethel Island and Altamont Pass sites are intended to monitors transport between the Bay area and the San Joaquin Valley. The Pacheco Pass site monitors transport between the north central coast and the SJV. The Tehachapi site monitors transport between the SJV and the Mohave Desert. Transport can go in both directions, and these interbasin transport sites are collocated with meteorological monitors. The source-oriented sites are intended to be near and downwind of source types identified in Section 2. Two urban source monitors are targeted for residential areas near the anchor sites in Fresno and Bakersfield to determine incremental amounts of exposure that might be contributed by neighborhood-scale contributions such as woodburning. The fall campaign will operate additional satellite sites for PM_{10} that are described in greater detail in Section 7.

4.5 Surface Meteorological Network

The existing meteorological network in central California is extensive, but uncoordinated among the different agencies. Figure 4.5-1 shows the locations of surface meteorological monitoring sites from the Air Resources Board (ARB), the Bay Area Air Quality Management District (BAAQMD), the National Oceanic and Atmospheric Administration (NOAA), the California Irrigation Management Information Service (CIMIS), Interagency Monitoring of PROtected Visual Environments (IMPROVE), the National Weather Service (NWS), Pacific Gas and Electric Company (PG&E), the U.S. Coast Guard, Remote Automated Weather Stations (RAWS) for firefighting, and a few miscellaneous monitors. CRPAQS surface stations are located on this map along transport pathways, at anchor sites, and at upper air measurement sites to supplement this network.

Figure 4.5-2 shows the surface meteorological observables measured at each monitoring location, regardless of the network from which they are derived. Wind speed and direction, temperature, and relative humidity are the most common measurements. The network or surface pressure and solar radiation measurements is also extensive. Three sites measure ultraviolet radiation in the Sacramento Valley, in the San Joaquin Valley, and along the south coast in Santa Barbara county.

The existing networks report hourly average wind speed and direction, temperature, relative humidity, solar radiation, and pressure measurements. The specific measurements at each site and the networks they belong to are documented in Appendix C. Sites that reported measurements on 12/31/96 are plotted in Figure 4.5-1, and the integrated network needs to be re-evaluated for data reported on 12/31/98, and again by 8/31/99 to determine that these networks will be in operation over the 1999-2001 CRPAQS monitoring period.

Thuillier et al. (1994) document the methods used to acquire and report data in most of these networks with their similarities and differences. Wind speed measurements are taken at heights ranging from 2 m to 10 m agl at most sites and temperatures are measured by aspirated and unaspirated thermometers. The major limitations of existing network instrumentation are: 1) wind thresholds of ~1 m/s for most instruments, which is adequate for non-winter periods, but not for low winds in the surface layer during winter; 2) relative humidity sensors that are inaccurate at high (<90%) humidities; and 3) insufficient temporal resolution (i.e. on the order of minutes) to detect wind gusts that might suspend dust.

The existing meteorological network will be supplemented with the CRPAQS sites shown in Figure 4.5-1 and described in Table 4.5-1. Ten meter meteorological towers at each of these sites will be equipped with low threshold (~0.3 m/s) wind sensors and high sensitivity relative humidity sensors. Section 10 describes the monitors available for these measurements. Five-minute average measurements will be acquired so that the data can be interpreted with respect to wind gusts that might raise dust, short-term shifts and wind direction that might correspond to pulses measured by continuous particle monitors, and short duration clouds and fogs that cause rapid changes in the 90% to 100% RH interval. With these supplemental measurements and surface measurements at the upper air sites, the existing surface monitoring network provides adequate coverage for the central California study domain.

4.6 Upper Air Meteorological Network

Section 2 showed substantial decoupling between surface meteorological conditions and those aloft for all but the afternoon periods. This situation occurs during both winter and non-winter months. The decoupling endures for a larger number of hours per day during winter when days are shorter. Non-winter meteorology has been documented in several prior studies, but little is known about conditions aloft during winter. As a result, the long-term upper air network will be supplemented with additional sites and special studies during winter.

Figure 4.6-1 shows the locations of types of upper air meteorological monitors to be deployed for the long-term campaign and Figure 4.6-2 shows how this network will be augmented for the winter campaign. Table 4.6-1 describes the upper air sites, their measurements and operators. Radar profilers, doppler sodars, and RASS are used at most sites because they acquire hourly average wind speed, wind direction, and temperature by remote sensing without constant operator intervention. Sodars are collocated with profilers at several locations because they provide greater vertical resolution in the first 100 m agl. This is especially important near terrain features and during winter. Radiosondes are needed to determine changes in relative humidity and to quantify conditions at elevations above ~2000 m agl. They are also the only practical means of acquiring upper air measurements in cities where the noise and siting requirements of remote sensing devices make them difficult to operate. NEXRAD radar sites are also located in Figures 6.5-1 and 6.5-2. While these are primarily used to identify precipitating clouds, algorithms are being constructed to deduce upper air wind speeds and directions from their output. Relevant output from these established sites will become part of the CRPAQS data base.

Several radar profilers are being installed to acquire a multi-year data base, and one of the important functions of the CRPAQS supplements to this network is to relate these relatively sparse measurements to the detailed meteorological patterns determined during CRPAQS. The backbone profiler network includes Travis AFB, Visalia, Sacramento, and Monterrey. Profilers may become operational at Vandenberg and Edwards Air Force bases before the end of 1999. These profilers are operated by different entities, and equivalent methods of data evaluation and reporting needs to be established among these entities prior to CRPAQS field campaigns.

Radiosondes are routinely launched through the year at 0400 and 1600 PST from the Oakland, Vandenberg, Edwards, and Pt. Mugu. None of these locations are within the central valley, so these will be supplemented by lunches at Fresno and Bakersfield during the 15 episodic days during winter. Figure 2.4-1 showed an information deficiency between 1000 and 1600 PST when substantial vertical mixing is believed to occur. For the 15 episodic days during winter, six radiosondes per day will be launched at 0400, 1000, 1200, 1400, 1600, and 2200 PST at the Oakland and Edwards sites (supplementing the twice per day launches), and at the Fresno and Bakersfield sites.

4.7 Micrometeorological Towers

It is feasible and cost effective to construct and maintain a 100 m, walk-up, scaffold tower at the Angiola site to support year-long micrometeorological measurements as well as other vertical experiments. For the long-term measurements, the tower will be instrumented at five elevations with high precision anemometers, relative humidity, and temperature measurements and will record five minute averages of wind speed, wind direction, temperature, and relative humidity as well as average cross-products in the vertical and horizontal directions. These micrometeorological measurements will be used to create a diurnal and seasonal climatology for surface layer evolution, describe turbulent mixing and dispersion at the sub-grid scale level, and to determine micrometeorological conditions near the surface that affect suspension and deposition of dust, gases, and fine particles.

In addition to supporting continuous micrometeorological measurements, the tall tower will provide a platform for measurements above the surface layer during nighttime and morning periods during winter and to evaluate the injection heights and deposition characteristics of fugitive dust during fall. These uses include:

- Continuous measurements of black carbon, nitrate, nitric acid, ammonia and sulfate at the top level and surface to determine mixing and transport concentrations above the surface layer only during the fall study and 20 wintertime episode days.

- Fog water size and chemistry measurements at the top level to determine differences with elevation above ground level.

The Walnut Grove tower between Stockton and Sacramento will be instrumented in a similar manner during the winter campaign to evaluate difference between the Sacramento and San Joaquin Valleys.

Table 4.4-1.
Air Resources Board $PM_{2.5}$ Backbone Network (see Table 4.4-4 for codes).

SITE[a]	NAME	AIR BASIN	PAMS	NAMS	SPM	OBJ	TYPE	FREQ	PM2.5	CPM2.5
ALT	Altamont Pass-Tracy	SJV				T	S	1 in 3	X	TBD
ATL	Atascadero-Lewis Ave	SCC				M,HS	C	1 in 6	XX	
BGS	Bakersfield-1120 Golden State	SJV	NO_2-O_3-HCS-CAR-MET			R,P	C	1 in 3	XXS	
BAC	Bakersfield-5558 California Ave	SJV				M,HS	C	everyday	XS	
BLIS1	D.L. Bliss State Park-TRPA	LT				B	I	1 in 3	Y	
BRV	Elk Grove-Bruceville Rd	SV				T	C	1 in 3	X	
BSE	Bakersfield-Southeast	SJV				R	C	1 in 3	X	
CCD	Concord-2975 Treat Blvd	SFB		CO-NO_2-O_3-PM_{10}		R	C	everyday	XS	
CHM	Chico-Manzanita Ave	SV				M	C	1 in 6	XS	
CLO	Clovis-908 N Villa Ave	SJV	NO_2-O_3-HCS-CAR-MET	O_3-PM_{10}		R,P	C	1 in 3	XS	
COP	Corcoran-Patterson Ave	SJV				M	C	1 in 3	XS	
CSS	Colusa-100 Sunrise Blvd	SV				R,T	C	1 in 3	X	
DOLA1[b]	Dome Land Wilderness-USFS	MC				B	I	1 in 3	Y	
ELM	El Rio-Mesa School #2	SCC				R,P	C	1 in 3	XS	
EU6	Eureka-Health Dept	NC				R	C	1 in 6	X	
FCW	Fremont-Chapel Way	SFB		CO-NO_2-O_3-PM_{10}		R	C	1 in 3	X	
FSE	Fresno-Southeast	SJV				R	C	1 in 3	X	
FSF	Fresno-3425 First Street	SJV		PM_{10}		M	C	everyday	XXS	
GVL	Grass Valley-Litton Building Site	MC				R,T	C	1 in 6	X	BAM or TEOM
HDB	Healdsburg-Limeric Lane	NC				R	C	1 in 6	X	
JAC	Jackson-201 Clinton Road	MC				R	C	1 in 3	X	
KCG	Keeler-Cerro Gordo Road	GBV				R	C	1 in 3	XX	
LCR	Lancaster-W Pondera Street	SED				R,T,HS	C	1 in 3	XS	
LKL	Lakeport-Lakeport Blvd	LC				M	C	1 in 6	X	

Table 4.4-1.
Air Resources Board $PM_{2.5}$ Backbone Network (continued)

SITE[a]	NAME	AIR BASIN	PAMS	NAMS	SPM	OBJ	TYPE	FREQ	PM2.5	CPM2.5
LTY	South Lake Tahoe-Sandy Way	LT				M	C	1 in 6	XXS	
LVF	Livermore Old First St	SFB		O_3		M,T	C	everyday	XS	TEOM requested
MAG	Mammoth Lakes-Gateway HC	GBV				R	C	1 in 3	XS	
MIS	Modesto-1100 I Street	SJV				M,HS	C	1 in 3	XS	
MOJ	Mojave-923 Poole Street	SED				R,T	C	1 in 3	XS	BAM or TEOM
MRM	Merced-Midtown	SJV				M	C	1 in 3	XS	
NLT	North Lake Tahoe-Near Tahoe City	LT				R	C	1 in 6	X	
PAG	Point Arguello	SCC				B	S	1 in 3	X	
PARN	Point Arena	NC				B	S	1 in 3	X	
PINN1	Pinnacles National Monument-NPS	NCC				B	I	1 in 3	Y	
PIR	Piru-2 mi SW	SCC				R,T	S	1 in 6	X	
POL	Portola	MC				M	C	1 in 3	XS	
PORE1	Point Reyes National Seashore-NPS	SFB				B	I	1 in 3	Y	
QUC	Quincy-267 North Church Street	MC				R	C	1 in 3	X	
RDH	Redding-Health Dept Roof	SV				R,T	C	1 in 6	X	
RED	Redwood City	SFB		PM_{10}		R	C	1 in 3	X	
RGI	Ridgecrest-Las Flores Ave	SED			PM_{10}	R,T	C	1 in 3	X	
ROS	Roseville-151 N Sunrise Blvd	SV				R,T	C	1 in 6	XS	
S13	Sacramento-1309 T Street	SV				M	C	everyday	XS	
SAL	Salinas	NCC				M	C	1 in 3	XXS	
SBC	Santa Barbara-3 W Carillo St	SCC				M,P	C	1 in 6	XS	
SCQ	Santa Cruz-2544 Soquel Dr	NCC				R	C	1 in 3	X	
SDP	Sacramento-Del Paso Manor	SV	NO_2-O_3-HCS-CAR-MET	SO_2-PM_{10}		M,P	C	1 in 3	XXS	
SEQU1	Sequoia National Park-NPS	MC				B	I	1 in 3	Y	

Table 4.4-1.
Air Resources Board $PM_{2.5}$ Backbone Network (continued)

SITE[a]	NAME	AIR BASIN	PAMS	NAMS	SPM	OBJ	TYPE	FREQ	PM2.5	CPM2.5
SFA	San Francisco-10 Arkansas St	SFB		NO_2-PM_{10}-Pb		M	C	1 in 3	XXS	
SGS	San Andreas-Gold Strike Road	MC				M,T	C	1 in 6	X	
SJ4	San Jose-4th St	SFB		CO-NO_2-PM_{10}-Pb		M	C	everyday	XXS	
SJT	San Jose-528 Tully Road	SFB		PM_{10}		M	C	everyday	X	
SLM	San Luis Obispo-Marsh St	SCC				M	C	1 in 6	X	
SOH	Stockton-Hazelton St	SJV		PM_{10}		M,HS	C	1 in 3	XS	
SOLA1	South Lake Tahoe-TRPA	LT				B	I	1 in 3	Y	
SQV	Squaw Valley-New site	LT				R	C	1 in 3	X	
SRF	Santa Rosa-837 Fifth St	SFB				M	C	1 in 3	X	
SST	Sacramento-Health Dept Stockton Blvd	SV		PM_{10}-Pb		R	C	everyday	X	
STL	Santa Maria-Library	SCC				R	C	1 in 6	X	
TRU	Truckee-Fire Station	MC				R	C	1 in 3	XXS	
UKC	Ukiah-County Library	NC				M	C	1 in 6	XXS	
VCS	Visalia-N Church Street	SJV				M,HS	C	1 in 3	XS	
VIA	Victorville-Armargosa Road	SED				M,T	C	1 in 3	XXS	
VJO	Vallejo-304 Tuolumne St	SFB				M,T	C	1 in 3	X	
WLN	Woodland	SV				R	C	1 in 3	X	
YAS	Yuba City-Almond Street	SV				R,T	C	1 in 6	XXS	
YOSE1	Yosemite National Park-Turtleback Dome	MC				B	I	1 in 3	Y	
YOY	Yosemite National Park-Yosemite Village	MC				M	C	1 in 3	X	

[a]Column Headers are defined in Table 4.4-4

[b]Seasonal operating period

Table 4.4-2.
Surface Meteorological Measurements at Backbone Sites.

SITE	NAME	$PM_{2.5}$	PM_{10} SSI	Dichot	PM_{10} TEOM/BAM	PM_{10} Ion Analysis	PM_{10} Carbon	TSP	SO4	NO3	COH	Neph	CO	NO2	O3	PB	SO2
ADN	Anderson-North Street		X		X	X											
ALT	Altamont Pass-Tracy	X															
AND	Anderson Springs			Mono-chot analysis only		K+ only											
ARB	Arbuckle-Hillsgate Road										X	X					
ARR	Arroyo Grande-Ralcoa Way		X	X		X K+ only											X
ATL	Atascadero-Lewis Avenue	XX	X		X									X	X		
BGS	Bakersfield-1120 Golden State	XXS	X										X	X	X		
BIM	Bishop-North Main Street		X														
BAC	Bakersfield-5558 California Ave	XS	X (a)	X (a)	X	X	X		X (a)		X	X (special prj only)	X	X	X	XX	X
BLIS1	D.L. Bliss State Park-TRPA	Y	Y														
BRV	Elk Grove-Bruceville Rd	X															
BSE	Bakersfield-Southeast	X															
BSW	Barstow		X			X no K+, NH4							X	X	X		
BTI	Bethel Island Road		X			X							X	X	X		X
CCD	Concord-2975 Treat Blvd	XS	X			X			X	X	X		X	X	X	X	X
CCY	Crescent City-9th and H Streets		X														
CHE	Chester-1st Street		X														
CHM	Chico-Manzanita Ave	XS	X			X	X				X	X	X	X	X	X	
CJN	Coso Junciton-10 miles E (facility site)		X														
CLK	China Lake-Powerline Road		X			X											
CLO	Clovis-908 N Villa Ave	XS	X		X	X							X	X	X		
CLV	Cloverdale		X														
CMV	Carmel Valley-Ford Road		X												X		
COP	Corcoran-Patterson Ave (opened 10/96)	XS	X opened 10/96	X opened 1/97	X opened 10/96												

Table 4.4-2.
Surface Meteorological Measurements at Backbone Sites (cont'd).

SITE	NAME	$PM_{2.5}$	PM_{10} SSI	Dichot	PM_{10} TEOM/BAM	PM_{10} Ion Analysis	PM_{10} Carbon	TSP	SO4	NO3	COH	Neph	CO	NO2	O3	PB	SO2
COS	Coso Junction-HWY 396 rest area		X	X		K+ only											
COV	Corcoran Van Dorsten Ave		X (a)	X		X											
CSA	Colusa-Fairgrounds (closed 10/96)				X closed 10/96						X closed 10/96	X closed 10/96					
CSS	Colusa-100 Sunrise Blvd	X	X		X opened 6/96	X	X				X opened 6/96	X opened 6/96			X		
DOLA1	Dome Land Wilderness-USFS	Y															
DVP	Davenport		X								X		X	X	X		X
DVS	Davis-UCD Campus										X	X	X	X	X		
ECP	El Capitan Beach		X (a)											X	X		X
ELM	El Rio-Mesa School #2	XS	X			X							X	X	X		X
EU6	Eureka-Health Department 6th and I Street	X	X														
FCW	Fremont-Chapel Way	X	X			X			X	X	X		X	X	X	X	
FSD	Fresno-Drummond		X										X	X	X		
FSE	Fresno-Southeast	X															
FSF	Fresno-3425 First Street	XXS	X	X (a)		X	X				X		X	X	X	X	X
FTB	Fort Bragg-North Franklin Street		X														
GFS	Truckee-Glenshire Fire Station		X														
GLH	Glenbrook-High Valley Road			Mono-chot analysis only		K+ only											
GRI	Gridley-Cowee Road										X	X					
GUE	Guerneville-Church & 1st		X														
GVC	Gaviota-GTC Site C		X (a)											X	X		X
GVE	Gaviota-East		X											X	X		X
GVH	Grass Valley-Henderson Street		X														
GVL	Grass Valley-Litton Building Site	X			X										X		
GVW	Gaviota-West		X											X	X		X

Table 4.4-2.
Surface Meteorological Measurements at Backbone Sites (cont'd).

SITE	NAME	$PM_{2.5}$	PM_{10} SSI	Dichot	PM_{10} TEOM/BAM	PM_{10} Ion Analysis	PM_{10} Carbon	TSP	SO4	NO3	COH	Neph	CO	NO2	O3	PB	SO2
HDB	Healdsburg-Limeric Lane	X	X		TEOM												
HES	Hesperia-Olive Street		X			X no K+, NH4							X	X	X		X
HIR	Hanford-South Irwin Street		X			X								X	X		
HST	Hollister-Fairview Road		X												X		
IYA	Inyokern-Airport (close 6/96)		X closed 6/96														
JAC	Jackson-201 Clinton Road	X											X		X		
KCC	Kettkeman City-CalTrans (closed 9/96)		X closed 9/96			X closed 9/96											
KCG	Keeler-Cerro Gordo Road	XX	X	X	TEOM	K+ only											
KCM	King City-Metz Road		X												X		
LCR	Lancaster-W Pondera Street	XS															
LEE	Lee Vining-SMS		X														
LF1	Las Flores Canyon #1		X														
LF2	Las Flores Canyon #2		X														
LKL	Lakeport-Lakeport Blvd	X	X								X	X			X		
LOM	Lompoc-South H Street		X										X	X	X		X
LOY	Loyalton-West 3rd Street		X														
LPE	Lone Pine-East Locust Street		X		X												
LTS	South Lake Tahoe-Stateline										X	X	X				
LTY	South Lake Tahoe-Sandy Way	XXS	X										X	X	X		
LUC	Lucerne Valley-Middle School		X			X no K+, NH4											
LVF	Livermore Old First St	XS	X		X	X							X	X	X		
LWP	Lancaster-West Pondera Street		X		X	X no K+, NH4							X	X	X		
M14	Modesto-814 14th Street				X						X	X	X	X	X		
MAG	Mammoth Lakes-Gateway HC	XS	X		TEOM		X						X		X		

Table 4.4-2.
Surface Meteorological Measurements at Backbone Sites (cont'd).

SITE	NAME	$PM_{2.5}$	PM_{10} SSI	Dichot	PM_{10} TEOM/BAM	PM_{10} Ion Analysis	PM_{10} Carbon	TSP	SO4	NO3	COH	Neph	CO	NO2	O3	PB	SO2
MBY	Morro Bay		X														
MER	Merced-Health Dept (closed 9/96)		X closed 9/96			X closed 9/96											
MIS	Modesto-1100 I Street	XS	X	X		X	X									X	
MLB	Madera-Library (closed 9/96)		X closed 9/96	X closed 9/96		X closed 9/96											
MLK	Mono Lake-Simis Residence		X														
MOJ	Mojave-923 Poole Street	XS															
MON	Monterey-Silver Cloud Court		X												X		
MOP	Mojave-Poole Street		X			X								X	X		
MRM	Merced-Midtown	XS															
NGR	Nipomo-Guadalupe Road		X (a)												X		X
NIP	Nipomo-South Wilson Street (closed 9/96)		X closed 9/96														
NJS	Napa-Jefferson Ave		X			X					X		X	X	X		
NLT	North Lake Tahoe (Near Tahoe City)	X															
NWH	Santa Clarita-County Fire Station		X			X no K+, NH4							X		X		
OLD	Oildale-Manor Street		X			X			X		X	X		X	X		X
OLW	Olancha-Walker Creek		X		X												
PAG	Point Arguello	X															
PARN	Point Arena	X															
PBG	Pittsburg-10th Street							X (a)	X (a)	X (a)			X	X	X	XX	X
PCN	Point Conception-Lighthouse		X (a)											X	X		X
PGN	Placerville-Gold Nugget Way		X										X		X		
PGV	Pleasant Grove-4 miles SW										X	X			X		
PINN1	Pinnacles National Monument-NPS	Y	Y														
PIR	Piru-2 mi SW	X	X												X		

Table 4.4-2.
Surface Meteorological Measurements at Backbone Sites (cont'd).

