1999 CALIFORNIA

PARTICULATE MATTER

MONITORING NETWORK

DESCRIPTION

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EXECUTIVE SUMMARY

This is the second particulate matter monitoring network description report documenting PM2.5 network design and implementation issues in California. On June 30, 1998, the Air Resources Board (ARB) and the air quality districts in California submitted the first report, *1998 California PM2.5 Monitoring Network Description*, to the Regional Administrator of the United States Environmental Protection Agency, Region 9 (U.S. EPA)(ARB, 1998). The current document, *1999 California Particulate Matter Monitoring Network Description*, fulfills the requirement for a 1999 update.

The PM2.5 monitoring network follows the regulations provided in Title 40 of the Code of Federal Regulations, Parts 50, 53, and 58, and published in the Federal Register on July 18, 1997. The goal of the PM2.5 monitoring program in California is to provide ambient data that support the State's air quality programs, including mass measurements and speciated data. Data from this program will be used for identifying nonattainment areas, development and tracking of implementation plans, assessments of regional haze, assistance for studies of health effects, and other ambient aerosol research activities.

This document provides an overview of the PM2.5 implementation effort in California to date and addresses the network expansion proposed for 1999, including the rationale for the various network components. In 1998, the network design effort focused on establishing monitoring sites to collect data for comparison to both the annual and the 24-hour PM2.5 National Ambient Air Quality Standards (NAAQS) and developing infrastructure for the program. The PM2.5 monitoring program in California now includes 78 community-oriented monitoring sites, 20 of which are collocated sites for quality assurance and quality control purposes, as well as five fully equipped laboratories for weighing PM2.5 Federal Reference Method (FRM) filters and a comprehensive quality assurance program.

This year's network design addresses the need for additional PM2.5 FRM mass measurements as well as other types of measurements, including continuous mass, speciation, and meteorological measurements. The proposal for network expansion in 1999 is summarized below:

- **FRM mass samplers** - Four additional community-oriented monitoring sites are proposed to collect data for NAAQS comparisons.
- **Continuous mass samplers**
  - Ten monitoring sites are proposed to collect continuous mass data for public reporting and/or better temporal representation. Eight of these sites are proposed to be located at the existing PM2.5 monitoring sites and two are proposed to be located at monitoring sites that currently do not have any PM2.5 monitoring equipment.
  - Three monitoring sites are proposed to collect data for background monitoring.
  - Two monitoring sites are proposed to collect data for transport assessment.

- **Speciation samplers**
  - Seven National Ambient Air Monitoring Stations (NAMS) sites are proposed to collect data for determining long-term trends of selected PM2.5 constituents.
  - State and Local Air Monitoring Stations (SLAMS) sites are proposed to be phased-in over the next three years to allow for time to better evaluate unproven sampling technologies. The deployment will proceed in three phases. The first phase includes special monitoring studies that will provide information useful for comparing the performance of different sampling technologies in the field. These studies are listed in the next paragraph. Then, a limited number of speciation sites will be proposed for deployment in the summer of 2000, and finally, the remaining sites will be proposed for deployment in 2001.
- **IMPROVE network -** IMPROVE sites are proposed to collect data for a regional haze program. These sites will augment the PM2.5 monitoring program by providing useful speciation and background concentration data.
- **Meteorological equipment -** Two monitoring sites are proposed to collect meteorological data for transport assessment.

Appendix A provides a table of community-oriented SLAMS sites in California along with operating agency, type of monitor, sampling begin date, sampling schedule, and supporting lab. Appendix B includes a table of existing and proposed PM2.5 monitoring sites in California and lists types of PM2.5 samplers operating at each site, including FRM, continuous mass, speciation, and dichot samplers.

Due to recent advances in monitoring technology, selecting a continuous mass sampler and speciation sampler for the California network presents major challenges. A few special studies in California will provide information useful in evaluating different monitoring technologies. The Air Resources Board, the California Regional PM10/PM2.5 Air Quality Study, and the University of California, Davis, conducted a one-month evaluation of particulate matter (PM) sampling technologies at Bakersfield in January of 1999. Upcoming special monitoring studies in central California, including the Fresno "Supersite Study" and the California Regional PM2.5/PM10 Air Quality Study, will provide opportunities to test and evaluate emerging speciation sampling systems. An evaluation that might be a scaled-down version of the Fresno "Supersite Study" is proposed in southern California where the meteorological conditions, source contributions, and aerosol chemical composition are different than in central California. Unlike the central California studies, which are being funded independently, the evaluation in Southern California is proposed to be funded from the Section 103 grant money allocated to Region 9 for PM2.5 monitoring.

1. INTRODUCTION

On July 18, 1997, the United States Environmental Protection Agency (U.S. EPA) promulgated new National Ambient Air Quality Standards (NAAQS) for particulate matter (PM) in 40 Code of Federal Register (CFR) Parts 50 (U.S. EPA, 1997a), 53, and 58 (U.S. EPA, 1997b). The NAAQS apply to the mass concentrations of particles with aerodynamic diameters less than 2.5 µm (PM2.5) and 10 µm (PM10). The U.S. EPA regulations require that the states submit an annual PM2.5 monitoring network description to the Regional Administrator by July 1. On June 30, 1998, the Air Resources Board and the air quality districts in California, submitted the first report, *1998 California PM2.5 Monitoring Network Description*, to the Regional Administrator of the U.S. EPA, Region 9 (ARB, 1998). The current document, *1999 California Particulate Matter Monitoring Network Description*, fulfills the requirement for a 1999 update.

There is some uncertainty concerning the future of the PM2.5 standards as a result of a recent decision in a legal challenge to the new standards. On May 14, 1999, a U.S. Court of Appeals for the District of Columbia Circuit vacated the revised national standards for PM10, declared the eight-hour ozone standard unenforcable, and asked for additional information to decide whether the PM2.5 standards should remain in place or be vacated. Since the court has not vacated the PM2.5 standards, the monitoring program remains in place. The Air Resources Board and the local air quality districts in California are proceeding with the network development as outlined in this plan. The U.S. EPA had previously committed to complete the next review of the standards in 2002, prior to setting the planning and control process in motion with area designations. Regardless of the legal outcome of this challenge, the U.S. EPA has the opportunity to reestablish fine particulate matter standards in 2002 without affecting the current schedule for State Implementation Plans (SIPs) in 2006-2008. Data from the monitoring network will provide valuable information on the nature and extent of particulate matter pollution nationwide to support the review of the standards and anticipated SIPs to reduce fine particle pollution. This information will also be useful in refining control strategies in current nonattainment areas for the pre-existing federal PM10 standards and to continue progress towards the state PM10 standards. For more information on the potential impacts of the court decision on California's air quality programs, see ARB's website at http://www.arb.ca.gov/aqs/aqs.htm.

Data from the PM2.5 monitoring program will be used for PM2.5 NAAQS comparisons, development and tracking of implementation plans, assessments of regional haze, assistance for studies of health effects, and other ambient aerosol research activities. In 1998, the California Air Resources Board (ARB) and the local air quality management districts established a comprehensive network of community representative (core) PM2.5 monitoring sites and developed an infrastructure for the program (ARB, 1998a). As a result, the PM2.5 monitoring network in California now includes 78 core monitoring sites, 20 collocated samplers for quality assurance and quality control purposes, and five fully equipped laboratories for weighing PM2.5 Federal Reference

Method (FRM) filters. The monitoring program also includes a comprehensive quality assurance program.

In 1999, the ARB and the local air quality districts plan to install additional types of monitoring instruments at the existing PM2.5 FRM sites and add ten new monitoring sites. The monitoring instruments proposed for deployment include FRM mass samplers, continuous mass samplers, speciation samplers, and meteorological equipment. The speciation network will include two elements: National Air Monitoring Stations (NAMS) for measurement of long-term trends of selected PM2.5 constituents, and State and local sites (SLAMS) to collect data needed to develop effective State Implementation Plans (SIPs). While the NAMS sites will be selected under U.S. Environmental Protection Agency (U.S. EPA) directives, the ARB and the air quality districts have flexibility to design the State and local portion of the speciation network. The State and local speciation network in California will be phased in over a three-year period (1999-2001) to allow time for evaluating newly emerging measurement technologies.

The statewide PM2.5 monitoring network will be integrated with special monitoring studies planned for California, including the Fresno "Supersite Study" and the California Regional PM2.5/PM10 Air Quality Study (CRPAQS). Among other activities, these special studies will test and evaluate new monitoring methods not currently used in the routine monitoring of particulate matter.

This document summarizes the PM2.5 network elements funded in 1998 (Chapter 2), describes additions to the network planned for 1999 (Chapter 3), and identifies the proposed sampling frequencies (Chapter 4). Chapters 5 and 6 outline quality assurance and data distribution and analysis. Monitoring programs that were set up in California to monitor fine particulate matter before the U.S. EPA established PM2.5 standards are described in Chapter 7. The document was prepared by the ARB and incorporates comments from the air quality districts and the public.

2. OVERVIEW OF PM2.5 MONITORING NETWORK FUNDED IN 1998

The primary objective of the PM2.5 monitoring program is to identify areas where PM2.5 concentrations exceed one or both of the national PM2.5 standards, i.e., annual and 24-hour standards (U.S. EPA, 1997a). During 1998, the first year of the PM2.5 monitoring program, the ARB and the air quality districts designed a comprehensive network of monitoring sites to collect data for comparison to both standards (ARB, 1998). The network now includes 78 monitoring sites, referred to as core State and Local Air Monitoring Stations (SLAMS).

2.1. Sampling Design

For the purpose of planning a PM2.5 monitoring network, the ARB and the local air districts divided the state into areas called Monitoring Planning Areas (MPAs). The

State is divided into 18 MPAs, as shown in Figure 2.1-1. They are determined to be the best divisions for the PM2.5 monitoring network planning based on an analysis of population, political boundaries, geography, and meteorology. With few exceptions, the boundaries of MPAs correspond to the boundaries of the various air basins in the State.

They are not intended for designating areas as attainment or nonattainment or for determining specific PM2.5 control measures. The boundaries to be used for these purposes will not be established until adequate PM2.5 data are available. The ARB and the local air districts will recommend appropriate nonattainment boundaries to the U.S. EPA in 2002/2003.

The following is the list of network design objectives that were given the highest priority during the PM2.5 network design:

- Satisfy the U.S. EPA core monitoring requirements.
- Represent California air basins and provide geographical representation.
- Represent high concentrations in populated areas.
- Characterize emission sources in high concentration areas.
- Consider the needs of ongoing special health studies for particle measurements.

The ARB and the local air quality districts analyzed all available information to develop a list of sites that would best satisfy these objectives. Preference was given to adapting existing sites to PM2.5 monitoring. The optimal site locations were selected based on the following factors:

- Population statistics.
- Land use characteristics.
- Climate.
- Suspected area emission sources (e.g., wood smoke, agricultural burning, etc.).
- Existing monitoring network.
- Existing particulate matter data, including dichot data and PM10 data.
- Potential transport corridors.
- Ongoing special health studies.

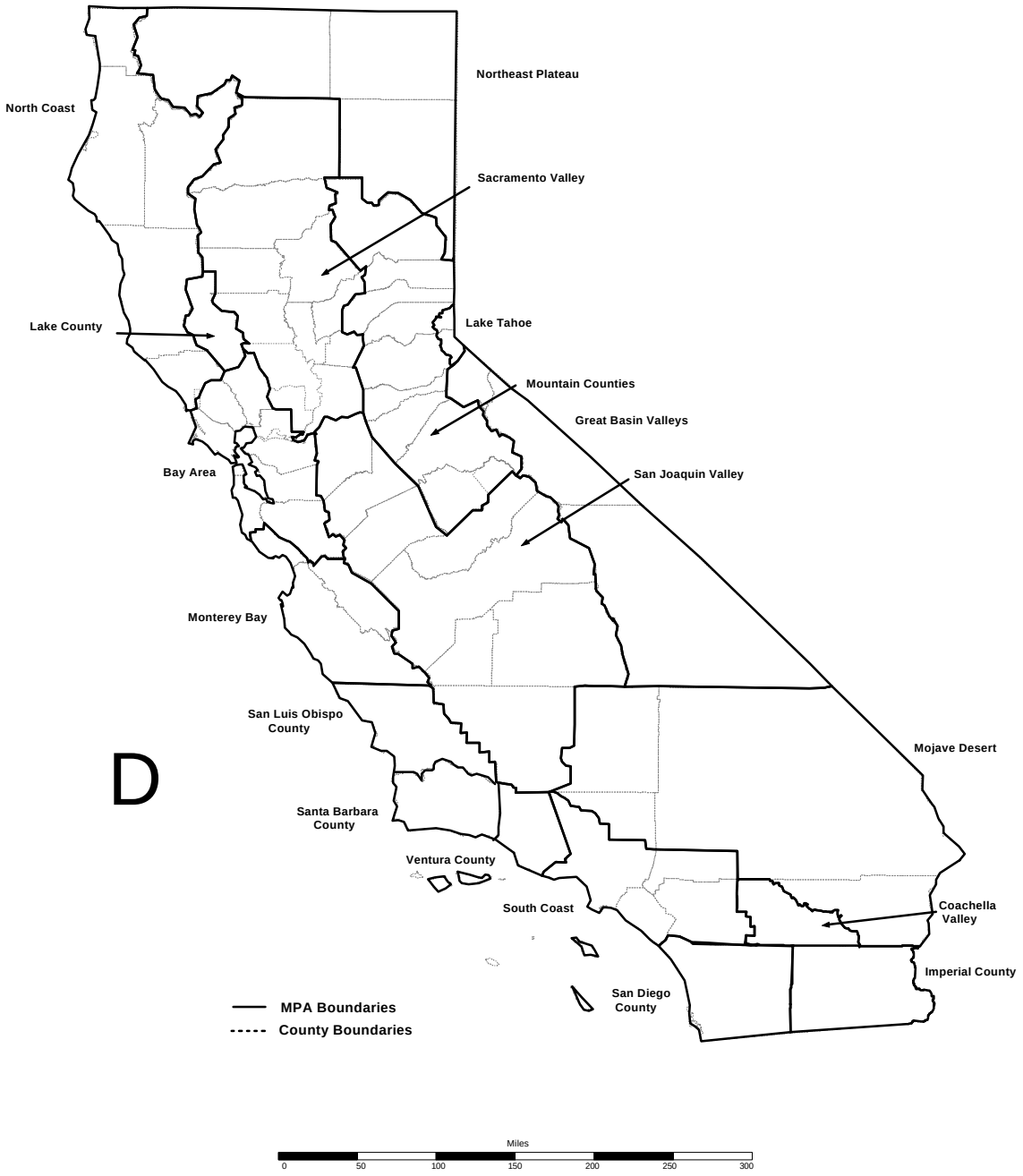

Figure 2.1-1 California PM2.5 Monitoring Planning Areas

The PM2.5 network funded in 1998 includes 78 core monitoring sites for determining compliance with the PM2.5 National Ambient Air Quality Standards (NAAQS). Figure 2.2-1 shows the locations of the proposed sites. Only data from core sites are eligible for comparison to both the annual and 24-hour PM2.5 NAAQS. Each core site meets the following characteristics:

- Population-oriented location.
- Neighborhood zone of representation.
- FRM measurement method.

A population-oriented location means that the site is situated to measure exposure where people live, work, and play. The neighborhood zone of representation means that the 24-hour concentrations within an area whose diameter is between 0.5 and 4 km should vary by no more than ±10 percent.

In addition to collecting data to determine attainment status with regard to both of the new PM2.5 standards, many core sites satisfy other monitoring objectives, including transport assessment and assistance in health studies. Each of the California air basins has at least one core PM2.5 monitoring site. Air basins with high population and expected high PM2.5 concentrations have additional monitoring sites to provide better geographical representation.

