BAY AREA

AIR QUALITY MANAGEMENT DISTRICT

AIR MONITORING

QUALITY ASSURANCE PROJECT PLAN

REVISION 1.05 4/14/2010

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
939 ELLIS STREET
SAN FRANCISCO, CA 94109

A1. APPROVAL SHEETS

BAY AREA AIR QUALITY MANAGEMENT DISTRICT APPROVAL SHEET

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A2.3 LIST OF ACRONYMS

Air District	Bay Area Air Quality Management District
AMTAC	ARB Air Monitoring Technical Advisory Committee
APCO	Air Pollution Control Officer
APTI	Air Pollution Technology Institute
ARB	California Air Resources Board
ARM	Area Recognized Method
AQIS	Air Quality Instrument Specialist
AQS	EPA's Air Quality System
AQTA	Air Quality Technical Assistant
ASTM	American Society for Testing and Materials
AWMA	Air and Waste Management Association
BAM	Beta Attenuation Monitor
BC	Black carbon
BGI	BGI, Incorporated
CAS	Chemical Abstracts Service (a chemical reference number)
CFR	U.S. Code of Federal Regulations
CH_4	Methane
CI	Confidence Interval
CO	Carbon monoxide
CoC	Chain of custody
COH	Coefficient of Haze
CV	Coefficient of variation
DAS	Data Acquisition System
District	Bay Area Air Quality Management District
DMS	Data management system
DNPH	2, 4-dinitrophenyl hydrazine
DQI	Data Quality Indicators
DQO	Data Quality Objectives
DVM	Digital Voltmeter
EECS	Electrical Equipment Calibration Service (in Fremont, CA)
EPA	U.S. Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
GLM	Ground Level Monitoring
GMW	General Metal Works (PM_{10} sampler manufacturer)
H_2S	Hydrogen sulfide
HC	Hydrocarbon
HPLC	High Performance Liquid Chromatograph
LCS	Laboratory Control Sample
LLD	Lower Limit of Detection
LOD	Limit of Detection
LOQ	Limit of Quantitation
lpm	Liters per minute

LIST OF ACRONYMS (continued)

MDL	Method Detection Limit
MQA	Meteorology and Quality Assurance
MS	Matrix spikes
NATTS	National Ambient Toxic Tends Stations
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NMHC	Non-methane hydrocarbon
NPAP	EPA National Performance Audit Program
NVLAP	National Voluntary Laboratory Accreditation Program
O_3	Ozone
OC/EC	Organic carbon/elemental carbon
ODAMN	Operations Data Action Monitoring Notification
PE	Performance Evaluation
PM_{10}	Particulate matter with mean aerodynamic diameter of 10 microns
$PM_{2.5}$	Particulate matter with mean aerodynamic diameter of 2.5 microns
PO	Purchase Order
ppb	Parts per billion
PSD	Prevention of significant deterioration
QA	Quality Assessment
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RTD	Resistance Temperature Detector
RTI	Research Triangle Institute, a research/consulting company
SO_2	Sulfur dioxide
SOP	Standard operating procedure
SPM	Special Purpose Monitor
SRP	Standard Reference Photometer
STN	Speciation Trends Network
TECO	Thermo Electron Corporation, now Thermo Fisher Scientific
THC	Total hydrocarbons
TSA	Technical systems audits
TSP	Total suspended particulates
UV	Ultraviolet

A3. DISTRIBUTION LIST

QAPP Recipient	Title	Organization	Telephone Number	Fax number	E-mail Address

This list shall remain confidential in the Quality Assurance Officer's custody.

PROJECT TASK ORGANIZATION

A4.1 QAPP PURPOSE AND STRUCTURE

The U.S. Environmental Protection Agency (EPA) requires all organizations conducting environmental programs that are fully or partially funded by EPA to establish and implement a structured quality system that ensures the production of quality information products. The Bay Area Air Quality Management District (the Air District) regularly provides information to the EPA, and therefore has put into place a quality system comprising various components as described in its Air Monitoring Quality Management Plan (Bay Area Air Quality Management District, 2008). This Quality Assurance Project Plan (QAPP) is one component of the Bay Area AQMD's quality system.

Although air quality data are used by many divisions within the Air District, once the monitoring plan has been approved by the data requestors and the data collectors, the measurement and review of the data are then carried out for the most part by the Technical Services Division of the Air District. This Air Monitoring QAPP describes the planning, implementation, and assessment of data using methodologies and thorough quality assessment (QA) and quality control (QC) activities that groups within the Air District's Technical Services Division conduct to ensure that data monitoring objectives are met. This QAPP is meant to define and clarify all operational aspects involved in maintaining an effective air monitoring network including, but not limited to, laboratory analysis, meteorological measurements, audits, QA/QC activities, and data management and analysis. This document is intended for field operators and supervisors and data processing and program managers responsible for implementing, designing, and coordinating air quality monitoring.

This QAPP adheres to EPA requirements for such documents and includes all 24 elements of a QAPP (U.S. Environmental Protection Agency, 2001, 2002). These elements are shown in **Table A4-1** and identified in the revision numbers contained in page headers of this document. This document is divided into the following four major sections:

- Section A explains Project Management including the purpose and structure of the Air Monitoring QAPP, Technical Services Division organization and Project Management Plan including program objectives and background, data quality objectives, and documentation;
- Section B describes data generation and acquisition activities conducted by the Technical Services Division;
- Section C describes assessment and oversight procedures to ensure high quality data;
- Section D describes the air quality data review and data submission (to EPA) processes;

This document also includes references to supporting documents and two appendixes. **Appendix A** contains all current Technical Services Division standard operating procedures (SOPs). SOPs are numbered and organized according to Division staff usage as indicated in **Table A4-2**. **Appendix B** is the current version of the Air Monitoring Network Plan.

Table A4-1. The 24 elements of a QAPP.

	A	B	C	D
	Project Management	**Data Generation and Acquisition**	**Assessment and Oversight**	**Data Validation and Usability**
1	Title and Approval Sheet	Sampling Process Design (Experimental Design)	Assessments and Response Actions	Data Review, Verification, and Validation
2	Table of Contents	Sampling Methods	Reports to Management	Verification and Validation Methods
3	Distribution List	Sample Handling and Custody		Reconciliation with User Requirements
4	Project/Task Organization	Analytical Methods		
5	Problem Definition and Background	Quality Control		
6	Project/Task Description	Instrument/Equipment Testing, Inspection, and Maintenance		
7	Quality Objectives and Criteria	Instrument/Equipment Calibration and Frequency		
8	Special Training/Certifications	Inspection/Acceptance of Supplies and Consumables		
9	Documentation and Records	Non-direct Measurements		
10		Data Management		

Table A4-2. Numbering system for Air Monitoring QAPP SOPs in Appendix A.

SOP Series Number	SOP Group
0xx	Administrative
1xx	Air Monitoring Operations
2xx	Air Monitoring Instruments
3xx	Laboratory
4xx	(reserved)
5xx	Meteorology
6xx	Data Management
7xx	Performance Evaluation
800-999	(currently unassigned)

A4.2 TECHNICAL SERVICES DIVISION ORGANIZATION

The Technical Services Division is one of ten administrative units within the Bay Area Air Quality Management District. The Division is divided into four sections as shown in the organization chart in **Figure A4-1**: the Air Monitoring Section, the Laboratory Services Section, the Meteorology and Quality Assurance Section (MQA), and the Source Test Section. The Director of Technical Services coordinates all Division activities; provides administrative support; and determines and disseminates Division goals, objectives, policies, and direction. Only the Air Monitoring, Laboratory Services, and MQA sections are directly involved with the ambient air monitoring program and descriptions of these sections follow. The personnel associated with the Division and Section management positions are included in the Division organization chart.

The Quality Assurance Officer, the Laboratory Quality Assurance Officer, and the Performance Evaluation Supervisor are part of the MQA and Laboratory sections with responsibility to manage the Division's Quality System activities. These positions are not part of the Division Management team, but may have supervisory responsibilities associated with their Quality System duties. The QA Officer is primarily responsible for maintaining Quality System documents, reviewing data quality performance with Division management, and providing recommendations to management on Quality Assessment issues and Quality System improvement. The Laboratory QA Officer's responsibilities parallel those of the QA Officer, but are specific to Laboratory operations. The Performance Evaluation Supervisor and his staff are responsible for conducting internal performance evaluations and flow rate audits, technical systems audits, and special projects as needed. The principal personnel associated with the Division Quality Assurance activities are included in the Division organization chart.

The Research and Modeling Section of the Planning Division is not shown in **Figure A4-1** but performs an external data review/quality assurance role in reviewing meteorological data. The Source Test Section measures emission levels from permitted facilities; this work is outside of the scope of this QAPP and the activities of this Section are not described further in this document.

A4.2.1 Air Monitoring Section

Air Monitoring Section staff operate and maintain all air quality monitoring stations for the Air District. Collected data are used for public reporting, National Ambient Air Quality Standards (NAAQS) compliance and/or research support, and these monitoring objectives are also identified in the Annual Network Plan. In addition, reports, plans, and rationale for actions taken by the Air District utilize monitoring data to identify and track trends, determine public exposure and health risks associated with ambient air toxics, determine air quality changes cause by enacted regulations, and validate modeling and other research objectives.