SITE	NAME	$PM_{2.5}$	PM_{10} SSI	Dichot	PM_{10} TEOM/BAM	PM_{10} Ion Analysis	PM_{10} Carbon	TSP	SO4	NO3	COH	Neph	CO	NO2	O3	PB	SO2
POL	Portola	XS	X	X													
PORE1	Point Reyes National Seashore-NPS	Y	Y														
PRF	Paso Robles-Santa Fe Avenue		X								X				X		
QUC	Quincy-267 North Church Street	X	X		X*		X								X		
RBL	Red Bluff-Messer Drive		X			X	X										
RDH	Redding-Health Dept Roof	X	X			X	X								X		
RED	Redwood City	X	X			X					X		X	X	X		
RGI	Ridgecrest-Las Flores Ave	X	X closed 6/96														
RIC	Richmond-13th Street		X			X			X	X			X	X	X	XX	X
ROC	Rocklin-Rocklin Road		X				X				X				X		
ROS	Roseville-151 N Sunrise Blvd	XS	X			X	X				X	X	X	X	X	X	
S13	Sacramento-1309 T Street	XS	X	X	X	X	X				X	X	X	X	X		
SAL	Salinas	XXS															
SAR	Sacramento-Airport Road (opened 8/97)		X opened 8/97		X opened 8/97												
SBC	Santa Barbara-3 W Carillo St	XS	X				X				X		X	X	X	X	
SBR	Sacramento-Branch Center		X														
SBU	Exxon Site 10-UCSB West Campus		X (a)											X	X		X
SCB	Santa Cruz-Bostwick Lane		X														
SCQ	Santa Cruz-2544 Soquel Dr	X													X		
SDP	Sacramento-Del Paso Manor	XXS	X		X								X	X	X		X
SED	Sacramento-Earhart Drive (closed 8/97)		X closed 8/97		X closed 8/97								X	X	X		
SEH	San Leandro-County Hospital		X			X									X		
SEQU1	Sequoia National Park-NPS	Y	Y														X
SFA	San Francisco-10 Arkansas St	XXS	X			X			X	X	X		X	X	X	XX	X
SGS	San Andreas-Gold Strike Road	X	X										X		X		
SIM	Simi Valley-Cochran Street		X			X		X					X	X	X	X	

Table 4.4-2.
Surface Meteorological Measurements at Backbone Sites (cont'd).

SITE	NAME	$PM_{2.5}$	PM_{10} SSI	Dichot	PM_{10} TEOM/BAM	PM_{10} Ion Analysis	PM_{10} Carbon	TSP	SO4	NO3	COH	Neph	CO	NO2	O3	PB	SO2
SJ4	San Jose-4th St	XXS	X	X	X	X			X	X	X		XX	X	X	XX	
SJD	San Jose-Piedmont Road		X			X											
SJK	San Jose-Moorpark Avenue		X			X		X	X	X						X	
SJT	San Jose-528 Tully Road	X	X			X											
SL2	Salinas No. 2-Natividad Road		X										X	X	X		
SLM	San Luis Obispo-Marsh St	X	X			X					X		X	X	X		
SML	Stockton-March Lane (open by 6/98)		X open by 6/98			X open by 6/98											
SMY	Santa Maria-Broadway				X						X			X	X		X
SNH	North Highlands-Blackfoot Way		X										X	X	X		X
SOH	Stockton-Hazelton St	XS	X	X	X	X	X				X	X	X	X	X	XX	
SOLA1	South Lake Tahoe-TRPA	Y	Y														
SQV	Squaw Valley-New site	X															
SRF	Santa Rosa-837 Fifth St	X	X			X					X		X	X	X		
SRL	San Rafael		X			X							X	X	X		
SST	Sacramento-Health Dept Stockton Blvd	X	X		X				X							X	
STL	Santa Maria-Library	X	X			X											
SWH	Stockton-Wagner/Holt School		X			X											
TAC	Taft College		X (a)	X		X			X								
THM	Thousand Oaks-Moorpark Road		X											X	X		
TNP	Twentynine Palms-6136 Adobe Rd		X			X no K+, NH4							X	X	X		X
TRL	Trona-Athol		X			X no K+, NH4		X	X	X				X	X		X
TRU	Truckee-Fire Station	XXS	X		TEOM										X		
TSM	Turlock-900 South Minaret Street		X										X	X	X		
UKC	Ukiah-County Library	XXS	X														
VAC	Vacaville-Marchant		X														
VAF	Vandenberg AFB-Watt Rd (closed 2/97)		X closed 2/97										X	X	X		X

Table 4.4-2.
Surface Meteorological Measurements at Backbone Sites (cont'd).

SITE	NAME	$PM_{2.5}$	PM_{10} SSI	Dichot	PM_{10} TEOM/BAM	PM_{10} Ion Analysis	PM_{10} Carbon	TSP	SO4	NO3	COH	Neph	CO	NO2	O3	PB	SO2
VBS	Vandenberg AFB-STS Power Plant		X (a)										X	X	X		X
VCS	Visalia-N Church Street	XS	X (a)	X		X					X		X	X	X		
VEN	Ventura County-East Main Street (closed 12/96)		X closed 12/96														
VIA	Victorville-Armargosa Road	XXS	X	X		X no K+, NH4							X	X	X		X
VJO	Vallejo-304 Tuolumne St	X	X			X							X	X	X		X
VTA	Ventura County-West Casitas Pass										X			X	X		
WAA	Watsonville-Airport Blvd		X												X		
WEV	Weaverville-Courthouse		X														
WLA	Woodland-unknown location (opened 7/97)										X opened 7/97						
WLF	Willits-Firehouse		X														
WLN	Woodland	X									X opened						
WLW	Willows-East Laurel Ave		X		X	X	X				X	X			X		
WSA	West Sacramento-15th Street		X														
WSS	Woodland-40 Sutter Street		X								X closed 7/97				X		
YAS	Yuba City-Almond Street	XXS	X		X		X				X	X	X	X	X		
YOSE1	Yosemite National Park-Turtleback Dome	Y	Y														
YOY	Yosemite National Park-Yosemite Village	X	X				X	X									

Table 4.4-3.
Collocated Air Quality Measurements at Backbone Sites.

SITE	NAME	NEW MET	WS	WD	VWS	AT	TD	RH	SOL	UV	PR
ADN	Anderson-North Street										
ALT	Altamont Pass-Tracy	X	A	A		X		X			
AND	Anderson Springs		A	A		X		X			
ARB	Arbuckle-Hillsgate Road		R	R		X					
ARR	Arroyo Grande-Ralcoa Way		R	R							
ATL	Atascadero-Lewis Avenue		R	R		X			X closed 3/97		
BGS	Bakersfield-1120 Golden State		A	A		X		X	X		X
BIN	Bishop-North Main Street		A,R	A		X		X			
BAC	Bakersfield-5558 California Ave										
BLIS1	D.L. Bliss State Park-TRPA										
BRV	Elk Grove-Bruceville Rd									X	
BSE	Bakersfield-Southeast										
BSW	Barstow		A	A		X					
BTI	Bethel Island Road										
CCD	Concord-2975 Treat Blvd										
CCY	Crescent City-9th and H Streets										
CHE	Chester-1st Street										
CHM	Chico-Manzanita Ave		R	R		X		X			
CJN	Coso Junciton-10 miles E (facility site)										
CLK	China Lake-Powerline Road										
CLO	Clovis-908 N Villa Ave		A	A		X		X	X		X
CLV	Cloverdale										
CMV	Carmel Valley-Ford Road										
COP	Corcoran-Patterson Ave		R opened 10/96	R opened 10/96		X opened 10/96					

Table 4.4-3.
Collocated Air Quality Measurements at Backbone Sites (cont'd).

SITE	NAME	NEW MET	WS	WD	VWS	AT	TD	RH	SOL	UV	PR
COS	Coso Junction-HWY 396 rest area										
COV	Corcoran Van Dorsten Ave										
CSA	Colusa-Fairgrounds (closed 10/96)		R closed 10/96	R closed 10/96		X closed 10/96					
CSS	Colusa-100 Sunrise Blvd		R opened 6/96	R opened 6/96		X opened 6/96					
DOLA1	Dome Land Wilderness-USFS										
DVP	Davenport										
DVS	Davis-UCD Campus		R	R		X					
ECP	El Capitan Beach		A,R	A,R	X	X					
ELM	El Rio-Mesa School #2		A,R	A,R		X		X	X		
EU6	Eureka-Health Department 6th and I Street										
FCW	Fremont-Chapel Way										
FSD	Fresno-Drummond										
FSE	Fresno-Southeast										
FSF	Fresno-3425 First Street		R	R		X					
FTB	Fort Bragg-North Franklin Street										
GFS	Truckee-Glenshire Fire Station										
GLH	Glenbrook-High Valley Road		A	A		X	X				
GRI	Gridley-Cowee Road		R	R		X		X			
GUE	Guerneville-Church & 1st										
GVC	Gaviota-GTC Site C		A,R	A,R	X	X					
GVE	Gaviota-East		A,R	A,R	X	X					
GVH	Grass Valley-Henderson Street										
GVL	Grass Valley-Litton Building Site										
GVW	Gaviota-West		A,R	A,R	X	X					
HDB	Healdsburg-Limeric Lane										
HES	Hesperia-Olive Street		A	A		X					

Table 4.4-3.
Collocated Air Quality Measurements at Backbone Sites (cont'd).

SITE	NAME	NEW MET	WS	WD	VWS	AT	TD	RH	SOL	UV	PR
HIR	Hanford-South Irwin Street		A opened 6/98	A opened 6/98		X opened 6/98					
HST	Hollister-Fairview Road		A,R	A,R		X					
IYA	Inyokern-Airport (close 6/96)										
JAC	Jackson-201 Clinton Road										
KCC	Kettkeman City-CalTrans (closed 9/96)										
KCG	Keeler-Cerro Gordo Road		A,R	A		X					
KCM	King City-Metz Road		R	R		X					
LCR	Lancaster-W Pondera Street										
LEE	Lee Vining-SMS		A,R	A		X					
LF1	Las Flores Canyon #1		A,R	A,R		X					
LF2	Las Flores Canyon #2		A,R	A,R		X					
LKL	Lakeport-Lakeport Blvd		R	R		X					
LOM	Lompoc-South H Street		A,R	A,R		X					
LOY	Loyalton-West 3rd Street										
LPE	Lone Pine-East Locust Street										
LTS	South Lake Tahoe-Stateline										
LTY	South Lake Tahoe-Sandy Way		R	R		X		X			
LUC	Lucerne Valley-Middle School										
LVF	Livermore Old First St										
LWP	Lancaster-West Pondera Street		A,R	A,R							
M14	Modesto-814 14th Street										
MAG	Mammoth Lakes-Gateway HC		A,R	A		X					
MBY	Morro Bay		R	R							
MER	Merced-Health Dept (closed 9/96)										
MIS	Modesto-1100 I Street		R	R		X					
MLB	Madera-Library (closed 9/96)										

Table 4.4-3.
Collocated Air Quality Measurements at Backbone Sites (cont'd).

SITE	NAME	NEW MET	WS	WD	VWS	AT	TD	RH	SOL	UV	PR
MLK	Mono Lake-Simis Residence		A,R	A		X					
MOJ	Mojave-923 Poole Street										
MON	Monterey-Silver Cloud Court										
MOP	Mojave-Poole Street		R	R		X					
MRM	Merced-Midtown										
NGR	Nipomo-Guadalupe Road		R	R		X					
NIP	Nipomo-South Wilson Street (closed 9/96)		R closed 9/96	R closed 9/96		X closed 9/96					
NJS	Napa-Jefferson Ave										
NLT	North Lake Tahoe (Near Tahoe City)										
NWH	Santa Clarita-County Fire Station		A,R	A,R							
OLD	Oildale-Manor Street		R	R		X					
OLW	Olancha-Walker Creek		A,R	A		X		X			X
PAG	Point Arguello	X	A	A		A		A			
PARN	Point Arena	X	A	A		A		A			
PBG	Pittsburg-10th Street										
PCN	Point Conception-Lighthouse		A,R	A,R	X	X					
PGN	Placerville-Gold Nugget Way		R	R		X					
PGV	Pleasant Grove-4 miles SW		R	R		X		X			
PINN1	Pinnacles National Monument-NPS										
PIR	Piru-2 mi SW		A,R	A,R		X		X	X		
POL	Portola										
PORE1	Point Reyes National Seashore-NPS										
PRF	Paso Robles-Santa Fe Avenue		R	R		X					
QUC	Quincy-267 North Church Street										
RBL	Red Bluff-Messer Drive										
RDH	Redding-Health Dept Roof										

Table 4.4-3.
Collocated Air Quality Measurements at Backbone Sites (cont'd).

SITE	NAME	NEW MET	WS	WD	VWS	AT	TD	RH	SOL	UV	PR
RED	Redwood City										
RGI	Ridgecrest-Las Flores Ave										
RIC	Richmond-13th Street										
ROC	Rocklin-Rocklin Road		R	R							
ROS	Roseville-151 N Sunrise Blvd		R	R		X		X			
S13	Sacramento-1309 T Street		R	R		X		X	X		
SAL	Salinas										
SAR	Sacramento-Airport Road (opened 8/97)		R opened 6/97	R opened 6/97		X opened 6/97		X opened 6/97	X opened 6/97		
SBC	Santa Barbara-3 W Carillo St		R	R		X					
SBR	Sacramento-Branch Center										
SBU	Exxon Site 10-UCSB West Campus		A,R	A,R	X	X					
SCB	Santa Cruz-Bostwick Lane										
SCQ	Santa Cruz-2544 Soquel Dr										
SDP	Sacramento-Del Paso Manor		R	R		X		X	X		X closed 6/97
SED	Sacramento-Earhart Drive (closed 8/97)		R closed 5/97	R closed 5/97		X closed 5/97		X closed 5/97			
SEH	San Leandro-County Hospital										
SEQU1	Sequoia National Park-NPS										
SFA	San Francisco-10 Arkansas St										
SGS	San Andreas-Gold Strike Road		R	R		X					
SIM	Simi Valley-Cochran Street		A,R	A,R		X		X	X	X	
SJ4	San Jose-4th St										
SJD	San Jose-Piedmont Road										
SJK	San Jose-Moorpark Avenue										
SJT	San Jose-528 Tully Road										
SL2	Salinas No. 2-Natividad Road										
SLM	San Luis Obispo-Marsh St		R	R		X					
SML	Stockton-March Lane (open by 6/98)										

Table 4.4-3.
Collocated Air Quality Measurements at Backbone Sites (cont'd).

SITE	NAME	NEW MET	WS	WD	VWS	AT	TD	RH	SOL	UV	PR
SMY	Santa Maria-Broadway		R	R		X					
SNH	North Highlands-Blackfoot Way										
SOH	Stockton-Hazelton St		R	R		X		X			
SOLA1	South Lake Tahoe-TRPA										
SQV	Squaw Valley-New site										
SRF	Santa Rosa-837 Fifth St										
SRL	San Rafael										
SST	Sacramento-Health Dept Stockton Blvd										
STL	Santa Maria-Library										
SWH	Stockton-Wagner/Holt School										
TAC	Taft College										
THM	Thousand Oaks-Moorpark Road		A,R	A,R		X		X	X		
TNP	Twentynine Palms-6136 Adobe Rd		A	A		X					X
TRL	Trona-Athol		A	A		X					X
TRU	Truckee-Fire Station										
TSM	Turlock-900 South Minaret Street		A	A							
UKC	Ukiah-County Library										
VAC	Vacaville-Marchant										
VAF	Vandenberg AFB-Watt Rd (closed 2/97)		A,R closed 2/97	A,R closed 2/97	X closed 2/97	X closed 2/97					
VBS	Vandenberg AFB-STS Power Plant		A,R	A,R	X	X					
VCS	Visalia-N Church Street		R	R		X					
VEN	Ventura County-East Main Street (closed 12/96)										
VIA	Victorville-Armargosa Road		A	A		X			X		
VJO	Vallejo-304 Tuolumne St										
VTA	Ventura County-West Casitas Pass		R	R		X					
WAA	Watsonville-Airport Blvd										

Table 4.4-3.
Collocated Air Quality Measurements at Backbone Sites (cont'd).

SITE	NAME	NEW MET	WS	WD	VWS	AT	TD	RH	SOL	UV	PR
WEV	Weaverville-Courthouse										
WLA	Woodland-unknown location (opened 7/97)		R opened 7/97	R opened 7/97							
WLF	Willits-Firehouse										
WLN	Woodland		R opened 7/97	R opened 7/97							
WLW	Willows-East Laurel Ave		R	R		X		X			
WSA	West Sacramento-15th Street										
WSS	Woodland-40 Sutter Street										
YAS	Yuba City-Almond Street		R	R		X					
YOSE1	Yosemite National Park-Turtleback Dome						X	X			
YOY	Yosemite National Park-Yosemite Village										

Table 4.4-4.
Column Heading Definitions.

Variable	Definition
SITE	Site code
NAME	Site name/address
AIR BASIN	Air basin name
PAMS	Photochemical Assessment Monitoring Site measurements
NAMS	National Ambient Monitoring Site measurements
SPM	Special Purpose Monitoring
OBJ	$PM_{2.5}$ Site objective: R = represent high concentrations in a populated area, M = Determine the highest concentration expected to occur in the area covered by the network (more than one site per area may be needed), T = Determine the extent of regional pollutant transport, P = Monitoring at PAMS areas, HS = To support special health studies, B = Background
TYPE	$PM_{2.5}$ Site type: C = Core SLAMS, S = non-core SLAMS, P = Special Purpose Monitors, I = IMPROVE
FREQ	Measurement collection frequency
CPM2.5	Proposed continuous $PM_{2.5}$ mass measurement site
$PM_{2.5}$	Proposed $PM_{2.5}$ measurement (X = FRM $PM_{2.5}$ monitor, XX = collocated FRMs, S = mass and speciation, Y=IMPROVE sampler)
PM_{10} SSI	Existing collocated PM_{10} high volume size selective inlet sampler
Dichot	Existing collocated PM fine ($PM_{2.5}$) and coarse ($PM_{2.5}$-PM_{10}) dichotmous sampler
PM_{10} TEOM/BAM	Existing collocated hourly TEOM or BAM sampler
PM_{10} Ion Analysis	Existing ion analysis (sulfate, nitrate, chloride, ammonium and potassium) performed on PM_{10} SSI samples
PM_{10} Carbon	Existing total carbon analysis on PM_{10} SSI samples
TSP	Existing TSP sampler
SO4	Existing TSP samples that are analyzed for the sulfates fraction
NO3	Exiting TSP samples that are analyzed for the nitrates fraction
COH	Existing AISI tape sampler for soiling index (Coefficient of Haze)
Neph	Existing Light scatter (nephelometer) measurements
CO	Existing carbon monoxide measurement
NO2	Existing nitrogen dioxide measurement
O3	Existing ozone measurement
PB	Existing lead measurement
SO2	Existing sulfur dioxide measurement
NEW MET	Indicates proposed meteorological sensors installed at that site
WS	Existing wind speed measurement at that site. A = arithmetic averaged values, R = resultant values
WD	Existing wind direction measurement at that site. A = arithmetic averaged values, R = resultant values
VWS	Existing vector wind speed measurement at that site. A = arithmetic averaged values, R = resultant values
AT	Existing ambient temperature at that site
TD	Exisitng dew point temperature at that site
RH	Existing relative humidity at that site
SOL	Existing solar radiation at that site
UV	Existing ultraviolet solar radiation at that site
PR	Existing surface pressure at that site

Table 4.4-5.
CRPAQS $PM_{2.5}$ Measurement Sites and Purposes.