2.2. Sampler Acceptance Testing

The PM2.5 samplers used in the California PM2.5 Ambient Air Quality Monitoring Network have been designated and certified as FRM samplers by the U.S. EPA. The monitoring network in California includes two types of FRM samplers: sequential Reference Ambient Air Sampler (RAAS) 2.5-300 manufactured by Andersen Instruments and single channel Partisol®-FRM Model 2000 sampler manufactured by Rupprecht & Patashnick (R&P). The sequential FRM samplers have been deployed in high population and/or high concentration areas to accommodate more frequent sampling (everyday or 1-in-3-day). The single channel FRM samplers have been deployed in less populated areas with PM2.5 concentrations estimated to be below the standards.

Prior to field installation, the ARB assembled the samplers and performed acceptance testing in the laboratory, adhering to the Acceptance Test procedure in Appendix E of the PM2.5 Quality Assurance Project Plan (QAPP). The acceptance testing included external and internal leak checks, and temperature, pressure, and multi-point flow rate verification checks. If any of these parameters were out of specification, the ARB contacted the vendor for initial corrective action. Each sampler that passed acceptance testing was delivered to a monitoring site. After each instrument was installed at a site, the field operators checked its performance. Samplers that performed within specifications in the field were considered ready for routine operation.

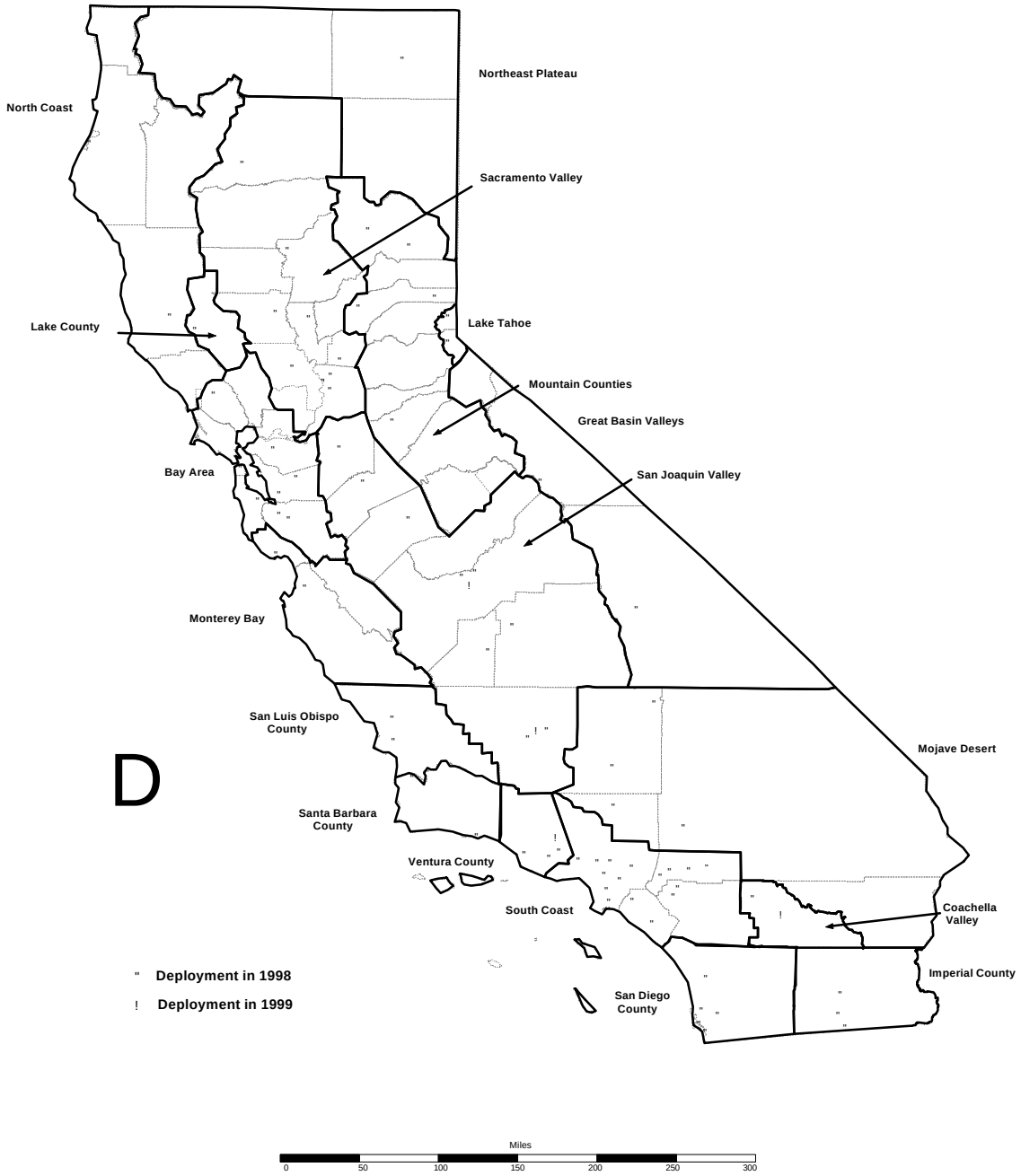

Figure 2.2-1 Federal Reference Method (FRM) Mass PM2.5 Monitoring Sites (With Monitoring Planning Areas and Counties)

The ARB and the local air quality districts purchased samplers through the National Procurement Contract. Information about the samplers is summarized in Table 2.2-1.

Table 2.2-1 PM2.5 FRM Samplers Purchased in 1998

Sampler Type	Manufacturer	Number of Samplers by Function		
		Primary	QA/QC	Total
Sequential FRM	Andersen	62	16	78
Single Channel FRM	R&P	16	4	20
Total		78	20	98

The ARB and the local air quality districts routinely collect mass results from trip blanks and field blanks sent with the sets of filters distributed for ambient air monitoring. The trip blanks are sent to field sites where they are left untouched and returned to the lab with other samples. The field blanks are sent to the field, placed in the sampler without sample air being drawn through them, and returned to the lab with the other samples. Several air quality districts in California have measured weight gains on the field blanks that exceeds a field blank acceptance criteria of ± 30 micrograms. This creates the potential for reporting PM2.5 concentrations higher than the actual ambient concentrations. Many factors involved in the measurement process may contribute to the weight gain, including: passive loading in the sampler, filter handling and cleaning techniques, and off-gassing of the delrin rings used in the samplers. The districts and the ARB follow the "Interim Guidance for Operation of Andersen RAAS PM2.5 Sequential Filter Sampler System" drafted by the U.S. EPA (http://www.epa.gov/ttn/amtic/files/cfr/recent/importan.pdf). This guidance includes the following measures:

- **Collecting more frequent field blanks and trip blanks to assist in characterizing the problem**. The ARB and the local air quality districts have increased the number of field blanks on a case-by-case basis. At some monitoring sites, the number of field blanks collected is 20% to 40% of the number of samples, instead of the 10% required by the U.S. EPA. Sites that have measured excessive weight gain on the field blanks, like Ontario-Airport and Riverside-Rubidoux in the South Coast Air Basin, collect a field blank with every sample. This puts a large burden on the field staff and on the labs.
- **Operating the sequential sampler in manual mode to maximize the collection of high quality PM2.5 samples.** The South Coast AQMD operates all of the PM2.5 samplers in manual mode. As a result, all monitoring sites in the South Coast Air Basin MPA and Coachella Valley MPA operate on a 1-in-3-day schedule instead of the originally recommended everyday sampling at five sites and 1-in-3-day sampling at the remaining sites.

Andersen Instruments redesigned the backplate/inlet filter to try to eliminate the potential for passive sampling. The ARB and the South Coast Air Quality Management District have tested redesigned instruments in the field. The South Coast AQMD is analyzing the data and will write a final report. The preliminary results do not show appreciable differences between the two designs, possibly because the ambient air PM2.5 concentrations were quite low during the study period.

The Monitoring and Laboratory Division (MLD) of the ARB designed a second retrofit. This retrofit includes a filter that slides on top of the filter carousel. The ARB is testing this instrument in the field.

2.3. Sampler Deployment

The installation of PM2.5 sites began in 1998 and is continuing in 1999. The current deployment status is summarized in Appendix A. The samplers were deployed in roughly a priority order as follows. The sites estimated to have the highest PM2.5 concentrations in each MPA (based on dichot and/or PM10 data) were installed first. Areas with estimated PM2.5 concentrations close to the PM2.5 standards and areas where PM2.5 concentrations are highest during the fall and winter were also given high priority. Existing dichot sites were favored for early deployment in an effort to collect data for the comparison of the dichot and FRM measurement methods. The dichot data will be used for an early indication about the attainment status. Another criterion for determining deployment was to ensure that each operating agency received at least one sampler early on to gain experience in operating the instrument.

A few monitoring sites have not yet been deployed. They are listed in Table 2.3-1.

Table 2.3-1 Monitoring Sites Funded in 1998, Beginning Sampling After May 1999

MPA/Site Location	**Sampling Begin Date**[1]	**Reason**
Bay Area AQMD Livermore	7/1/99	The area surrounding the existing site in Livermore has changed and the site no longer meets siting criteria. The District is looking for a replacement site.
Great Basin Unified APCD Mammoth Lakes-Gateway HC	7/1/99	The building, which houses the Mammoth site, was extensively renovated. The site was closed during the renovation.
Lake Tahoe Air Basin North-West Lake Tahoe	9/1/99	This will be a new site. The search for a site was delayed due to winter weather.
Mojave Desert Air Basin Ridgecrest	7/1/99	In the 1998 network plan, this site was referred to as Ridgecrest-Las Flores Avenue. Since the Ridgecrest-Las Flores Avenue site could not be used for PM2.5 monitoring, a new site was established.
Mountain Counties Air Basin Truckee Fire Station	6/1/99	Samplers (primary and collocated) were installed in late fall/early winter. The actual sampling was delayed due to operational problems combined with difficulties in servicing instruments due to cold weather and snow.
South Coast Air Basin Mission Viejo	6/1/99	In the 1998 network plan, this site was referred to as Lake Forest. The Lake Forest site was relocated from the fire station in the city of Lake Forest to the water district in the city of Mission Viejo due to the loss of the lease. The new site is about 3/4 mile away from the old site.

[1] All dates are approximate.

The deployment of a few monitoring sites was delayed. The three monitoring sites in Mountain Counties Air Basin, i.e., Quincy-North Church Street, Portola, and Truckee-Fire Station, were deployed in late fall/early winter. Field staff experienced numerous operational problems, but could not service the instruments due to the extreme cold weather. As a result, the actual sampling was delayed. The monitoring sites at Quincy and Portola began sampling in March of 1999 (3/26/99 and 3/25/99, respectively). As of May 10, 1999, the sampler at Truckee is expected to be in operation by June 1, 1999. The performance of the sequential FRM sampler in cold weather (typical for these locations) will be re-evaluated next winter. The samplers will be expected to operate with only minimal service during wintertime (e.g., changing filters and minor repairs) because repairs taking longer than few minutes can not be accomplished during extremely cold weather. This is especially important in the Mountain Counties Air Basin where the PM2.5 concentrations are highest during the winter months.

The San Joaquin Valley APCD established a new site for PM2.5 and PM10 monitoring in Merced. In the 1998 network plan, this site was referred to as Merced-"Midtown" and is now called Merced-M Street. Sampling began on April 12, 1999. The site has a PM2.5 FRM sampler and a PM10 SSI sampler.

The Santa Maria-Library monitoring site in the Santa Barbara County APCD was relocated due to the loss of the lease. Sampling began on May 1, 1999, at the new location.

3. PM2.5 NETWORK EXPANSION IN 1999

As described earlier, the ARB and the districts developed a comprehensive network of PM2.5 core sites in 1998 to collect data for determining attainment designations. This network will be expanded in 1999 by adding ten new monitoring sites for additional purposes and by adding other types of monitoring equipment at the existing sites. This section addresses each element of the PM2.5 network eligible for funding as part of the U.S. EPA's 1999 Section 103 Grant. Included are FRM samplers, continuous mass samplers, speciation samplers, and meteorological equipment. Appendix B summarizes the main types of PM2.5 monitoring instruments at each PM2.5 monitoring site.

3.1. FRM Mass Samplers

In 1999, four monitoring sites operating FRM samplers will be added to the PM2.5 network. Three of these sites, Bakersfield-"Southeast", Fresno-"Southeast", and Palm Springs-Fire Station, were selected to satisfy the U.S. EPA requirements for adequate coverage in heavily populated areas.

Two new core PM2.5 SLAMS sites will be established in 1999 in the San Joaquin Valley MPA, Bakersfield-"Southeast" and Fresno-"Southeast". As indicated by the tentative names of the sites, they will be located in the southeastern part of the respective cities where, based on the 1995 Integrated Monitoring Study (IMS95) (Solomon et al., 1999), high PM2.5 concentrations are expected. Each site will collect PM2.5 data in a predominately residential area to determine exposures of large numbers of people. The San Joaquin Valley APCD determined that none of the existing sites in Fresno and Bakersfield that do not yet have an FRM sampler could fulfill these monitoring objectives. They either do not meet the average population-oriented exposure requirement or the minimum PM2.5 siting requirements. The ARB will operate the Bakersfield-"Southeast" site and the San Joaquin Valley APCD will operate the Fresno-"Southeast" site. The Bakersfield-"Southeast" site is proposed to be located at the Bakersfield Municipal Airport. The ARB is in the process of negotiating a lease agreement and expects to begin sampling in the summer of 1999. The Fresno-"Southeast" site is proposed to be located near the Fresno Fairgrounds, south of Ventura Avenue and east of Cedar Avenue.

The Palm Springs-Fire Station monitoring site, proposed for the deployment of a PM2.5 FRM sampler in 1999, is an existing site located in a residential area of the Coachella Valley MPA. In 1998, the South Coast AQMD deployed only one PM2.5 core SLAMS site in the Coachella Valley MPA. The population of Coachella Valley is expected to grow from 267,000 in 1990 to 598,000 in 2020. The PM2.5 data from Palms Spring will help define the boundaries of the attainment/nonattainment areas and identify transport corridors. The Palm Springs-Fire Station monitoring site has collected PM10 data since 1987. The PM10 data for the last eight years are summarized in Table 3.1-1.

Table 3.1-1 Summary of 1990-1997 PM10 Data from Palm Springs-Fire Station

(Data in micrograms per cubic meter)

Year	Number of Samples	Highest 24-hour Concentrations				AAM[1]
		1st	2nd	3rd	4th	
1990	59	83	82	74	60	34.21
1991	56	197	124	98	71	43.39
1992	60	175	66	53	52	29.72
1993	60	58	50	49	48	26.85
1994	60	55	51	50	48	27.72
1995	56	68	56	46	44	27.44
1996	61	130	88	50	47	29.11
1997	59	63	50	44	42	27.06

[1] Annual Arithmetic Mean Concentration.

The fourth site, which is not required by the regulation, is proposed to be located at an existing monitoring site at Piru, in the northeastern portion of Ventura County. The PM2.5 data collected at this site would represent the ambient PM2.5 concentrations in the

Santa Clara River Valley, which includes the cities of Santa Paula and Fillmore and the community of Piru. The total population of the valley is about 45,000 and it continues to grow. There are no area source emissions "hot spots" or major point sources near this site. The Santa Clara River Valley is in a heavily traveled corridor that connects to a highly populated portion of Los Angeles County (Santa Clarita). The monitoring site at Piru has collected PM10 data since 1985. The PM10 data for the last eight years are summarized in Table 3.1-2. For the last eight years, the annual average PM10 concentrations at Piru were about twice the level of the PM2.5 annual standard and the maximum 24-hour PM10 concentrations exceeded the level of the PM2.5 24-hour standard (with the exception of 1994 and 1995).