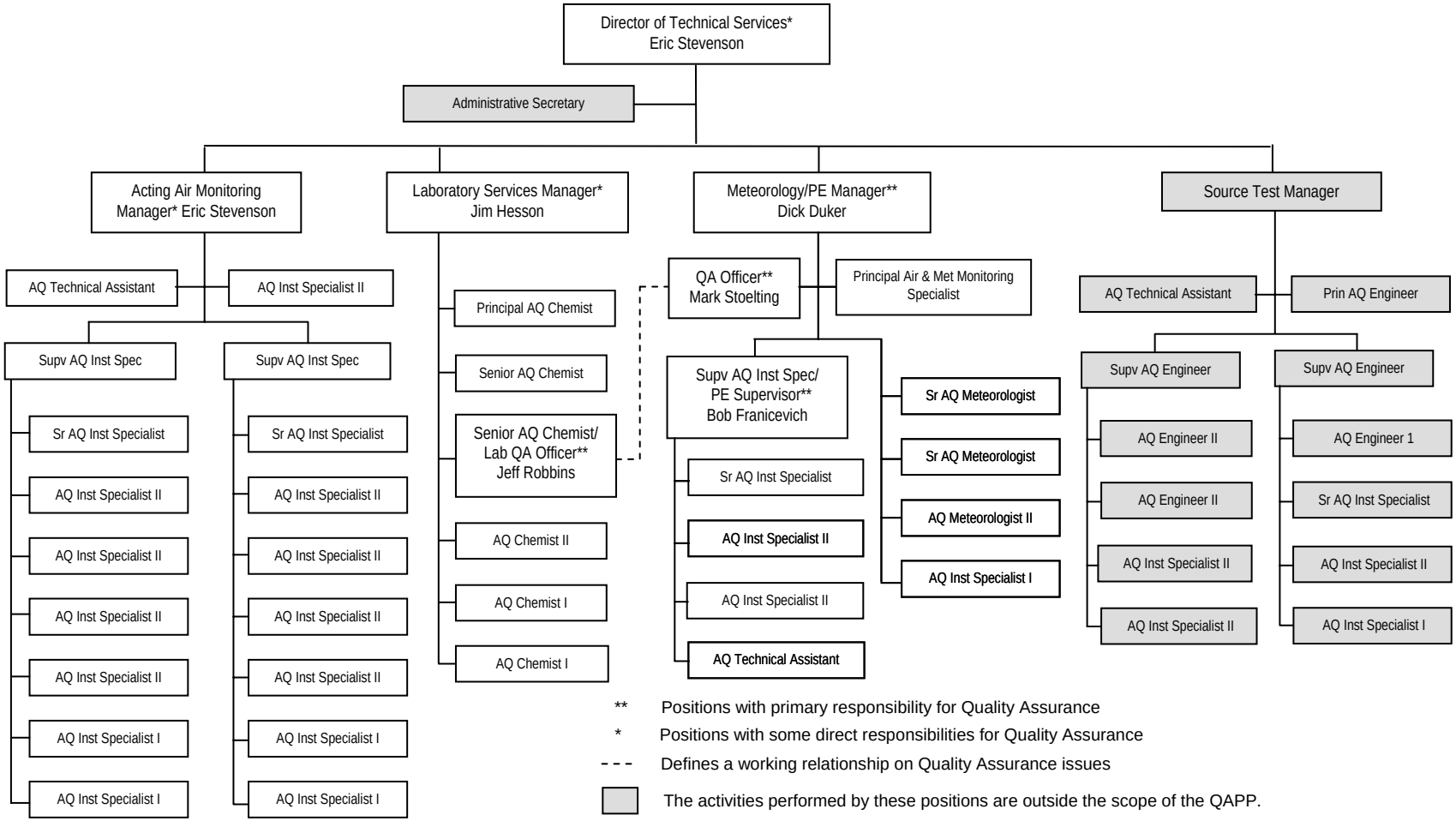

Figure A4-1. Organization chart for the Technical Services Division

This Section is responsible for the installation, maintenance, QC activities, repairs, and day-to-day operations of all Air District air monitoring sites. In addition to operating the analyzers and conducting first level data QC, qualified Air Quality Instrument Specialists also perform preventive maintenance and minor repairs on the instrumentation. Two (North Zone, South Zone) Supervising Air Quality Instrument Specialists (AQIS) and two (North Zone, South Zone) Senior Air Quality Instrument Specialists provide technical assistance to station operators, provide secondary QC, and perform the more technically advanced tasks related to station operations. One AQIS performs third level data QC and data entry.

The Air Monitoring Manager reports to the Director of Technical Services. This person is responsible for managing the operation and maintenance of equipment and facilities to meet or exceed EPA, California Air Resources Board (ARB), and Air District monitoring requirements and to ensure that data lost due to equipment malfunction and facilities infrastructure issues are minimized. The Air Monitoring Manager accomplishes this by providing adequate training and guidance to staff, and ensuring that the equipment parts inventory is adequately stocked to allow staff to maintain existing equipment. In addition, the Air Monitoring Manager enforces a long-range strategy to ensure that equipment that has reached the end of its useful life is replaced and that facility infrastructure is maintained and updated to meet all equipment and staffing needs.

The Air Monitoring Manager is also responsible for maintaining all operational SOPs and policies to ensure that methodologies and practices, including QC, meet or exceed EPA, ARB, and Air District guidance, requirements and recommendations. The Air Monitoring Manager accomplishes this by regularly and thoroughly reviewing SOPs, policies, procedures, and practices and by ensuring staff has the resources and knowledge to adequately perform these duties. This review is performed annually at a minimum.

The Air Monitoring Section Manager is the Program Manager for the criteria gas sampling networks (ozone, NO_2, CO, and SO_2), non-criteria gases (NO, H_2S, CH_4, non-methane hydrocarbons, and ambient toxics), criteria and non-criteria Particulate Matter ($PM_{2.5}$ and PM_{10}, speciation samplers and carbon/soot), the National Ambient Toxics Trends Station (NATTS), and the Chemical Speciation Network (CSN).

A4.2.2 Laboratory Services Section

The Air Monitoring field staff collects air quality samples using particulate filters, and gaseous sampling canisters and cartridges. These samples are transported to the Technical Services Division laboratory at the Air District office in San Francisco for analysis. Laboratory staff also analyze samples collected by the Air District's mobile surveillance vans. The laboratory staff provides all primary review of data generated. The Laboratory Services Manager has responsibilities similar in scope and purpose to the Air Monitoring Manager, with a focus on laboratory analytical equipment, chemical analysis of collected air samples, and analysis performed on filter media. The Laboratory Services Manager is responsible for the development of SOPs and policies to ensure that methodologies and practices meet all applicable requirements and recommendations. This is accomplished by regular and thorough review of SOPs, policies, procedures, and practices and by ensuring that laboratory staff have the resources

and knowledge to adequately perform these duties. Reviews are performed annually at a minimum.

An Air Quality Chemist is currently performing the duties of the Laboratory Quality Assurance Officer. The duties of the position include:

1. Review and co-signature for all laboratory SOPs.
2. Review of Air Monitoring QAPP.
3. Review of all official laboratory logbooks.
4. Review of laboratory data quality objectives.

The Laboratory does not directly manage any Monitoring Program associated with this Quality System. However, laboratory analysis activities play critical roles in the criteria and non-criteria PM, and ambient toxics Monitoring Programs. The Division Laboratory does not conduct analysis for TSP metals such as hexavalant chromium. This work is done by the California Air Resources Board laboratory in Sacramento. The Division also contracts with RTI International for chemical speciation analysis of filter samples collected as part of the CSN Monitoring Program and with ERG for analysis of PM_{10} metals and polycyclic aromatic hydrocarbons (PAHs) associated with the NATTS. The Technical Division Quality Plan does not extend to any analytical work done by ARB, RTI or ERG.

A4.2.3 Meteorology and Quality Assurance Section

The MQA Section is responsible for auditing the air monitoring instruments, quality assuring the air quality data, summiting data to EPA, operating and maintaining the Air District's meteorological network, and generating daily air quality forecasts.

Within the MQA section is the Performance Evaluation (PE) group, who are responsible for performing audits of all air quality instruments at air monitoring stations. The PE group operates under the direction of the PE group supervisor who reports directly to the MQA manager. This structure is designed to ensure the independence of the PE group from the programs and personnel it audits. The PE group is responsible for conducting internal performance evaluations of air quality monitors and particulate monitor flow rate audits, and special projects as needed. Staff also perform periodic technical system audits, where sampling systems and siting are evaluated, and assist with any performance evaluations or technical system audits conducted by outside agencies such as EPA or ARB.

This Section is also responsible for the electronic collection of the Air District air quality and meteorological data; final review of data to ensure that all ambient air monitoring data meet or exceed EPA, ARB, and Air District QA/QC requirements; archival of final air quality data in the Technical Services Division database, and submitting data to EPA in a timely manner. This is accomplished by developing, reviewing, and implementing data review SOPs and performing equipment, facilities, and technical systems audits. The MQA Manager provides the training and resources to staff that enable them to meet or exceed EPA, ARB, and Air District guidelines, requirements, and recommendations. Data are reviewed by the group's Air Quality

Meteorologists and the Principal Air and Meteorological Monitoring Specialist and prepared for timely submission to EPA.

The MQA Manager is the Program Manager for the Division's Meteorological Monitoring program, a network of monitoring towers throughout the District. Meteorological data are collected to meet forecasting and modeling needs of the Air District. Currently, MQA staff operates 21 stations within the Air District, and are responsible for all maintenance and audits of the system. Air District and Non-District meteorological data are reviewed, and corrected as needed, before being archived in Air District databases.

Air District air quality and meteorological information, along with National Weather Service forecast data, are used to generate daily air quality forecasts. Air Quality Meteorologists perform the forecasting, which is reviewed by the MQA Section Manager.