Site ID	Name	Annual[c]	Winter or Summer Additions[d]	Fall Additions[e]	Purpose	Status[f]	Elevation (m MSL)
ACP	Angels Camp	Sat-ABC	Sat-15 Ep Days		Intrabasin Gradient	New	475
AGBR	Agricultural fields, with emphasis on burning	Sat-ABCD	Sat-15 Ep Days		Source, Agdust/Burning	New	~100
ALT	Altamont Pass-Tracy	Bac-E (3rd day)	Bac-15 Ep Days		Intrabasin Gradient	New	~300
ALT1	Altamont Pass	Sat-AB	Sat-15 Ep Days		Interbasin Transport	New	~300
ANGI	Angiola-ground level	Anc-AGHIJKLMNOP Sat-D	Anc-QRSTUVWXZabe		Intrabasin Gradient Vertical Gradient Visibility	New	100
ANGI1	Angiola-2 m agl	Anc-I			Vertical Gradient	New	102
ANGI2	Angiola-10 m agl	Anc-I			Vertical Gradient	New	110
ANGI3	Angiola-25 m agl	Anc-I			Vertical Gradient	New	125
ANGI4	Angiola-50 m agl	Anc-I			Vertical Gradient	New	150
ANGIT	Angiola-100 m agl	Anc-I	Anc-AGQRST		Vertical Gradient	New	200
ATL	Atascadero-Lewis Avenue	Bac-E(6th day)			Community Exposure	Exist	262
BAC	Bakersfield-5558 California Street	Anc-AGHIJKLMNOP Bac-E(everyday)F Sat-D	Anc-QRSTUVWXYe		Community Exposure Visibility	ARB	120
BARS	Barstow	Sat-A			Visibility		692
BGS	Bakersfield-1120 Golden State	Bac-E(3rd day)F Sat-fgh(6th day lag)	Bac-15 Ep Days		Community Exposure	Exist	123
BLIS1	D.L. Bliss State Park	Bac-F(3rd day)i			Visibility	TRPA	2042
BQUC	Bouquet Canyon		Sat-A (summer)		Interbasin Transport Visibility	New	~1000
BRES	Residential area near BAC, with woodburning	Sat-ABC	Sat-15 Ep Days		Source, woodburning	New	~100
BRV	Bruceville-Elk Grove	Bac-E(3rd day)	Bac-15 Ep Days		Community Exposure	Exist	6
BSE	Bakersfield (Southeast)	Bac-E(3rd day)	Bac-15 Ep Days		Source	New	~120
BTI	Bethel Island	Sat-ABCD	Anc-GHIJKLMNOPQRSTUVWX		Interbasin Transport	BAAQMD	0
C05	Corcoran-Pickrell			Sat-f	Source	IMS-95	61
C06	Corcoran-Yoder			Sat-f	Source	IMS-95	61
C07	Corcoran-Newark			Sat-fgh*	Receptor	IMS-95	60
C08	Corcoran-Josephine			Sat-f	Receptor	IMS-95	61
C09	Corcoran-Canal			Sat-fgh*	Receptor	IMS-95	56
C10	Corcoran-Jepsen			Sat-fgh*	Receptor	IMS-95	61
C12	Corcoran-King			Sat-f	Source	IMS-95	61

Table 4.4-5.
CRPAQS $PM_{2.5}$ Measurement Sites and Purposes (cont'd).

Site ID	Name	Annual[c]	Winter or Summer Additions[d]	Fall Additions[e]	Purpose	Status[f]	Elevation (m MSL)
C15	Corcoran-Pueblo			Sat-fgh*	Source	IMS-95	57
C16	Corcoran-Bainum			Sat-f	Source	IMS-95	61
C17	Corcoran-Miller			Sat-fgh*	Receptor	IMS-95	59
CAJP	Cajon Pass		Sat-A (summer)		Interbasin Transport Visibility	New	~1200
CANT	Cantil		Sat-A (summer)		Intrabasin Gradient Visibility	New	~500
CARP	Carrizo Plain	Sat-AB	Sat-15 Ep Days		Intrabasin Gradient Visibility	New	~600
CCD	Concord-2975 Treat Blvd	Bac-E(everyday)F	Bac-15 Ep Days		Source	Exist	26
CF01	Corcoran-fall saturation #1			Sat-f	Receptor	New	60
CF02	Corcoran-fall saturation #2			Sat-f	Receptor	New	59
CF03	Corcoran-fall saturation #3			Sat-f	Receptor	New	56
CF05	Corcoran-fall saturation #5			Sat-f	Receptor	New	61
CF06	Corcoran-fall saturation #6			Sat-f	Receptor	New	61
CF07	Corcoran-fall saturation #7			Sat-f	Receptor	New	61
CF08	Corcoran-fall saturation #8			Sat-f	Receptor	New	61
CF09	Corcoran-fall saturation #9			Sat-f	Receptor	New	61
CF10	Corcoran-fall saturation #10			Sat-f	Receptor	New	61
CF11	Corcoran-fall saturation #11			Sat-f	Receptor	New	61
CF12	Corcoran-fall saturation #12			Sat-f	Receptor	New	61
CF13	Corcoran-fall saturation #13			Sat-f	Receptor	New	61
CF16	Corcoran-fall saturation #16			Sat-f	Receptor	New	61
CF17	Corcoran-fall saturation #17			Sat-f	Receptor	New	60
CF18	Corcoran-fall saturation #18			Sat-f	Receptor	New	61
CF19	Corcoran-fall saturation #19			Sat-f	Receptor	New	61
CF20	Corcoran-fall saturation #20			Sat-f	Receptor	New	61
CF21	Corcoran-fall saturation #21			Sat-f	Receptor	New	61
CF22	Corcoran-fall saturation #22			Sat-f	Receptor	New	61
CF24	Corcoran-fall saturation #24			Sat-f	Receptor	New	61
CF25	Corcoran-fall saturation #25			Sat-f	Receptor	New	60
CF26	Corcoran-fall saturation #26			Sat-f	Receptor	New	61
CF29	Corcoran-fall saturation #29			Sat-f	Receptor	New	61
CF30	Corcoran-fall saturation #30			Sat-f	Receptor	New	61
CHL	China Lake	Sat-A			Visibility	VIS	697
CHM	Chico-Manzanita Avenue	Bac-E(6th day)F	Bac-15 Ep Days		Community Exposure	Exist	61
CLO	Clovis-908 N Villa Avenue	Bac-E(3rd day)F	Bac-15 Ep Days		Source	Exist	86
COA	Coalinga	Sat-A	Sat-15 Ep Days		Intrabasin Gradient	IMS-95	~200

Table 4.4-5.
CRPAQS $PM_{2.5}$ Measurement Sites and Purposes (cont'd).

Site ID	Name	Annual[c]	Winter or Summer Additions[d]	Fall Additions[e]	Purpose	Status[f]	Elevation (m MSL)
COP	Corcoran-Patterson Avenue	Bac-E(3rd day)F Sat-fgh(6th day lag) Sat-D	Bac-15 Ep Days		Community Exposure	Exist	~60
COV	Corcoran-1000 Van Dorsten			Sat-f	Receptor	IMS-95	61
CRD	Crows Landing	Sat-A	Sat-15 Ep Days		Intrabasin Gradient	VAQS, AUSPEX	~100
CSS	Colusa-100 Sunrise Blvd	Bac-E(3rd day)	Bac-15 Ep Days		Intrabasin Gradient	Exist	17
DOLA1	Dome Land Wilderness	Bac-F(3rd day)			Background Visibility	USFS	897
DUB1	Dublin	Sat-A	Anc-BCGQRS		Intrabasin Gradient	New	~50
EDI	Edison	Sat-AB	Sat-15 Ep Days		Intrabasin Gradient	AUSPEX	~100
EDW	Edwards Air Force Base	Sat-ABCD	Anc-GJK (summer only)		Intrabasin Gradient Visibility	VIS	~730
ELM	El Rio-Mesa School #2	Bac-E(3rd day)F			Intrabasin Gradient	Exist	34
FCW	Fremont-Chapel Way	Bac-E(3rd day)	Bac-15 Ep Days		Source	Exist	18
FEDL	Feedlot or Dairy	Sat-ABCD	Sat-15 Ep Days		Source, Animals	New	~100
FEL	Fellows	Sat-ABCD	Sat-15 Ep Days		Source, Oilfields	VAQS	~140
FELF	Foothills above Fellows	Sat-ABC	Sat-15 Ep Days		Intrabasin Gradient	New	~900
FRER	Fresno (south Fresno gradient site)	Sat-ABC	Sat-15 Ep Days		Intrabasin Gradient	New	~100
FRES	Residential area near FSF, with woodburning	Sat-ABCD	Sat-15 Ep Days		Source, woodburning	New	~100
FSD	Fresno Drummond	Sat-fgh(6th day lag)			Community Exposure	Exist	~100
FSE	Fresno (Southeast)	Bac-E(3rd day)	Bac-15 Ep Days		Source	New	~96
FSF	Fresno-3425 First Street	Anc-AGHIJKLMNOP Bac-E(everyday)F Sat-D	Anc-QRSTcd		Community Exposure Visibility	ARB	96
GVL	Grass Valley-Litton Building Site	Bac-E(6th day)			Community Exposure	Exist	853
HAN	Hanford-Irwin St.	Sat-fgh(6th day lag)			Community Exposure	Exist	~60
HDB	Healdsburg-Limeric Lane	Bac-E(6th day)			Source	New	31
HELM	Helm-Central Fresno County	Sat-ABC	Sat-15 Ep Days		Intrabasin Gradient	New	~56
JAC	Jackson-201 Clinton Road	Bac-E(3rd day)			Intrabasin Gradient	Exist	377
KCG	Keeler-Cerro Gordo Road	Bac-E(3rd day)			Source	Exist	1097
KCW	Kettleman City	Sat-AB	Sat-15 Ep Days		Intrabasin Gradient	New	30
KRV	Sierra Nevada Foothills-Kings River Valley	Sat-A	Sat-15 Ep Days		Interbasin Transport	New	~500

Table 4.4-5.
CRPAQS $PM_{2.5}$ Measurement Sites and Purposes (cont'd).

Site ID	Name	Annual[c]	Winter or Summer Additions[d]	Fall Additions[e]	Purpose	Status[f]	Elevation (m MSL)
KWF	Kern Wildlife	Sat-ABCD	Sat-15 Ep Days		Intrabasin Gradient	VAQS, AUSPEX	~100
LCR	Lancaster-West Pondera Street	Bac-E(3rd day)F			Community Exposure	Exist	709
LKL	Lakeport-Lakeport Blvd	Bac-E(6th day)			Intrabasin Gradient	Exist	405
LTY	South Lake Tahoe-3337 Sandy Way	Bac-E(6th day)F			Source	Exist	~1900
LVF	Livermore Old First Street	Bac-E(everyday)F Sat-D	Bac-15 Ep Days		Interbasin Transport	Exist	146
M14	Modesto-14th Street	Sat-fgh(6th day lag)			Community Exposure	Exist	~30
MAG	Mammoth Lakes-Gateway HC	Bac-E(3rd day)F			Source	Exist	2396
MIS	Modesto-1100 I Street	Bac-E(3rd day)F Sat-D	Anc-AGQRS Bac-15 Ep Days		Community Exposure	Exist	27
MOJ	Mojave-923 Poole Street	Bac-E(3rd day)F			Community Exposure	Exist	841
MRM	Merced-Midtown	Bac-E(3rd day)F	Bac-15 Ep Days		Community Exposure	New	~50
NLT	North Lake Tahoe (near Tahoe City)	Bac-E(6th day)			Source	Exist	~1915
OLD	Oildale-Manor	Sat-fgh(6th day lag)			Community Exposure	Exist	~40
OLW	Olancha	Sat-ABCDU	Sat-15 Ep Days		Background Visibility	New	1100
PAC1	Pacheco Pass	Sat-AB	Sat-15 Ep Days		Interbasin Transport	New	~400
PAG	Point Arguello	Bac-E(3rd day)			Background	New	~10
PARN	Point Arena	Bac-E(3rd day)F Sat-U	Anc-AGQRS Bac-15 Ep Days		Background	Exist	~60
PINN1	Pinnacles National Monument	Bac-F(3rd day)i			Background Visibility	NPS	317
PIR	Piru-2 mi SW	Bac-E(6th day)			Intrabasin Gradient	Exist	182
PLE	Pleasant Grove (north of Sacramento)	Sat-ABC	Sat-15 Ep Days		Intrabasin Gradient	New	~100
POL	Portola	Bac-E(3rd day)F			Intrabasin Gradient	Exist	~1480
PORE1	Point Reyes National Seashore	Bac-F(3rd day)i			Background Visibility	NPS	38
RED	Redwood City	Bac-E(3rd day)	Bac-15 Ep Days		Source	Exist	5
RGI	Ridgecrest-Las Flores Avenue	Bac-E(3rd day) Sat-D			Community Exposure	Exist (CRPAQS upgrade to speciation site)	723

Table 4.4-5.
CRPAQS $PM_{2.5}$ Measurement Sites and Purposes (cont'd).

Site ID	Name	Annual[c]	Winter or Summer Additions[d]	Fall Additions[e]	Purpose	Status[f]	Elevation (m MSL)
ROS	Roseville-151 North Sunrise Blvd	Bac-E(6th day)F	Bac-15 Ep Days		Intrabasin Gradient	Exist	161
S13	Sacramento-1309 T Street	Bac-E(everyday)F Sat-D	Bac-15 Ep Days		Community Exposure	Exist	7
SAL	Salinas	Bac-E(3rd day)F	Bac-15 Ep Days		Source	New	~13
SBC	Santa Barbara-3 West Carillo Street	Bac-E(6th day)F			Community Exposure	Exist	16
SCQ	Santa Cruz-2544 Soquel Drive	Bac-E(3rd day)	Bac-15 Ep Days		Community Exposure	Exist	78
SDP	Sacramento-Del Paso Manor	Anc-AG Bac-E(3rd day)F Sat-D	Anc-QRS Bac-15 Ep Days		Community Exposure	Exist (Anchor operated by SCAPCD)	25
SEQU1	Sequoia National Park	Bac-F(3rd day)i			Background Visibility	NPS	549
SFA	San Francisco-10 Arkansas Street	Bac-E(3rd day)F	Bac-15 Ep Days		Source	Exist	5
SGS	San Andreas-Gold Strike Road	Bac-E(6th day)			Intrabasin Gradient	Exist	~300
SJ4	San Jose-4th Street	Anc-AG Bac-E(everyday)F Sat-D	Anc-QRS Bac-15 Ep Days		Community Exposure	Exist (Anchor operated by BAAQMD)	24
SJT	San Jose-528 Tully Road	Bac-E(everyday)	Bac-15 Ep Days		Community Exposure	Exist	38
SLDC	Soledad Canyon		Sat-A (summer)		Interbasin Transport Visibility	New	~400
SLM	San Luis Obispo-Marsh Street	Bac-E(6th day)			Source	Exist	66
SNFH	Sierra Nevada Foothills	Sat-ABCD	Anc-GHIJKLMNOPQRSTUVWX		Vertical Gradient Intrabasin Gradient Visibility	New	~500
SOH	Stockton-Hazelton Street	Bac-E(3rd day)F	Bac-15 Ep Days		Community Exposure	Exist	13
SOLA1	South Lake Tahoe	Bac-F(3rd day)i			Visibility	TRPA	1899
SQV	Squaw Valley-New Site	Bac-E(3rd day)			Source	New	~1990
SRF	Santa Rosa-837 Fifth Street	Bac-E(3rd day)	Bac-15 Ep Days		Community Exposure	Exist	49
SST	Sacramento-Health Department Stockton Blvd	Bac-E(everyday)	Bac-15 Ep Days		Community Exposure	Exist	8
STL	Santa Maria-Library	Bac-E(6th day)			Source	Exist	152
SWC	SW Chowchilla	Sat-ABC	Sat-15 Ep Days		Intrabasin Gradient	IMS-95	~100

Table 4.4-5.
CRPAQS $PM_{2.5}$ Measurement Sites and Purposes (cont'd).

Site ID	Name	Annual[c]	Winter or Summer Additions[d]	Fall Additions[e]	Purpose	Status[f]	Elevation (m MSL)
TEH2	Tehachapi Pass	Sat-AB	Sat-15 Ep Days		Interbasin Trasnport Visibility	New	~1300
TEJ	Tejon Pass	Sat-A	Sat-15 Ep Days		Interbasin Transport	New	~1260
TRU	Truckee-Fire Station	Bac-E(3rd day)F			Source	Exist	1676
UKC	Ukiah-County Library	Bac-E(6th day)F			Community Exposure	Exist	192
VCS	Visalia-North Church Street	Bac-E(3rd day)F Sat-fgh(6th day lag)	Bac-15 Ep Days		Community Exposure	Exist	92
VIA	Victorville-Armagosa Road	Bac-E(3rd day)F			Intrabasin Gradient	Exist	876
VJO	Vallejo-304 Tuolumne Street	Bac-E(3rd day)	Bac-15 Ep Days		Interbasin Transport	Exist	23
WAG	Walnut Grove-ground level	Sat-A	Anc-GIQRST		Vertical Gradient	New	6
WAGT	Walnut Grove-300 m agl		Anc-AGIQRST		Vertical Gradient	New	306
WLKP	Walker Pass	Sat-A	Sat-15 Ep Days		Interbasin Transport	New	~1600
WLN	Woodland	Bac-E(3rd day)	Bac-15 Ep Days		Community Exposure	New	~17
YAS	Yuba City-Almond Street	Bac-E(6th day)F	Bac-15 Ep Days		Intrabasin Gradient	Exist	20
YOSE1	Yosemite National Park-Turtleback Dome	Bac-F(3rd day)i Sat-DU	Bac-15 Ep Days		Background Visibility	IMPROVE	1605
YOY	Yosemite Village	Bac-E(3rd day)			Intrabasin Gradient	Exist	1216

[a]Anc=Anchor network, Bac=$PM_{2.5}$ Backbone network, Sat=Satellite network. See Table 4.4-6 for measurement code definitions.

[b]Bac sites sample every day unless indicated every third or sixth day. Speciation monitors operate every sixth day.
Filter measuremets at Backbone PM_{10} sites operate every 6th day, but 3-days later than the Bac schedule.

[c]Annual period is from 12/1/1999 through 1/31/2001

[d]Winter unless otherwise designated. Winter period is 60 consecutive days from 11/16/2000 through 1/31/2001.
Summer period is 62 consecutive days from 7/1/2000 through 8/31/2000.

[e]Fall period is 60 consecutive days from 9/1/2000 through 10/30/2000.

[f]TRPA=Tahoe Regional Planning Agency, NPS=National Park Service, USFS=United States Forest Service

[*]Fall Minivol sites to be moveable at 14-day intervals in response to review of nephelometer data at other sites in the neighborhood-scale network.

Table 4.4-6.
CRPAQS Air Quality Measurement Methods, Frequencies, and Durations.

Code	Observable and Method	Frequency	Avg Time
A	Light scattering/$PM_{2.5}$ mass (TBD portable nephelometer)	daily@Anc at least 6th day@Sat Winter 15 Ep days	5-min 5-min 5-min
B	$PM_{2.5}$ mass, elements, ammonia (Minivol with Teflon/citric acid & Grav, XRF, AC)	6th day@Sat Winter 15 Ep days	24-hr 24-hr
C	$PM_{2.5}$ ions, carbon, nitric acid (Minivol with -quartz-NaCl & IC, AC, AA & TOR)	6th day@Sat Winter 15 Ep days	24-hr 24-hr
D	$PM_{2.5}$ Organic compounds (Minivol-Teflon coated glass fiber & GC/MS)	6th day@Sat Winter 15 Ep days	24-hr 24-hr
E	$PM_{2.5}$ mass,elements (FRM single with Teflon & Grav, XRF on 10 days)	daily&3rd day@Bac	24-hr
F	$PM_{2.5}$ elements, ions, carbon (EPA or IMPROVE speciation sampler)	6th day@Bac	24-hr
G	Light absorption/elemental carbon (aethalometer)	daily@Anc	5-min
H	$PM_{2.5}$ organic and elemental carbon (TBD continuous carbon analyzer)	daily@Anc	30-min
I	Particle size distribution (optical particle counter)	daily@Anc	5-min
J	PM_{10} mass (ambient T and RH TEOM)	daily@Anc	10-min
K	$PM_{2.5}$ mass (ambient T and RH TEOM)	daily@Anc	10-min
L	$PM_{2.5}$ mass and elements (sequential sampler with Teflon filter)	daily@Anc Winter 15 Ep days	24-hr 3-8-hr[a]
M	$PM_{2.5}$ ions and carbon (sequential sampler with denuder -quartz--NaCl cellulose)	daily@Anc Winter 15 Ep days	24-hr 3-8-hr[a]
N	NO_2 (high sensitivity chemiluminescent monitor)	daily@Anc	5-min
O	NO_y (TBD high sensitivity chemiluminescent monitor with external converter)	daily@Anc	5-min
P	O_3 (ultraviolet absorption monitor)	daily@Anc	5-min
Q	$PM_{2.5}$ nitrate (TBD continuous monitor)	daily@Anc	10-min
R	Nitric acid (TBD continuous monitor)	daily@Anc	5-min
S	Ammonia (TBD continuous monitor)	daily@Anc	5-min
T	$PM_{2.5}$ sulfate (TBD continuous monitor)	daily@Anc	5-min
U	Light hydrocarbons (canister & GC/FID)	6th day@Sat Winter 15 Ep days	24-hr 5 to 8-hr[b]
V	Heavy hydrocarbons (TENAX & GC/TSD/FID)	Winter 15 Ep days	5 to 8-hr[b]
W	$PM_{2.5}$ organic compounds (Teflon coated glass fiber/PUF/XAD & GCMS)	Winter 15 Ep days	5 to 8-hr[b]
X	Aldehydes (DNPH & HPLC)	Winter 15 Ep days	5 to 8-hr[b]
Y	SO_2 (TBD high sensitivity continuous monitor)	daily	5-min
Z	Hydrogen peroxide (peroxydaze enzyme)	daily	30-min
a	Free radicals (TBD continuous monitor)	daily	10-min
b	PAN (TBD continuous luminol or GC/EC)	daily	30-min
c	Gravimetric analysis and ion size distribution (MOUDI with Teflon & IC, AC)	Intermittant on Winter 15 Ep days	> 6-hr
d	Carbon size distribution (MOUDI with aluminum & TOR)	Intermittant on Winter 15 Ep days	> 6-hr
e	Aerosol Time of Flight Mass Spectrometer	Intermittant on 15 Ep days & during Fall	5-min
f	Light scattering/PM_{10} mass (TBD portable nephelometer)	daily on Fall Ep days@Sat	5-min
g	PM_{10} mass, elements, ammonia (Minivol with Teflon/citric acid & Grav, XRF, AC)	6th day w 3-day lag@Sat daily on Fall Ep days@Sat	24-hr 24-hr
h	PM_{10} ions, carbon, nitric acid (Minivol with quartz-NaCl & IC, AC, AA & TOR)	6th day w 3-day lag@Sat daily on Fall Ep days@Sat	24-hr 24-hr
i	IMPROVE PM_{10} module D (Teflon)	3rd day@Bac	24-hr

[a]Sequential samples from 0000-0500, 0500-1000, 1000-1300, 1300-1600, 1600-2400 PST

[b]Sequential samples from 0000-0500, 0500-1000, 1000-1600, 1600-2400 PST

Table 4.5-1.
Surface Meteorological Measurements for Annual and Winter Studies
(Surface measurements will also be acquired at upper air sites)

Site ID	Name	Purpose	Operator[a]	Basin	Measurements	Elev (m MSL)
BAC	Bakersfield-California Street	Community Exposure	ARB	SJV	High time sensitivity surface meteorological measurements	120
FSF	Fresno-First Street	Community Exposure	ARB	SJV	High time sensitivity surface meteorological measurements	96
ALT1	Altamont Pass	Interbasin Transport	ARB	SFB	Regular WS, WD, T	~300
BTI	Bethel Island	Interbasin Transport	CRPAQS	SFB	High time sensitivity surface meteorological measurements	~0
PAC1	Pacheco Pass	Interbasin Transport	CRPAQS	NCC	Regular WS, WD, T	~400
KRV	Kings River Valley	Interbasin Transport	CRPAQS	SJV	Regular WS, WD, T	
WLKP	Walker Pass	Interbasin Transport	CRPAQS	MOJ	Regular WS, WD, T	1609
ANGI	Angiola	Intrabasin Gradient	CRPAQS	SJV	100 m micrometeorological tower	61
WAG	Walnut Grove	Vertical Gradient	CRPAQS	SFB	300 m tower	

[a]CRPAQS = This study, ARB = California Air Resources Board

Table 4.6-1.
Upper Air Meteorological Measurements for Annual and Winter Studies.