Table 3.1-2 Summary of 1990-1997 PM10 Data from Piru

(Data in micrograms per cubic meter)

Year	Number of Samples	Highest 24-hour Concentrations				AAM[1]
		1st	2nd	3rd	4th	
1990	56	133	128	61	55	34.84
1991	60	79	79	68	63	36.35
1992	60	67	66	63	53	30.72
1993	59	118	57	53	53	28.55
1994	61	58	53	50	48	28.93
1995	59	64	60	55	51	27.68
1996	59	100	79	76	72	29.26
1997	61	140	93	87	67	32.39

[1] Annual Arithmetic Mean Concentration.

The only PM2.5 data collected at Piru are from a special study conducted by the Ventura County Air Pollution Control District in 1996-1997 (Mikel et al., 1997). The study was conducted using ARIMETRICS Mini-Vol saturation samplers. The maximum 24-hour average concentration at Piru was 48 $\mu g/m^3$ and the annual average was 15.2 $\mu g/m^3$.

3.2. Continuous Mass Samplers

Continuous PM2.5 mass samplers will collect diurnally resolved data. These data will be used for public reporting, understanding diurnal and episodic behavior of fine particles, background monitoring, and transport assessment. Figure 3.2-1 shows the locations of the proposed continuous PM2.5 samplers.

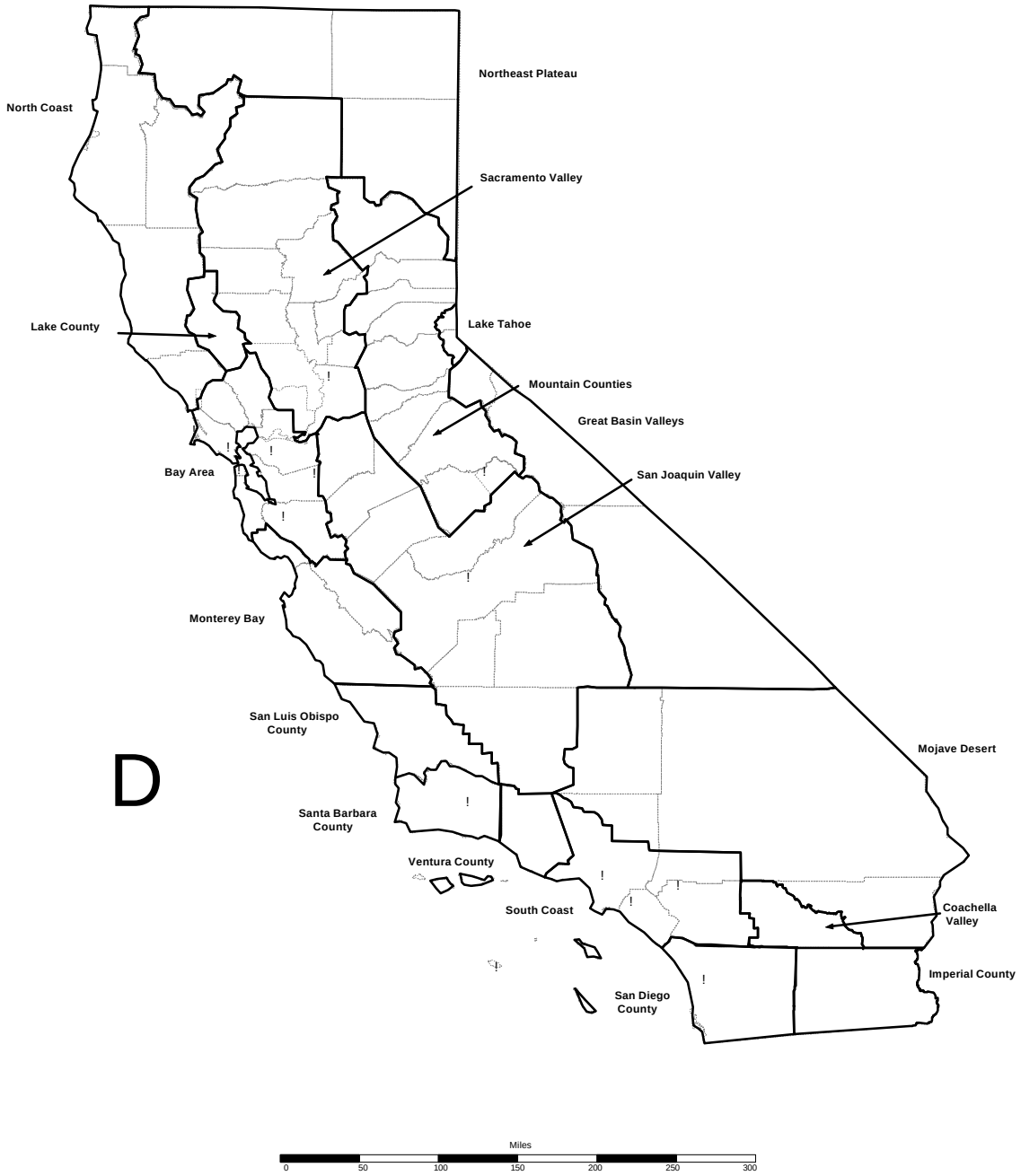

Figure 3.2-1 Proposed PM2.5 Continuous Mass Monitoring Sites

(With Monitoring Planning Areas and Counties)

3.2.1. Public Reporting and Better Diurnal Representation

The ARB and the local air quality districts in California propose to deploy ten continuous samplers in California in 1999 for public reporting and/or better temporal representation. The candidate sites were selected based on the following criteria:

- High population density.
- Estimated or measured high PM2.5 concentrations.
- Ongoing health studies.
- Ongoing studies designed to improve understanding the physics and chemistry of high PM concentrations.

The proposed sites are listed in the Table 3.2-1. Eight of these sites are required in metropolitan areas with a population greater than 1 million (U.S. EPA, 1997c). The two sites not required by the regulation are Fresno-1st Street in the San Joaquin Valley MPA and Yosemite Village in the Mountain Counties MPA.

Table 3.2-1 Proposed Continuous Samplers for Public Reporting and/or Better Diurnal Representation

Monitoring Planning Area	MSA/PMSA	Monitoring Site
Mountain Counties	Not in an MSA	Yosemite Village
Sacramento Valley	Sacramento, PMSA	Sacramento-Del Paso Manor
San Diego	San Diego, MSA	Escondido
San Francisco Bay Area	Oakland, PMSA	Prescott Park[1]
	San Francisco, PMSA	San Francisco-Arkansas
	San Jose, PMSA	San Jose-4th Street
San Joaquin Valley	Fresno, PMSA	Fresno-1st Street
South Coast	Los Angeles-Long Beach, PMSA	Los Angeles-North Main St.
	Riverside-San Bernardino, PMSA	Riverside-Rubidoux
	Orange County, PMSA	Anaheim

[1] This is a tentative proposal contingent upon this site receiving funding as part of the U.S. EPA grant program, Environmental Monitoring for Public Access and Community Tracking (EMPACT). The continuous PM2.5 mass sampler would be funded as part of the PM2.5 network. All other monitoring equipment proposed at this site would be funded as part of the EMPACT project. If the site is not funded as part of the EMPACT project, the ARB and the Bay Area AQMD will coordinate on the selection of another site in west Oakland.

None of the Metropolitan Statistical Areas in the San Joaquin Valley MPA is required to operate a continuous PM2.5 sampler. However, a continuous sampler is proposed for deployment in the Fresno MSA for the following reasons:

- The population of the Fresno MSA is now close to one million.
- The PM2.5 data collected using a dichotomous sampler indicate that this site will exceed the annual standard and it may also exceed the 24-hour standard. The dichot data are summarized in Table 3.2-2.
- The air quality "Supersite" established at Fresno-1st Street will benefit from having a continuous instrument.

Table 3.2-2 Summary of 1990-1997 PM2.5 Dichot Data from Fresno-1st St.

(Data in micrograms per cubic meter)

Year	Number of Samples	Highest 24-hour Concentrations				AAM[1]
		1st	2nd	3rd	4th	
1990	42	76	67	62	61	21.33
1991	60	92	92	86	86	25.92
1992	56	71	68	64	60	21.60
1993	60	92	74	72	67	21.47
1994	55	80	68	66	61	23.24
1995	63	65	61	54	52	17.99
1996	62	56	41	37	33	15.86
1997	57	105	65	59	47	18.66

[1] Annual Arithmetic Mean Concentration.

The monitoring site at Yosemite Village in the Mountain Counties MPA was also selected to have a continuous PM2.5 sampler funded in 1999. This sampler is not required by the regulation. Limited PM10 data from the Yosemite Village site indicate the potential for high PM2.5 concentrations (Table 3.2-3). Since Yosemite is a popular tourist destination, a continuous sampler that can measure real-time concentrations is preferred over the filter-based FRM sampler. The real-time concentrations can be used to issue alerts or to implement periodic control strategies (e.g., burning bans and no-drive days).

Table 3.2-3 Summary of 1990-1997 PM10 Data from Yosemite Village

(Data in micrograms per cubic meter)

Year	Number of Samples	Highest 24-hour Concentrations				AAM[1]
		1st	2nd	3rd	4th	
1990	65	209	190	156	124	40.90
1991	56	350	210	125	101	47.82
1992	57	104	81	60	55	30.87
1993	53	126	72	58	52	30.54
1994	60	115	98	73	66	34.59
1995	56	71	65	62	58	27.97
1996	46	106	96	82	52	21.88
1997	56	62	39	36	34	21.47

[1] Annual Arithmetic Mean Concentration.

Currently available instruments for continuous measurements of suspended particulate mass may have shortcomings. The Tapered Element Oscillating Microbalance (TEOM) sampler uses a heated inlet, which causes evaporation of some of the volatile components of the air sample. The Beta Attenuation Monitor (BAM), which samples at ambient temperatures and relative humidities, may overestimate particle concentrations by allowing liquid water to be collected along with particles. Several models of continuous mass samplers were operated in the field, side by side with conventional PM sampling technologies for approximately four weeks in Bakersfield, California during January 1999. Section 4.3.3 contains a brief description of the Bakersfield study. The final report is due in July. At that time, the ARB plans to send a letter to the air quality districts in California with recommendations regarding continuous mass samplers for the California PM2.5 monitoring network.

3.2.2. Background Monitoring

Background sites are intended to quantify regionally representative PM2.5 concentrations for sites located away from populated areas and other significant emission sources. Background concentrations for the PM2.5 program are defined as concentrations that would be observed in the absence of anthropogenic emissions of PM and the aerosol particles formed from anthropogenic precursor emissions of VOC, NO_x, and SO_x. Background monitoring data are important for developing control plans in areas expected to exceed PM2.5 standards. The following background sites are proposed in California:

- Northern California background site - Proposed to be located at the existing Point Reyes National Seashore IMPROVE site.

- Two southern California background sites - One site is proposed to be located at the proposed San Rafael Wilderness IMPROVE site. The other site is proposed to be located on San Nicolas Island.

The Point Reyes National Seashore and San Rafael Wilderness monitoring sites will have IMPROVE samplers (installed as part of the IMPROVE network) operating in parallel with continuous PM2.5 samplers. By siting the PM2.5 background monitoring at IMPROVE sites, analysts can take advantage of historical and current IMPROVE data. The IMPROVE data, along with continuous PM2.5 data, would be useful in identifying divergences from background conditions, such as impacts of wildfires and sea salt. For example, the 1995 chemical speciation data from Point Reyes indicate that the largest contributor to fine particulate matter concentrations is sea salt (26%), followed by sulfate (18%), organic carbon (16%), and nitrate (13%). A strong correlation between sodium and chloride concentrations at this site indicates that both species come from the same emission source, most likely sea salt spray. The PM2.5 concentrations further inland, where the sea salt spray is not expected to be a factor, can be estimated by subtracting the sea salt mass from the total mass measured at the coastal background site. The relatively strong seasonal variation in PM2.5 species concentrations further supports the need for speciation sampling at background sites. At Point Reyes, sulfate concentrations were highest in the summer and lowest in the winter. Nitrate showed the opposite trend, with highest concentrations in the winter and lowest in the summer. The 1995 chemical speciation data from Point Reyes are summarized in Tables 3.2-4 and 3.2-5.

Table 3.2-4 Statistical Summary of PM2.5 Data at Point Reyes (IMPROVE Program, 1995)

Pollutant	Average ($\mu g/m^3$)	Minimum ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	Number of Observations
PM2.5 Mass	6.53±0.05	0.62	25.28	81
Sulfate ($SO_4^=$)	1.16±0.01	0.16	3.69	81
Chloride (Cl^-)	0.98±0.01	0.03	5.26	81
Sodium (Na)	0.75±0.01	0.05	3.46	81
Nitrate (NO_3^-)	0.82±0.02	0.04	9.64	81
Ammonium (NH_4^+)	NA	NA	NA	NA
Organic Carbon (OC)	1.04±0.01	0.20	6.49	81
Elemental Carbon (EC)	0.17±0.002	0.02	1.27	81

NA = Not Available

Table 3.2-5 Sea Salt Contribution to Fine PM2.5 Mass at Point Reyes (IMPROVE Program, 1995)

Pollutant	Average	Minimum	Maximum	Number of Observations
Sea salt (NaCl) in µg/m^3	1.73±0.02	0.08	8.54	81
NaCl/PM2.5(%)	27%	1%	66%	81

The third background site is proposed to be located 80 miles off the southern California coast, on San Nicolas Island. Annual average PM10 Technical Enhancement Program (PTEP) data for 1995 indicate that the largest contributor to fine particulate matter concentrations is sulfate (25%), followed by organic carbon (21%), ammonium nitrate (21%), and sea salt (18%). There is a relatively strong seasonal variation in PM2.5 species concentrations. The 1995 chemical speciation data from San Nicolas Island are summarized in Table 3.2-6. It is unknown at this time what sources may be contributing to a relatively high sulfate concentrations at this site. More data are needed to characterize the changes in the annual average concentrations, as well as the seasonal changes, and to identify sulfate sources. The monitoring site on San Nicolas Island is proposed to have a speciation sampler and a continuous mass sampler. The ARB Research Division will donate a speciation sampler, previously used in the epidemiological studies, to the PM2.5 monitoring program. This sampler requires minimal supervision, can be set-up to sample over an averaging period of weeks, and is easy to operate. These factors are very important in a remote location like San Nicolas Island. The PM2.5 continuous mass sampler is proposed to be funded as part of the PM2.5 program.

Table 3.2-6 Statistical Summary of PM2.5 Data at San Nicolas Island (PTEP Program, 1995)

Pollutant	Average (µg/m^3)	Minimum (µg/m^3)	Maximum (µg/m^3)	Number of Observations
PM2.5 Mass	5.57±0.09	0.39	14.49	36
Sulfate ($SO_4^=$)	1.41±0.03	0.01	4.38	36
Chloride (Cl^-)	0.35±0.01	0.01	2.65	35
Sodium (Na)	0.63±0.01	0.10	2.73	36
Nitrate (NO_3^-)	0.60±0.02	0.01	3.02	36
Ammonium (NH_4^+)	0.57±0.01	0.02	1.84	36
Organic Carbon (OC)	1.19±0.02	0.02	2.78	27
Elemental Carbon (EC)	0.21±0.01	0.02	0.58	27

3.2.3. Transport Monitoring

Transport sites are intended to measure fine particulate contributions from upwind source areas that move into a planning area. Due to the current uncertainty about the extent of transport and the best monitoring configuration for transport assessment, only one transport corridor will be evaluated initially in California. The corridor between the Bay Area AQMD and San Joaquin Valley APCD via Altamont Pass was determined to be the most appropriate for this evaluation based on the following factors:

- Documented history of ozone transport.
- Availability of supplemental air quality and meteorological measurements from various special studies.
- Existing infrastructure.