The MQA Manager supervises and is also responsible for all QA actions taken by the Quality Assurance Officer. While the QA Officer reports to the MQA Manager, the QA Officer may make recommendations directly to the Division Director on Quality System issues. The QA Officer or staff working under the QA Officer's direction:

- Maintains the Quality System Documents including reviews, approvals, updates, publishing, and change notifications to the QMP, QAPP, and SOPs
- Has signature approval authority over the QMP, QAPP, and non-laboratory SOPs
- Reviews data quality with program managers and technical staff to determine whether data quality objectives for ongoing programs are being met, or makes recommendations to Division management on changes needed
- Participates in the project planning process to insure that data quality objectives are defined and the project plan produces data meeting plan objectives
- Manages periodic internal assessments evaluating data management and quality as requested by senior management
- Reviews Laboratory procedures and data quality in consultation with the Laboratory Quality Assurance Officer

While this person may investigate cause and seek input regarding equipment performance and/or data accuracy, the MQA Manager alone determines the relevance of the final data.

A4.2.4 Research and Modeling Section of the Planning Division

The Planning Division's Research and Modeling Section is one of the consumers of Meteorological Monitoring Program data. This section is completely outside of the Technical Division and Planning Division staff meteorologists provide an independent review of all meteorological data generated by the Meteorological Monitoring Program. After review, meteorological data may be used in pollution modeling calculations, by the general public for unrestricted use, and for submission to AQS.

A5. PROBLEM DEFINITION AND BACKGROUND

As the number of autos increased in the San Francisco Bay Area in the 1950s and 60s, emissions from mobile sources became significant, resulting in pollutant levels that significantly decreased atmospheric visibility and caused respiratory problems amongst the residents. In the 1950s, air pollution control agencies of the five Bay Area counties that surround the San Francisco Bay began measuring these smog levels. The counties were Alameda, Contra Costa, San Francisco, San Mateo, and Santa Clara. To measure smog, the agencies used instruments that measured oxidant, which included the pollutants ozone, nitrogen dioxide, hydrocarbons, and photochemical aerosols.

The first statewide air pollution standards were set by the California Department of Public Health in 1959. These standards included total suspended particulates, photochemical oxidants, sulfur dioxide, nitrogen dioxide, and carbon monoxide. In 1962, the Air District took over air monitoring responsibilities from the counties, thereby becoming the first regional monitoring system in the country. This measurement program was intended to measure Bay Area pollution levels and provide staff with useful data for developing strategies to improve air quality.

In 1970, Congress passed the Clean Air Act authorizing the formation of the US Environmental Protection Agency, and requiring States to determine attainment of the NAAQS based on monitoring of the five criteria air pollutants: particulates, oxidant, sulfur dioxide, nitrogen dioxide, and carbon monoxide. For areas that already had an air monitoring program, the California Air Resources Board transferred monitoring responsibility to the local air pollution control agencies, such as the Bay Area Air Quality Management District. Ambient air quality monitoring and data reporting regulations were revised by EPA in 1979 and listed in Part 58 of 40 CFR. This regulation describes the minimum number of monitors for each pollutant, the type of monitors, the methodology for locating the monitors, the quality assurance needed for the monitors, and the schedule for reporting data to EPA. Since 1979, the Air District has followed the ambient air monitoring requirements specified in 40 CFR, Part 58.

What began as local ambient air monitoring program has now become a part of a national monitoring program due to the requirements of the Clean Air Act and its revisions. The Air District's monitoring program was initially focused on the five criteria pollutants and meteorology. The monitoring network was expanded in 1973 to add lead monitoring, in 1985 to add PM_{10} monitoring, in 1986 to add toxics monitoring, and in 1999 to add $PM_{2.5}$ monitoring. The CSN program was added in 2000, and the NATTS program was added in 2003. Ambient air monitoring data historically have been and will continue to be the basis for any decisions regarding the attainment or non-attainment of the NAAQS in the Bay Area. In addition, other monitoring programs are operated to define population exposure to air contaminants known or suspected to cause adverse health effects and/or to cause damage to property or sensitive ecosystems. All current Air District monitoring programs are summarized below.

A5.1 CRITERIA GASEOUS PROGRAM

These pollutants are defined by the Clean Air Act and EPA regulations as ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. 40 CFR Part 58 requires that these pollutions be measured within the District and reported to EPA quarterly. The regulation also lists appropriate instrumentation, specifies the minimum number of monitors, sets MQOs, and recommends siting criteria. The Air District operates a network of stations that measure these pollutants and meets EPA monitoring requirements. The purpose of this program is to: judge compliance with and/or progress made towards meeting the NAAQS; provide criteria air pollution data to the general public in a timely manner; observe pollution trends throughout the region, including non-urban areas; and provide a data base for research and evaluation of control effects.

A5.2 PM_{10} PROGRAM

These are particulates equal to or smaller than 10 microns in size. The Air District had been operating a total suspended particulate (TSP) network since 1968 and in 1984 added a PM_{10} sampler at San Jose in response to the new California PM_{10} standard implemented in 1983. EPA implemented new PM_{10} standards in 1987, and rescinded the TSP national standards. By 2008, the Air District's PM_{10} network grew to maximum of 15 stations, though the network has since been reduced. PM_{10} samples are collected on filters at Air District stations, concentrations are determined by weighing the filters at the Air District particulate laboratory in San Francisco, and data are then reported to EPA quarterly. The purpose of this program is to: judge compliance with and/or progress made towards meeting the PM_{10} NAAQS; provide PM_{10} data to the general public in a timely manner; observe PM_{10} trends throughout the region, including non-urban areas; and provide a data base for research and evaluation of control effects.

A5.3 $PM_{2.5}$ PROGRAM

The $PM_{2.5}$ program measures ambient concentrations of particles equal to or smaller than 2.5 microns in size. The Air District began monitoring $PM_{2.5}$ in 1999 in response to a new $PM_{2.5}$ NAAQS that became effective in 1997. Samples are collected on filters, concentrations are measured at the Air District particulate laboratory in San Francisco, and data are reported to EPA quarterly. $PM_{2.5}$ concentrations are also measured with a network of filter tape samplers that report continuous, real-time hourly data to the public and also provide data for air quality forecasting. The purpose of this program is to: judge compliance with and/or progress made towards meeting the $PM_{2.5}$ NAAQS; provide $PM_{2.5}$ data to the general public in a timely manner; observe $PM_{2.5}$ trends throughout the region, including non-urban areas; and provide a data base for research and evaluation of control effects.

A5.4 LEAD PROGRAM

The Air District has been measuring concentrations of atmospheric lead since 1970, when the California Air Resources Board established an air quality standard for lead. In 1978, EPA established both primary and secondary NAAQS for lead. The purpose of lead monitoring was

to determine if the Bay Area was in compliance with California and national standards. After EPA passed regulations that gradually decreased the content of lead in gasoline, beginning in 1975, ambient lead levels showed a steady decrease. By the end of 1998, lead levels were sufficiently well below State and national standards that EPA allowed the District to stop monitoring for lead. In 2008, EPA promulgated a new lead standard which may require the Air District to start up its lead monitoring program again.

A5.5 NATTS PROGRAM

EPA established the National Air Toxics Trends Stations (NATTS) network in 2003. NATTS was created to expand and improve national toxics monitoring with the major goal of identifying toxics trends in urban and rural settings throughout the United States. EPA and the Air District agreed to include the San Jose air monitoring station in the NATTS network because it is a large, urban population center in Northern California, and because several toxic compounds have been measured at the site since 1985.

EPA identified 188 Hazardous Air Pollutants (HAPs) of interest in the Federal Clean Air legislation of 1990. Within this list, fifteen were selected for trends analysis in the original 2003 NATTS monitoring program. These required HAPs were selected by EPA based on toxicity, available measurement methods, cost of measurement, correlation with other important HAPs, and anticipated concentration levels. **Table A6-8** lists the fourteen HAPs measured by the Air District along with the year measurements began. Hexavalant chromium is the only required NATTS airborne toxic compound that the Air District does not measure. The Air District does not measure hexavalant chromium because the compound is unstable and partially changes into trivalent chromium during sampling and transport to the laboratory. In the future, the Air District may sample for hexavalant chromium when better sampling techniques are developed.

The Air District operates two continuous monitors at San Jose for NATTS measurement of high-sensitivity carbon monoxide and for black carbon (soot). High sensitivity carbon monoxide is measured as an analysis tool because of correlation to benzene and 1,3 butadiene, two of the largest contributors to air toxic exposure. Black carbon is measured because it is correlated to diesel emissions that are identified by EPA as a mobile source air toxic. High sensitivity carbon monoxide measurements began in November 2002 and black carbon measurements began in May 2004.

Beginning with the 2007-8 EPA grant funding cycle, the Air District agreed to measure a number of Polycyclic Aromatic Hydrocarbons (PAHs) under the NATTS program. PAHs are found primarily in soil, sediment and oily substances, as opposed to in water or air. However, they are also a component of concern in particulate matter in air and have probable human carcinogenic (cancer), mutagenic (genetic mutation), and teratogenic (birth defects) properties. These compounds are listed in **Table A6-9** and Air District measurements began in May 2008.

A5.6 CSN PROGRAM

EPA finalized new regulations in 1997 that established national 24-hour and annual standards for fine particles less than or equal to 2.5 microns in diameter, known as $PM_{2.5}$, and required each state and local agency to begin ambient monitoring using Federal Reference Method (FRM) samplers for these particulates. Included in the regulations was a plan for what was known then as the Speciation Trends Network, a national monitoring network that would gather data on the chemical makeup of these particles.