Site ID	Name	Purpose	Oper-ator[a]	Radar[b]	RASS[b]	Sodar[b,c]	Radio Sonde[b]
ACP	Angel's Camp	Interbasin Transport	CRPAQS			WC	
ANGI	Angiola	Intrabasin Transport	CRPAQS	A	A	WC	
BAC	Bakersfield-California	Urban Heat Island	CRPAQS				WE
CRO	Crows Landing	Intra&Interbasin Transport	CRPAQS	A	A		
EDI	Edison	Interbasin Transport	ARB	A	A		
EDW	Edwards AFB	Desert Mixed Layer	USAF	A			A
ELN	El Nido	Intrabasin Transport	CRPAQS	A	A	WC	
FSF	Fresno-First Street	Urban Heat Island	CRPAQS				WE
HUR	Huron	Intrabasin Transport	CRPAQS	A	A		
LGR	Lagrange	Upslope/Downslope flow	CRPAQS	WC	WC	WC	
MCK	Mckittrick	Intrabasin Transport	CRPAQS	A	A		
MEN	Mendota	Intrabasin Transport	CRPAQS	WC	WC	WC	
MKR	Mouth Kings River	Upslope/Downslope flow	CRPAQS	A	A	WC	
MON	Monterey	Onshore/Offshore Transport	USNPGS	A	A		
MTL	Mettler	Southern Valley Barrier	CRPAQS	WC	WC	WC	
NTD	Point Mugu USN	Onshore/Offshore Transport	USN				A
OAK	Oakland airport	Onshore/Offshore Transport	NWS				A
RBF	Red Bluff	Northern Valley Barrier	CRPAQS		WC	WC	
RIC	Richmond	Onshore/Offshore Transport	CRPAQS			A	
RSA	Rosamond-Mojave Desert	Interbasin Transport	ARB	A	A		
SAC	Sacramento	Intrabasin Transport	SMUAPCD	A	A		
SAM	Santa Maria	Interbasin Transport	CRPAQS	WC	WC		
SJO	San Jose	Intrabasin Transport	CRPAQS	WC	WC	WC	
TRA	Travis AFB	Intrabasin Transport	USAF or NWS	A	A	WC	
VBG	Vandenberg AFB	Onshore/Offshore	NWS				A
VIS	Visalia	Intrabasin Transport	SJV	A	A		
WIL	Williams	Northern Valley Barrier	CRPAQS	WC			

[a]CRPAQS=This study; ARB=Air Resoures Board; USN=U.S. Navy; USAF=U.S. Air Force; USNPGS=U.S. Navy Post Graduate School; SJV=SJV Unified Air Pollution Control District; NWS=National Weather Service, SMUAPCD=Sacramento Metro Unified Air Pollution Control District.

[b]A=Annual continuous measurements; WC=Winter continuous measurements 12/1/00-1/31/01; WE=Winter episodic measurements on 20 forecasted days.

[c]Sodars added at all sites as part of CRPAQS.

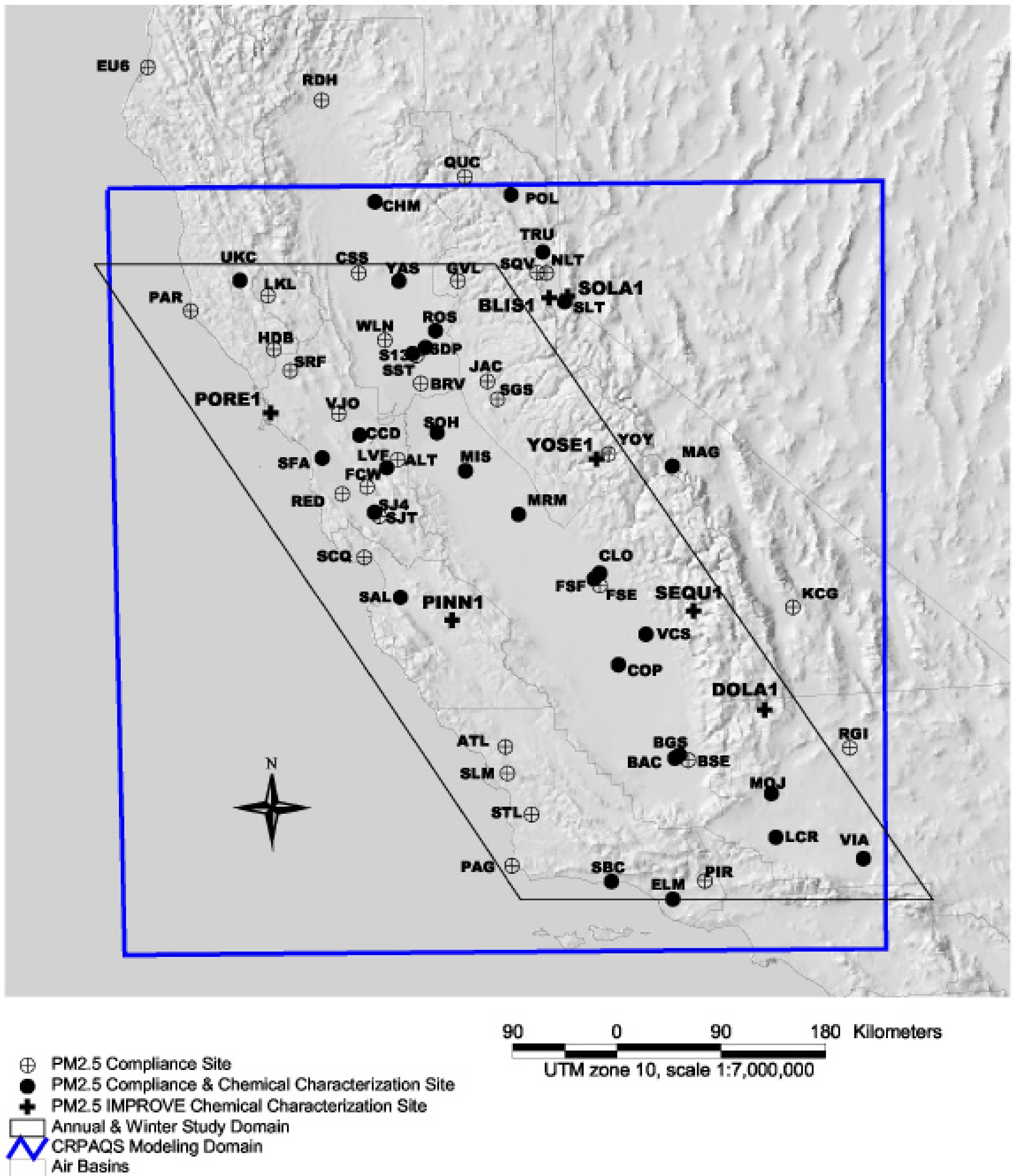

Figure 4.3-1. ARB Backbone $PM_{2.5}$ network with Federal Reference Method (FRM) mass measurement and chemical speciation sites. IMPROVE visibility sites are separately designated. The heavy continuous line represents the modeling domain while the light continuous line represents the annual and winter measurement domain.

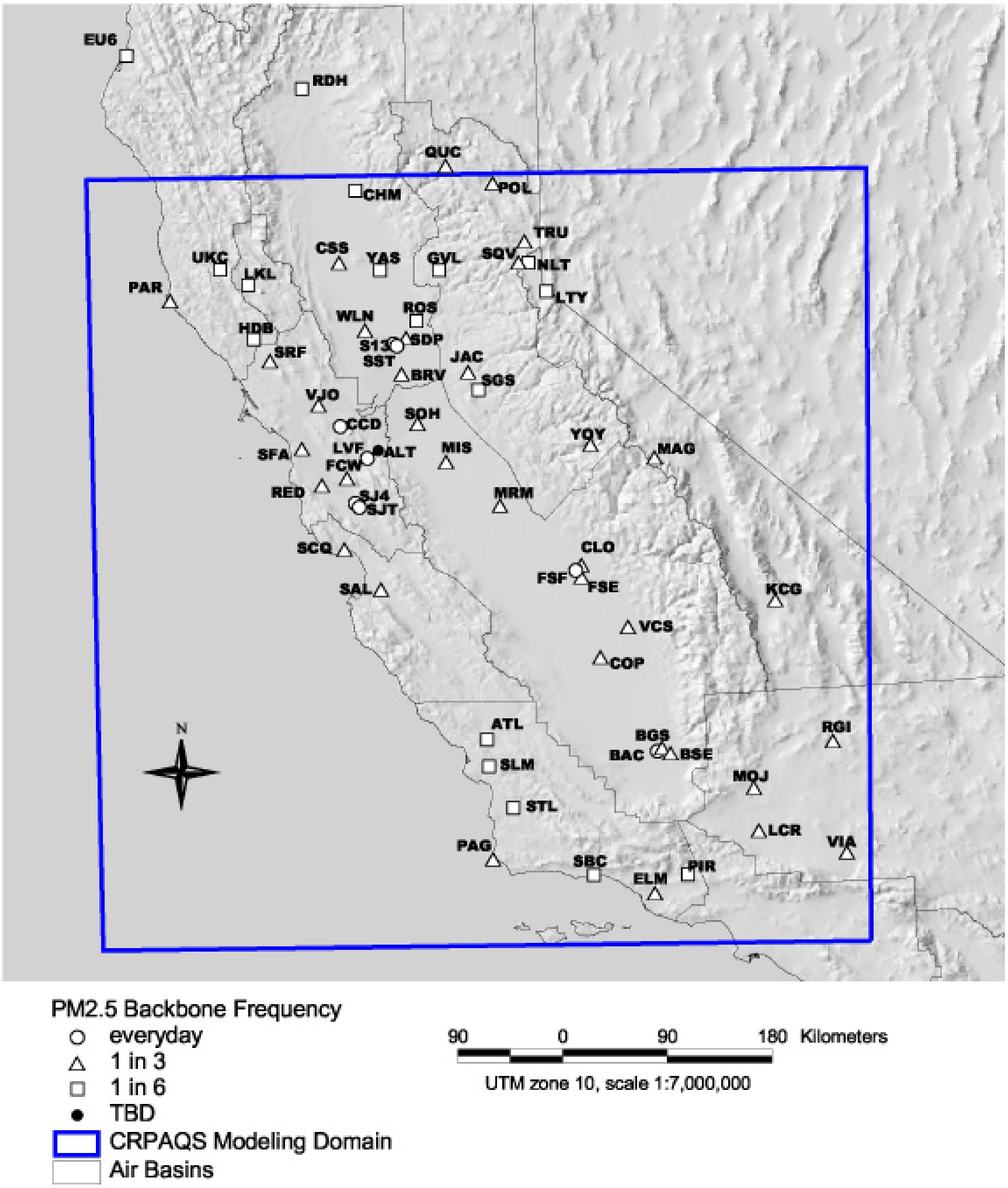

Figure 4.3-2. Sampling Frequencies for FRM $PM_{2.5}$ mass measurements in the ARB backbone $PM_{2.5}$ network.

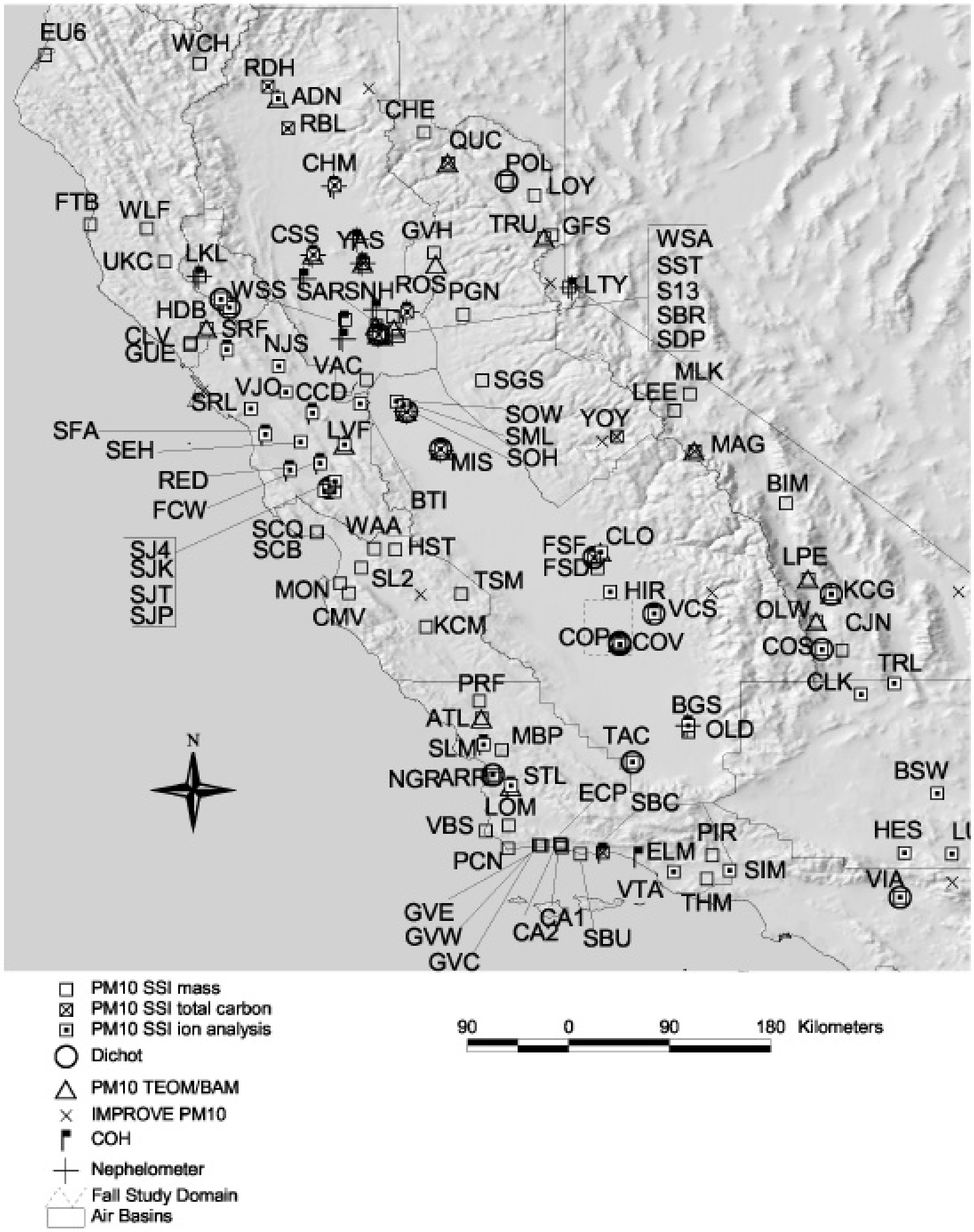

Figure 4.3-3. ARB backbone PM_{10} network. Hivol size-selective inlet (SSI) and dichotomous (Dichot) samplers have operated every sixth day at most of the sites. Hourly measurements are acquired everyday for PM_{10} mass at TEOM/BAM sites, for light absorption at COH sites, and for light scattering at nephelometer sites. The dotted line shows where the fall study will be conducted.

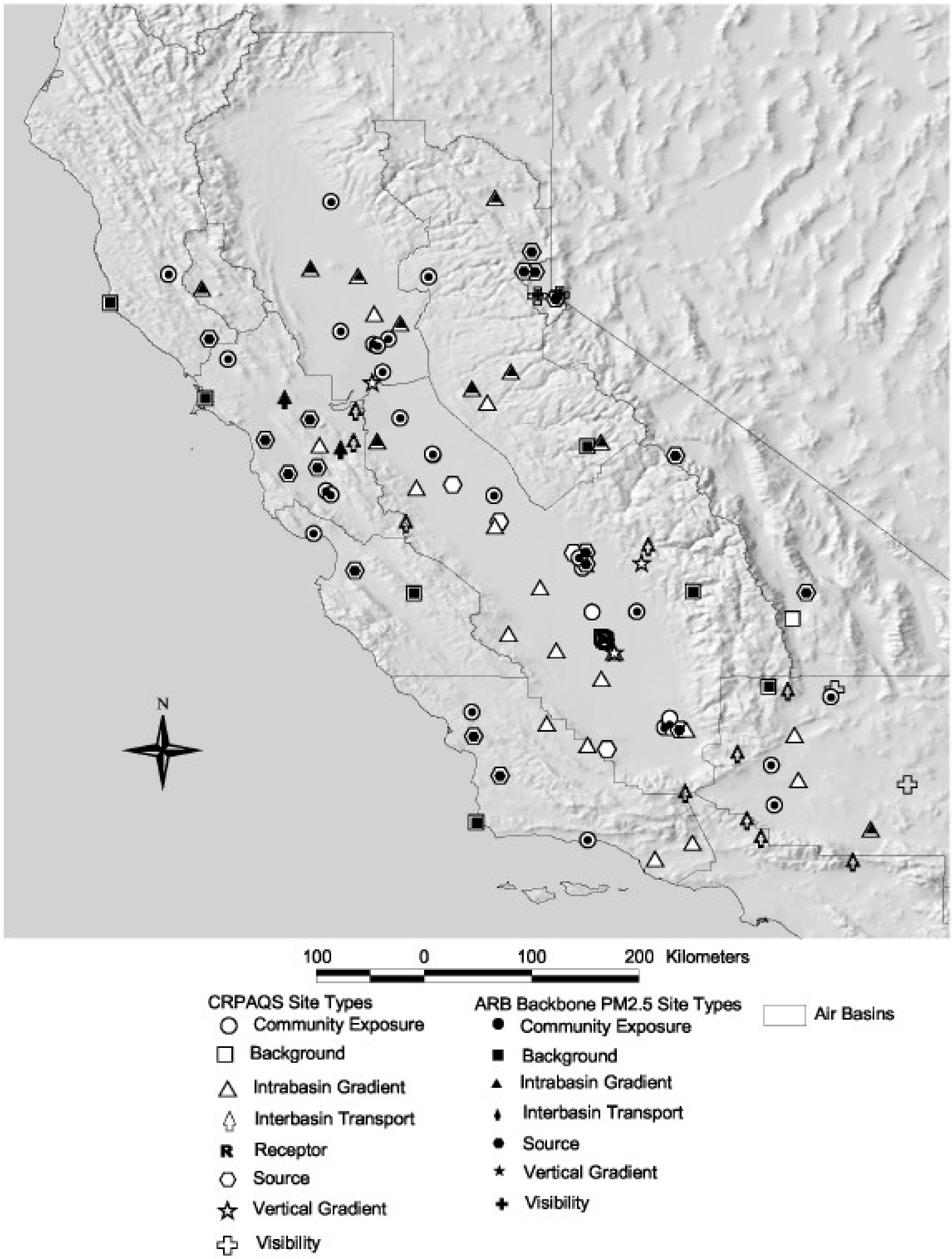

Figure 4.4-1. Site classifications for backbone, anchor, and satellite $PM_{2.5}$ sites.