The transport assessment project, funded as part of the PM2.5 network, would include two monitoring sites, one in the Livermore area and one in the Tracy area. Each site would include a continuous PM2.5 sampler and meteorological equipment. The continuous samplers at Livermore and Tracy and the selected meteorological equipment at Tracy are proposed to be funded as part of the transport assessment study. The existing monitoring site at Tracy is located on land that was recently sold for residential development. The San Joaquin Valley APCD is looking for a new site located in the downwind area affected by transported PM2.5, away from local sources (e.g., roadways and fireplaces). The site has to meet siting requirements for PM2.5 and preferably for ozone and nitrogen oxide. The meteorological equipment that needs to be funded at Tracy, as part of the routine PM2.5 network, includes a new mast and a relative humidity instrument. The instruments for measuring temperature, wind speed, and wind direction will be relocated from the existing Tracy site.

Transport assessment is an example of integrating the routine PM2.5 monitoring network in California with special studies like CRPAQS to maximize the monitoring resources. Thanks to funding provided by CRPAQS, the transport assessment project will include two additional monitoring sites, one in the Altamont Pass and one at Bruceville. CRPAQS is considering funding a continuous mass sampler and meteorological equipment at the Altamont Pass monitoring site. This site will help determine if PM2.5 is transported between Livermore and Tracy via Altamont Pass. CRPAQS is also considering funding a continuous mass sampler at the Bruceville Road monitoring site in Sacramento County. This site will help to identify potential transport between Bay Area and Sacramento via Bruceville.

3.3. Speciation Samplers

The chemical speciation network in California will include two elements: National Air Monitoring Stations (NAMS) sites for measurement of long-term trends of

selected PM2.5 constituents, and State and local sites to collect data needed to develop effective State Implementation Plans (SIPs) (U.S. EPA, 1999).

3.3.1. NAMS Trends Network

The NAMS sites are dedicated to providing air quality trends over time and therefore, require consistent sampling and analysis protocols. The major requirements for a NAMS network description include:

- **Sampler Type** - To ensure consistency, the U.S. EPA, through consultation with the speciation workgroup, will determine the sampler type(s) utilized at NAMS sites. The sampler will be a multiple filter device capable of collecting the target analytes listed below.
- **Sampling Frequency** - One 24-hour sample will be collected at each site every three days. Selected sites that are determined to be core NAMS will sample every day for a limited period of time.
- **Target Analytes** - Elements will be determined using X-ray fluorescence spectroscopy (XRF); major ions (sodium, potassium, sulfate, nitrate, and ammonium) will be determined using ion chromatography (IC); and total, elemental, organic, and carbonate carbon will be determined by thermal optical analysis (TOA).

California has unique characteristics that require a different monitoring approach for PM2.5 than in the eastern United States (Dolislager and Motallebi, 1999). These include:

- Particle concentrations in California are less uniform than in the eastern United States.
- In most of California, the high PM seasons do not coincide with the high ozone seasons. The ozone concentrations are highest from late spring through the early fall and the PM concentrations are highest during the fall and winter for most of the State and the summer and fall for the South Coast Air Basin.
- Different chemical constituents dominate fine particulate matter in California than in the eastern United States. The fine particulate matter in the eastern United States is dominated by sulfates. In California, the fine particulate matter has a larger contribution of nitrates and organic carbon. The different chemical composition can be attributed to differences in sources and atmospheric conditions.

Due to the lower uniformity of particle concentrations in California, the selection of the PM2.5 NAMS speciation sites in California focused on local characteristics of the particulate matter problem. California asked for relief from the requirement to establish one NAMS trend site at a PAMS type 2 site in each PAMS area and proposed one additional NAMS site for the San Francisco Bay Area. The PAMS type 2 sites were selected to measure maximum ozone precursors during summer. In the fall and winter,

when the PM2.5 concentrations are high, wind directions and speeds are likely to be different. Sites with a long history of air quality monitoring representative of particle sources impacting large populations were primary candidates for PM2.5 speciation monitoring. Because PAMS Type 2 sites and PM2.5 sites have a population-oriented location, in a couple of areas it is appropriate to locate a PM2.5 speciation sampler at a PAMS site. In other areas, a site other than the Type 2 PAMS site may be a better location for the PM2.5 speciation sampler. The NAMS speciation samplers are proposed to be located exclusively at the core PM2.5 FRM sites to allow comparison of speciated data to the PM2.5 FRM data. Sites with other particulate matter samplers, like dichot and SSI, were also given priority during the site selection.

The U.S. EPA expects to select samplers and install all NAMS speciation trends sites by April of 2000. Selection of the NAMS speciation trends sites should be considered as tentative until sufficient FRM data from the California network are available for evaluation.

The monitoring sites proposed for the NAMS trends sites in California are listed in the Table 3.3-1 below. The U.S. EPA will not require a single trend sampler as proposed originally. Any sampler that meets performance criteria will be approved for use at the NAMS speciation sites listed below.

Table 3.3-1 Recommended Sites for the NAMS PM2.5 Speciation Trends Network

Monitoring Planning Area	Site Name	AIRS #
Sacramento Air Basin	Sacramento-Del Paso Manor	060670006
San Diego County	El Cajon-Redwood Avenue	060730003
San Francisco Bay Area	San Jose-4th Street	060850004
San Joaquin Valley Air Basin	Bakersfield-5558 California Ave.	060290014
	Fresno-1st Street	060190008
South Coast Air Basin	Riverside-Rubidoux [1]	060658001
Ventura County	Simi Valley-Cochran Street	061112002

[1] Selected as collocated speciation sampling site.

In the Sacramento Valley MPA, the Sacramento-Del Paso Manor monitoring site is proposed for a speciation trends site. The Sacramento-Del Paso Manor site is a Type 2 PAMS site with a long history of air quality monitoring. The site was also proposed as a core PM2.5 FRM site because it is located in a residential area with high PM2.5 concentrations. The data from this site would be indicative of the particulate matter sources impacting air quality in the Sacramento area.

In San Diego County MPA, a speciation trends site is proposed to be located at the existing El Cajon site. This site is located within a large urban area and has a long history of air quality monitoring.

In the San Joaquin Valley MPA, the Fresno-1st Street and the Bakersfield-5558 California Avenue monitoring sites are proposed for NAMS speciation trends sites. These sites represent maximum PM2.5 concentrations in the Fresno and Bakersfield MPAs, respectively. Both sites are located in predominately residential areas. They are the most intensively monitored sites in the San Joaquin Valley Air Basin. Many special studies have taken place at these sites. They will also be a major focus of the California Regional PM10/PM2.5 Air Quality Study.

In the South Coast Air Basin MPA, the Riverside-Rubidoux monitoring site is proposed for a speciation trends site. This site has a long history of particulate matter monitoring, is located in a heavily populated area, and has measured high PM2.5 concentrations in the past. Riverside-Rubidoux is likely to be the highest PM2.5 concentrations site in the United States, and it is also a historical site with long-term intensive air quality monitoring. At the Riverside-Rubidoux monitoring site, the South Coast AQMD will operate a NAMS speciation sampler in parallel with the PTEP sampler to characterize the correlation between these samplers. The District will also operate PTEP samplers at three locations (Anaheim, Los Angeles-North Main, and Fontana). For more information about the PTEP program, refer to Section 8.4 TEP 2000 Enhanced Ambient Air Monitoring Program, of this report.

The Simi Valley monitoring site (PAMS Type 3 site) in the Ventura County MPA is proposed for the NAMS speciation trends site. In the past, this site has measured higher concentrations of particulate matter, ozone, and nonmethane hydrocarbons than other sites in this area.

One speciation trends site is proposed to be located at the San Jose-4th Street monitoring site in the San Francisco Bay Area. The San Francisco Bay Area is not a PAMS area but is one of the major population centers in California. The existing San Jose-4th Street site was selected because it has a long history of air quality monitoring and is located in a heavily populated area with high concentrations of particulate matter. Both of these factors are important for suitable trends sites.

Figure 3.3-1 shows the proposed locations of the PM2.5 NAMS speciation sites.

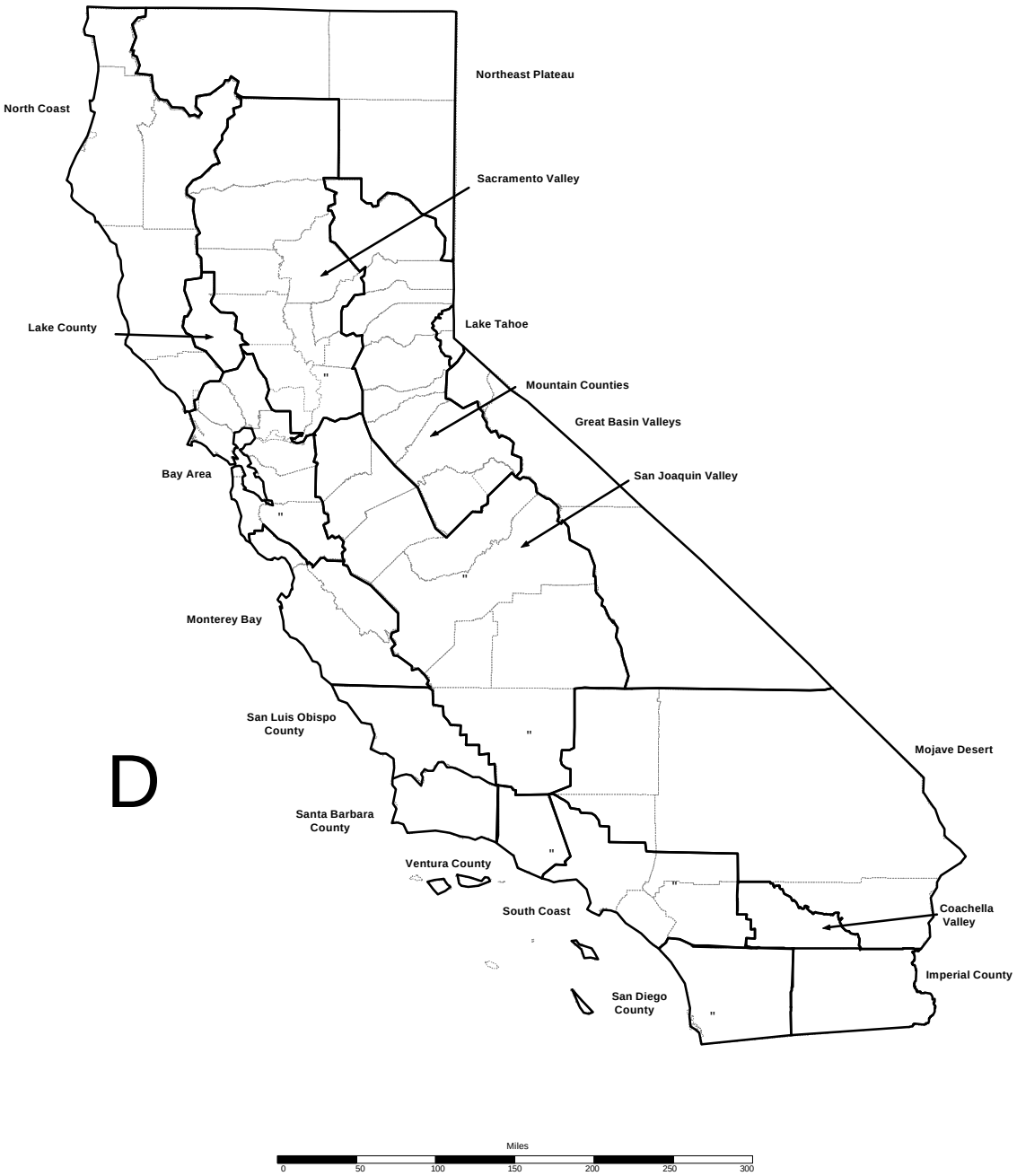

Figure 3.3-1 Proposed NAMS Speciation Monitoring Sites

(With Monitoring Planning Areas and Counties)

3.3.2. State and Local Sites

For the allocation of these speciation monitors, the ARB proposes to classify areas within the State into three categories depending on their need for speciation data for SIP development. The proposed categories are described below:

- **An area likely to attain both standards -** There is no need to collect routine speciation data, other than the NAMS speciation data, in the attainment areas.
- **Potential nonattainment area where special studies are being conducted -** Areas like Central California will collect sufficient data for SIP development through special studies. The seven NAMS sites, supplemented with additional equipment, will collect long-term trend data in these areas. They will require very little or no additional routine speciation monitoring.
- **Potential nonattainment area where no special studies are being conducted -** These areas will be the focus of the State and local speciation program.

The ARB is proposing a phased deployment of the State and local portion of the speciation network. The individual phases are described below.

The one-month evaluation study at Bakersfield identified promising technologies. More evaluation is needed before monitoring technologies for the full California speciation network are selected. The monitoring community in California is especially interested in evaluating continuous analyzers, which offer superior data resolution and reduced operation and maintenance costs when compared to filter based samplers. The upcoming special monitoring studies in California, including the Fresno "Supersite Study" and the California Regional PM2.5/PM10 Air Quality Study, will provide an opportunity to test and evaluate new speciation sampling methods. These studies are briefly summarized below and a broader discussion is included in Chapter 7, Special Studies.

- **Fresno Supersite -** One of the general objectives of the Supersite program is to test and evaluate non-routine monitoring methods, with the intent to establish their comparability with existing methods and determine their applicability to SIP development and health monitoring. The chemical measurements will be collected from August 1999 through August 2001.
- **California Regional PM2.5/PM10 Air Quality Study (CRPAQS) -** The CRPAQS field study will consist of a long-term field measurement campaign from 12/1/1999 through 1/31/2001, with a fall intensive study within the period of 9/1/2000 through 10/31/2000, and a winter intensive study within the period of 11/15/2000 through 1/31/2001 (http://www.arb.ca.gov/ccaqs/crpaqs/crpaqs.htm).

These monitoring efforts will provide opportunities to test new technologies in central California and gain practical experience. A similar evaluation is needed for Southern California where the meteorological conditions, source contributions, and

aerosol chemical composition are different than in central California. The air quality monitoring community in California will then be better able to evaluate which sampling method to use as part of the routine network. The implementation of the speciation network is proposed to have three phases, listed below:

- **September 1999 through September 2000 -** Conduct intercomparison testing (similar to Fresno Supersite) in Southern California. The PTEP sampler used by South Coast AQMD is a good filter-based sampler but it does not provide diurnally resolved data and laboratory analysis of the samples is expensive. The South Coast AQMD will evaluate the PTEP sampler, continuous speciation samplers, and the filter-based speciation sampler(s) at the southern California test site. Our goal is to compare measurements and gain experience in instrument operation.
- **Summer 2000 -** Complement the CRPAQS by adding speciation samplers in the Northern Sacramento Valley and the Bay Area.
- **2001 -** Start filling in the routine speciation network.

3.3.3. Winter 1999 Bakersfield PM Method Evaluation

The ARB, the CRPAQS team, and UC Davis are conducting an evaluation of PM sampling technologies capable of providing continuous (or hourly) PM mass measurement and/or continuous (or hourly) measurement of PM chemical species (such as nitrate, sulfate, and carbon). These continuous methods were operated in the field, side-by-side with conventional PM sampling technologies for approximately four weeks in Bakersfield, California, during January 1999. The time and location of the field sampling were chosen because historical data indicate that Bakersfield experiences high levels of fine PM in January as well as the same cold, foggy conditions experienced throughout the Central Valley. During this past January, a variety of weather conditions were observed in Bakersfield including clear weather, fog, rain, and snow. Twenty-four hour PM2.5 levels ranged from less than 5 $\mu g/m^3$ to over 130 $\mu g/m^3$ as measured with conventional filter techniques. The field portion of the evaluation was successful in acquiring and operating nearly thirty different sampling technologies.

The goals of this sampling method evaluation are:

- To determine which continuous sampling technologies have the accuracy and precision to serve as surrogates for conventional filter technologies.
- To evaluate technologies considered for use in the upcoming CRPAQS San Joaquin Valley Study.