Between 1999 and 2001, fifty-four STN sites were developed nationwide. One of the sites was located in the Bay Area in San Jose. San Jose was chosen to be included in the STN network because it is has an extensive PM sampling history and is the most populated city in Northern California with a population of 989,496 in 2007. In 2000, STN monitoring began at the Air District's San Jose air monitoring station, then located on Fourth Street and relocated since 2002 at nearby Jackson Street. Samples for speciation analysis are collected using a Met One Spiral Ambient Speciation Sampler (SASS). Collocated with the SASS at the San Jose site is a $PM_{2.5}$ FRM sampler, which is used to measure compliance with the NAAQS. Both samplers are operated on the same schedule allowing the Air District to determine compositional variations of $PM_{2.5}$ mass.

In 2008, EPA changed the program name from Speciation Trends Network (STN) to Chemical Speciation Network (CSN). Information gathered by the CSN will be used to develop plans to reduce the sources of $PM_{2.5}$ and to measure the effectiveness of $PM_{2.5}$ control strategies. Additionally, EPA expects that the nationwide network will be used to determine trends in concentration levels of selected ions, metals, carbon species, and organic compounds found in $PM_{2.5}$.

A5.7 NON-CRITERIA GASEOUS PROGRAM

The Air District also monitors for H_2S, methane, non-methane hydrocarbons, NO, and NO_x. H_2S is measured in residential areas near refineries to determine if levels of these gases are in compliance with the State 1-hour standard and the Air District's 3-minute standard. Hydrocarbons and NO/NO_x are measured because they are needed for photochemical modeling studies. There are no EPA requirements for measuring these compounds. Monitoring for these compounds is performed to the same siting and quality assurance standards as criteria gases. Data are reviewed and submitted to the EPA database similar to the EPA required criteria pollutants.

A5.8 TOXICS PROGRAM

Toxic air pollutants are known to cause or are suspected of causing cancer, birth defects, reproduction problems, and other serious illnesses. Exposure to certain levels of some toxic air pollutants can cause difficulty in breathing, nausea or other illnesses. Exposure to certain toxic pollutants can even cause death.

The goal of the Air District's toxics program is to reduce public exposure to HAPs (Hazardous Air Pollutants), or air toxics. Initially, the California Air Resources Board (ARB) established five monitoring sites in the Bay Area in 1985 to collect toxics air samples. In 1986 the BAAQMD began measuring toxic compounds independently at five stations to supplement the ARB monitoring program. The Air District's program is not mandated by either California or EPA regulations and there are no State or national ambient standards for these compounds. Since 1986 the Air District has added additional monitoring sites, and added new compounds to be analyzed. The current Toxic VOCs measured by the Air District are listed in **Table A6-14**.

As part of the District's overall toxics program, an ambient air quality monitoring program has been developed with the objectives of:

- Establishing trends and evaluating the effectiveness of HAP reduction strategies.
- Characterizing ambient concentrations in local areas.
- Providing data to support and evaluate dispersion and deposition models.
- Providing data to the scientific community to support studies to reduce uncertainty about the relationships between ambient levels of HAPs, actual human exposure to air toxics, and health effects from such exposures.

A5.9 METEOROLOGICAL PROGRAM

The Air District operates a meteorological network to provide data for air quality forecasting, photochemical modeling, source impact modeling, air quality data validation, and real-time public information. Meteorological measurements at air monitoring stations began in the 1970's at Air District stations. Prior to then, staff used meteorological data from local airports reported by the National Weather Service for analyses. In 1987, the Air District improved the meteorological network in order that data would meet EPA's recommendations for Prevention of Significant Deterioration modeling standards. The current network follows EPA's more recent recommendations for siting, instrumentation, and maintenance as listed in the *Meteorological Monitoring Guidance for Regulatory Modeling Applications, February 2000.* In addition to the Air District's meteorological network, meteorological data are collected on a routine basis at most airports and sewage treatment plants, and at various facilities by private companies. Because non-District meteorological data are often used in regulatory modeling submitted to the Air District, the Air District advises sewage treatment plants and private companies on the proper operation and maintenance of their meteorological stations. If these data are to be archived in the Air District's database, Air District meteorologists review and edit them prior to archiving.

A6. PROJECT/TASK DESCRIPTION

The Air District currently operates nine air monitoring programs. Some of the monitoring programs are designed to meet State or federal ambient monitoring requirements; some monitoring programs measure pollutants for which ambient standards do not exist, but are known carcinogens; while other monitoring programs are designed to provide data needed to meet the needs of other programs within the Air District. As an example of the latter, the meteorological monitoring program provides data needed for the Air District's forecasting and modeling programs. Additionally, there are other monitoring programs which collect data to aid in the understanding of pollutant transport and atmospheric chemistry.

In general, the purpose of all the Air District's monitoring programs is to provide information that will help reduce health risks from air pollution. The Air District's monitoring programs have been designed to meet one or more of the following monitoring objectives:

- To determine representative concentrations in areas of high population density
- To determine highest concentrations expected to occur in the area of the network
- To determine the impact from significant sources
- To determine general background concentration levels
- To determine the extent of regional pollutant transport

Each year, the Technical Services Division submits an Air Monitoring Network Plan to the EPA. A copy of this document is provided in **Appendix B**. The Air Monitoring Network Plan is intended to describe each monitoring program as it currently exists, and to list any proposed changes over the next year. A summary of the Air District's current air monitoring programs are described below.

The Technical Division operates air monitoring equipment within a set of Measurement Quality Objectives (MQOs) designed to maintain high data quality and exceed Data Quality Objectives required for each monitoring Program. A summary of these MQOs is included here as **Table 6-1** for reference throughout this Element and many Air Monitoring SOPs.

Table A6-1. Measurement Quality Objectives and Acceptance Criteria.

Parameter	Requirement	Frequency	Acceptance Criteria
Ozone [1]	Precision Checks	Every 2 days	≤ ± 7%
	Precision (QC Checks)	Annual	≤ 7%
	Bias (QC Checks)	Annual	≤ ± 7%
	Shelter Temperature	Hourly	15 - 35 °C
Carbon Monoxide [2]	Precision Checks	Every 2 days	≤ ± 10%
	Precision (QC Checks)	Annual	≤ 10%
	Bias (QC Checks)	Annual	≤ ± 10%
	Shelter Temperature	Hourly	15 - 35 °C

Parameter	Requirement	Frequency	Acceptance Criteria
Carbon Monoxide (Trace level)	Precision Checks	Every 2 days	≤ ± 15%
	Precision (QC Checks)	Annual	≤ 10%
	Bias (QC Checks)	Annual	≤ ± 10%
	Shelter Temperature	Hourly	15 - 35 °C
Nitric Oxide, Nitrogen Dioxide, Nitrogen Oxides [2]	Precision Checks	Every 2 days	≤ ± 10%
	Precision (QC Checks)	Annual	≤ 10%
	Bias (QC Checks)	Annual	≤ ± 10%
	Shelter Temperature	Hourly	15 - 35 °C
Sulfur Dioxide [2]	Precision Checks	Every 2 days	≤ ± 10%
	Precision (QC Checks)	Annual	≤ 10%
	Bias (QC Checks)	Annual	≤ ± 10%
	Shelter Temperature	Hourly	15 - 35 °C
Hydrogen Sulfide	Precision Checks	Biweekly	≤ ± 10%
	Precision (QC Checks)	Annual	≤ 15%
	Bias (QC Checks)	Annual	≤ ± 15%
	Shelter Temperature	Hourly	15 - 45 °C
Total Hydrocarbon, Methane, Non-Methane Hydrocarbon	Precision Checks	Every 2 days	≤ ± 15%
	Precision (QC Checks)	Annual	≤ 15%
	Bias (QC Checks)	Annual	≤ ± 15%
	Shelter Temperature	Hourly	15 - 35 °C
$PM_{2.5}$ FRM [3]	Flow Rate Verification	Monthly	≤ ± 4% of std. ≤ ± 5% of design
	Leak Check	Monthly	≤ .08 L/min
	Pressure Verification	Monthly	≤ ± 10 mmHg
	Temperature Verification	Monthly	≤ ± 2 °C
	Flow CV	Each Run	≤ 2%
	Precision (Co-loc)	Annual	≤ 10%
	Bias (PEP audits)	Annual	≤ ± 10%
	Bias (flow rates)	Annual	≤ ± 10%
PM_{10} Hi-Vol [2]	Flow Rate Verification	Quarterly	≤ ± 7% of std. ≤ ± 10% of design
	Precision (Co-loc)	Annual	≤ 10%
	Bias (flow rates)	Annual	≤ ± 10%
$PM_{2.5}$ Beta Attenuation [2]	Flow Rate Verification	Biweekly	≤ ± 4% of std. ≤ ± 5% of design
	Leak Check	Biweekly	≤ 1 L/min

Parameter	Requirement	Frequency	Acceptance Criteria
	Pressure Verification	Biweekly	≤ ± 10 mmHg
	Temperature Verification	Biweekly	≤ ± 2 °C
	Precision (flow rates)	Annual	≤ 10%
	Bias (flow rates)	Annual	≤ ± 10%
Aethalometer [4]	Flow Rate Verification	Monthly	≤ ± 7% of std. ≤ ± 7% of design
	Dynamic Zero Test	Monthly	≤ 0.1 μg/m^3

[1] Precision and Bias MQOs taken from 40 CFR Part 58, Appendix A, Section 2.3.1
[2] Precision and Bias MQOs taken from EPA QA Handbook Vol II, Appendix D, March 2008 revision.
[3] Precision and Bias MQOs taken from 40 CFR Part 58, Appendix A, Section 2.3.1. All other MQOs are taken from EPA QA Guidance Document 2.1.2 Section 3.0
[4] MQOs taken from EPA NATTS Technical Assistance Document, Section 4.6.4.2, 2004 revision.