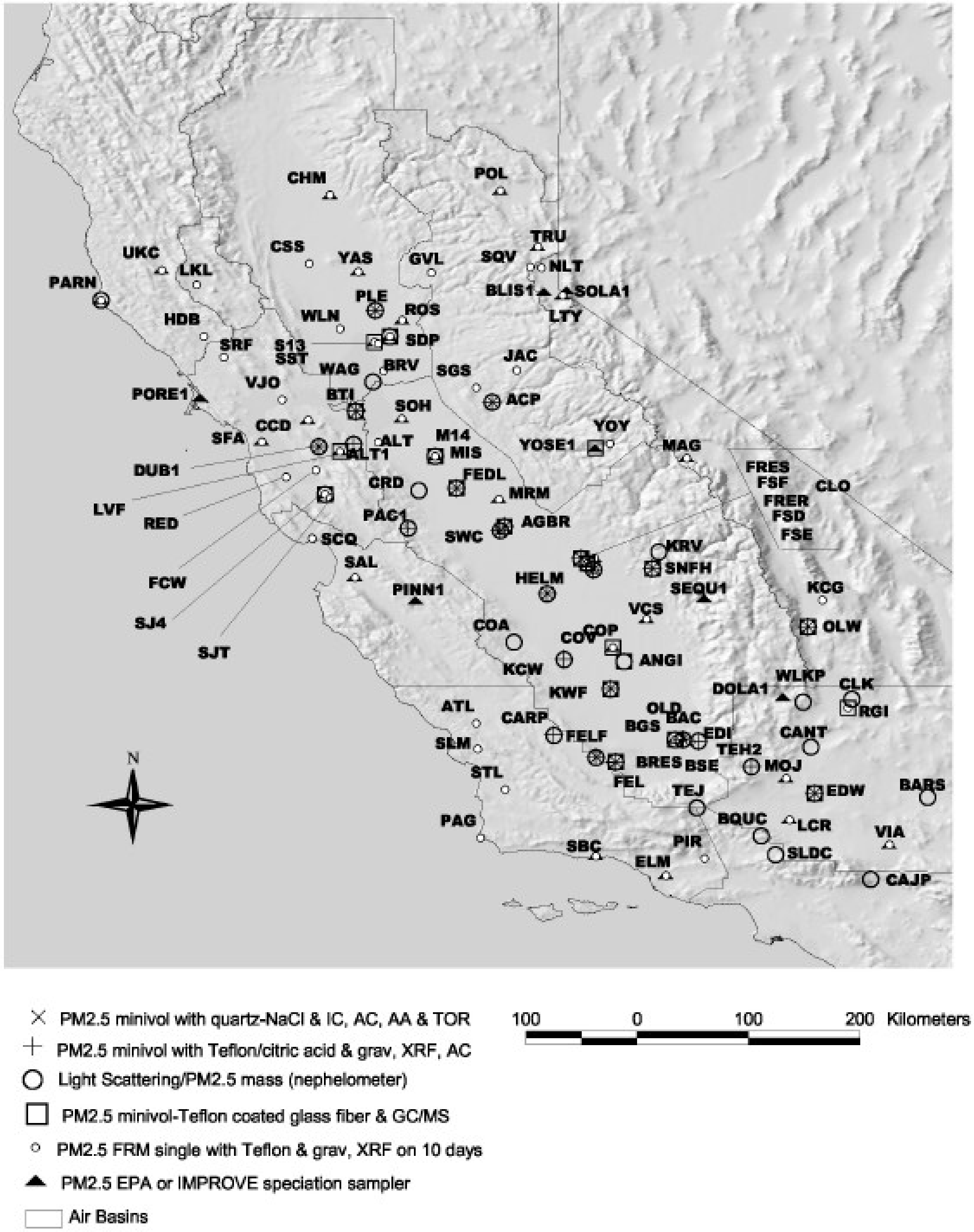

Figure 4.4-2. $PM_{2.5}$ mass, chemical, and light scattering measurements at backbone, anchor, and satellite sites. See Table 4.4-5 and 4.4-6 for a more detailed description of measurements at each site.

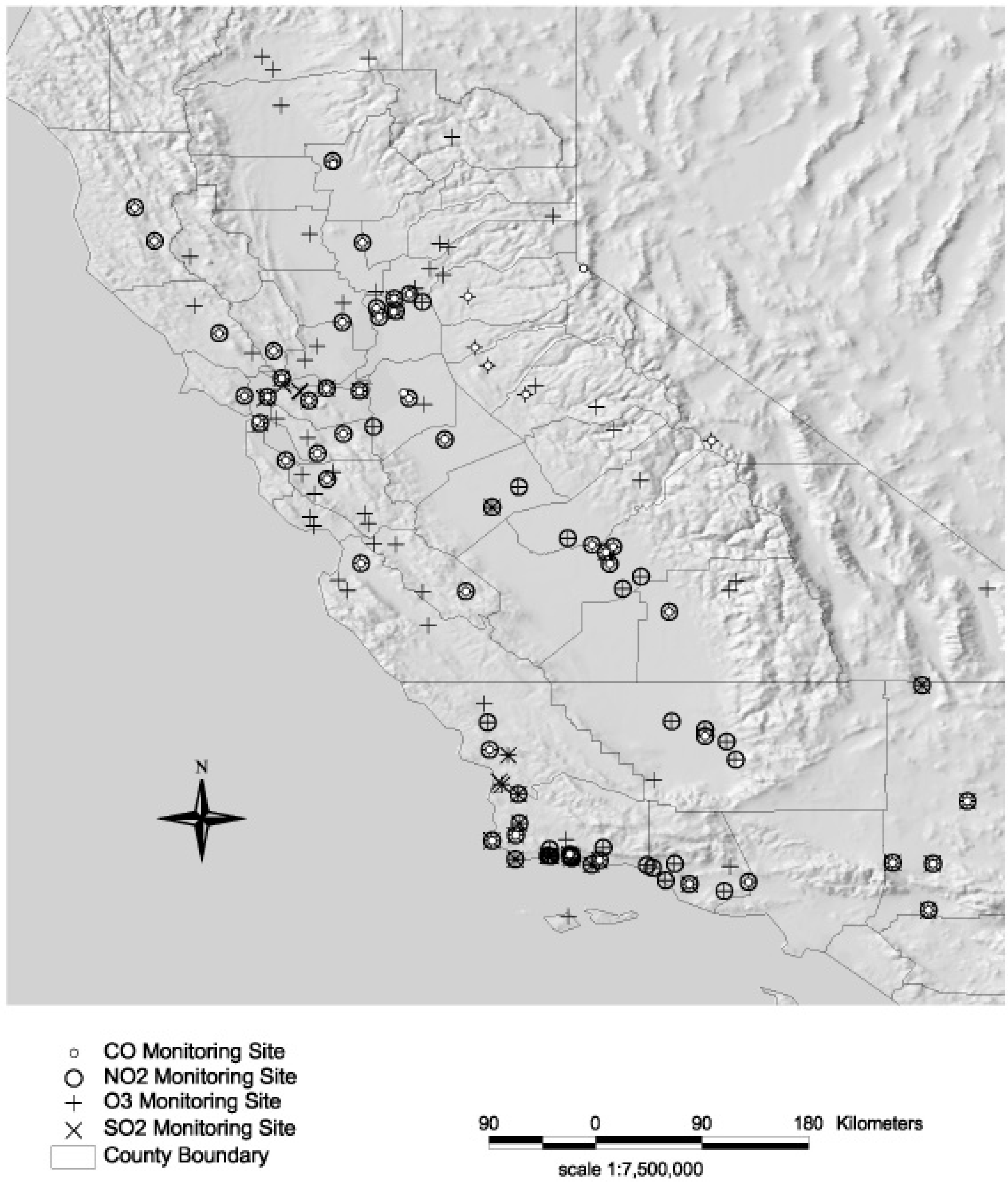

Figure 4.4-3. Carbon monoxide, oxides of nitrogen, ozone and sulfur dioxide monitors operating in central California.

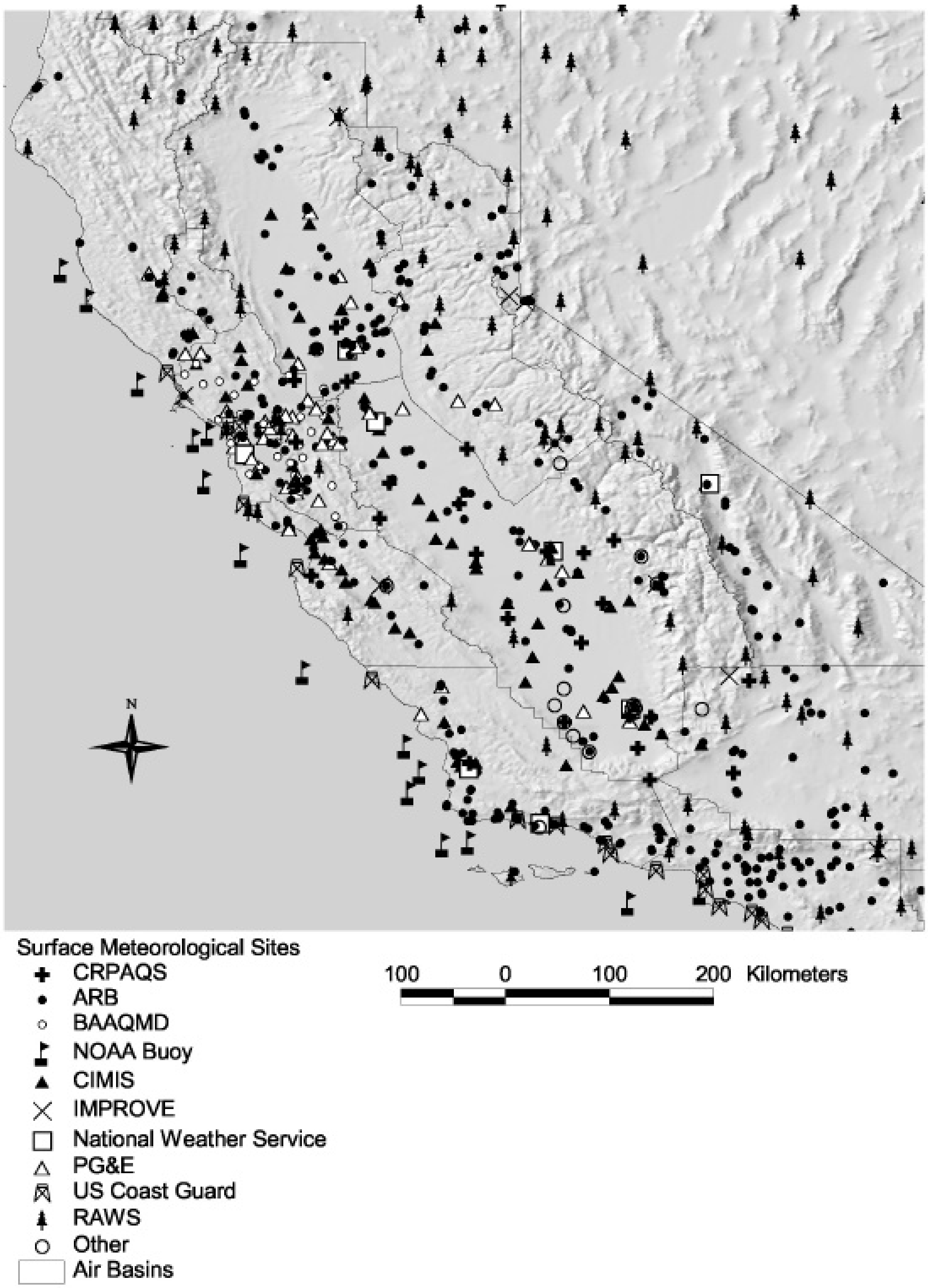

Figure 4.5-1. Central California surface meteorological networks and measurement locations.

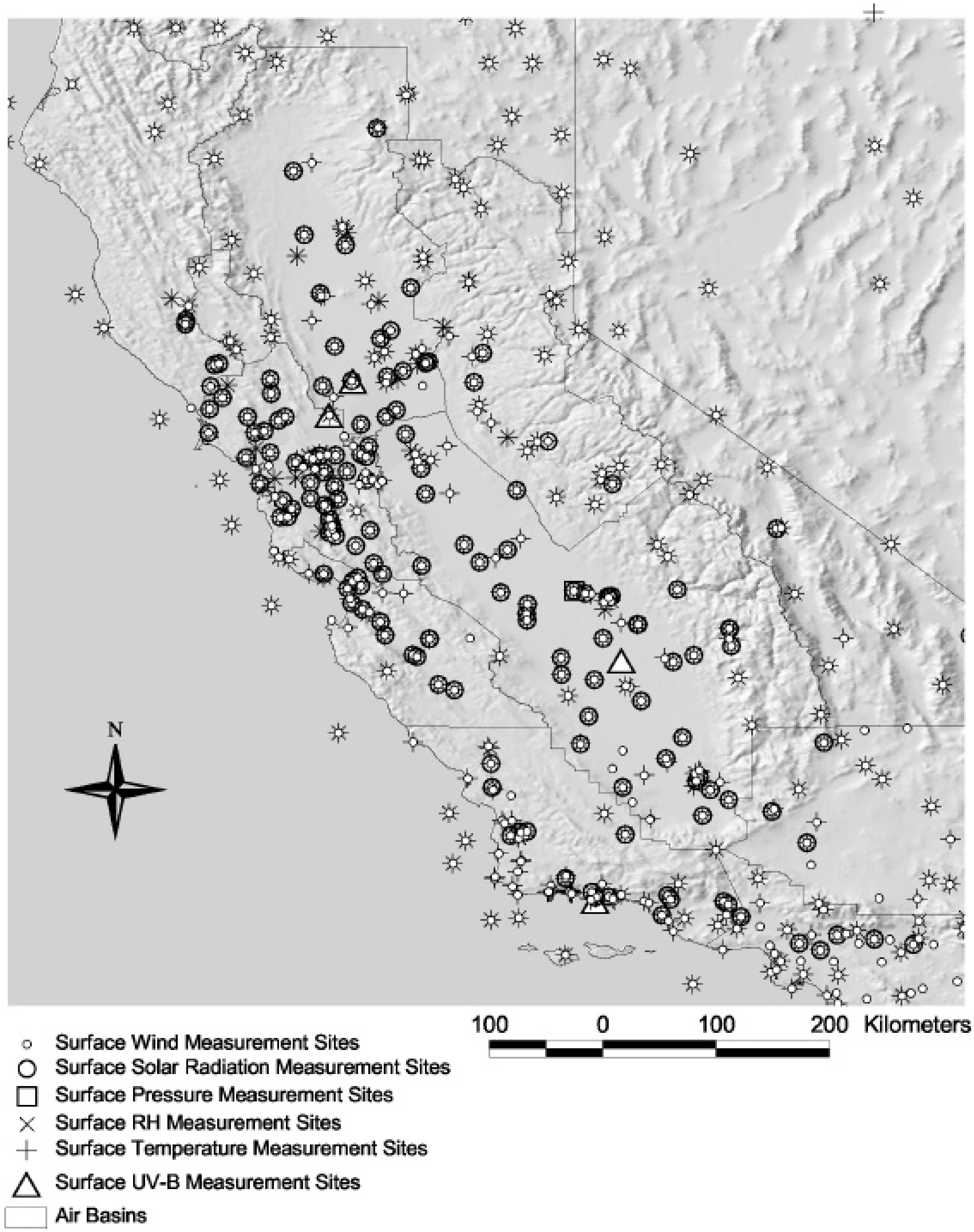

Figure 4.5-2. Surface meteorological observables measured in the combined central California meteorological network.

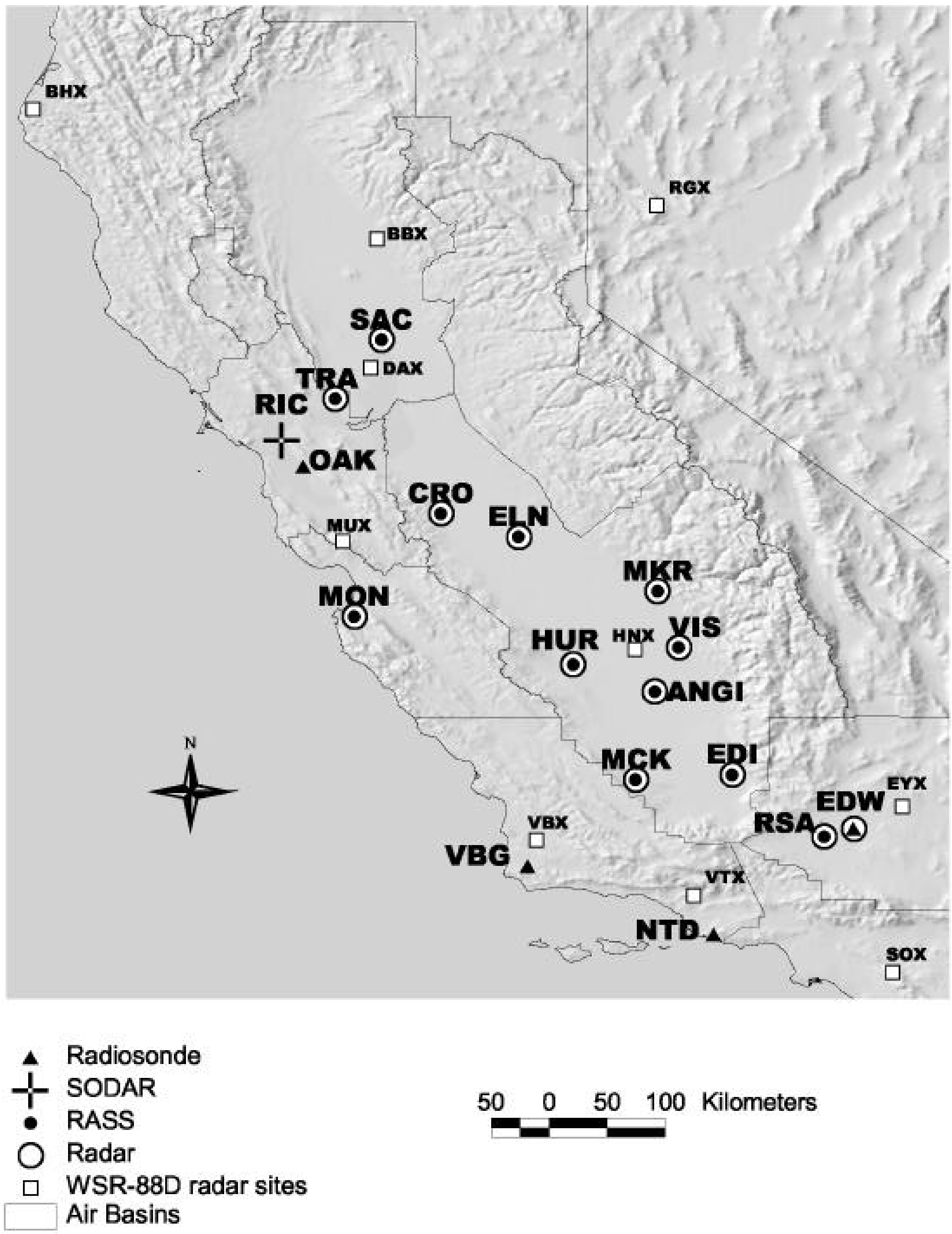

Figure 4.6-1. Upper air meteorological measurements during the annual average measurement campaign, including NEXRAD (WSR-88D) profilers.

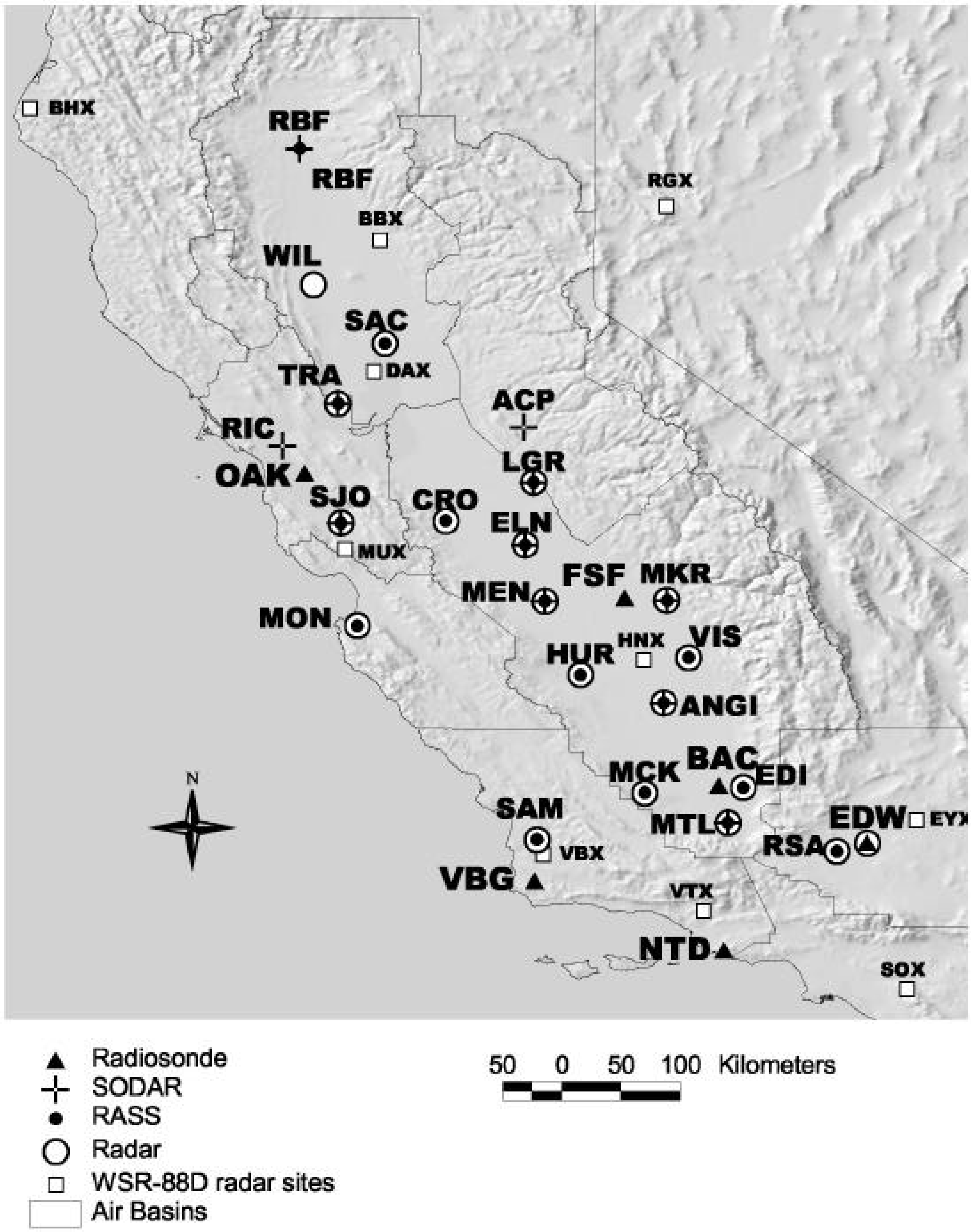

Figure 4.6-2. Upper air meteorological measurements during the winter campaign, including annual average study sites and NEXRAD (WSR-88D) profilers.