The final report will be available in July, 1999.

3.3.4. Fresno Supersite

An air quality supersite will be operated at the Fresno First Street monitoring site in the San Joaquin Valley MPA. A supersite is a monitoring site that includes an extensive array of types of monitoring equipment. This site will specialize in particulate monitoring equipment. This is one of four to eight supersites that are to be established in urban areas within the United States by the U.S. EPA to better understand particulate measurement technologies, source contributions, control strategies, and the effects of suspended particles on health. The information derived from the Fresno Supersite will complement information from the statewide PM network. The Fresno Supersite will be designated and operated to provide data for studies related to control strategy development and health assessment in central California.

3.3.5. California Regional PM10/PM2.5 Air Quality Study

The California Regional PM10/PM2.5 Air Quality Study (CRPAQS) is a comprehensive, multi-year program designed to provide an improved scientific understanding of emissions, meteorology, and dynamic atmospheric processes leading to elevated particulate matter (PM) concentrations and visibility impairment in central California (Magliano et al., 1999). As part of CRPAQS, major field monitoring campaigns are planned from December 1999 to January 2001. Additional information about this project is included on the web at (http://www.arb.ca.gov/ccaqs/crpaqs/crpaqs.htm).

The objectives of the field programs are to collect an aerometric database of specified accuracy, precision, and validity to support the following:

- Refinement of conceptual models to explain the interactions among emissions, meteorology, and ambient PM concentrations.
- Evaluation and application of source and receptor oriented models to address the effects of emission control programs.
- Assessment of the extent to which the longer-term ARB/district monitoring networks represent population exposure under a variety of meteorological and emissions conditions.

The field data collection efforts will include three components: 1) a long-term program from December 1, 1999 through January 31, 2001; 2) a fall episodic program between September 15, 2000 and October 31, 2000; and 3) a winter episodic program occurring over 15 days between December 1, 2000 and January 31, 2001. The field measurements will be collected over a domain extending from the Pacific Ocean on the west to the Mojave desert on the east and from the Tehachapi mountains on the south to the northern end of the Sacramento Valley. Monitoring sponsored by CRPAQS is intended to enhance the existing long-term monitoring networks operated by the ARB and local APCDs.

The CRPAQS field measurements will include an upper air meteorological network of rawinsondes and radar profiler/RASS systems. The surface air quality network will consist of anchor sites with enhanced temporal resolution, measurement of precursor species and complete organic characterization, satellite sites to characterize inter- and intra-basin transport as well as near source concentrations, and a 100-meter tower to measure micrometeorological and air quality parameters. Special studies that will be conducted on intensive sampling days will include aloft air quality measurements, single particle measurements, fog chemistry, and assessment of dust suspension and deposition characteristics.

3.4. IMPROVE Network

In 1997, the U.S. EPA promulgated new regional haze regulations for protection of visibility in national parks and wilderness areas. The regulations call for states to establish goals for improving visibility in national parks and wilderness areas and to develop long-term strategies for reducing emissions of air pollutants that cause visibility impairment. The rule allows states the flexibility to develop plans for cost-effective pollution reductions and encourages states to collaborate on regional strategies. The IMPROVE network will collect data to support the regional haze program. It will also complement the state and local PM2.5 network by collecting air quality data in remote locations.

The IMPROVE program is planning to add 78 monitoring sites in 1999 in Federal Class I national parks and wilderness areas. To optimize limited program funds, the IMPROVE program has proposed that new monitoring sites be located so that they may represent "clusters" of Federal Class I areas. The ARB has been involved in the site selection process to ensure that the new IMPROVE sites meet the needs of the regional haze program and PM2.5 program. Based on discussions with IMPROVE participants, the ARB proposed 17 clusters to monitor 29 Class I areas in the state. Additional information on the IMPROVE program, network expansion, and siting guidelines, are available from the following U.S. EPA and National Park Service Internet sites: http://www.epa.gov/ttnamti1/visdata.html; and http://www.nature.nps.gov/ard/vis/vishp.html.

IMPROVE proposes to include (and fund) some of the existing IMPROVE and "protocol" sites (sites operated according to IMPROVE monitoring protocols, but funded separately from the IMPROVE contract) in California's network, and add other sites for Class I areas not previously monitored. Of the 17 clusters recommended by the ARB, 8 are covered by existing sites, including 2 IMPROVE and 6 "protocol" sites. Other clusters will require new monitoring sites. To guide cluster designations, staff considered prevailing winds, air quality regimes, source areas, and elevational gradients. The proposed clusters are described below.

- **Redwood National Park - Kalmiopsis.** An IMPROVE "protocol" site is located at Redwood NP. The site is located at an elevation of 760 ft, above

the minimum elevation for Kalmiopsis. Although located 30 km from the coast, the Kalmiopsis Wilderness (Siskiyou National Forest, Oregon) has a marine regime very similar to Redwood NP, and is therefore paired with the Redwood NP to represent conditions for the far north coast of California. Assigning the Kalmiopsis Wilderness to Redwood NP also conforms to the 100 km distance criteria between Class I areas. A cluster involving the Kalmiopsis will need to be discussed with the Oregon Department of Environmental Quality and the USDA Forest Service Region 6. Min/Max Elevations (ft): 0 -3117 (Redwood NP); 217-5092 (Kalmiopsis)

- **Marble Mountain - Yolla Bolly.** This cluster represents upper elevation interior Coast Range conditions for the Marble Mountain Wilderness (Klamath National Forest, a.k.a. Klamath NF) and the Yolla Bolly Middle Eel Wilderness (located between the Six Rivers NF and the Mendocino NF). The two wilderness areas are approximately 60 km from the coast and approximately 167 km from each other. Shasta County AQMD suggested a potential site at Shasta Bally Mountain (elevation 6209 ft), located in the Whiskeytown Unit of the Whiskeytown-Shasta-Trinity National Recreation Area. The site is approximately 120 km from Marble Mt. and 66 km from Sugar Loaf Mt. (Yolla Bolly). Other potential sites may exit within the Hayfork Ranger District (Shasta-Trinity NF). Min/Max Elevations (ft): 741-7895 (Marble Mt.); 2284-7713 (Yolla Bolly)

- **Lava Beds - South Warner.** Located within the Modoc NF, this cluster represents plateau conditions in northeast California, covering the Lava Beds National Monument (Lava Beds NM) and the South Warner Wilderness. Siskiyou County APCD operates a PM10 air monitoring site at Lava Beds NM. Air monitoring staff at Lava Beds NM also expressed interest in receiving an IMPROVE site. Schonchin Butte (Lava Beds NM) and Eagle Peak (South Warner) are separated by approximately 122 km. Suitable sites may exist between the two areas, at Happy Camp Mountain, Manzanita Mountain, or Likely Mountain. Min/Max Elevations (ft): 4000-5400 (Lava Beds); 4587-9437 (South Warner)

- **Lassen -Thousand Lakes - Caribou.** This cluster is covered by an IMPROVE "protocol" site located at Lassen Volcanic National Park and represents conditions both at the park and at the Thousand Lakes and Caribou Wilderness areas within the Lassen NF. Min/Max Elevations (ft): n.a.-10457 (Lassen); 5353-8090 (Thousand Lakes); 6035-7678 (Caribou).

- **Point Reyes.** This cluster also represents background coastal conditions for northern California, but within the known reach of pollutant transport from the San Francisco Bay Area. An IMPROVE "protocol" site is located at Point Reyes National Seashore. Min/Max Elevations (ft): 0-1409

- **Pinnacles - Ventana.** This cluster represents two slightly different regimes: marine central coast (Ventana Wilderness, within the Los Padres NF) and inland upper elevation between the Salinas and San Joaquin Valleys (Pinnacles National Monument). An IMPROVE "protocol" site located at Pinnacles NM, is operated by the National Park Service. Nitrate monitoring data from the Pinnacles site indicate occasional episodes of urban influence from the southern San Francisco Bay (100 km to the north). By contrast, the Ventana Wilderness is dominated by marine air. Urban influence on the Ventana may occur during episodes when flows out of the San Francisco Bay are recirculated south and east into the Monterey Bay. Min/Max Elevations (ft): 800-3304 (Pinnacles); 540-5627 (Ventana).

- **D.L. Bliss - Desolation - Mokelumne.** This cluster represents conditions in the northern Sierra in and around the Lake Tahoe Basin, and the Desolation and Mokelumne Wilderness areas. An IMPROVE "protocol" site (elevation 6700 ft) is located at D.L. Bliss State Park. Min/Max Elevations (ft): 6229-7200 (D.L. Bliss); 5938-9415 (Desolation); 3754-9720 (Mokelumne).

- **Kaiser - Ansel Adams.** This cluster represents high central Sierra elevations. Min/Max Elevations (ft): 6660-9730 (Kaiser); 3200-12350 (Ansel Adams).

- **Emigrant - Yosemite.** This cluster represents mid-to-upper elevation western slopes of the central Sierra Nevada mountain range, which are influenced by air masses originating from the San Francisco Bay Area and the San Joaquin Valley and transported up west-facing watersheds and river canyons. An IMPROVE site (elevation 5300 ft) is located at Yosemite National Park. Min/Max Elevations (ft): 4593-10964 (Emigrant); 2000-13000 (Yosemite)

- **Hoover - "North" John Muir.** This cluster represents upper elevation *east* slopes of the Sierra Nevada, to account for eastward transport over the range. A monitoring site located near the eastside of the Sonora Pass could represent conditions at the Hoover and the northern portion of the John Muir wilderness areas. Other suitable sites may exist near Virginia Lakes, Conway Summit, or the June Mountain Ski Area. Min/Max Elevations (ft): 7640-12446 (Hoover); 4873-13880 (John Muir).

- **Kings Canyon - Sequoia - "South" John Muir.** This cluster represents west-facing upper elevations of the southern Sierra, which are impacted by air mass transport from the San Joaquin Valley. An IMPROVE "protocol" site operates near the Ash Mountain entrance to Sequoia National Park. This site is within the Middle Fork of the Kaweah River canyon. To better represent upper elevation conditions outside of river canyons, a monitoring site may be located near Moro Rock (above Giant Forest Village), or Olancha Peak. Min/Max Elevations (ft): 1500-14494 (Sequoia); 1500-14494 (Kings Canyon); 4873-13880 (John Muir).

- **Dome Land.** This cluster represents upper elevations of the southern Sierra, which are influenced by air mass transport from the southern San Joaquin Valley, through the Walker Pass and into the northern Mojave Desert. The summer seasonal IMPROVE site (elevation 2942 ft) between Onyx and Walker Pass has experienced frequent power outages (33% of sampling days). While IMPROVE monitoring data suggest little significant difference between Sequoia NP and Dome Land sulfate and nitrate concentrations, San Joaquin Valley Unified APCD and ARB staff believe it is important to monitor this area. The Dome Land Wilderness is in the Sequoia NF and on Bureau of Land Management holdings. The current IMPROVE protocol site should be moved to a site with more reliable power. Suitable alternatives may exist at a former ARB research site near the town of Canebrake, or at the Walker Pass campground. Min/Max Elevations (ft): 2670-9224.

- **San Rafael.** This cluster is the first of a series of clusters for southern California. The San Rafael Wilderness is located within the southern portion of the Los Padres NF and represents upper elevation background conditions east of the Santa Maria Valley and north of the Santa Barbara Channel. The Bates Ridge fire lookout station on Sierra Madre Road may be a suitable monitoring site. Min/Max Elevations (ft): 1109-6311.

- **San Gabriel - Cucamonga.** This cluster represents the San Gabriel and Cucamonga Wilderness areas within the Angeles NF, directly adjacent to the Los Angeles air basin. Numerous air quality studies have been conducted in the vicinities of Cogswell Reservoir, the San Dimas Experimental Forest, and Mount Baldy. A suitable site may exist at "the Notch" ski lift area (7600 ft) on Mount Baldy. The Cucamonga is generally higher in elevation and a little further downwind from urban sources than the San Gabriel.
Min/Max Elevations (ft): 1593-7675 (San Gabriel); 4285-8583 (Cucamonga).

- **San Gorgonio - San Jacinto.** Located east of the Los Angeles basin within the San Bernardino NF, the San Gorgonio and San Jacinto Wilderness areas are influenced by flow regimes into and out of the LA airshed. An IMPROVE site is located at the San Gorgonio Wilderness. An air quality research site, operated by the Forest Service - Pacific Southwest Research Station, is also located at Barton Flats. Min/Max Elevations (ft): 3116-10911 (San Gorgonio); 1348-8922 (San Jacinto Wilderness. Note that the actual San Jacinto summit, elevation 10804 ft, is located within the Mount San Jacinto State Park.).

- **Joshua Tree.** Joshua Tree National Park represents high desert conditions further east of the LA basin. Min/Max Elevations (ft): 1200-5814.

- **Agua Tibia.** The Agua Tibia Wilderness is located in a middle portion of the Cleveland NF near the astronomical observatory at Mount Palomar, mid-way between Los Angeles and San Diego. The Agua Tibia mountains are one of

several southern California coastal mountain ranges, which include the Santa Ana, Santa Rosa and Laguna mountain ranges. Min/Max Elevations (ft): 1615-4763.

3.5. Meteorological Equipment

In 1999, meteorological equipment will be added at the following sites: Redding-Health Department in the Sacramento Valley MPA, Ridgecrest in the Mojave Desert MPA, and Tracy in the San Joaquin Valley MPA (Table 3.5-1). The PM2.5 mass data and meteorological data collected at these sites will be used for transport assessment. Each site will have a PM2.5 mass sampler (FRM samplers at Redding and Ridgecrest and a continuous sampler at Tracy). The meteorological equipment proposed at these sites includes wind speed, wind direction, outside temperature, and relative humidity. The equipment that needs to be funded at Tracy includes only a new mast and a relative humidity instrument. The instruments for measuring temperature, wind speed, and wind direction will be relocated from the existing Tracy site.

Table 3.5-1 Sites Proposed for Funding for Meteorological Equipment in 1999

Monitoring Planning Area	Monitoring Site
Sacramento Valley Air Basin	Redding-Health Department Roof
San Joaquin Valley Air Basin	Tracy (New site)
Mojave Desert Air Basin	Ridgecrest (New site)

4. SAMPLING FREQUENCY

According to U.S. EPA monitoring regulations everyday sampling is required at 29 core PM2.5 sites in California (two sites per area over 500,000 population and one site per PAMS area) (U.S. EPA, 1997c). All other sites are required to sample once every three days. To facilitate the deployment of the PM2.5 network, the U.S. EPA issued two memorandums outlining guidance on sampling frequency during 1998 and 1999. Based on these memorandums, fewer sites were required to sample everyday and some sites were allowed to sample less than once in three days. One or more core SLAMS must sample everyday through 1999 in the following areas.

- In each large metropolitan area (population greater than 1 million).
- In each medium metropolitan area (population between 500,000 and 1 million) without a PM2.5 correlated acceptable continuous analyzer.
- In each PAMS area, collocated with a PAMS site during June-August.

In addition, daily sampling was encouraged at one or more SLAMS sites in monitoring areas where violations of a controlling 24-hour PM2.5 NAAQS are anticipated during seasons of the highest PM2.5 concentrations. A 1-in-6-day sampling schedule was allowed at any Special Purpose Monitoring (SPM) site.