A6.1 CRITERIA GASEOUS PROGRAM

Monitoring for the criteria gaseous pollutants takes place at 24 sites in the Bay Area including 23 SLAMS and 1 temporary SPM. This monitoring is continuous and ongoing, with no defined stop date. **Figure A6-1** shows the geographic locations of these sites. In general, sites are located in areas representing high population density, highest expected concentration, or both. A few sites are located near significant sources, such as refineries, or in areas meant to measure the extent of regional transport. All sites are held to the siting criteria in 40 CFR Part 58 Appendix E. Details on network design and individual station siting can be found in **Appendix B**, Annual Network Report.

Equipment selection, purchasing, and acceptance testing is performed by the Air Monitoring Section. Only automated continuous monitors with EPA reference or equivalent method designations as defined in 40 CFR Part 53 are used for criteria gaseous pollutant monitoring. A full list of monitors used and their methodology is contained in **Table B2-1** in the Sampling Methods section of this document. All equipment is operated within the operating parameters listed for the specific monitor in EPA's *List of Designated Reference and Equivalent Methods*.

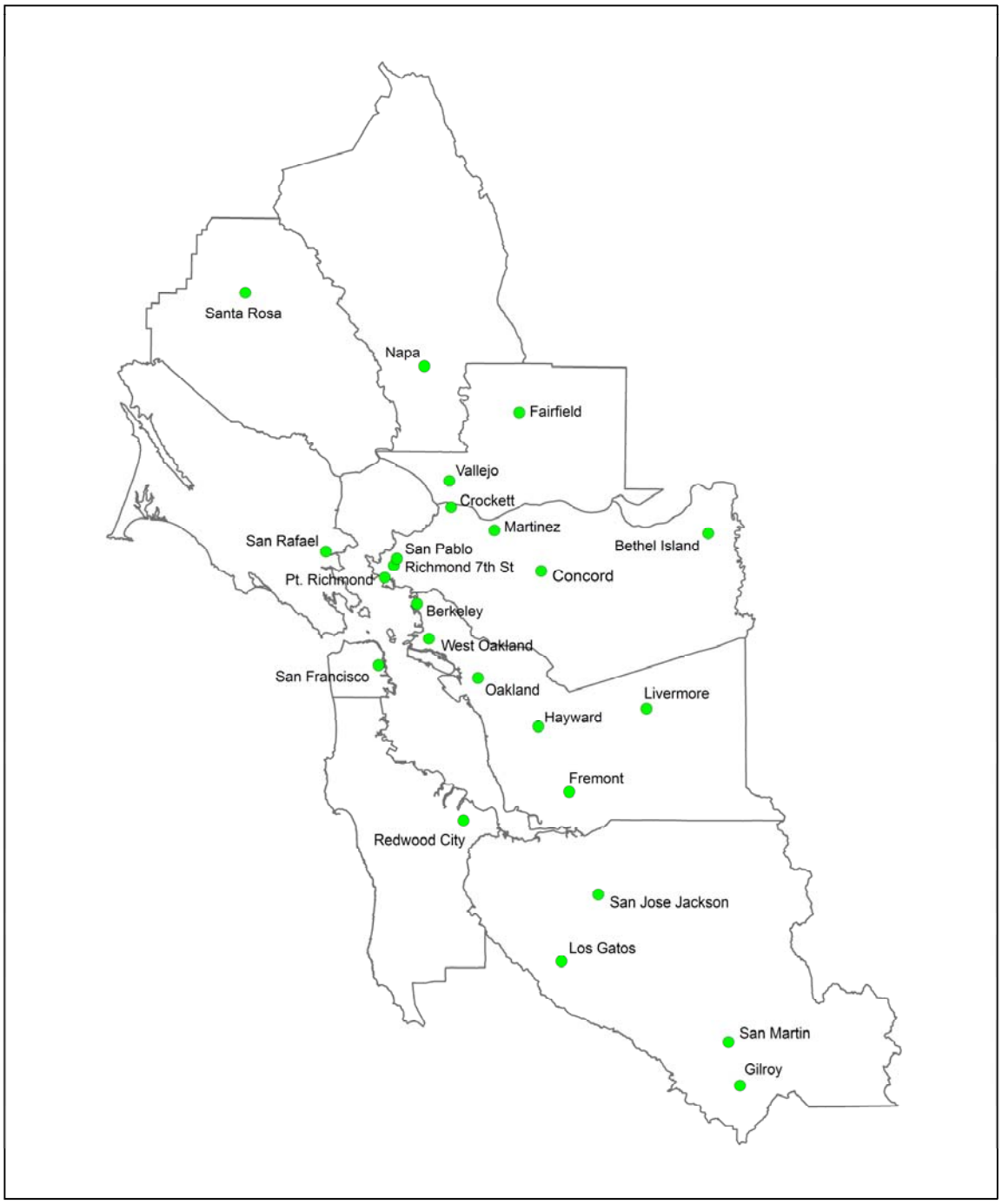

Figure A6-1. Map of Air District criteria gaseous monitoring sites

Air quality measurements are collected automatically by data loggers into 1-minute averages which are used to construct hourly averages for reporting purposes. A central polling system automatically transfers this data to the District Office where it is stored, as well as sent to

a District run website for access by the public. Air Monitoring Section staff perform a daily review of data collected the day before, as well as any strip charts produced. This includes checking for typical signs of malfunction, environmental conditions that may affect data (e.g. station temperature control out of range), and flagging data recorded during periods of malfunction, maintenance, or outside interference. These daily reports are collected monthly and reviewed by a Supervising AQIS before being sent to the MQA Section for further review.

QC checks are automated and run every night and routinely reviewed by Air Monitoring staff to ensure, to the extent possible, proper response and instrument operation. These QC Checks alternate between a precision check, which is the same as a One Point QC Check as defined in 40 CFR Part 58 Appendix A, and a zero and span check. If a QC check exceeds the Quality Control Limits specified in **Table B5-1**, corrective action is initiated. Data are not invalidated unless the QC check exceeds the MQOs as defined in the Measurement Quality Objectives **Table A6-1** and is deemed uncorrectable. The results of precision checks are sent to the District Office once per week for review and submittal to AQS.

At least twice per year, each monitor is subjected to a performance evaluation. These are performed by Performance Evaluation Group staff and meet the requirements in 40 CFR Part 58 Appendix A. If the results of a performance evaluation exceed the audit acceptance criteria specified in **Table C2-1**, then corrective action is initiated. Findings of the resultant investigation and any corrective actions taken are formally documented following the procedures outlined in QA SOP 705. This process ensures proper documentation of both the problem and solution, and management notification. For detailed information on performance evaluations consult QA SOP 702, 703, and 706.

Every three to five years, the Performance Evaluation group conducts a Technical Systems Audit on Air Monitoring sites. The purpose of this audit is to ensure that ambient air monitoring stations meet 40 CFR Part 58 siting criteria, QA/QC standards, and all documentation requirements of EPA, ARB and this Air Monitoring QAPP.

Any data corrections identified by the Air Monitoring review process are made by the TSD secretary prior to final review by the MQA staff. On a monthly basis, data undergoes a final review by MQA staff. This review includes the confirmation of changes or invalidations made by the Air Monitoring section, reviewing performance evaluations and QC checks, evaluating data for spatial consistency with meteorological conditions, investigating anomalies, and qualitatively checking diurnal patterns at each site between pollutants and with other local pollutant data. Any problems uncovered by this review are reported to both the Air Monitoring and MQA Managers. Once this review is completed, data are submitted to EPA via AQS. The target for AQS submittal is no later than 90 days after the end of the month in which data were generated.

Both quarterly and annually the achieved data quality is compared to EPA data quality objectives as specified in 40 CFR Part 58 Appendix A. This is accomplished through the use of the AMP 255 Precision and Accuracy Reports as well as the AMP 430 Data Completeness Report. The results are analyzed to determine if the completeness and measurement uncertainty

requirements were met. Any discrepancies are reported to the Division management who will determine the appropriate course of action to correct the problem.

A summary of Criteria Pollutant Monitoring Program activities, their frequency, responsible personnel, and references to more detailed discussions of the programs themselves can be found in **Table A6-2**.

Table A6-2. Criteria Gaseous Pollutant Program schedule of activities.

Activity	Frequency	Responsible Personnel	Reference
Site Selection	Ongoing	Technical Division Management	QAPP Section A6 QAPP Section B1 QAPP Appendix B
Site Setup and Operations	Daily	Air Monitoring Section Staff	QAPP Section B1-B10 SOP 101 Station Operator SOP 211-220 Instruments
Quality Control Checks	Nightly	Air Monitoring Section Staff	QAPP Section B5 SOP 101 Station Operator SOP 211-220 Instruments
Performance Evaluations	Semiannual minimum	Performance Evaluation Group Staff	QAPP Section C1 SOP 701-703 Station Audits SOP 705-706 ODAMN
Data Retrieval	Hourly	Air Monitoring Staff and MQA Staff	QAPP Section B10 SOP 101 Station Operator
Preliminary Data Review	Daily	Air Monitoring Section Staff	QAPP Section D1 SOP 101 Station Operator SOP 601 Crit. Data Mgmt
Final Data Review and archival	Monthly	MQA Staff	QAPP Section D1 SOP 601 Crit. Data Mgmt.