5. ANNUAL AVERAGE MEASUREMENT PROGRAM

The annual average measurement program will provide information to understand the causes of $PM_{2.5}$ annual averages that might exceed the 15 $\mu g/m^3$ limit. This section specifies the variables measured, averaging times, sampling and analysis frequencies, monitoring systems, and sampling sites that will be installed and operated by CRPAQS for the long-term annual average study. It also describes how CRPAQS measurements and those assembled from other networks will be used to address each of the study objectives specified in Section 1.

5.1 CRPAQS Annual Average Aerosol Measurements

Table 5.1-1 specifies the CRPAQS particle and precursor gas measurements to be taken for the 12/1/1999 through 1/31/2001 long-term monitoring period. These measurements complement and supplement those acquired as part of the ARB backbone network. Taken together, they constitute a large coverage of background, interbasin transport, intrabasin gradient, source-oriented, and community exposure sites.

The entire network includes the application of advanced, middle, and simple technologies for particle measurements. Advanced continuous and filter-based measurements are applied at the anchor sites. These sites require a large and expensive infrastructure in terms of hardware, software, technician training, space, power and security. The urban anchor sites include community-representative CORE sites that were shown in Section 2 to be most likely to exceed the annual and 24-hour $PM_{2.5}$ NAAQS.

Middle technology measurements are implemented by the ARB backbone $PM_{2.5}$ network using a combination of EPA Federal Reference Method (FRM) filter samplers, EPA speciation samplers, Federal Equivalent Method (FEM) sequential filter and IMPROVE samplers, and Correlated Acceptable Continuous (CAC) monitors. As shown in Section 4, this network is extensive in sampling frequency and spatial representation. It will be supplemented by CRPAQS measurements with more frequent chemical sampling and analysis and, in some cases, with upgraded equipment to permit chemically speciated sampling, especially at background sites. Fixed sites supporting these measurements require substantial support infrastructure, but this will be provided by the ARB and central California air quality districts with minimal supplemental support provided by CRPAQS. The measurement technologies applied in the backbone network are well established, but they were heretofore only applied in research networks.

Simple technology measurements apply battery-powered, Minivol filter samplers collocated with low-cost, battery-powered nephelometers to acquire information between the backbone and anchor network sites. These stations require no physical infrastructure beyond the sampling equipment, can be maintained by local part time operators, and are relatively inexpensive to implement. Extra battery powered samplers with quartz filters are located at some of the anchor, backbone, and satellite sites to obtain groups of samples that will be extracted together to obtain a representative organic speciation for annual average source apportionment.

Annual average aerosol samples will be analyzed for mass concentration, elements (Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Br, Rb, Sr, Y, Zr, Mo, Pd, Ag, Cd, In, Sn, Sb, Ba, La, Au, Hg, Tl, Pb, and U), water-soluble ions (chloride, sulfate, nitrate, ammonium, and potassium), and carbon (organic and elemental carbon). CRPAQS aerosol chemical measurements should be compatible with and comparable to those acquired from the speciation monitors operated at backbone sites identified in Section 4. CRPAQS will augment the planned one in twelve days sampling frequency to every sixth day sampling and analysis at the speciation sites. All of the sixth-day satellite site samples with 24-hour filter sampling will be analyzed for the entire 14-month annual average period. The particulate organic samples will be aggregated for the year 2000 at each sampled for extraction and analysis of an entire year's worth of samples. Samples from up to ten days between the sixth day sampling schedule may be selected for elemental analysis, based on elevated concentrations observed at some sites. These will most probably be days that correspond to nearby source or windblown dust events. Up to 100 total samples from anchor sites with daily sequential samples may be submitted to full chemical analysis to examine episodes that might develop outside the winter intensive measurement campaign. This total includes the sixth day samples.

5.2 CRPAQS Annual Average Surface Meteorological Measurements

As shown in Section 4, the existing surface meteorological network is extensive in spatial extent, but it is insufficient with respect to averaging time, wind thresholds, and sensitivity to high relative humidities. Table 5.2-1 describes the supplementary instrumentation to be supplied at key locations to complement the existing network. These locations emphasize anchor sites, where high quality temperature and relative humidity are needed to apply chemical equilibrium models, at interbasin transport sites to determine flows and particle fluxes (estimated by nephelometer/particle measurements, and at several of the upper air measurement sites to correspond with the elevated meteorological measurements.

5.3 CRPAQS Annual Average Upper Air Measurements

Table 5.3-1 details the upper air measurements to be acquired with radar profiler, RASS, and radiosonde systems for the long-term study. Half of the planned profilers will be operated by other agencies and half will be operated by CRPAQS over the study period. Profilers and RASS require substantial support infrastructure and have strict siting requirements with respect to nearby obstructions that interfere with the signals and residents who are annoyed by the high-pitched noise. CRPAQS additions to the existing network are listed in order of priority. The radiosonde launches are the normal twice per day (0400 and 1600 PST) measurements acquired at military bases and by the National Weather Service.

5.4 Annual Average Micrometeorological Tower

Table 5.4-1 identifies the instrumentation to be located on the 100 m tower. This tower will acquire high time resolution measurements of meteorology and particle size at several levels and is a key element in the interpretation of boundary layer evolution. It will be operated throughout the year to provide a database that can be examined under a variety of climatological conditions.

5.5 Annual Average Special Studies

Three preparatory and one summer study will be conducted as part of the long-term measurement program. The three preparatory studies are: 1) measurement evaluation study; 2) Sierra Foothills site evaluation study; and 3) winter forecast accuracy study. The summer 2000 study is a detailed particle organic characterization study.

5.5.1 Measurement Evaluation Study

The objectives of the measurement evaluation study are to: 1) evaluate the practicality and durability of new monitoring instruments under central California winter conditions, especially continuous monitors; 2) develop data acquisition and reduction procedures for these measurements; 3) determine the equivalence and predictability among different measurement methods, and 4) evaluate the extent to which the expected pulse-widths of high-time resolution instruments assists in the interpretation and modeling of integrated aerosol samples. Method development is explicitly excluded as an objective for this study owing to resource limitations. Only instruments that exist and have proven their operability elsewhere are part of this evaluation.

The measurement evaluation study will be conducted at the Bakersfield-California site during 12/1/1998 through 1/25/99. This site has been used for several comparison studies (e.g. Pitchford et al., 1997). Table 5.5-1 identifies the instruments to be evaluated along with the observables to be measured. Several of these are the same as those specified in Table 5.1-1, and these specifications may change as a result of this evaluation. Other instruments, specifically those that continuously measure sulfate, nitrate, ammonia, and nitric acid, are included owing to their use in winter studies described in Section 6.

The measurement evaluation study will be conducted in collaboration with the ARB's Monitoring and Laboratory Division (MLD) that will supply some of the needed instrumentation and operate the site and with ARB's Research Division that will sponsor Time-Of-Flight Mass spectrometric measurements.

Several of the continuous instruments may be left operating after the study with assistance from the MLD to determine their longevity and resource requirements. These will serve as the basic infrastructure for the Bakersfield anchor site during long-term monitoring. Power requirements and environmental sensitivities of each instrument will be recorded to plan site requirements for the other anchor and satellite sites.

5.5.2 Winter Forecast Accuracy Study

The forecast accuracy study is being conducted during the winters of 1998-99 and 1999-2000. The objective of this study is to develop, apply, refine, and evaluate a wintertime forecast protocol that allows the meteorological conditions conducive to high wintertime $PM_{2.5}$ episodes to be predicted. A similar study was conducted prior to SCOS-97 and episode forecasting was substantially improved. As explained in Sections 2 and 3, persistent Great Basin high pressure systems with at least four days persistence between Pacific storm fronts usually result in the prolonged periods of low ventilation during which $PM_{2.5}$ levels increase and are sustained.

5.5.3 Sierra Foothills Elevation Study

The purpose of this study during winter 1998-1999 is to evaluate several candidate sites in the Sierra Foothills east of Fresno/Visalia to determine the extent to which they are within or outside of the valleywide mixed layer during winter. Sites being evaluated are:

- **Marshall Station (~400 m asl, N 37° 00' 50", W 119° 34' 11"):** This site at the California Department of Forestry's Hurley fire station is in a small valley with open exposure to the SJV, to the south.

- **Trimmer (~520 m asl, N 36° 55' 14", W 119° 18' 18"):** This site is ~15 km south of the other sites, near Pine Flat Lake. The USFS heliport has good exposure to the valley (to the south), and may be a good choice for a fifth site to illustrate any lateral differences in the valley airmass, as compared to Prather.

- **Prather (~550 m asl, N 37° 02' 09", W 119° 30' 42"):** This site in the town of Prather is at the USFS ranger station; other possible sites exist in the town. Haze in the SJV can be seen beyond a wooded ridge from this site.

- **Millerton Lake (~200 m asl, N 36° 59' 13", W 119° 41' 10"):** This site is on the south side of Millerton Lake, near Friant Dam. It is near a campground entrance road and the State Park headquarters building. To the southwest is a valley just over the small ridge. This site is expected to be within the valleywide layer most of the time.

- **Mountain Rest (~1300 m asl, N 37° 03' 13", W 119° 22' 20"):** This is a USFS ranger station that is believed to be above the valleywide layer. Although the valley is not clearly visible from the USFS building, the area is exposed to the valley and views can found from nearby ridges..

DUSTTRAK nephelometers with 5-min averaging times have been located at each of these sites. Their measurements are being be examined to determine when they are in clear air and when they detect elevated particle concentrations or fog. Short-term spikes reveal the extent to which local, rather than regional-scale, particles reach each site. The site that best shows ~50% of its afternoon concentrations within the valleywide layer, as evidenced by high scattering, and ~50% above this layer, as evidenced by low scattering, and that also has minimal impact from local sources will be pursued as the fixed background site.

5.5.4 Summer Organic Aerosol Composition Study

The objectives of this study are: 1) determine detailed source contributions to 24-hour summertime organic carbon in an urban area; and 2) contrast compositions and source contributions with wintertime measurements at the same location. Ten 24-hour filter/PUF/XAD samples are taken on the sixth day schedule at the Fresno-First Street anchor site between 7/1/2000 and 8/31/2000 and submitted to detailed analyses for the types of organic compounds identified in Section 2. This special study supplements detailed organic speciation to be obtained in from the annual analyses to be obtained from filter composites.

- **Anchor site at Edwards Air Force Base:** An anchor site oriented toward components of light extinction will be operated in the Mojave desert to evaluate the timing and intensity of light extinction and the aerosol components that cause it.

- **Satellite transport sites from South Coast Air Basin:** Satellite sites using portable nephelometers will be located along transport pathways during the summer period to determine the magnitude, direction, and duration of visibility-reducing atmospheric constituents along pathways from the Los Angeles area for comparison with long-term measurements of these constituents moving from the San Joaquin Valley into the desert. The BQUC, SLDC, CAJP, and CANT sites will be used for this study.

5.6 Uses of Annual Study Measurements to Attain Objectives

The following sub-sections briefly describe how the measurements described for the long-term study will be used to accomplish each of the CRPAQS field study objectives specified in Section 1. Separate CRPAQS modeling and data analysis plans pose questions similar to those of Section 3 and describe the activities that will be completed to answer these questions using CRPAQS field study data.

5.6.1 Annual Study Objective 1: Quality Data Base

Performance tests, quality audits, and measurement comparisons will be used to evaluate the accuracy, precision, validity, and completeness of the CRPAQS database. This evaluation will be especially important for the continuous aerosol measurement methods that are likely to be incorporated into the backbone network for long-term monitoring. Section 3 described how tests to date show that some of these instruments provide $PM_{2.5}$ measurements that are reasonably equivalent under some aerosol composition and meteorological conditions, but that are widely divergent under other conditions. The existing meteorological network also has limitations that can only be quantified via comparisons with the more accurate and precise measurement methods to be deployed as part of CRPAQS.

In particular, comparisons will be made among light scattering, light absorption, and TEOM continuous methods and filter-based measurements for different humidities, temperatures, monitor locations, chemical compositions, and concentration levels. Cases of large disagreement between collocated measurements will be examined in detail to identify the special circumstances that cause that disagreement.

These evaluations, supplemented by periodic performance tests and quality audits, will result in data qualification statements for each measurement network, measurement device, and specific sub-sets of measurements that will be integral parts of the CRPAQS data base. These statements will guide further analyses that use these data and provide quantitative uncertainty estimates that should be propagated through those analyses.

5.6.2 Annual Study Objective 2: Evaluate Backbone Network

The backbone network will determine which Metropolitan Planning Areas (MPA) are in compliance with the annual $PM_{2.5}$ NAAQS of 15 µg/m^3. This determination may or may not involve spatial averaging in Community Monitoring Zones (CMZ) that include multiple samplers, such as those in Fresno, Bakersfield, and other large cities. The combination of high time resolution measurements at anchor sites with the supplemental spatial resolution of satellite sites allows quantification of the degree to which these fixed locations represent concentrations in other areas.

Five and ten minute average concentrations at anchor and selected satellite sites will be examined for short pulses of $PM_{2.5}$ that can be attributed to nearby intermittent emissions or to small and short-duration changes in wind direction. These pulses will be separated from the more smoothly varying diurnal changes in $PM_{2.5}$ concentrations and integrated to estimate neighborhood-scale contributions with respect to urban-scale and regional-scale contributions. Urban contributions will be separated from regional contributions by comparison of time series from urban sites with those at interbasin gradient and background sites.

The spatial variability of $PM_{2.5}$ concentrations will also be evaluated for $PM_{2.5}$ and specific chemical components for different meteorological and emissions situations. Backbone network sites that show large deviations from nearby satellite monitors will be identified and the causes of the discrepancies will be sought. Redundancy among measurements from backbone monitors within a CMZ will also be determined. These data and their analyses will indicate how the ARB $PM_{2.5}$ network can be optimized with respect to location and frequency for compliance determination.

5.6.3 Annual Study Objective 3: Temporal and Spatial Distributions

Aerosol measurements will be examined to determine diurnal, weekly, and seasonal variability with respect to mass and chemical composition. These patterns will be interpreted in terms of changes in meteorology, proximity to or distance from emissions sources, variability within and between modeling grid squares, and representation of community exposure.

5.6.4 Annual Study Objective 4: Boundary Layer and Regional Circulation

Horizontal winds from profilers and surface stations at various elevations above ground level will be examined for different times of the day, week, season and year. Large-scale flows will be related to different synoptic conditions and variations will be identified.

In particular, the extent to which the permanent meteorological network represents, or does not represent, interbasin and intrabasin transport will be determined. Common transport directions and transport duration will be determined for each layer and related to simple indicators, such as Oakland/Las Vegas pressure gradients, where possible.

Large-scale features of boundary layer evolution will be determined from RASS data, with special attention given to how surface and valleywide layers change for different synoptic conditions, different times of the year, and different central California locations.

Small-scale features of boundary layer evolution will be determined from the 100 m tower measurements. The timing and extent of vertical mixing between the surface layer and the valleywide layer will be determined. Upward movement of particles owing to heat buoyancy and turbulence will be balanced against downward movements owing to heat and momentum transfer as well as gravitational settling. Dispersion under low wind speed conditions will be elucidated for better customization of dispersion models.

The frequency, duration, spatial extent, and intensity of meteorological variables that affect pollution will be compiled by season to create a pollution climatology. This will include: 1) temperatures and relative humidities that affect ammonium nitrate equilibrium; 2) insolation that affects photochemical transformations; 3) precipitation that facilitates particle removal; 4) above threshold wind velocities that might suspend dust; and 5) fogs and low clouds that might enhance secondary aerosol formation.

Meteorological models will be applied to the profiler, RASS, and tower measurements. These measurements will also be used to evaluate the accuracy and validity of the model formulations.

5.6.5 Annual Study Objective 5: Source Zones of Influence and Contributions

$PM_{2.5}$ chemical measurements will be used with the CMB model to estimate primary source contributions to ambient concentrations for individual samples and annual averages. The annual average organic compound measurements will determine subsets of contributions to organic carbon, including diesel, cold start, high emitter, and hot stabilized vehicle exhaust contributions. Contributions from field burning, residential heating, cooking, and other organic carbon sources will be sought.

Outputs from the wind models will be used in transport and transformation models to determine which source areas or specific sources could have made negligible, minor, moderate, large, or major contributions at each receptor. Source contribution estimates at different locations will be compared to determine their consistency with emissions inventories and modeled zones of influence.

5.6.6 Annual Study Objective 6: Secondary Aerosol Sources

This objective will not be extensively studied as part of the long-term study. It is a major focus of the winter and fall studies.

For the long-term annual average study chemical transformation mechanisms will be included in air quality models for comparison with the CMB-apportioned ammonium nitrate and ammonium sulfate. The possibility of precursors from different source regions will be determined.

5.6.7 Annual Study Objective 7: Conceptual Model Refinement

Results of data analysis and modeling will be used to refine the conceptual models in Section 3, especially those related to nearby sources and high wind fugitive dust. Additional situations favoring high $PM_{2.5}$ may be encountered as part of these analyses.

5.6.8 Annual Study Objective 8: Simulation Methods

This objective will be addressed by the winter study. As part of the long-term annual average study, adjustments will be made to meteorological and air quality dispersion models to incorporate new concepts and parameters derived from the 100 m meteorological tower. Detailed analysis of modeling results will be made on selected episodes that represent different meteorological situations and $PM_{2.5}$ levels.

Table 5.1-1.
Aerosol Measurements for Annual Average Study.

Observable	Frequency	Avg Time	Monitoring Method (code)	Number of Monitors	Sites[a]
PM_{10} Mass	Daily	10-min	R&P PM_{10} TEOM[c] (J)	3	BAC, FSF, ANGI
$PM_{2.5}$ Mass	Daily	10-min	R&P $PM_{2.5}$ TEOM[c] (K)	3	BAC, FSF, ANGI
Particle Size Distribution	Daily	5-min	Grimm Optical Particle Counter (I)	8	ANGI, ANGI1, ANGI2, ANGI3, ANGI4, ANGIT, BAC, FSF
Light Scattering/Mass	Daily	5-min	Light scattering/$PM_{2.5}$ mass (nephelometer) (A)	5	ANGI, BAC, FSF, SDP, SJ4
$PM_{2.5}$ Light Absorption/Elemental Carbon	Daily	5-min	Aethalometer (G)	5	ANGI, BAC, FSF, SDP, SJ4
NO_y/NO	Daily	5-min	Continuous NO_y monitor with HNO_3 & NO_2 separation (O)	3	ANGI, BAC, FSF
Ozone	Daily	5-min	Continuous O_3 Monitor (P)	3	ANGI, BAC, FSF
Nitrogen Dioxide	Daily	5-min	Continuous NO_2 Monitor (N)	3	ANGI, BAC, FSF
$PM_{2.5}$ Elem/Org Carbon	Daily	30-min	Continuous Carbon Analyzer (H)	3	ANGI, BAC, FSF
$PM_{2.5}$ Mass, Elements[b]	Daily	24-hr	Sequential filter sampler/Teflon (L)	3	ANGI, BAC, FSF
$PM_{2.5}$ Ions, Carbon[b]	Daily	24-hr	Sequential filter sampler/Denuder-Quartz-NaCl (M)	3	ANGI, BAC, FSF
$PM_{2.5}$ Light Scattering/Mass	6th Day	5-min	Light scattering/$PM_{2.5}$ mass (nephelometer) (A)	31	ACP, AGBR, ALT1, BARS, BRES, BTI, CARP, CHL, COA, CRD, DUB1, EDI, EDW, FEDL, FEL, FELF, FRER, FRES, HELM, KCW, KRV, KWF, OLW, PAC1, PLE, SNFH, SWC, TEH2, TEJ, WAG, WLKP
$PM_{2.5}$ Mass, Elements, Ammonia[e]	6th Day	24-hr	Minivol sampler/Teflon-Citric Acid (B)	22	ACP, AGBR, ALT1, BRES, BTI, CARP, EDI, EDW, FEDL, FEL, FELF, FRER, FRES, HELM, KCW, KWF, OLW, PAC1, PLE, SNFH, SWC, TEH2
$PM_{2.5}$ Ions, Carbon, Nitric Acid[e]	6th Day	24-hr	Minivol filter sampler/Quartz-NaCl (C)	16	ACP, AGBR, BRES, BTI, EDW, FEDL, FEL, FELF, FRER, FRES, HELM, KWF, OLW, PLE, SNFH, SWC

Table 5.1-1 (Continued)
Aerosol Measurements for Annual Average Study.

Observable	Frequency	Avg Time	Monitoring Method (code)	Number of Monitors	Sites[a]
$PM_{2.5}$ Organic Compounds[e]	6th Day	24-hr	Minivol filter sampler/Teflon-coated glass fiber (D)	20	AGBR, ANGI, BAC, BTI, COP, EDW, FEDL, FEL, FRES, FSF, KWF, LVF, MIS, OLW, RGI, S13, SDP, SJ4, SNFH, YOT
$PM_{2.5}$ Mass, Elements[f]	6th Day	24-hr	FRM Speciation Sampler (F)	29	BGS, CCD, CHM, CLO, COP, ELM, FSF, LCR, LTY, MOJ, MAG, MIS, MRM, PARN, POL, ROS, S13, SAL, SBC, SDP, SFA, SJ4, SOH, TRU, UKC, VCS, VIA, YAS, YOT
$PM_{2.5}$ Ions, Carbon[f]	6th Day	24-hr	FRM Speciation Sampler (F)	29	BGS, CCD, CHM, CLO, COP, ELM, FSF, LCR, LTY, MOJ, MAG, MIS, MRM, PARN, POL, ROS, S13, SAL, SBC, SDP, SFA, SJ4, SOH, TRU, UKC, VCS, VIA, YAS, YOT
$PM_{2.5}$ Mass, Elements[g]	6th Day (10 samples/site for elemental analysis)	24-hr	FRM Sampler/Teflon (E)	57	ATL,BAC,BGS,BRV,BSE,CCD,CHM,CLO,COP,CSS, ELM,FCW,FSE,FSF,GVL,HDB,JAC,KCG,LCR,LKL, LTY,LVF,MAG,MIS,MOJ,MRM,NLT,DAG,PARN,PIR,POL,RED,RGI,ROS,S13,SAL,SBC,SCQ,SDP,SFA,SGS,SJ4,SJT,SLM,SOH,SQV,SRF,SST,STL,TRU,UKC, VCS,VIA,VJO,WLN,TAS,YOY
Light Hydrocarbons[h]	6th Day	24-hr	Canister & GC/FID(U)	3	OLW, PARN, YOT

[a]Sites are described in Table 4.4-5.