The ARB and the local air quality districts considered multiple factors before proposing a sampling frequency for each monitoring site. The main objective was to ensure that the collected data will adequately support area designations, modeling, health studies, and other monitoring objectives during the second year covered by the network plans (July 1, 1999 through June 30, 2000). Daily sampling was recommended in areas with PM2.5 concentrations close to the standard (based on the dichotomous data and/or PM10 data). In areas where 24-hour PM2.5 concentrations are well above or below the 24-hour standard on a seasonal basis (based on the dichot data and/or PM10 data), the sampling frequency will be adjusted seasonally. In areas where 24-hour concentrations are below the 24-hour standard year round (based on three or more years of PM2.5 and/or PM10 data), the sampling frequency will be 1-in-6-day. The passive sampling problem, discussed in more detail in Chapter 2.2, Sampler Acceptance Testing, forced some districts to operate samplers in the manual mode and consequently reduce the sampling frequency from everyday to 1-in-3-day. This includes all of the monitoring sites in the South Coast Air Basin and Coachella Valley MPAs that were proposed for everyday sampling in the 1998 network plan.

The following is a summary of the exemptions that the ARB and the local air quality districts considered when determining locations where less frequent sampling would be allowed:

- Exemptions from everyday or 1-in-3-day sampling during seasons or periods of low PM2.5 concentrations. (A minimum frequency of 1-in-6-day sampling will be required.)
- Alternatives to everyday sampling schedules at sites with correlated acceptable continuous analyzers.
- Exemptions from 1-in-3-day sampling where existing information suggest that the maximum 24-hour-average measurements are less than the level of the standard.
- Less frequent sampling (1-in-3-day or 1-in-6-day) at monitoring sites operating Andersen sequential samplers in a manual mode in order to reduce the passive sampling problem.

The proposed sampling frequencies are summarized in Appendix A. There are seven monitoring sites in California sampling everyday for PM2.5 on a year around basis. An additional six sites will sample everyday during the period of expected high PM2.5 concentrations (October 1 through March 31 for these sites). The remaining sites will sample on a 1-in-3-day or 1-in-6-day schedule, depending on the type of sampling equipment and estimated PM2.5 concentrations. Some sites with PM2.5 concentrations estimated to be below the standard will sample on a 1-in-6-day schedule.

The sampling schedule will be re-evaluated during the annual network review next year. Monitoring sites with PM2.5 concentrations above the 24-hour standard will be considered for more frequent sampling during the high PM2.5 season, which for most of the State is during the fall and winter.

5. QUALITY ASSURANCE

The ARB has developed a PM2.5 Quality Assurance Project Plan (QAPP) which is part of the overall network plan. The QAPP covers administrative, laboratory, and field activities. Except for district-specific information or procedures, districts can refer to the ARB QAPP rather than having to develop their own QAPP.

5.1. Collocated Samplers

The purpose of collocated samplers and the FRM performance evaluation is to estimate the precision and bias of the various PM2.5 samplers. According to 40 CFR Part 58, Appendix A, Section 3.5.2 (U.S. EPA, 1997d), for each method designation at least 25% (minimum of one in each state) of PM2.5 monitoring sites must operate collocated samplers. The sequential sampler and the single channel sampler have a different method designation. To satisfy this requirement, in 1998 the ARB and the local air quality districts installed sixteen sites with collocated sequential FRM samplers (25% of 62) and four sites with collocated single channel samplers (25% of 16). In 1999, a collocated sequential sampler will be added to the primary sampler deployed in 1998 at Indio-Jackson Street in the Coachella Valley MPA. With this collocated sampler, the 25 percent requirement will continue to be met as four additional FRMs are deployed from 1999 funding. Table 5.1-1 summarizes primary and collocated PM2.5 FRM samplers in California.

Table 5.1-1 PM2.5 FRM Samplers (1998 and 1999 Deployment)

FRM Sampler Type	Deployment Year	Number of Samplers by Function		
		Primary	QA/QC	Total
Andersen RAAS Sequential	1998	62	16	78
	1999	4	1	5
R&P Single Channel	1998	16	4	20
Total	1998 and 1999	82	21	103

The ARB and the California air districts selected collocated PM2.5 sites based on the following criteria listed in order of importance:

- **Measured or estimated PM2.5 concentrations -** Monitoring sites with high measured PM2.5 concentrations or high estimated PM2.5 concentrations based on PM10 data were selected to operate collocated samplers.

- **Operating agency -** Agencies operating more than four PM2.5 monitoring sites have about 25% of their PM2.5 sites collocated. Agencies operating less than four monitoring sites were geographically grouped together and a relatively high concentration site was selected to represent a group.
- **Geographical representation -** Collocated sites were selected to ensure geographical representation throughout California because varying meteorological and air quality conditions may influence the precision and bias of various PM2.5 samplers.
- **Practical considerations -** The monitoring sites selected to operate collocated PM2.5 samplers had to have enough platform room to maintain 1 to 4 meter spacing between primary and collocated sampler and adequate power available.

The Salinas monitoring site in the Monterey Bay Unified Air Pollution Control District was selected during the 1998 network planning process as a location for a collocated sampler. However, the existing Salinas site could not accommodate an additional sampler. The Monterey Bay Unified Air Pollution Control District installed a collocated sampler at the Santa Cruz monitoring site instead. The District is planning to relocate the existing Salinas site and at that time may request to relocate the collocated monitor to the new site.

5.2. PM2.5 Laboratory Pre-Certification Program

The new PM2.5 program required that the existing laboratories be upgraded to include the appropriate environmental controls and a microbalance. Because of the capital investment required to set up a proper filter weighing facility, only five laboratories were upgraded in California. The responsibility for weighing filters in California was divided among these laboratories, as indicated in Appendix A. The laboratories are operated by the following agencies:

- Bay Area AQMD.
- California Air Resources Board.
- San Diego County APCD.
- South Coast AQMD.
- Ventura County APCD.

In order to assure the quality of the PM2.5 air monitoring data and to facilitate a timely initiation of laboratory operations, the California Air Resources Board (ARB) implemented a Laboratory Pre-Certification Program. The program included a laboratory pre-certification questionnaire and an on-site visit of the laboratory. Each laboratory had to be pre-certified before submitting PM2.5 data to the U.S. EPA Aerometric Information Retrieval System (AIRS) - Air Quality Subsystem (AQS).

A laboratory pre-certification questionnaire addressed requirements that a laboratory conducting PM2.5 mass analysis determinations must follow. The

questionnaire also included recommendations on how to improve the overall quality of a laboratory's PM2.5 operations. The requirements are found primarily in 40 CFR 50, Appendix L, section 8.0 (U.S. EPA, 1997e). The recommendations are found in U.S. EPA's Quality Assurance Handbook, Volume II, Method 2.12 (U.S. EPA, 1989). The pre-certification questionnaires were sent in mid-summer 1998. As part of the pre-certification, the labs were required to submit the following items:

- The final draft PM2.5 Quality Assurance Project Plan.
- The Standard Operating Procedures (SOP) that include PM2.5 filter processing and weighing.
- A two-consecutive-week period of relative humidity and temperature records indicating that the mean temperature is held constant (±2ºC standard deviation) between 20ºC and 23ºC and the mean relative humidity is held constant (±5% RH standard deviation) between 30% RH and 40% RH).

The pre-certification questionnaire helped laboratories become aware of what is necessary to assure good quality data. The ARB Quality Assurance Section (QAS) staff visited each PM2.5 laboratory to follow-up on the pre-certification questionnaire. In addition, the QAS conducted the following performance audits:

- Standard weight checks using a set of Class 1 standard weights to ensure that the microbalance measures within ±0.003 milligrams of the actual weight.
- Relative humidity and temperature sensor checks to ensure that the relative humidity sensor response is within ±2% RH of the actual relative humidity and the temperature sensor response is within ±2ºC of the actual temperature.

Each of the five laboratories meet the necessary conditions for submittal of data to AIRS. The methodology used to analyze the mass of fine particulate matter (PM2.5) samples collected on Teflon filters is summarized in the Standard Operating Procedure for Mass Analysis of Fine Particulate Collected on Teflon Filter included in the QAPP.

5.3. PM2.5 Mass Analysis System and Performance Audits

The ARB's Quality Assurance Section has implemented a PM2.5 Laboratory Mass Analysis System Audit Program. A system audit will be conducted for each of the five California federally funded PM2.5 mass analysis laboratories in 1999. The audit entails completion of a laboratory operations system audit questionnaire and on-site inspection and assessment of the total measurement system (sample collection, sample analysis, data processing, etc.). Included with the system audit is a performance audit consisting of on-site review to check the accuracy of the PM2.5 filter weighing balance(s), and relative humidity and temperature sensors, and a check of the laboratory operations to verify their ability to generate data of acceptable quality. The balances are checked using a set of class 1 standard weights, and the relative humidity and temperature sensors are compared against NIST traceable relative humidity and temperature sensors. The performance audits will be conducted annually following the initial system audit. The system audits and annual checks will help to ensure comparable results among the laboratories.

5.4. Sampler Performance and System Audits of Field Samplers

The primary goal of an auditing program is to identify system errors that may result in suspect or invalid data. The audit procedures described here provide quantitative estimates of a PM2.5 sampler's performance. These quantitative values consist of the flow rate percent difference, the design flow rate percent difference, the ambient temperature difference, the filter temperature difference, and the barometric pressure difference. In addition for multiple filter samplers, the audit procedures provide quantitative values of the inactive filter temperature difference and the dry gas meter (DGM) temperature difference.

The flow rate percent difference indicates the accuracy of the sampler's indicated flow rate by comparing the indicated flow rate measurement with the measurement from an audit transfer standard. The design flow rate percent difference determines how closely the sampler's flow rate matches the inlet design flow rate under ideal operating conditions. The ambient temperature, filter temperature, and barometric pressure differences reflect the difference between the audit measurement for temperature or pressure and the respective measurement indicated by the sampler.

A calibrated transfer standard mass flow meter (MFM) is used to measure the sampler's operational flow rate. The sampler's indicated flow rate is then compared with the actual flow rate indicated by the MFM. The sampler's indicated flow is also compared with the design flow rate of 16.67 lpm. Audit techniques may vary with different models of samplers due to differences in sampler configuration, sampler software, etc.

The purpose of a field sampler system audit is to check if the monitoring site meets PM2.5 siting criteria and if the site and equipment are clean and properly maintained. The initial system audit consists of completing a Comprehensive Quality Assurance Site Survey and a Quality Assurance Site Conditions Report. Annually thereafter, during each sampler performance audit, a Quality Assurance Site Conditions Report is completed.

The ARB staff audits each monitoring site in California once a year. The audit includes a performance audit and a system audit. The monitoring sites operated by the Bay Area AQMD, San Diego County APCD, and South Coast AQMD are audited each quarter. Over the course of a year at each site in these districts, the ARB conducts one audit and the districts mentioned above (or the contractor) conduct three audits.

5.5. The National Performance Audit

The National Performance Audit Program is a quality assurance activity which will be used to evaluate measurement system bias of the PM2.5 monitoring network. The pertinent regulations for this performance evaluation are found in 40 CFR Part 58, Appendix A, Section 3.5.3 (U.S. EPA, 1997d). The strategy is to collocate a portable FRM PM2.5 air sampling instrument within 1 to 4 meters of a routine NAMS/SLAMS air monitoring instrument, operate both monitors as required in the Federal Reference Method and standard operating procedures (SOPs), and compare the results. The U.S. EPA is responsible for implementing this program. Each year 25 percent of the SLAMS/NAMS monitors will be identified for performance evaluation at a frequency of four times per year.

6. DATA DISTRIBUTION AND ANALYSIS

6.1. Data Distribution

The data collected as part of the PM2.5 network will be available from the U.S. EPA Aerometric Information and Retrival System (AIRS) and the ARB air quality database (ADAM). The ARB has a very effective, customer oriented data distribution system that includes:

- The **ARB Air Quality Website** (www.arb.ca.gov/aqd/aqd.htm) provides access to ambient air quality data, maps of areas that violate the national and state air quality standards, plans for PM2.5 monitoring, and electronic versions of several of the reports described below.

- **Interactive data queries** of the entire California database are available from the above website or more directly at www.arb.ca.gov/adam. You can query: 1) the top 4 values and the number of days over the standards for O_3, PM10, dichot fine particles, CO, SO_2, and NO_2; 2) hourly data listings for a selected day for all gaseous pollutants; and 3) 10-week summaries of daily maximum

data and other daily statistics. PM2.5 summaries will be added by the end of this year.

- **Predefined data tables** are available that include O_3 data through 1998, PM10 data through 1997, and selected toxics data through 1996 at www.arb.ca.gov/aqd/aqd.htm. The O_3 and PM10 web pages include maps for each air basin showing the location of monitoring sites. These pages include the highest values and counts of days exceeding the standards for each air basin, district, and monitoring site. The air basin and district summary tables include data from 1980 and on, while the site summary tables include data for the last several years. Web pages for PM2.5 will be added when 3 years of data are available.

- New **1998 CD-ROM**s contain hourly, daily, and annual summary data during 1980-1997 for O_3, CO, NO, NO_2, NO_x, SO_2, H_2S, THC, NMHC, CH_4, TSP, PM10, dichot fine particles, COH; and speciated TSP, PM10, dichot, and hydrocarbons. Toxics data for 1990-1997 are also included, as are a number of predefined annual reports which enable the user to quickly obtain key data, including approximately half of annual Blue Sky report content and substantial portions of the content of the State & Local Air Monitoring Network Plan. PM2.5 FRM data will be added in fall 2000. As with the first edition, there are two versions of the 1998 CD-ROM. The **Voyager CD** has maps and graphs for interactive browsing of the data, while the **basic-data CD** includes compressed ASCII hourly data as well as daily and annual data in ASCII and DBF formats. Both CDs have the predefined annual reports. Additionally, the basic-data version contains user-friendly screens to display, print, or export a year of daily data for a single variable and location.

- Our new **1999 California Almanac of Emissions & Air Quality** provides key O_3, PM10, and CO indicators (expected peak day concentration, design values, annual average, and number of exceedances) for counties and air basins, from 1980 through 1997. A few indicators for NO_2 and SO_2 are also included. PM2.5 FRM data will be added in fall 2000. An electronic version of the Almanac is available at www.arb.ca.gov/aqd/almanac/almanac.99.htm.

- The **1998 State & Local Air Monitoring Network Plan** describes current air quality, including PM2.5, and meteorological monitoring at all sites. Instrument types, chemical analysis methods, and maps are included. The report is also available at www.arb.ca.gov/aqd/namslams/namslams.htm.

6.2. Data Analysis

Data derived from the PM2.5 monitoring network include both aerosol mass measurements and chemically-resolved or speciated data. Mass measurements are used principally for identifying areas as attainment or nonattainment of the ambient PM2.5 air

quality standards. The mass data will also be used in assessing trends in ambient PM2.5 air quality. Chemically speciated data are used to assess trends and develop mitigation approaches to reduce ambient aerosol emissions in relation to SIPs. This involves emission inventory and air quality model evaluation, source attribution analysis, and tracking the success of emission control programs.

6.2.1. Area Designations and Network Review

National Ambient Air Quality Standards (NAAQS) apply to PM2.5 and PM10 mass concentrations. The NAAQS specifies the following:

- Twenty-four-hour average PM2.5 not to exceed 65 $\mu g/m^3$ for a three-year average of annual 98th percentiles at any community-representative (core) site in a monitoring area.

- Three-year annual-average PM2.5 not to exceed 15 $\mu g/m^3$ from a single community-representative (core) site or the spatial average of eligible community representative sites in a monitoring area.

- Twenty-four-hour average PM10 not to exceed 150 $\mu g/m^3$ for a three-year average of annual 99th percentiles at any site in a monitoring area.

- Three-year average of annual arithmetic means of PM10 concentrations not to exceed 50 $\mu g/m^3$ at any site in a monitoring area.

California has a separate State standards for PM10, but not for PM2.5. The designation criteria for the California Ambient Air Quality Standards specify the following:

- Twenty-four-hour average PM10 not to exceed 50 $\mu g/m^3$ more than once on average for a three year period at any site in a monitoring area using a statistical evaluation.

- The annual geometric mean of PM10 concentrations not to exceed 30 $\mu g/m^3$ at any site in a monitoring area.