A6.2 PM_{10} PROGRAM

The PM_{10} Ambient Air Quality Monitoring Program consists of a network of filter-based samplers that meet EPA Federal Reference Method (FRM) or Federal Equivalent Method (FEM) standards for regulatory monitoring. Data from the samplers are used to determine if the Air District meets the PM_{10} NAAQS established in the 1987. All PM_{10} equipment samples for a 24-hour period every 6th day beginning at midnight on January 1, 2009, in step with all other PM_{10} equipment across the entire nation. After gravimetric measurements are complete, exposed PM_{10} filters are also selectively analyzed for organic and elemental carbon, and potassium, ammonium, sulfate, nitrate, and chloride ion concentrations. This post-measurement analysis work is not directly involved with the PM_{10} program itself, but helps define the sources of PM and provides information on devising control strategies.

The PM_{10} monitoring network is designed to confirm continued Air District attainment of EPA's PM_{10} NAAQS of 150 $\mu g/m^3$ measured over 24 hours. In 2009, the monitoring network included seven SLAMS sites at Concord, Bethel Island, San Pablo, San Rafael, Napa, San

Francisco, and San Jose, and one SPM site at Berkeley. For Quality Control purposes, a collocated sampler is operated at the Napa site as well. Selection of each monitoring location was based on a number of EPA siting criteria including minimum monitoring requirements, distances from PM_{10} sources, prevailing wind patterns, population centers, and pollution potential. **Figure A6-2** shows the location of all PM_{10} sampling sites active in 2009.

Appendix B includes the latest version of the Air District's Ambient Air Monitoring Network Plan. The Plan includes in-depth information on each PM_{10} sampling site including exact location, monitoring objective, spatial scale, population, seasonal pollution patterns, distance to and traffic counts on nearby roads, and sampling site information. The Plan also includes recent PM_{10} monitoring network changes, as well as planned changes for the following year.

The goal of the PM_{10} Ambient Air Quality Monitoring Program network is to measure the concentration, in units of micrograms per cubic meter ($\mu g/m^3$), of particulates less than or equal to 10 micrometers (μm) that have been collected on a quartz microfiber filter at each monitoring site. These data are submitted to AQS and compared to the annual PM_{10} NAAQS 24-hour Standard of 150 $\mu g/m^3$ to determine whether the Air District continues to meet the PM_{10} Air Quality Standard. A description of the PM_{10} NAAQS and attainment formulas can be found in the 40 CFR Part 50 Appendix K.

The Air District uses only EPA certified sampling equipment that meets all the requirements for measuring PM_{10} concentration. Filters are provided directly from EPA. No special personnel, equipment, or extra ordinary training is required to operate this equipment. Particulate matter is collected at monitoring sites by drawing sample air through an inertial particle size separator that removes PM larger than 10 microns. PM_{10} particles that remain in the sample flow are collected on the filter for a 24 hour sampling period. After extraction from the sampler, filters are placed in a freezer and kept below 4ºC until ready for transport. During transport, the filters are kept in a cooler with frozen blue-ice to keep the sample below 4ºC.

After arrival at the Air District PM_{10} Laboratory, the filters are placed in a freezer until time for processing. Processing begins with the filters being placed on open shelves in a temperature/RH-controlled laboratory. The laboratory temperature is kept between 20º and 23ºC ±2ºC, with relative humidity kept between 30% to 40% ±5%. The filters are exposed to this environment for 24-hours to allow for moisture and temperature equilibration. After 24 hours, each filter is weighed in the Air District PM_{10} Laboratory before and after sample collection to determine the net weight (mass) gain due to collected PM_{10}. The total volume of air sampled is determined by the sampler from the sampler flow rate and sampling time. The mass concentration of PM_{10} in the ambient air is computed as the total mass of collected particles in the PM_{10} size range divided by the actual volume of air sampled, and is expressed in micrograms per actual cubic meter of air ($\mu g/m^3$). During sampling, ambient temperature and pressure are measured so that PM mass concentration can be calculated based on standard conditions (25°C, 760 mmHg) as well. Criteria PM_{10} mass concentration pollutant data based on both actual and standard sampling conditions are submitted quarterly to AQS within 90 days of the end of each quarter.

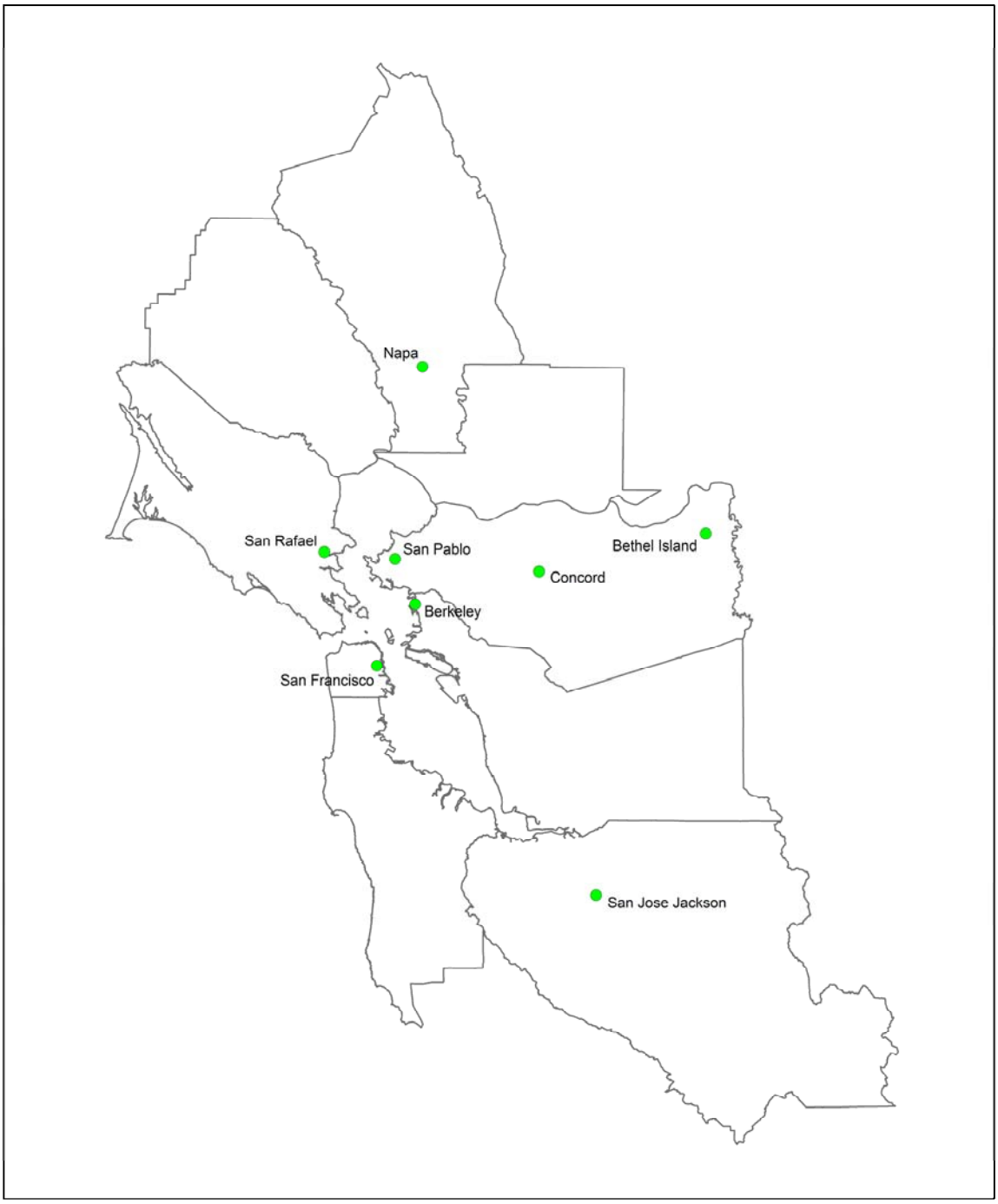

Figure A6-2. Map of Air District PM_{10} monitoring sites

After PM mass activities are complete, selected PM_{10} filters are sectioned and further analyzed for ammonium and potassium cations, chloride, nitrate, and sulfate anions, and organic and elemental carbon concentrations. **Table A6-3** contains a summary of all data measured from the PM_{10} Program network and reported in units of $\mu g/m^3$. Table entries of "m" or "A" indicate data are measured and reviewed. "A" table entries indicate data are submitted to AQS.

Table A6-3. PM_{10} program filter analysis data products.

Mass concentration:	PM_{10}		Cations		Anions			Carbon	
AQS parameter no.	85101	81102	82301		82203	82306	82403		
Monitoring Site	Actual	Standard	NH_4^+	K^+	Cl^-	NO_3^-	$SO_4^=$	OC	EC
Concord	A	A	A	m	A	A	A	m	m
Bethel Island	A	A	A	m	A	A	A	m	m
San Pablo	A	A	A	m	A	A	A	m	m
San Rafael	A	A	A	m	A	A	A		
Napa	A	A	A	m	A	A	A	m	m
Napa collocated	m	A	m	m	m	m	m		
San Francisco	A	A	A	m	A	A	A	m	m
San Jose	A	A	A	m	A	A	A	m	m
Berkeley (SPM)	A	A	A	m	A	A	A		

m = measured and reviewed
A = measured, reviewed, and submitted to AQS

If a QC check exceeds the Quality Control Limits specified in **Table B5-1**, corrective action is initiated. Data are not invalidated unless the QC check exceeds the MQOs as defined in the Measurement Quality Objectives **Table A6-1** and is deemed uncorrectable.