[b]100 samples will be submitted to detailed analysis, including those on the sixth-day schedule.

[c]Operated at filter equilibration temperature and relative humidity.

[e]Teflon and quartz samples analyzed individually. Organic compound samples extracted together and analyzed for annual average composition

[f]Increased sampling and analysis frequency from 12th to 6th day.

[g]Up to ten samples per site submitted to elemental analysis during identified annual episodes.

[h]Light hydrocarbon measurements at PARN and OLW background sites to determine off shore and Mojave desert air basin boundary conditions.

Table 5.2-1.
Surface Meteorological Measurements for Annual Average Study.

Observable	Frequency	Avg Time	Monitoring Method	Number of Sites	Sites[a]
Vector Wind Speed	Daily	5-min	Low Threshold Anemometer and Wind Vane	25	ACP, ALT1, ANGI, BAC, BTI, CRO, EDI, ELN, FSF, HUR, KRV, LVF, MCK, MKR, PAC1, RIC, RSA, SAC, TEH2, TEJ, TRA, VIS, VJO, WAG, WLKP
Scalar Wind Speed	Daily	5-min	Low Threshold Anemometer	25	ACP, ALT1, ANGI, BAC, BTI, CRO, EDI, ELN, FSF, HUR, KRV, LVF, MCK, MKR, PAC1, RIC, RSA, SAC, TEH2, TEJ, TRA, VIS, VJO, WAG, WLKP
Resultant Wind Direction	Daily	5-min	Low Threshold Anemometer and Wind Vane	25	ACP, ALT1, ANGI, BAC, BTI, CRO, EDI, ELN, FSF, HUR, KRV, LVF, MCK, MKR, PAC1, RIC, RSA, SAC, TEH2, TEJ, TRA, VIS, VJO, WAG, WLKP
Sigma Theta	Daily	5-min	Low Threshold Anemometer and Wind Vane	25	ACP, ALT1, ANGI, BAC, BTI, CRO, EDI, ELN, FSF, HUR, KRV, LVF, MCK, MKR, PAC1, RIC, RSA, SAC, TEH2, TEJ, TRA, VIS, VJO, WAG, WLKP
Relative Humidity	Daily	5-min	High sensitivity lithium chloride detector	25	ACP, ALT1, ANGI, BAC, BTI, CRO, EDI, ELN, FSF, HUR, KRV, LVF, MCK, MKR, PAC1, RIC, RSA, SAC, TEH2, TEJ, TRA, VIS, VJO, WAG, WLKP
Temperature	Daily	5-min	High sensitivity aspirated thermister	25	ACP, ALT1, ANGI, BAC, BTI, CRO, EDI, ELN, FSF, HUR, KRV, LVF, MCK, MKR, PAC1, RIC, RSA, SAC, TEH2, TEJ, TRA, VIS, VJO, WAG, WLKP
Soil Temperature	Daily	5-min	Soil Temperature Sensor	1	ANGI
Soil Moisture	Daily	5-min	Soil Moisture Sensor	1	ANGI

[a]Sites are described in Table 4.5-1.

Table 5.3-1.
Upper Air Meteorological Measurements for Annual Average Study.

Observable	Frequency	Avg Time	Monitoring Method	Number of Sites	Annual Sites[a]
Vertical wind speed & direction, 30-500 m agl	Daily	15-min	Radar Profiler	13	ANGI, CRO, EDI, EDW, ELN, HUR, MCK, MKR, MON, RSA, SAC, TRA, VIS
Vertical virtual temperature, 100-800 m agl	Daily	15-min	RASS	12	ANGI, CRO, EDI, ELN, HUR, MCK, MKR, MON, RSA, SAC, TRA, VIS
Vertical wind speed & direction, 100-2000 m agl	Daily	15-min	Sodar	1	RIC
Vertical wind speed & direction, 10-10000 m agl	2/day	~1-min	Radiosondes[b]	4	EDW, NTD, OAK, VBG
Vertical temperature, 10-10000 m agl	2/day	~1-min	Radiosondes[b]	4	EDW, NTD, OAK, VBG
Vertical relative humidity, 10-10000 m agl	2/day	~1-min	Radiosondes[b]	4	EDW, NTD, OAK, VBG

[a]Sites are described in Table 4.6-1.

[b]Radiosondes normally launched at 0400 and 1600 PST.

Table 5.4-1.
Angiola Tower Meteorological and Particle Measurements for Annual Average Study.

Observable	Frequency	Avg Time	Monitoring Method	Levels
u, v, w wind direction	Daily	1-min	Sonic anemometer	2, 10, 25, 50, 100 m agl
u, v, w wind speed	Daily	1-min	Sonic anemometer	2, 10, 25, 50, 100 m agl
Vertical and horizontal turbulence cross products	Daily	1-min	Sonic anemometer	2, 10, 25, 50, 100 m agl
Vertical temperature	Daily	1-min	Matched aspirated thermisters	2, 10, 25, 50, 100 m agl
Heat fluxes	Daily	1-min	Matched aspirated thermisters	2, 10, 25, 50, 100 m agl
Particle size distribution	Daily	1-min	Grimm Optical Particle Counter	2, 10, 25, 50, 100 m agl

Table 5.5-1.
Instruments in Measurement Methods Evaluation Study.

Monitoring Equipment	Observables	Avg Time	Power
R&P $PM_{2.5}$ sequential filer sampler/Teflon/citric	Mass, elements, ammonia	6-hr	Line
R&P $PM_{2.5}$ denuded sequential filer sampler/quartz/nylon	Ions, carbon, volatilized nitrate	6-hr	Line
Airmetrics Minivol/Teflon/citric	Mass, elements, ammonia	6-hr	Batt/Sol
Airmetrics Minivol/quartz/nylon	Ions, carbon, volatilized nitrate	6-hr	Batt/Sol
R&P PM_{10} TEOM	Mass	10-min	Line
R&P $PM_{2.5}$ TEOM/NaCl filter	Mass	10-min	Line
TEI Pulsed fluorescence SO_2 (43a high sensitivity)	Sulfur dioxide, <1 ppb	5-min	Line
TEI ozone (49c)	Ozone	5-min	Line
$PM_{2.5}$ aethalometer	Light absorption, Elemental Carbon	5-min	Line
Continuous nitric acid analyzer	Nitric acid	10-min	Line
Continuous nitrate sampler (3 methods)	Particle nitrate	10-min	Line
Continuous sulfate sampler	Paricle sulfate	10-min	Line
R&P Continuous Carbon Analyzer	Organic and elemental carbon	30-min	Line
TSI DUSTTRAK forward scattering nephelometer	Light scattering, PM surrogate	5-min	Batt/Sol
MIE forward scattering nephelometer	Light scattering, PM surrogate	5-min	Batt/Sol
Met-1 optical particle counter	Light scattering, PM size	5-min	Batt/Sol
Grimm forward scattering optical particle counter	Light scattering, PM size	5-min	Batt/Sol
R.M. Young Winds	Low threshold wind speed and direction	5-min	Line
Rotronics/Visala Relative Humidity	High sensitivity RH	5-min	Line
Caltech strand fog collector	Fog samples for organic analysis	1-hr	Line
GC/MS and Electrospray MS	Fog organic analytical development	N/A	N/A
Plastic sheet fog deposition collectors	Fog deposition	1-hr	N/A
Time-of flight MS (2 methods)	Single particle measurements	<1-min	Line

6. WINTER MEASUREMENT PROGRAM

The winter measurement program is designed to understand the detailed causes of primary and secondary components of $PM_{2.5}$ during pollution buildup episodes and to apply and evaluate state-of-the-art air quality models. This section specifies the variables measured, averaging times, sampling and analysis frequencies, monitoring systems, and sampling sites that will supplement those operated during the annual average study. The network description tables show the total number of monitors (including those for the annual average networks) as well as the numbers and types of measurements to be added during winter. It describes how these additional data will be used to expand on the data uses specified in Section 5 to attain each CRPAQS objective.

6.1 CRPAQS Winter Aerosol Measurements

As noted in Section 4, several sites will be upgraded to anchor sites for the winter campaign and additional instrumentation will be added to the annual average anchor sites. Table 6.4-1 specifies the instruments that will be operated continuously at each of these sites. Several of these are the same as those used for the annual program, but additional chemical speciation of secondary compounds and precursors is added for the winter. All of the annual study measurements take place at the six day intervals specified in Section 5 throughout the winter study period. The continuous monitors are operated every day, throughout the day, over the 60-day period to be selected between 11/15/2000 and 1/31/2001. High sensitivity sulfur dioxide is monitored only at the Bakersfield site to examine correspondence of SO_2 pulses with sulfate pulses that might arise from nearby oilfield operations. Hydrogen peroxide and radicals are measured at Angiola, as this site is distant from the very reactive but spatially non-representative species anticipated near source emissions in cities.

Detailed chemical measurements, as described in Table 6.4-2, will be acquired for intensive operating periods consisting of $PM_{2.5}$ episodes of three days duration or more. Up to 15 days of episodic measurements will be acquired, consisting of three to five separate $PM_{2.5}$ episodes during the 60 day study period. Monitoring during these episodes will be initiated by a forecast team that has refined and tested the forecast methodology during two prior winters.

Filter samples will be taken throughout each episode to characterize organic and inorganic chemistry. The sampling periods have been selected to encompass periods during which emissions and meteorology have been observed to change. Rapid changes in vertical mixing between 1000 and 1300 PST are represented by a single sample, as is the morning rush hour period between 0500 and 1000 PST. The afternoon period from 1300 to 1600 is when vertical mixing is believed to be most vigorous. Semi-volatile organic compounds require more sample, and these samples are not taken for less than 5-hour sample durations.

The satellite sites and backbone network will operate everyday during each episode. This frequency may need to be adjusted for some sites to accommodate samplers that require a manual sample change.

6.2 CRPAQS Winter Upper Air Measurements

Table 6.2-1 specifies how the annual upper air measurements will be supplemented for the Winter study. Profiler and RASS systems are added to characterize different parts of central California. Doppler sodars collocated at the profiler sites are needed to understand the transport and vertical mixing between the surface layer and the valleywide layer that appears to occur each morning below the 100 m lower limit of the profilers. These continuous monitors will operate throughout the winter study period.

Additional radiosondes will be launched during the 15 episodic days, with greater frequency during the vertical mixing period between 1000 and 1400 PST. The launch frequency at the NWS Oakland site will be supplemented with four additional airsondes corresponding to the CRPAQS schedule. These launches supplement the remotely sensed wind and temperature with measurements at lower and higher elevations and with relative humidity.

6.3 Tower Measurements

In addition to the meteorological and particle size measurements acquired during the annual program, continuous measurements for nitric acid, nitrate, sulfate, ammonia, ozone, NO_y, and elemental carbon (aethalometer) will be acquired at the 100 m level of the Angiola tower and at a level between 100 m and 300m on the Walnut Grove tower using the same instrumentation as that described in Table 6.3-1. The Walnut Grove tower will also be instrumented with micrometeorological sensors similar to those on the Angiola tower during the winter period. These measurements will be minimally acquired on the 15 episode days, and on as many other days in between that are practical with logistical, cost, and weather constraints. These measurements will allow detailed examination of vertical pollutant transfer between the surface layer and the valleywide layer to test the hypothesis that vertical mixing and non-afternoon transport above the surface layer mixes pollutants from different sources. From ~1700 to 1000 PST the next day, the 100 m measurements will estimate concentrations above the surface layer, but below the top of the valleywide layer.

6.4 Winter Special Studies

Four special studies are conducted during one or more of the four episodes: 1) valleywide layer depth study; 2) chemical composition aloft; 3) in situ single particle quantification; and 4) fog size and chemistry.

6.4.1 Aircraft Valleywide Layer Depth Study

The primary objective of the valleywide layer depth study is to determine the variability in height of the valleywide mixed layer at and between upper air measurement locations in central California. This information is needed to determine the accuracy to which layer depths can be estimated by interpolation of upper air measurements that are acquired throughout the winter campaign. Limited upper air measurements from IMS-95 found substantial difference in layer depths at different locations within the San Joaquin Valley.

A secondary objective is to obtain wind speed, wind direction, and relative humidity measurements at the top end and above the upper range of radar profilers. These measurements are needed to determine the uniformity or variability of wind directions above 3000 m agl between the radiosonde launch sites and release times. The tertiary objective is to estimate the number and thickness of sub-layers within the valleywide layer when the sky is clear enough to allow the ground to be seen from the air.

A relatively inexpensive single-engine aircraft will be equipped with a Micro-Pulse downlooking lidar and a GPS wind sounding unit to acquire these data. During the morning of each episode day the aircraft will fly from a Bay Area airport and through the central valley passing over as many surface-based profiler sites as possible between 0500 and 0900 PST prior to landing at a Mojave Desert airport (e.g. Tehachapi or Mojave). Cruising altitude will be ~2000 m agl. The aircraft will return north between 1300 and 1700 PST after the surface layer has coupled to the valleywide layer. The lidar will measure layer locations and heights above ground level when the ground is visible. Such visible patches in clouds or fog will be sought by the pilot. The effective height of the valleywide layer will be measured at a minimum. The GPS wind sounding system will acquire continuous measurements of wind speed and direction at the airplane's cruising height. It will also be possible to locate some light, fast response instrumentation, such as a nephelometer or ozone monitor, on the aircraft to acquire more information on concentrations above the valleywide layer.

6.4.2 Chemical Composition Aloft

Measurements at the Sierra Nevada Foothills site and at the two tower sites are intended to acquire measurements above the surface layer both above and below the valleywide layer. The 100 m level is not very high in the valleywide layer, however, and the Sierra Foothills site may be influenced by edge effects in a valley.

The purpose of this special study is to measure secondary aerosol and precursors with continuous airborne samplers near anchor sites within the SJV. The might be done with an instrumented aircraft or a hot air balloon equipped with continuous measurements for nitric acid, nitrate, sulfate, ammonia, ozone, NO_y, and elemental carbon (aethalometer), in that order of priority. A could make ascents near a site in foggy as well as clear weather up to and through the top of the valleywide layer. Measurements should be taken during ascents and descents on as many of the 15 episode days as is practical during the morning, the afternoon, and after sunset.

6.4.3 In Situ Single Particle Quantification:

This experiment intends to examine individual particles to determine their formation mechanisms and sources. Time of flight mass spectrometers will be deployed at the Fresno and Angiola sites to quantify the composition and size of individual particles. MOUDI particle size samples will accompany the single particle measurements at Fresno on the 15 episode monitoring days.

6.4.4 Fog Characterization

The main purpose of fog characterization is to understand the extent to which fog attenuates $PM_{2.5}$ concentrations by occult deposition. Quantity and composition of fog that deposits to the surface will be measured, as will fog composition in fog droplets of different sizes at different levels of the micrometeorological tower. Less detailed measurements will be taken at the Fresno and Bakersfield sites when fog is present to obtain a horizontal distribution. Detailed fog intensity and chemical measurements will be taken at ground level and at the top of the 100 m micrometeorological tower at the Angiola site during morning and afternoon when fog is present. Less detailed measurements will be taken at the Fresno and Bakersfield sites when fog is present to obtain a horizontal distribution.

6.5 Uses of Winter Study Measurements to Attain Objectives

The following sub-sections briefly describe how the Winter study will be used to accomplish each of the CRPAQS field study objectives specified in Section 1.

6.5.1 Winter Study Objective 1: Quality Data Base

Performance tests, quality audits, and measurement comparisons will be used to evaluate the accuracy, precision, validity, and completeness of the CRPAQS Winter study database. Winter conditions are harsher than other times of the year, with substantial fog and rain that will challenge sampler reliability. The particles being sampled are also more labile, containing larger amounts of liquid water, ammonium nitrate, and volatile organic carbon from wood combustion. The contrast of instrument performance during winter with that for other seasons will reveal how accuracy and precision can differ with environmental conditions. Additional comparisons of continuous and filter measurements will be made for nitrate and sulfate.

6.5.2 Winter Study Objective 2: Evaluate Backbone Network

Five and ten minute average sulfate and nitrate concentrations will be examined for short pulses of $PM_{2.5}$ that can be attributed to nearby intermittent emissions or to small and short-duration changes in wind direction. The correspondence of sulfur dioxide with sulfate at the Bakersfield site will likely represent contributions from nearby sources that can be separated from more regional contributions.

The spatial variability of $PM_{2.5}$ concentrations will also be evaluated for $PM_{2.5}$ and specific chemical components for different meteorological and emissions situations. The large array of gradient sites will allow the presumption of secondary aerosol spatial uniformity to be evaluated throughout the region.

6.5.3 Winter Study Objective 3: Temporal and Spatial Distributions

Diurnal, weekly, and seasonal variability are likely to be different during winter than during other parts of the year when surface flows are better defined and more consistent. Changes in primary and secondary aerosol concentrations with time of day will be given attention to determine consistency or inconsistency with the hypothesis of afternoon mixing as the main dilution mechanism for primary particles and the main augmentation mechanism for secondary particles. Measurements from the Sierra Foothills and 100 m tower will be examined over the morning layer coupling transition and as the valleywide layer top passes through the Sierra Foothills monitors.

6.5.4 Winter Study Objective 4: Boundary Layer and Regional Circulation

Horizontal winds from profilers, sodars and surface stations at various elevations above ground level will be examined for different times of the day, week, season and year. Wind directions, speeds, and potential transport distances within the surface layer and between the top of the surface layer and top of the valleywide layer will be examined to determine how long pollutants might reside aloft and how far they might travel. This will be examined for interbasin transport pathways, especially between the Bay area and the SJV and between the Sacramento Valley and the SJV. Comparisons with the aircraft measurements will assign uncertainties to valleywide layer depths interpolated from upper air measurements.

Measurements from the hot air balloon or low-level aircraft will be compared with those at the surface, at the top of the towers, and the Sierra Foothills measurements to estimate uncertainties in the longer-term fixed site measurements. Concentrations will be coupled with meteorology to test the hypotheses of non-afternoon trapping of pollutants at the surface and aloft and afternoon vertical homogenization of these pollutant concentrations.

Variations in the timing and extent of vertical mixing between the surface layer and the valleywide layer will be determined for episodes. The vertical and horizontal extent of fogs will be examined from a combination of RH, aircraft lidar, nephelometer, ASOS, and NWS observations. Upward movement of particles owing to heat buoyancy and turbulence will be balanced against downward movements owing to heat and momentum transfer as well as gravitational settling for fog and non-fog situations to evaluate particle growth in fog as a major deposition mechanism. Dispersion under low wind speed conditions will be elucidated for better customization of dispersion models. Specific values for dispersion parameters will be estimated from tower turbulence measurements for each monitored layer and time of day.

The frequency, duration, spatial extent, and intensity of meteorological variables that affect pollution will be different from winter as compared to other seasons. Exceptions to these hypotheses will be sought: 1) temperatures and relative humidities favor particulate ammonium nitrate; 2) insolation is insufficient to affect photochemical transformations near the surface and most of this takes place near the top of the valleywide layer; 3) storms effectively reduce particle concentrations to low levels; and 5) fogs and low clouds enhance secondary aerosol formation more than they remove it during $PM_{2.5}$ buildup episodes.

Meteorological models will be applied to the profiler, RASS, and tower measurements. These measurements will serve as model inputs and to evaluate the accuracy and validity of the model formulations.

6.5.5 Winter Study Objective 5: Source Zones of Influence and Contributions

$PM_{2.5}$ chemical measurements will be used with the CMB model to estimate primary source contributions to ambient concentrations for individual samples and annual averages. The CMB will use all gaseous and particulate organic and inorganic speciation data for the diurnal sampling periods. In addition to quantifying primary source contributions, the CMB analysis will determine differences between primary emissions profiles and ambient concentrations consistent with, and at odds with, secondary aerosol formation. The organic compound measurements at the anchor sites will permit the distinction of diesel, cold start, high emitter, and hot stabilized vehicle exhaust, wood burning, cooking, and other organic carbon sources to be distinguished by time of day. The afternoon samples will quantify these urban-generated contributions that reach non-urban areas and presumably reach other urban areas via the vertical mixing and valleywide layer transport pathway.

Outputs from the wind models will be used in transport and transformation models to determine which source areas or specific sources could have made negligible, minor, moderate, large, or major contributions at each receptor. More careful attention to transport in the surface and valleywide layers will be needed in these models. Source contribution estimates at different locations will be compared to determine their consistency with emissions inventories and modeled zones of influence.

6.5.6 Winter Study Objective 6: Secondary Aerosol Sources

Aerosol equilibrium models will be applied to the continuous sulfate, nitrate, ammonia, and nitric acid measurements to verify the hypothesis that there is sufficient ammonia to completely neutralize available acid throughout each day of each episode.

Organic gaseous precursors and particle organic compounds will be examined for changes in abundances that indicate secondary aerosol formation

6.5.7 Winter Study Objective 7: Conceptual Model Refinement

Wintertime flows at the surface, within the valleywide layer, and above the layer will be established for different synoptic conditions. These are currently unknown. The vertical mixing with reaction and transport aloft hypothesis in Section 3 will be tested. This is crucial to understanding the effect of one urban area's emissions on pollution levels on other central California urban areas during winter, especially for secondary aerosol components.

6.5.8 Winter Study Objective 8: Simulation Methods

Full-scale application of the most advanced emissions, meteorological, and air quality models will be applied to the winter episodes. The winter measurements will supply initial and boundary conditions as model inputs. They will supply parameters for deposition and dispersion. They will supply substantial data for comparison with model outputs in order to evaluate which components of the models are not representing the physical and chemical processes that occur during winter in central California.