The first official PM2.5 area designations will take place in the year 2002 or 2003, based on three full years of FRM data for PM2.5, and will become updated annually as new information becomes available. As PM2.5 data are collected, values exceeding the PM2.5 NAAQS will be evaluated for influence by natural/exceptional events. The U.S. EPA allows PM2.5 data that meet established natural/exceptional events guidelines to be excluded from the designation determination.

Due to the current lack of sufficient FRM data, initial estimates of the attainment status of areas throughout California will be based on available dichot data and PM10

data. The extent to which FRM data correlates with dichot and PM10 data will be evaluated. Since the correlation may depend on the season, seasonal effects will be included in the evaluation. If these data are correlated, historical dichot and PM10 data will be used to estimate long-term trends in the PM2.5 FRM concentrations.

The statewide PM2.5 network will be evaluated annually to assess the adequacy of the spatial and temporal coverage of the network. Any changes to the network, including site additions and deletions, and changes to sampling frequency and monitor designation, will be documented.

6.2.2. Air Quality Trends and Source Attribution

The monitoring network in California includes 16 sites operating PM2.5 FRM samplers in parallel with dichotomous and PM10 SSI samplers. There are over ten years of dichot and PM10 data at many of these sites. The PM2.5 FRM, dichot, and PM10 SSI mass data will be compared to evaluate the extent to which these data correlate. The correlation will be examined under different atmospheric conditions, including high and low sampling temperatures and high and low relative humidities for each season. Changes in the correlation of the mass measured using different sampling methods will also be evaluated as a function of the dominant PM2.5 fraction (primary versus secondary). If there is a good correlation between FRM and dichot or PM10 data, historical data will be used to estimate long-term trends in the PM2.5 FRM concentrations.

The speciation data will be analyzed for the annual trends in PM2.5 constituents and for changes in relative contribution of species to total mass. The speciation data will be critical for determining sources and their relative contributions to PM problems. Some specific projects proposed by the ARB include:

- Conduct Chemical Mass Balance modeling to determine sources and their relative contributions to PM problems.
- Conduct analyses (e.g., PM2.5 Federal Reference Method/dichot comparisons, PM2.5/PM10 fractions) to assess the quality and improve the utility of the PM monitoring program.
- Analyze causes (e.g., rainfall, precursor controls) of declining annual average PM10 and PM2.5 concentrations.
- Determine if there is a weekday/weekend effect for PM due to lower diesel NO_x and PM emissions.
- Attempt correlations of dichot data and CADMP data with health endpoints.

7. PRE-1998 PM2.5 MONITORING NETWORKS IN CALIFORNIA

California has had long-term PM2.5 monitoring programs that predate the promulgation of the National Ambient Air Quality Standards (NAAQS) for PM2.5 and

were funded outside the current Section 103 Grant funding. A summary of particulate matter monitoring resources in California can be found in *The State and Local Monitoring Network Plan* (ARB, 1998b). The following describes four long-term monitoring programs that have included monitoring of fine particles, including: California's routine monitoring with the dichotomous (dichot) sampler, the California Acid Deposition Monitoring Program (CADMP), the PM10 Technical Enhancement Program (PTEP), and the Interagency Monitoring of PROtected Visual Environments (IMPROVE) measurement program. In these programs, particulate matter samples are collected over 24-hour periods, usually from midnight to midnight every sixth day. In addition, many areas of the State have had special fine particle monitoring programs of limited (i.e., one year or less) duration.

7.1. Dichotomous (Dichot) Sampler Network

The dichotomous sampler network has been in operation since 1983, and currently consists of almost 20 sites collecting 24-hour samples (midnight to midnight) every sixth day. The dichotomous sampler, or virtual impactor, uses a low-volume PM10 inlet followed by a virtual impactor which splits the air stream in two, separating particles into two fractions: fine particles (PM2.5, i.e., particles with aerodynamic diameters of less than 2.5 μm) and coarse particles (i.e., those having diameters of 2.5 to 10 μm). The sum of the fine and coarse fractions provides a measure of total PM10. Both fractions collected by the dichot sampler are analyzed by X-ray fluorescence (XRF) spectroscopy for 30 elemental species. Particles are collected on 37 mm diameter filters with a total specified flowrate of 16.7 liters per minute (lpm). Ten percent of the total flow is directed to the coarse particle filter, while the remainder goes to the fine particle filter. Thus, the coarse particles are collected at a low velocity, and may not adhere well to the filter. This may be one reason why PM10 concentrations measured by dichot samplers average 15 percent lower than PM10 concentrations measured by SSI samplers at a majority of sites in California on days when the state standard is exceeded (above 50 $\mu g/m^3$), based on 1990 to 1997 data. At some sites, the difference is more than 25 percent.

7.2. California Acid Deposition Monitoring Program (CADMP)

The California Acid Deposition Monitoring Program was established in early 1988 to determine the spatial and temporal patterns of acidic pollutant concentrations in the state. The CADMP dry-deposition network initially consisted of ten samplers located in Azusa, Bakersfield, Fremont, Gasquet, Long Beach, Los Angeles, Sacramento, Santa Barbara, Sequoia National Park, and Yosemite National Park. A collocated sampler was situated at the Sacramento site until July 1993, when it was moved to Azusa. Originally, the CADMP sampler had two units designed for collection of particulate species in two size fractions and for collection of acidic gases. The PM10 unit collected particles less than 10 μm aerodynamic diameter on a Teflon filter, and had impregnated back filters for collection of ammonia and sulfur dioxide. The Teflon filter was analyzed for sulfate, nitrate, chloride, ammonium, sodium, magnesium, calcium, and potassium ions. The PM2.5 unit collected two samples of particles less than 2.5 μm aerodynamic diameter,

one on a Teflon-nylon filter pack without a nitric acid denuder, and the other on a nylon filter after a denuder (consisting of anodized aluminum tubes). The Teflon filter is analyzed for the same species as the PM10 Teflon filter while the nylon back filter is analyzed for nitrate ions. The difference between the total nitrate measured by the filter pack and that by the nylon filter below the denuder is a measure of gaseous nitric acid by the "denuder difference" approach. Concentrations of dry-deposition particles and gases were measured by collecting consecutive 12-hour daytime (0600 to 1800 PST) and nighttime (1800 to 0600 PST) samples, once every sixth day.

Over the years, as the data were reviewed and the limited extent of the acid deposition problem in California became known, the number of pollutants sampled and the number of sites declined. In September 1995, the CADMP network was reduced to five monitoring sites primarily in urban areas (i.e., Azusa, Bakersfield, Long Beach, Los Angeles, and Sacramento). The sample collection was changed from two 12-hour samples to one 24-hour sample commencing at midnight like the routine particulate matter monitoring network, and the sampling was reduced to PM2.5 monitoring only. The CADMP sampler uses a 20 lpm flowrate for collecting the PM2.5 sample, similar to the 16.7 lpm flowrate proposed by the U.S. EPA for the PM2.5 FRM.

7.3. PM10 Technical Enhancement Program (PTEP)

In December 1994, the SCAQMD initiated a comprehensive program, the PM10 Technical Enhancement Program (PTEP), to characterize fine particulate matter in the South Coast Air Basin (SoCAB). To build an optimal PM database for the 1997 PM10 State Implementation Plan (SIP) and Air Quality Management Plan (AQMP) revision, a one-year special particulate monitoring program was initiated in January 1995 as part of the PTEP program. Under this enhanced monitoring, nitric acid, ammonia, and speciated PM10 and PM2.5 concentrations were measured at five stations in the SoCAB and at one background station at San Nicholas Island, located 80 miles off the Southern California Coast. The PM10 data were the first speciated particulate data collected for air quality planning purposes in the SoCAB since 1986, and the PM2.5 data were the first such speciated data collected in the SoCAB on an annual basis. The successful one-year PTEP monitoring program was essential to the modeling analysis and development of the 1997 AQMP.

7.4. TEP 2000 Enhanced Ambient Air Monitoring Program

As a sequel to the PTEP program, the SCAQMD has initiated a comprehensive program to characterize the ozone and PM problem in the SoCAB for the upcoming 2000 AQMP. Under this Technical Enhancement Program for the 2000 AQMP revision (TEP 2000), the South Coast AQMD is conducting a one-year special monitoring program in the SoCAB from August 1998 through July 1999. The program includes eight sites, Downtown Los Angeles, Anaheim, Diamond Bar, Fontana, Rubidoux, Ontario, Long Beach, and Costa Mesa, operating on a one-in-three day sampling schedule. Three of these sites, Downtown Los Angeles, Anaheim, and Rubidoux, have sampled daily during the peak October through November period. The TEP 2000 ambient monitoring program will provide a much more complete database for the chemical speciation required under EPA's new PM10/PM2.5 regulatory standards, and more complete data for receptor and dispersion modeling. For a detailed description of the PM sampler, sampling location and schedule, and sample analysis for the TEP 2000 program please refer to the PM2.5 Air Monitoring Plan for the South Coast Air Quality Management District (South Coast AQMD, 1998).

7.5. IMPROVE Network

In 1977, amendments to the Federal Clean Air Act established a national goal to remedy and prevent future deterioration of visibility in Federal Class I national parks and wilderness areas. In response, federal land management agencies (National Park Service; U.S. Fish and Wildlife Service; Bureau of Land Management; and U.S.D.A. Forest Service) and the U.S. EPA coordinated a visibility program, called IMPROVE (Interagency Monitoring for PROtected Visual Environments). The IMPROVE air monitoring network began operation in 1987 and is presently composed of 30 sites nationwide. The IMPROVE program includes the characterization of haze by photography, the measurement of optical extinction with transmissometers and nephelometers, and the measurement of the composition and concentration of fine particulate matter that produce the extinction and the tracers that identify emission sources.

In California, there are two IMPROVE monitoring sites: one in Yosemite National Park (NP) and another in the San Gorgonio Wilderness (San Bernardino National Forest). In addition, there are six sites ("protocol" sites) operated according to IMPROVE monitoring protocols, but without the full suite of instrumentation: Redwood National Park; Lassen Volcanic NP; Point Reyes National Seashore; Pinnacles National Monument; Sequoia NP; and Dome Land Wilderness (Sequoia National Forest).

Aerosol monitoring in the IMPROVE network is accomplished by a combination of particle sampling and sample analysis. The sampler was designed specifically for IMPROVE. It collects four simultaneous samples: one PM10 sample on a Teflon filter and three PM2.5 samples on Teflon, nylon, and quartz filters. The IMPROVE sampler is programmed to collect two 24-hour duration samples per week (i.e., 26 per season, 104 per year). The PM10 filter is used to determine total PM10 mass. The PM2.5 Teflon filter is used to measure total fine aerosol mass, individual chemical species using Proton Induced X-ray Emission (PIXE) and Proton Elastic Scattering Analysis (PESA), and light-absorption coefficient using the Hybrid Integrating Plate and Sphere (HIPS). The nylon filter is used to measure nitrate and sulfate aerosol concentrations with Ion Chromatography (IC). Finally, the quartz filters are analyzed for organic and elemental carbon using the Thermal Optical Reflectance (TOR) method.

Of the 30 sites nationwide, transmissometers are employed to measure the light-extinction coefficient at 15 of the IMPROVE sites, and 11 sites have integrating nephelometers, which measure the scattering coefficient. Transmissometers measure the light transmitted through the atmosphere over a distance of one to fifteen kilometers. The light transmitted between the light source (transmitter) and the light monitoring component (receiver) is converted to the path-averaged light extinction coefficient (b_{ext}), which is the sum of scattering (b_{scat}) and absorption (b_{abs}). Integrating nephelometers measure the scattering of light over a defined band of visible wavelengths from an enclosed volume of air, which represents a point measurement of scattering. By combining the absorption coefficient from the particle sampler with the scattering coefficient from the nephelometer, the extinction coefficient can be reconstructed at the 11 nephelometer sites. Relative humidity is measured continuously at the transmissometer and nephelometer sites.

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Appendix A. Core PM2.5 State and Local Air Monitoring Stations (Stations with FRMs)

SQ Federal Reference Method (FRM) PM2.5 sequential sampler.
Col SQ Collocated PM2.5 FRM sequential samplers.
SCH PM2.5 FRM single channel sampler.
Col SCH Collocated PM2.5 FRM single channel samplers.

Italicized font indicates that funding was allocated in 1999.

Site Location (by MPA)	AIRS Site ID	Operating Agency*	Type of Monitor	Sampling Begin Date	Sampling Schedule	Supporting Lab
Bay Area AQMD						
Concord-2975 Treat Blvd	060130002	BA	SQ	1/9/99	Everyday (Oct-March) 1 in 6 day (April-Sept)	BA
Fremont-Chapel Way	060011001	BA	SQ	1/3/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
Livermore	New site	BA	SQ	Not started	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
Redwood City	060811001	BA	SQ	1/3/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
San Francisco-Arkansas Street	060750005	BA	Col SQ	1/3/99	Everyday (Oct-March) 1 in 6 day (April-Sept)	BA
San Jose-4th Street	060850004	BA	Col SQ	1/3/99	Everyday (Oct-March) 1 in 6 day (April-Sept)	BA
San Jose-Tully Road	060852003	BA	SQ	1/3/99	Everyday (Oct-March) 1 in 6 day (April-Sept)	BA
Santa Rosa-5th Street	060970003	BA	SQ	1/3/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
Vallejo-304 Tuolumne Street	060950004	BA	SQ	2/20/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
Coachella Valley						
Indio-Jackson Street	060652002	SC	*Col* SQ	2/5/99	1 in 3 day	SC
Palm Springs-Fire Station	*060655001*	*SC*	*SQ*	*Not started*	*1 in 3 day*	*SC*
Great Basin Unified APCD						
Keeler-Cerro Gordo Road	060271003	GBU	Col SQ	1/3/99	1 in 3 day	VEN
Mammoth Lakes-Gateway HC	060510001	GBU	SQ	Not started	1 in 3 day	VEN
Imperial County APCD						
Brawley-Main Street	060250003	IMP	SQ	1/3/99	1 in 3 day	SD
Calexico-Ethel Street	060250005	ARB	Col SQ	1/3/99	1 in 3 day	SD
El Centro-9th Street	060251003	IMP	SQ	1/3/99	1 in 3 day	SD
Lake County Air Basin						
Lakeport-Lakeport Blvd	060333001	LAK	SCH	1/6/99	1 in 6 day	BA
Lake Tahoe Air Basin						
North-West Lake Tahoe	New site	ARB	SCH	Not started	1 in 6 day	ARB
South Lake Tahoe-Sandy Way	060170005	ARB	Col SCH	2/5/99	1 in 6 day	ARB
Mojave Desert Air Basin						
Lancaster-W Pondera Street	060379002	MD	SQ	1/3/99	1 in 3 day	SD
Mojave-923 Poole Street	060290011	ARB	SQ	1/3/99	1 in 3 day	SD
Ridgecrest-Las Flores Avenue	060290012	KER	SQ	Not started	1 in 3 day	SD
Victorville-Armagosa Road	060710014	MD	Col SQ	1/3/99	1 in 3 day	SD