At least once per quarter, each sampler is subjected to a performance evaluation. These are performed by Performance Evaluation group staff and are based on the requirements in 40 CFR Part 58 Appendix A. If the results of a performance evaluation exceed the audit acceptance criteria specified in **Table C1-2**, then corrective action is initiated. Findings of the resultant investigation and any corrective actions taken are formally documented following procedures outlined in QA SOP 705. For detailed information on performance evaluations and corrective actions consult QA SOP 702 and 703.

Every three to five years, the Performance Evaluation group conducts a Technical Systems Audit on Air Monitoring sites. The purpose of this audit is to ensure that ambient air monitoring stations meet 40 CFR Part 58 siting criteria, QA/QC standards, and all documentation requirements of both EPA and this Air Monitoring QAPP.

Any data corrections identified by the Air Monitoring or Laboratory review process are noted prior to final review by the MQA staff performed on a monthly basis. This review includes the confirmation of changes or invalidations made by the Air Monitoring or Laboratory section, reviewing performance evaluations and QC checks, evaluating data for spatial consistency with meteorological conditions, investigating anomalies, and qualitatively checking diurnal patterns at each site between pollutants and with other local pollutant data. Any problems uncovered by this review are reported to both the Air Monitoring and MQA Managers. Once this review is completed, data are submitted to EPA via AQS. The target for AQS submittal is no later than 75 days after the end of the month in which data were generated.

Both quarterly and annually, the achieved data quality is compared to Measurement Quality Objectives listed in **Table A6-1**. This is accomplished through the use of the precision checks in conjunction with the precision and bias statistics defined in 40 CFR Part 58 Appendix A. Until the AQS AMP 255 report is expanded to include non-criteria pollutants, the Air District will track these statistics internally. The results are analyzed to determine if the completeness and measurement uncertainty requirements were met. Any discrepancies are reported to the Division management who will determine the appropriate course of action to correct the problem.

An overview of the PM_{10} Program Activities, responsible personnel, and references for more detailed procedures are included in **Table A6-4**.

Table A6-4. PM_{10} program activities, personnel, and references.

Activity	Frequency	Responsible Personnel	Reference
Site Selection	Ongoing as needed	Technical Division Management	40 CFR Pt. 58, Appendix D, E QAPP Appendix B QAPP Sections A7, B1
Site Setup/ Operations	Once upon setup/ Ongoing	Air Monitoring Section Staff	40 CFR Pt. 58, Appendix D, E QAPP Sections B1-3 SOP 201-204 PM_{10} operations
Quality Control Checks	One collocated site, 1 in 6 day sampling; Quarterly instrument checks	Air Monitoring Section Staff	QAPP Section B5-6 SOP 201-204 PM_{10} operations
Laboratory Operations	Before and after sample runs	Laboratory Section Staff	QAPP Section B4-5 SOP 301 PM_{10} Filter Mgt SOP 303-304 Ion operations SOP 307 Ion data SOP 305 OC/EC
Performance Evaluations	Quarterly	Performance Evaluation Staff of MQA Section	QAPP Section B5 SOP 707-708 PM_{10} Audit SOP 701-703 Station Audits SOP 705 ODAMN
Preliminary Data Review	Approximately Weekly	Laboratory Section Staff	QAPP Section B3-5 SOP 301 PM_{10} Filter Mgt SOP 307 Ion data
Final Data Review, Reporting, and Archiving	Monthly and Quarterly	Data Management Staff of MQA Section	QAPP Sections B10, D1-2 SOP 602 PM_{10} Data Mgt. AQS AMP 403 Completeness AQS AMP 255 Prec & Acc

A6.3 $PM_{2.5}$ PROGRAM

The $PM_{2.5}$ Ambient Air Quality Monitoring Program consists of two distinct monitoring networks. The Federal Reference Method (FRM) network is focused primarily on regulatory monitoring to determine attainment of the $PM_{2.5}$ NAAQS first established in the 1997 Federal

Register. This network uses filter-based, 24-hour samplers that meet FRM monitoring requirements for $PM_{2.5}$. The Continuous $PM_{2.5}$ monitoring network is focused on real-time (hourly) measurements that provide PM air quality information to the public, current PM data for AQI forecasts, and hourly data for research purposes. The 24-hour averages of continuous sampling data generally agree with FRM sampler data. However, the instruments are not certified by EPA for regulatory monitoring so data are not used for determining Air District attainment of the $PM_{2.5}$ NAAQS.

Appendix B includes the latest version of the Air District's Ambient Air Monitoring Network Plan. The Plan includes in-depth information on each FRM and Continuous sampling site including exact location, monitoring objective, spatial scale, population, seasonal pollution patterns, distance to and traffic counts on nearby roads, and sampling site information. The Plan also includes recent $PM_{2.5}$ monitoring network changes, as well as planned changes for the following year.

A6.3.1 FRM

The goal of the $PM_{2.5}$ FRM Ambient Air Quality Monitoring Program network is to measure the concentration, in units of micrograms per cubic meter ($\mu g/m^3$), of particulates less than or equal to 2.5 micrometers (μm) that have been collected on a 46.2-mm polytetrafluoroethylene (PTFE) filter at each monitoring site. These data are submitted to AQS and compared to the annual $PM_{2.5}$ NAAQS of 15.0 $\mu g/m^3$, and the 24-hour Standard of 35 $\mu g/m^3$ to determine whether the Air District has met the $PM_{2.5}$ Air Quality Standards. A description of the $PM_{2.5}$ NAAQS and attainment formulas can be found in the 40 CFR Part 50 Appendix L.

The FRM monitoring network was designed to meet the EPA requirements for determining attainment of the $PM_{2.5}$ NAAQS. In 2009, the monitoring network included nine SLAMS sites and one SPM site. Selection of each monitoring location was based on a number of EPA siting criteria including minimum monitoring requirements, distances from $PM_{2.5}$ sources, prevailing wind patterns, population centers, and pollution potential. **Figure A6-3** shows the location of all FRM sampling sites active in 2009.

The Air District uses only EPA certified sampling equipment that meets all the requirements for measuring $PM_{2.5}$ concentration. Filters are provided directly from EPA. No special personnel, equipment, or extra ordinary training is required to operate this equipment. $PM_{2.5}$ is measured by the size selective inlet-low volume sampler – gravimetric analysis method. Particulate matter is collected at monitoring sites by drawing air at a constant volumetric flow rate into a specially shaped inlet and through an inertial particle size separator (cyclone) where the suspended particulate matter in the $PM_{2.5}$ size range is separated for collection over a 24-hour sampling period. After extraction from the sampler, filters are placed in a freezer and kept below 4ºC, per EPA protocol, until ready for transport. During transport, the filters are kept in a cooler with frozen blue-ice to keep the sample below 4ºC.