Table 6.1-1.
Continuous Aerosol Measurements for the Winter Study.

Observable	Frequency	Avg Time	Monitoring Method[d] (code)	Total Number of Monitors (increment over annual)	Sites[a]
Light Scattering/$PM_{2.5}$ Mass	Daily	5-min	DUSTTRAK Nephelometer (A)	39 (3)	MIS, PARN, WAGT, ANGI, BAC, FSF, SDP, SJ4, ACP, AGBR, ALT1, BARS, BRES, BTI, CARP, CHL, COA, CRD, DUB1, EDI, EDW, FEDL, FEL, FELF, FRER, FRES, HELM, KCW, KRV, KWF, OLW, PAC1, PLE, SNFH, SWC, TEH2, TEJ, WAG, WLKP
$PM_{2.5}$ Mass	Daily	10-min	R&P $PM_{2.5}$ TEOM[c] (K)	5 (2)	BTI, SNFH, ANGI, BAC, FSF
NO_y/NO	Daily	5-min	Continuous NO_y Monitor with HNO_3 & NO_2 separation if possible (O)	5 (2)	BTI, SNFH, ANGI, BAC, FSF
Ammonia	Daily	5-min	Continuous NH_3 Monitor (S)	13 (13)	ANGI, ANGIT, BAC, BTI, DUB1, FSF, MIS, PARN, SDP, SJ4, SNFH, WAG, WAGT
Nitrogen Dioxide	Daily	5-min	Continuous NO_2 Monitor (N)	5 (2)	BTI, SNFH, ANGI, BAC, FSF
Nitric Acid	Daily	5-min	Continuous HNO_3 Monitor (R)	13 (13)	ANGI, ANGIT, BAC, BTI, DUB1, FSF, MIS, PARN, SDP, SJ4, SNFH, WAG, WAGT
$PM_{2.5}$ Sulfate	Daily	5-min	Continuous SO_4 Monitor (T)	8 (8)	ANGI, ANGIT, BAC, BTI, FSF, SNFH, WAG, WAGT
$PM_{2.5}$ Nitrate	Daily	10-min	Continuous Particle Nitrate Monitor (Q)	13 (13)	ANGI, ANGIT, BAC, BTI, DUB1, FSF, MIS, PARN, SDP, SJ4, SNFH, WAG, WAGT

Table 6.1-1.
Continuous Aerosol Measurements for the Winter Study.

Observable	Frequency	Avg Time	Monitoring Method[d] (code)	Total Number of Monitors (increment over annual)	Sites[a]
$PM_{2.5}$ Elemental/Organic Carbon	Daily	30-min	Continuous Carbon Analyzer (H)	5 (2)	ANGI, BAC, BTI, FSF, SNFH
PM_{10} Mass	Daily[b]	10-min	R&P PM_{10} TEOM[c] (J)	5 (2)	ANGI, BAC, BTI, FSF, SNFH
Particle Size Distribution	Daily	5-min	Grimm Optical Particle Counter (I)	11 (4)	ANGI, ANGI1, ANGI2, ANGI3, ANGI4, BAC, BTI, FSF, SNFH, WAG, WAGT
$PM_{2.5}$ Light Absorption/Elemental Carbon	Daily	5-min	Aethalometer (G)	13 (8)	ANGI, ANGIT, BAC, BTI, DUB1, FSF, MIS, PARN, SDP, SJ4, SNFH, WAG, WAGT
Ozone	Daily	5-min	Dasibi UV Absorption Photometer (P)	5 (2)	FSF[f], ANGI, SNFH, BAC[f], BTI
Sulfur Dioxide	Daily	5-min	Continuous SO_2 TEI 43S Monitor (Y)	1 (1)	BAC
Radicals	Daily	10-min	Radical Device (a)	1 (1)	ANGI
Hydrogen Peroxide	Daily	30-min	Peroxydaze (Z)	1 (1)	ANGI
PAN	Daily	30-min	Luminol or GC/EC (b)	1 (1)	ANGI

[a]Sites are described in Table 4.4-5.

[b]Measurements acquired everyday from 12/1/2000 through 1/31/2001

[c]Operated at filter equilibration temperature and relative humidity

[d]Methods will be specified after Methods Evaluation Study

[e]DUSTTRAK nephelometers already available at ANGI and BTI

[f]FSF and BAC possess ozone monitors, but data are reported only to the nearest 10 ppb instead of 1 ppb.

Table 6.1-2.
Episodic Aerosol Measurements for the Winter Study.

Observable	Frequency	Avg Time	Monitoring Method (code)	Number of Sites	Sites[a]
$PM_{2.5}$ Mass, Elements	15 Ep Days[b]	24-hr	FRM Single Filter Sampler/Teflon (E)	57 (0)	ATL,BAC,BGS,BRV,BSE,CCD,CHM,CLO,COP,CSS,ELM,FCW,FSE,FSF,GVL,HDB,JAC,KCG,LCR,LKL,LTY,LVF,MAG,MIS,MOJ,MRM,NLT,DAG,PARN,PIR,POL,RED,RGI,ROS,S13,SAL,SBC,SCQ,SDP,SFA,SGS,SJ4,SJT,SLM,SOH,SQV,SRF,SST,STL,TRU,UKC,VCS,VIA,VJO,WLN,TAS,Y
$PM_{2.5}$ Mass, Elements	15 Ep Days[b]	24-hr	FRM Sequential Filter Sampler/Teflon	0	
$PM_{2.5}$ Mass, Elements	15 Ep Days[b]	24-hr	FRM Speciation Sampler[f] (F)	29 (0)	BGS, CCD, CHM, CLO, COP, ELM, FSF, LCR, LTY, MOJ, MAG, MIS, MRM, PARN, POL, ROS, S13, SAL, SBC, SDP, SFA, SJ4, SOH, TRU, UKC, VCS, VIA, YAS, YOT
$PM_{2.5}$ Ions, Carbon	15 Ep Days[b]	24-hr	FRM Speciation Sampler[f] (F)	29 (0)	BGS, CCD, CHM, CLO, COP, ELM, FSF, LCR, LTY, MOJ, MAG, MIS, MRM, PARN, POL, ROS, S13, SAL, SBC, SDP, SFA, SJ4, SOH, TRU, UKC, VCS, VIA, YAS, YOT
$PM_{2.5}$ Mass, Elements	15 Ep Days[b]	3 to 6 hr[c]	Sequential sampler/Teflon (L)	5 (2)	ANGI, BAC, BTI, FSF, SNFH
$PM_{2.5}$ Mass, Elements, Ammonia, nitric acid	15 Ep Days[b]	24-hr	Minivol sampler/Teflon-Citric Acid, cloth NH_3 denuder (B)	23 (1)	ACP, AGBR, ALT1, BRES, BTI, CARP, DUB1, EDI, EDW, FEDL, FEL, FELF, FRER, FRES, HELM, KCW, KWF, OLW, PAC1, PLE, SNFH, SWC, TEH2
$PM_{2.5}$ Ions, Carbon, Nitric Acid	15 Ep Days[b]	24-hr	Minivol sampler/Denuder-Quartz-NaCl, cloth denuder (C)	17 (1)	ACP, AGBR, BRES, BTI, EDI, EDW, FEDL, FEL, FELF, FRER, FRES, HELM, LWF, OLW, PLE, SNFH, SWC
$PM_{2.5}$ Ions, Carbon	15 Ep Days[b]	3 to 6 hr[c]	Sequential sampler/Denuder-Quartz-NaCl (M)	5 (2)	ANGI, BAC, BTI, FSF, SNFH
Light Hydrocarbons	15 Ep Days[b]	5 to 6 hr[d]	Canister & GC/FID (U)	7 (4)	ANGI, BAC, BTI, OLW, PARN, SNFH, YOT
Heavy Hydrocarbons	15 Ep Days[b]	5 to 6 hr[d]	TENAX & GC/TSD/FID (V)	4 (4)	ANGI, BAC, BTI, SNFH
Particulate Organic Compounds	15 Ep Days[b]	5 to 6 hr[d]	Medvol Teflon coated glass fiber/PUF/XAD & GCMS (W)	4 (4)	ANGI, BAC, BTI, SNFH
Aldehydes	15 Ep Days[b]	5 to 6 hr[d]	DNPH & HPLC (X)	4 (4)	ANGI, BAC, BTI, SNFH
Particle Size Distribution, Nitrate, Sulfate, Ammonium	Intermittant on 15 Ep Days[b]	> 6 hr	MOUDI with Teflon substrate (c)	1	FSF
Particle Size Distribution, Organic and Elemental Carbon	Intermittant on 15 Ep Days[b]	> 6 hr	MOUDI with Aluminum substrate (d)	1	FSF
Particle Size Distribution, Ion Mass Spectra of Individual Particles	Intermittant on 15 Ep Days[b]	5-min	Aerosol Time Of Flight Mass Spectrometer	2 (2)	ANGI, BAC

[a]Sites are described in Table 4.4-5.

[b]Monitoring occurs on 15 days selected by forecast between 12/1/2000 and 1/31/2001.

[c] Five sampling periods of 0000-0500, 0500-1000, 1000-1300, 1300-1600, and 1600-2400 PST

[d]Four sampling periods of 0000-0500, 0500-1000, 1000-1600, and 1600-2400 PST

[e]BTI and SNFH upgraded to anchor sites for winter study.

[f]Special provisions may be needed to acquire samples on sequential days.

[g]24-hour measurement

Table 6.2-1.
Upper Air Meteorological Measurements for Winter Study.

Observable	Frequency	Avg Time	Monitoring Method	Number of Sites (increment over annual)	Annual Sites[a]	Additional Winter Sites[a]
Vertical wind speed & direction, 30-500 m agl	Daily	15-min	Radar Profiler	19 (6)	ANGI, CRO, EDI, EDW, ELN, HUR, MCK, MKR, MON, RSA, SAC, TRA, VIS	LGR, MEN, MTL, SAM, SJO, WIL
Vertical virtual temperature, 100-800 m agl	Daily	15-min	RASS	19 (7)	ANGI, CRO, EDI, ELN, HUR, MCK, MKR, MON, RSA, SAC, TRA, VIS	LGR, MEN, MTL, RBF, SAM, SJO, WIL
Vertical wind speed & direction, 100-2000 m agl	Daily	15-min	Sodar	11 (1)	RIC	ACP, ANGI, ELN, LGR, MEN, MKR, MTL, RBF, SJO, TRA
Vertical wind speed & direction, 10-10000 m agl	2-6/day[b], 15 days[c]	~1-min	Radiosonde	6 (2)	EDW, NTD, OAK, VBG	BAC, FSF
Vertical temperature, 10-10000 m agl	2-6/day[b], 15 days[c]	~1-min	Radiosonde	6 (2)	EDW, NTD, OAK, VBG	BAC, FSF
Vertical relative humidity, 10-10000 m agl	2-6/day[b], 15 days[c]	~1-min	Radiosonde	6 (2)	EDW, NTD, OAK, VBG	BAC, FSF

[a]See Table 4.6-1 for details

[b]Radiosondes normally at 0400, 1000, 1200, 1400, 1600 and 2200 PST at BAC and FSF.
Oakland supplemented with 1000, 1200, 1400 and 2200 PST.

[c]Monitoring occurs on 15 days selected by forecast between 112/1/2000 and 1/31/2001.

7. FALL MEASUREMENT PROGRAM

The fall measurement program is designed to understand the detailed causes of PM_{10} as well as $PM_{2.5}$ concentrations. The major component of the coarse particle fraction of PM_{10} during fall is fugitive dust. The major components of the $PM_{2.5}$ of PM_{10} are ammonium nitrate, organic carbon, and fugitive dust. A significant part of the organic carbon also arises from dust contributions owing to a 10% to 20% abundance of carbon in most central California dust emissions.

7.1 CRPAQS Fall Study Measurements

The fall study period is intended to bracket in time activities associated with the cotton harvest peak in the Corcoran area. The study domain in Figure 7.1-1 is of neighborhood rather than urban or regional scale. This is imbedded in the annual average monitoring measurements that take place on a regional scale. The main objectives of the Fall study are: 1) determine the zone of influence of and contributions from different fugitive dust sources; and 2) evaluate the causes of moderate ammonium nitrate concentrations under clear sky stagnation conditions.

The fall study will be conducted in and around Corcoran, CA, where the highest PM_{10} concentrations have been measured in previous years. Twenty-four hour duration PM_{10} samples will be acquired everyday on Teflon filters amenable to elemental analysis at the Corcoran and Hanford sites. These will be used to determine how PM_{10} and its coarse fugitive dust fraction throughout this period of traditionally high PM_{10} levels.

Figure 7.1-1 shows the satellite PM_{10} network that will be operated for 60 days between 9/1/2000 and 10/31/2000. Thirty-one satellite sites with portable PM_{10} nephelometers will be operated in and around the Corcoran area to detect dust clouds that move through the area and the contributions from nearby sources. These will be accompanied at five sites by Minivol PM_{10} samplers with Teflon and quartz filters to evaluate chemical composition. Measurements from the continuous monitors will be evaluated every two weeks over the 60-day campaign to determine which sites are hot-spots, and the Minivols will be moved throughout the networks to chemically characterize the PM_{10} at some of these sites.

Up to five surface meteorological stations will be located within and around the Corcoran satellite network to acquire five-minute average wind speed and wind direction. Measurements from these sites will be compared with the measurements from the long-term station at Corcoran to determine the extent to which it represents transport directions and dust suspension properties induced by meteorology. These measurements will also be used to assign directionality to pulses measured by continuous nephelometers and to relate these pulses to wind erosion during gusts.

A sodar will operate near the Corcoran airport to evaluate the evolution of the boundary layer and to quantify the potential transport distances of materials that are suspended above the surface layer.

These measurements complement and supplement those acquired as part of the long-term annual PM_{10} backbone network and the seven-site supplemental PM_{10} measurements in the annual study. Taken together, they constitute a large coverage of background, interbasin transport, intrabasin gradient, source-oriented, and community exposure sites, with special attention given to the central San Joaquin Valley. The sites in Figure 7.1-1 receptor zone of representation and source zone of influence sites.

7.2 Fall Special Studies

Two special studies will be conducted as part of the fall term measurement program: 1) in situ single particle quntification; and 2) fugitive dust marker measurements.

7.2.1 In Situ Single Particle Quantification

This experiment intends to examine individual particles to determine their formation mechanisms and sources. Time of flight mass spectrometers will be deployed for short periods at the Corcoran and Fresno sites to quantify the composition and size of individual particles. The timing, size, and chemical nature of individual particles with a large chemical component will be contrasted between these two sites to evaluate the extent to which urban and non-urban fugitive dust sources affect PM_{10} levels in a large metropolitan area (Fresno) and a nearby rural town (Corcoran).

7.2.2 Fugitive Dust Marker Measurements

Specific markers of different fugitive dust sources will be quantified on 24-hour PM_{10} samples in Fresno, Corcoran, and Angiola to distinguish between specific sources such as road dust, construction dust, and agricultural dusts associated with different crops and farming operations. Sampling and analysis methods for this part of the fall campaign will be finalized after the Fugitive Dust Characterization Study. This will be the first ambient test of chemical and physical markers found in distinct sources that might quantify their contributions to receptors. Marker categories include microscopic size and composition, pesticides, lipids, microbes, and fatty acids.

This study may require 24-hour PM_{10} samples at each site on: 1) Teflon membrane filters for high sensitivity XRF or PIXE analyses; 2) Teflon membrane filters for FTIR analysis; 3) quartz filters for ion and carbon analyses; 4) quartz filters for volatilization mass spectrometric analysis; 5) hivol quartz filters for detailed organic analysis; and 6) Nucelpore filters for microscopic analysis.

7.3 Uses of Fall Measurements to Attain Objectives

The following sub-sections briefly describe how the measurements described for the fall study will be used to accomplish each of the CRPAQS field study objectives specified in Section 1.

7.3.1 Fall Study Average Objective 1: Quality Data Base

Performance tests, quality audits, and measurement comparisons will be used to evaluate the accuracy, precision, validity, and completeness of the CRPAQS database. Special attention will be given to PM_{10} measurement accuracy and precision for measurements acquired in this study.

7.3.2 Fall Study Objective 2: Evaluate Backbone Network

Data will be used to evaluate the PM_{10} network, especially the sites that remain within the fall study domain.

7.3.3 Fall Study Objective 3: Temporal and Spatial Distributions

Spatial and temporal analyses similar to those specified in Section 5 will be applied to the PM_{10} measurements, especially those from the portable nephelometers. Commonalities and differences with respect to the $PM_{2.5}$ variations will be sought. The hypothesis, that the PM_{10} zone of representation is much smaller than the $PM_{2.5}$ zone of representation, will be tested by comparing chemical concentrations from the satellite sites.

7.3.4 Fall Study Objective 4: Boundary Layer and Regional Circulation

Micrometeorological and particle size measurements from the Angiola tower will determine which sizes attain elevations sufficient to be transported long distances by winds aloft. Horizontal winds aloft will be applied to concentrations measured at the top of the 100 m tower to estimate the directions and distances that coarse particles might reach populated urban areas.

7.3.5 Fall Study Objective 5: Source Zones of Influence and Contributions

Chemical and physical measurements will be used with the CMB model to estimate primary source contributions to ambient PM_{10} concentrations at Fresno and Angiola. The goal of these source apportionments will be to distinguish among paved road dust, agricultural dust, construction dust, and dust raised by wind from exposed areas. The urban and rural concentrations of fugitive dust markers will be compared and contrasted to determine how much urban and non-urban dust sources intermix.

7.3.6 Fall Study Objective 6: Secondary Aerosol Sources

Ammonia distributions measured in the satellite network will be examined to determine the zone of influence for ammonia emitters in the Corcoran area.

7.3.7 Fall Study Objective 7: Conceptual Model Refinement

The clear sky stagnation conceptual model will be examined and updated.

7.3.8 Fall Study Objective 8: Simulation Methods

Emissions models, especially for ammonia and fugitive dust, will be compared with ambient measurements and emissions surveys during this study period.

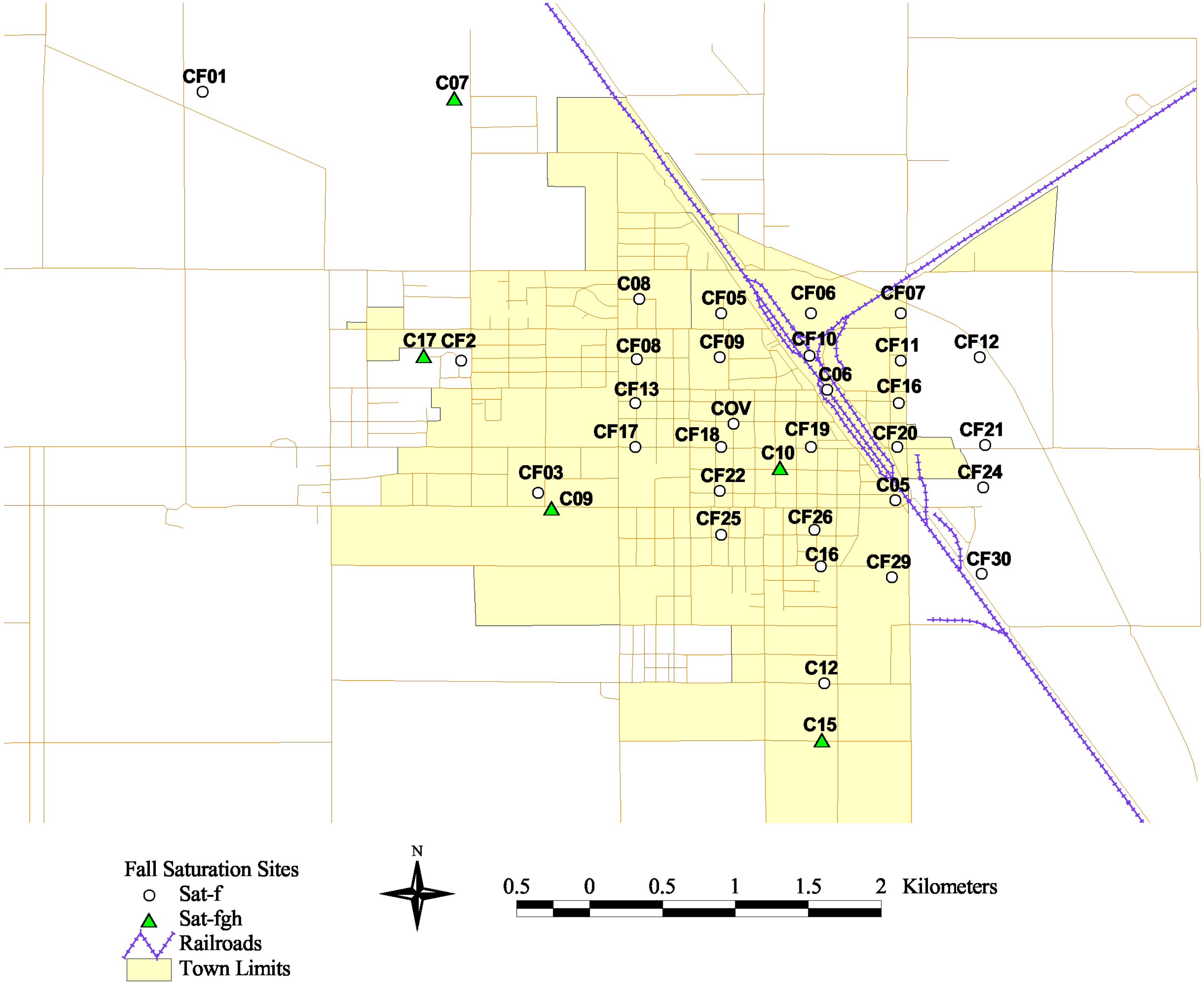

Figure 7.1-1. Locations of proposed fall study satellite sites.