Site Location (by MPA)	AIRS Site ID	Operating Agency*	Type of Monitor	Sampling Begin Date	Sampling Schedule	Supporting Lab
Monterey Bay Unified APCD						
Salinas No.3	060531003	MBU	SQ	1/15/99	1 in 3 day	BA
Santa Cruz-Soquel Drive	060870007	MBU	Col SQ	1/6/99	1 in 3 day	BA
Mountain Counties Air Basin						
Grass Valley-Litton Building Site	060570005	NSI	SCH	1/3/99	1 in 6 day	ARB
Portola	060631008	NSI	SQ	3/25/99	1 in 3 day	ARB
Quincy-N Church Street	060631006	NSI	SQ	3/26/99	1 in 3 day	ARB
San Andreas-Gold Strike Road	060090001	ARB	SCH	1/6/99	1 in 6 day	ARB
Truckee-Fire Station	060571001	NSI	Col SQ	Not started	1 in 3 day	ARB
North Coast Air Basin						
Eureka-Health Dept 6th and I Street	060231002	NCU	SCH	1/8/99	1 in 6 day	BA
Ukiah-County Library	060452001	MEN	Col SCH	1/7/99	1 in 6 day	BA
Northeast Plateau Air Basin						
Alturas-W 4th Street	060490001	SIS	SCH	1/18/99	1 in 6 day	ARB
Sacramento Valley Air Basin						
Chico-Manzanita Avenue	060070002	ARB	SCH	12/19/98	1 in 6 day	ARB
Colusa-Sunrise Blvd	060111002	ARB	SQ	12/16/98	1 in 3 day	ARB
Redding-Health Dept Roof	060890004	SHA	SCH	12/19/98	1 in 6 day	ARB
Roseville-N Sunrise Blvd	060610006	ARB	SCH	12/31/98	1 in 6 day	ARB
Sacramento-Del Paso Manor	060670006	SAC	Col SQ	1/3/99	Everyday (Oct-March) 1 in 3 day (April-Sept)	ARB
Sacramento-Health Dept Stockton Blvd	060674001	SAC	SQ	2/2/99	Everyday (Oct-March) 1 in 3 day (April-Sept)	ARB
Sacramento-T Street	060670010	ARB	SQ	12/13/98	Everyday	ARB
Woodland	New site	YS	SQ	1/9/99	1 in 3 day	ARB
Yuba City-Almond Street	061010003	ARB	Col SCH	12/19/98	1 in 6 day	ARB
San Diego County APCD						
Chula Vista	060730001	SD	SQ	1/3/99	1 in 3 day	SD
El Cajon-Redwood Avenue	060730003	SD	SQ	1/1/99	Everyday	SD
Escondido-E Valley Parkway	060731002	SD	SQ	1/1/99	Everyday	SD
San Diego-12th Avenue	060731007	SD	SQ	1/1/99	Everyday	SD
San Diego-Overland Avenue	060730006	SD	Col SQ	1/3/99	1 in 3 day	SD
San Joaquin Valley Unified APCD						
Bakersfield-1120 Golden State Avenue	060290010	ARB	SQ	1/6/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	VEN
Bakersfield-5558 California Avenue	060290014	ARB	Col SQ	1/3/99	Everyday	VEN
Clovis-N Villa Avenue	060195001	SJV	SQ	1/3/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	VEN
Corcoran-Patterson Avenue	060310004	SJV	SQ	1/3/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	VEN
Fresno-1st Street	060190008	ARB	Col SQ	1/3/99	Everyday	ARB
Merced-M Street	060472510	SJV	SQ	4/12/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	VEN
Modesto-814 14th Street	060990005	ARB	SQ	1/3/99	1 in 3 day	ARB
Stockton-Hazelton Street	060771002	ARB	SQ	1/3/99	1 in 3 day	ARB
Visalia-N Church Street	061072002	ARB	SQ	1/3/99	1 in 3 day	ARB
Bakersfield-"Southeast"	*New site*	*ARB*	*SQ*	*Not started*	*1 in 3 day*	*VEN*
Fresno-"Southeast"	*New site*	*SJV*	*SQ*	*Not started*	*1 in 3 day (Oct-March)* *1 in 6 day (April-Sept)*	*VEN*

Site Location (by MPA)	AIRS Site ID	Operating Agency*	Type of Monitor	Sampling Begin Date	Sampling Schedule	Supporting Lab
San Luis Obispo County APCD						
Atascadero-Lewis Avenue	060798001	SLO	Col SCH	1/6/99	1 in 6 day	VEN
San Luis Obispo-Marsh Street	060792002	ARB	SCH	1/6/99	1 in 6 day	VEN
Santa Barbara County APCD						
Santa Barbara-W Carillo Street	060830010	ARB	SCH	1/6/99	1 in 6 day	VEN
Santa Maria-Library	060834001	ARB	SCH	5/1/99	1 in 6 day	VEN
South Coast Air Basin						
Anaheim-Harbor Blvd	060590001	SC	Col SQ	1/3/99	1 in 3 day	SC
Azusa	060370002	SC	SQ	1/3/99	1 in 3 day	SC
Big Bear	060718001	SC	SQ	2/8/99	1 in 3 day	SC
Burbank-W Palm Avenue	060371002	SC	SQ	1/21/99	1 in 3 day	SC
Mission Viego	New site	SC	SQ	Not started	1 in 3 day	SC
Fontana-Arrow Highway	060712002	SC	Col SQ	1/3/99	1 in 3 day	SC
Los Angeles-North Main Street	060371103	SC	Col SQ	1/18/99	1 in 3 day	SC
Lynwood	060371301	SC	SQ	1/3/99	1 in 3 day	SC
North Long Beach	060374002	SC	SQ	1/3/99	1 in 3 day	SC
Ontario-Fire Station	060710025	SC	SQ	1/3/99	1 in 3 day	SC
Pasadena-S Wilson Avenue	060372005	SC	SQ	1/27/99	1 in 3 day	SC
Pico Rivera	060371601	SC	SQ	1/15/99	1 in 3 day	SC
Reseda	060371201	SC	SQ	1/15/99	1 in 3 day	SC
Riverside-Magnolia	060651003	SC	SQ	1/3/99	1 in 3 day	SC
Riverside-Rubidoux	060658001	SC	Col SQ	1/3/99	1 in 3 day	SC
San Bernardino-4th Street	060719004	SC	SQ	1/3/99	1 in 3 day	SC
Ventura County APCD						
El Rio-Rio Mesa School #2	061113001	VEN	SQ	1/9/99	1 in 3 day	VEN
Simi Valley-Cochran Street	061112002	VEN	SQ	1/6/99	1 in 3 day	VEN
Thousand Oaks-Moorpark Road	061110007	VEN	Col SQ	1/6/99	1 in 3 day	VEN
Piru-2 miles SW	*061110004*	*VEN*	*Col SQ*	*Not started*	*1 in 3 day*	*VEN*

***Key to Operating Agency Codes:**

ARB	Air Resources Board
BA	Bay Area Air Quality Management District
GBV	Great Basin Valleys Unified Air Pollution Control District
IMP	Imperial County Air Pollution Control District
KER	Kern County Air Pollution ControlDistrict
LAK	Lake County Air Quality Management District
MBU	Monterey Bay Unified Air Pollution Control District
MD	Mojave Desert Air Quality Management District
MEN	Mendocino County Air Quality Management District
NCU	North Coast Unified Air QualityManagement District
NSI	Northern Sierra Air Quality Management District
SAC	Sacramento Metropolitan Air Quality Management District
SC	South Coast Air Quality Management District
SD	San Diego County Air Pollution Control District
SHA	Shasta County Air Quality Management District
SIS	Siskiyou County Air Pollution Control District
SJV	San Joaquin Valley Unified Air Pollution Control District
SLO	San Luis Obispo County Air Pollution Control District
VEN	Ventura County Air Pollution Control District
YS	Yolo Solano County Air Quality Management District

Appendix B. Existing and Proposed PM2.5 Monitoring Network in California

FRM	Federal Reference Method (FRM) PM2.5 sequential or single channel mass sampler.
Continuous	PM2.5 continuous mass monitor.
Speciation	Included in this column are National Air Monitoring Station (NAMS) speciation trend sites and two IMPROVE sites that will be used for background monitoring. The State and local monitoring sites are not yet determined.
Dichot	Existing dichotomous samplers.
XX	Collocated PM2.5 FRM monitoring instruments collecting precision data.
X-99	Proposed for funding allocation in 1999.

Site Location (by MPA)		AIRS Site ID	Operating Agency*	PM2.5 Sampling Method			
				FRM	Continuous	Speciation	Dichot
Bay Area AQMD							
	Concord-2975 Treat Blvd	060130002	BA	X			
	Fremont-Chapel Way	060011001	BA	X			
	Livermore	New site	BA	X	X-99		
	Redwood City	060811001	BA	X			
	San Francisco-Arkansas Street	060750005	BA	XX	X-99		
	San Jose-4th Street	060850004	BA	XX	X-99	NAMS	X
	San Jose-Tully Road	060852003	BA	X			
	Santa Rosa-5th Street	060970003	BA	X			
	Vallejo-304 Tuolumne Street	060950004	BA	X			
	Prescott Park [1]	New site	BA		X-99		
	Point Reyes		IMPROVE		X-99	IMPROVE	
Coachella Valley							
	Indio-Jackson Street	060652002	SC	XX			
	Palm Springs-Fire Station	060655001	SC	X-99			
Great Basin Unified APCD							
	Cosco Junction-10 miles E	060271014	GBU				X
	Keeler-Cerro Gordo Road	060271003	GBU	XX			X
	Mammoth Lakes-Gateway HC	060510001	GBU	X			
Imperial County APCD							
	Brawley-Main Street	060250003	IMP	X			
	Calexico-Ethel Street	060250005	ARB	XX			X
	El Centro-9th Street	060251003	IMP	X			
Lake County Air Basin							
	Lakeport-Lakeport Blvd	060333001	LAK	X			
Lake Tahoe Air Basin							
	North Lake Tahoe	New site	ARB	X			
	South Lake Tahoe-Sandy Way	060170005	ARB	XX			

[1] This is a tentative proposal contingent upon this site receiving funding as part of the U.S. EPA grant program, Environmental Monitoring for Public Access and Community Tracking (EMPACT). The continuous PM2.5 mass sampler would be funded as part of the PM2.5 network. All other monitoring equipment proposed at this site would be funded as part of the EMPACT project. If the site is not funded as part of the EMPACT project, the ARB and the Bay Area AQMD will coordinate on the selection of another site in west Oakland.

Site Location (by MPA)	AIRS Site ID	Operating Agency*	PM2.5 Sampling Method			
			FRM	Continuous	Speciation	Dichot
Mojave Desert Air Basin[2]						
Lancaster-W Pondera Street	060379002	MD	X			
Mojave-923 Poole Street	060290011	ARB	X			
Ridgecrest	New site	KER	X			
Victorville-Armagosa Road	060710014	MD	XX			X
Monterey Bay Unified APCD						
Salinas No.3	060531003	MBU	X			
Santa Cruz-Soquel Drive	060870007	MBU	XX			
Mountain Counties Air Basin						
Grass Valley-Litton Building Site	060570005	NSI	X			
Portola	060631008	NSI	X			X
Quincy-N Church Street	060631006	NSI	X			
San Andreas-Gold Strike Road	060090001	ARB	X			
Truckee-Fire Station	060571001	NSI	XX			
Yosemite Village	060431001	tbd		X-99		
North Coast Air Basin						
Eureka-Health Dept 6th and I Street	060231002	NCU	X			
Ukiah-County Library	060452001	MEN	XX			
Northeast Plateau Air Basin						
Alturas-W 4th Street	060490001	SIS	X			
Sacramento Valley Air Basin						
Chico-Manzanita Avenue	060070002	ARB	X			
Colusa-Sunrise Blvd	060111002	ARB	X			
Redding-Health Dept Roof	060890004	SHA	X			
Roseville-N Sunrise Blvd	060610006	ARB	X			
Sacramento-Del Paso Manor	060670006	SAC	XX		NAMS	
Sacramento-Health Dept Stockton Blvd	060674001	SAC	X			
Sacramento-T Street	060670010	ARB	X			X
Woodland-Gibson Road	New site	YS	X			
Yuba City-Almond Street	061010003	ARB	XX			
San Diego County APCD						
Chula Vista	060730001	SD	X			
El Cajon-Redwood Avenue	060730003	SD	X		NAMS	
Escondido-E Valley Parkway	060731002	SD	X	X-99		
San Diego-12th Avenue	060731007	SD	X			
San Diego-Overland Avenue	060730006	SD	XX			
San Joaquin Valley Unified APCD						
Bakersfield-1120 Golden State Avenue	060290010	ARB	X			
Bakersfield-5558 California Avenue	060290014	ARB	XX		NAMS	X
Clovis-N Villa Avenue	060195001	SJV	X			
Corcoran-Patterson Avenue	060310004	SJV	X			X
Fresno-1st Street	060190008	ARB	XX	X-99	NAMS	X
Merced-M Street	060472510	SJV	X			
Modesto-814 14th Street	060990005	ARB	X			X
Stockton-Hazelton Street	060771002	ARB	X			X
Visalia-N Church Street	061072002	ARB	X			X
Fresno-"Southeast"	New site	SJV	X-99			

[2] This table does not include a Special Purpose Monitoring site located at Marine Corps Air Ground Combat Center Twentynine Palms. The site will include continuous and gravimetric PM2.5 monitors. The site needs to be inspected and approved by the ARB's Monitoring and Laboratory Division before it is considered part of the routine network.

Site Location (by MPA)		AIRS Site ID	Operating Agency*	PM2.5 Sampling Method			
				FRM	Continuous	Speciation	Dichot
San Joaquin Valley Unified APCD (continued)							
	Bakersfield-"Southeast"	New site	ARB	X-99			
	Tracy	New site	SJV		X-99		
	Taft College	060292004	ARB				X
San Luis Obispo County APCD							
	Atascadero-Lewis Avenue	060798001	SLO	XX			
	San Luis Obispo-Marsh Street	060792002	ARB	X			
Santa Barbara County APCD							
	Santa Barbara-W Carillo Street	060830010	ARB	X			
	Santa Maria-Library	060834001	ARB	X			
	San Rafael Wilderness		IMPROVE		X-99	IMPROVE	
South Coast Air Basin							
	Anaheim-Harbor Blvd	060590001	SC	XX	X-99		
	Azusa	060370002	SC	X			X
	Big Bear	060718001	SC	X			
	Burbank-W Palm Avenue	060371002	SC	X			
	Mission Viego	New site	SC	X			
	Fontana-Arrow Highway	060712002	SC	XX			
	Los Angeles-North Main Street	060371103	SC	XX	X-99		
	Lynwood	060371301	SC	X			
	North Long Beach	060374002	SC	X			X
	Ontario-Fire Station	060710025	SC	X			
	Pasadena-S Wilson Avenue	060372005	SC	X			
	Pico Rivera	060371601	SC	X			
	Reseda	060371201	SC	X			
	Riverside-Magnolia	060651003	SC	X			
	Riverside-Rubidoux	060658001	SC	XX	X-99	NAMS	
	San Bernardino-4th Street	060719004	SC	X			
Ventura County APCD							
	El Rio-Rio Mesa School #2	061113001	VEN	X			
	Simi Valley-Cochran Street	061112002	VEN	X		NAMS	
	Thousand Oaks-Moorpark Road	061110007	VEN	XX			
	Piru-2 miles SW	061110004	VEN	X-99			

***Key to Operating Agency Codes:**

ARB	Air Resources Board
BA	Bay Area Air Quality Management District
GBV	Great Basin Valleys Unified Air Pollution Control District
IMP	Imperial County Air Pollution Control District
IMPROVE	IMPROVE Steering Committee
KER	Kern County Air Pollution Control District
LAK	Lake County Air Quality Management District
MBU	Monterey Bay Unified Air Pollution Control District
MD	Mojave Desert Air Quality Management District
MEN	Mendocino County Air Quality Management District
NCU	North Coast Unified Air Quality Management District
NSI	Northern Sierra Air Quality Management District
SAC	Sacramento Metropolitan Air Quality Management District
SC	South Coast Air Quality Management District
SD	San Diego County Air Pollution Control District
SHA	Shasta County Air Quality Management District
SIS	Siskiyou County Air Pollution Control District
SJV	San Joaquin Valley Unified Air Pollution Control District
SLO	San Luis Obispo County Air Pollution Control District
VEN	Ventura County Air Pollution Control District
YS	Yolo Solano County Air Quality Management District