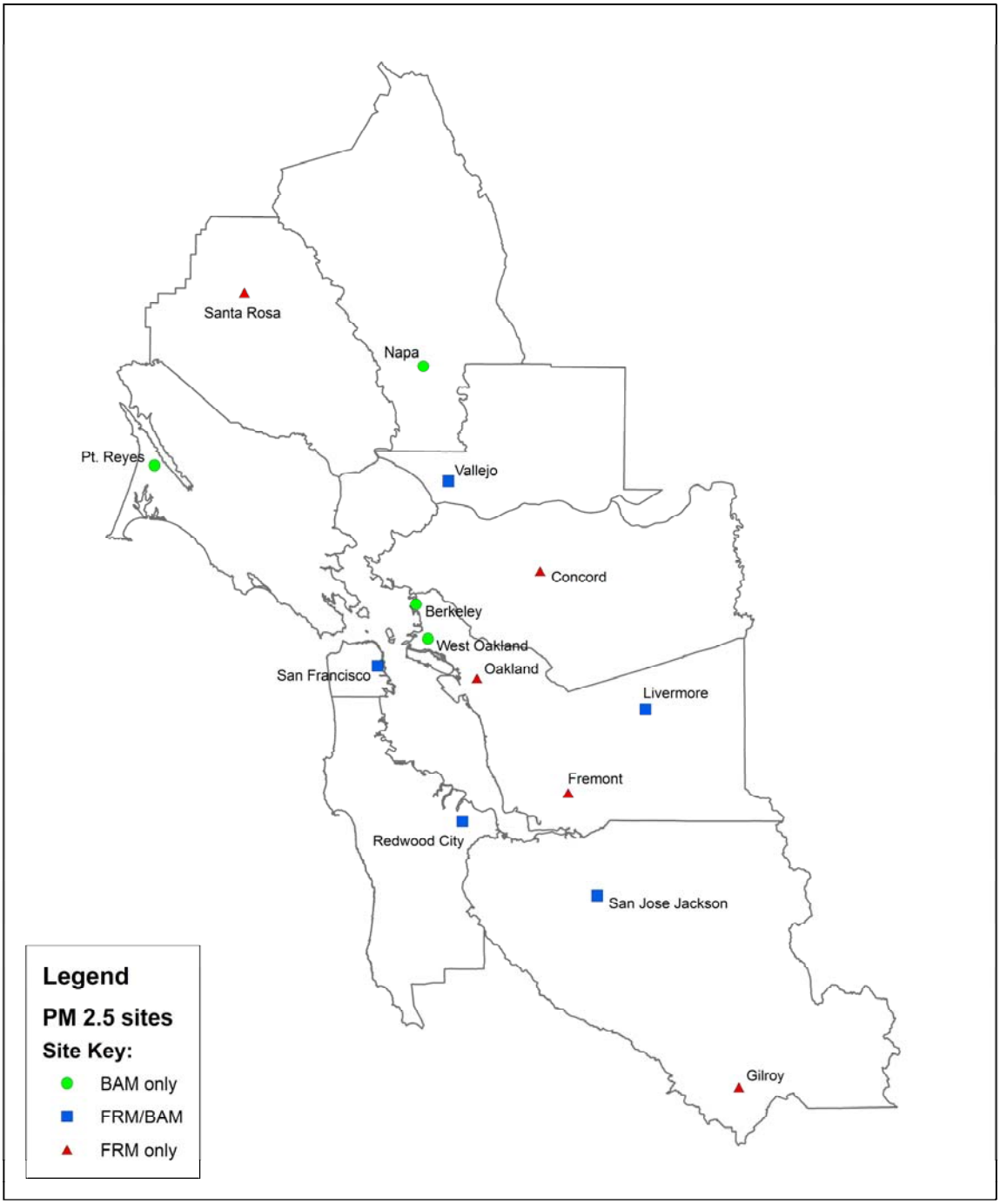

Figure A6-3. Map of Air District FRM and Continuous $PM_{2.5}$ monitoring sites.

After arrival at the Air District $PM_{2.5}$ Laboratory, the filters are placed in a freezer until time for processing. Processing begins with the filters being placed on open shelves in a temperature/RH-controlled laboratory. The laboratory temperature is kept between 20º and 23ºC ±2ºC, with relative humidity kept between 30% to 40% ±5%. The filters are exposed to this

environment for 24-hours to allow for moisture and temperature equilibration. After 24 hours, each filter is weighed in the Air District $PM_{2.5}$ Laboratory before and after sample collection to determine the net weight (mass) gain due to collected $PM_{2.5}$. The total volume of air sampled is determined by the sampler from the measured flow rate at actual ambient temperature and pressure, and the sampling time. The mass concentration of $PM_{2.5}$ in the ambient air is computed as the total mass of collected particles in the $PM_{2.5}$ size range divided by the actual volume of air sampled, and is expressed in micrograms per actual cubic meter of air ($\mu g/m^3$). In addition to the computed PM mass, other sampling parameters such as flow variation, sample volume, ambient temperature and pressure, and elapsed sample time are submitted quarterly to AQS within 90 days of the end of each quarter.

If a QC check exceeds the Quality Control Limits specified in **Table B5-1**, corrective action is initiated. Data are not invalidated unless the QC check exceeds the MQOs as defined in the Measurement Quality Objectives **Table A6-1** and is deemed uncorrectable.

At least twice per year, each sampler is subjected to a performance evaluation. These are performed by Performance Evaluation group staff and are based on the requirements in 40 CFR Part 58 Appendix A. If the results of a performance evaluation exceed the audit acceptance criteria specified in **Table C1-2**, then corrective action is initiated. Findings of the resultant investigation and any corrective actions taken are formally documented following procedures outlined in QA SOP 705. For detailed information on performance evaluations and corrective actions consult QA SOP 702 and 703.

Every three to five years, the Performance Evaluation group conducts a Technical Systems Audit on Air Monitoring sites. The purpose of this audit is to ensure that ambient air monitoring stations meet 40 CFR Part 58 siting criteria, QA/QC standards, and all documentation requirements of both EPA and this Air Monitoring QAPP.

Any data corrections identified by the Air Monitoring or Laboratory review process are noted prior to final review by the MQA staff performed on a monthly basis. This review includes the confirmation of changes or invalidations made by the Air Monitoring or Laboratory section, reviewing performance evaluations and QC checks, evaluating data for spatial consistency with meteorological conditions, investigating anomalies, and qualitatively checking diurnal patterns at each site between pollutants and with other local pollutant data. Any problems uncovered by this review are reported to both the Air Monitoring and MQA Managers. Once this review is completed, data are submitted to EPA via AQS. The target for AQS submittal is no later than 75 days after the end of the month in which data were generated.

Both quarterly and annually, the achieved data quality is compared to Measurement Quality Objectives listed in **Table A6-1**. This is accomplished through the use of the precision checks in conjunction with the precision and bias statistics defined in 40 CFR Part 58 Appendix A. Until the AQS AMP 255 report is expanded to include non-criteria pollutants, the Air District will track these statistics internally. The results are analyzed to determine if the completeness and measurement uncertainty requirements were met. Any discrepancies are reported to the Division management who will determine the appropriate course of action to correct the problem.

Table A6-5 contains a list of the specific FRM sampling sites and frequency of 24-hour filter data collection. All 2009 sampling sequences are referenced to a January 1 sample day, and continue indefinitely under current grant funding arrangements until the FRM sampling network is altered by the Air District with EPA agreement. Samplers operate for 24 hours on a schedule that differs by site and season. For example, the Concord sampler is operated everyday from October 1 to March 30, and every third day the rest of the year; while the San Francisco sampler is operated every third day from October 1 to March 30, and every sixth day the rest of the year

Table A6-5. FRM sites and sampling schedule.

Sampling Site	Q1,4 (Winter)	Q2,3 (Summer)
Fremont	every 3rd day	every 6th day
Livermore	every day	every 6th day
Oakland (SPM site)	every 3rd day	every 6th day
Concord Concord collocated	every day every 6th day	every 3rd day every 6th day
San Francisco	every 3rd day	every 6th day
Redwood City	every 3rd day	every 6th day
Gilroy	every 3rd day	every 3rd day
San Jose	every day	every 3rd day
Vallejo	every day	every 6th day
Santa Rosa	every 3rd day	every 6th day

An overview of the FRM Program Activities, responsible personnel, and references for more detailed procedures are included in **Table A6-6**.

Table A6-6. $PM_{2.5}$ program FRM activities, personnel, and references.

Activity	Frequency	Responsible Personnel	Reference
Site Selection	Ongoing as needed	Technical Division Management	40 CFR Pt. 58, Appendix D, E QAPP Appendix B QAPP Sections A7, B1
Site Setup/ Operations	Once upon setup/ Ongoing	Air Monitoring Section Staff	40 CFR Pt. 58, Appendix D, E QAPP Sections B1-3 SOP 205 FRM operation
Quality Control Checks	One collocated site, 1 in 6 day sampling; Monthly instrument checks	Air Monitoring Section Staff	QAPP Section B5-6 SOP 205 FRM operation
Laboratory Operations	Before and after sample runs	Laboratory Section Staff	QAPP Section B4-5 SOP 302 $PM_{2.5}$ Filter Mgt
Performance Evaluations	Quarterly	Performance Evaluation Staff of MQA Section	QAPP Section B5 SOP 709 FRM Audit SOP 701-703 Station Audits SOP 705 ODAMN
Preliminary Data Review	Approximately Weekly	Laboratory Section Staff	QAPP Section B3-5 SOP 302 $PM_{2.5}$ Filter Mgt
Final Data Review, Reporting, and Archiving	Monthly and Quarterly	Data Management Staff of MQA Section	QAPP Sections B10, D1-2 SOP 603 $PM_{2.5}$ Data Mgt. AQS AMP 403 Completeness AQS AMP 255 Prec & Acc

A6.3.2 Continuous $PM_{2.5}$

The goal of the Continuous $PM_{2.5}$ Ambient Air Quality Monitoring Program network is to measure the concentration, in units of micrograms per cubic meter ($\mu g/m^3$), of particulates less than or equal to 2.5 micrometers (µm) that have been collected hourly on the filter tape of a MetOne Beta Attenuation Monitor (BAM). Hourly BAM data are automatically quality checked for errors, then published on public web sites and used for air quality forecasting. Quarterly BAM data are thoroughly reviewed before submission to AQS within 90 days of the end of each quarter. Although the EPA has designated a specific model of MetOne BAMs as a Federal Equivalent Monitor (FEM), the Air District does not currently employ this model in its network. As a result, data from these monitors can not be used for NAAQS determination. However, all BAM are sited and operated in accordance with 40 CFR Part 58 and if the Air District ever employs the FEM BAM, it can be used for NAAQS determination.

The Continuous $PM_{2.5}$ monitoring network was designed to meet several different needs. First, it augments FRM network data, giving a more complete picture of $PM_{2.5}$ concentrations across the entire Air District. Second, hourly PM data provides timely air quality information to the public and current data for AQI forecasting purposes. Third, hourly PM data provides diurnal data to analyze high PM episodes and research control strategies to reduce NAAQS exceedances. Finally, at sites where both FRM and Continuous measurements are collected, data from the two measurement methods can be compared to estimate how well continuous

measurements emulate the regulatory samplers. **Figure A6-3** shows the locations of the Air District's nine Continuous $PM_{2.5}$ SLAMS monitoring sites active in 2009.

No special personnel, equipment, or extra ordinary training is required to operate this equipment. Particulate matter is collected at monitoring sites by drawing air at a constant volumetric flow rate through a size selective inlet that removes particles larger than 2.5 µm. The remaining $PM_{2.5}$ is collected on a filter tape for 50 minutes each hour. Particulate mass on the tape is determined by measuring the difference in attenuation of beta particles transmitted through the tape from a ^{14}C source before and after the 50-minute deposition. Combined with the volume of air sampled, the BAM provides an hourly $PM_{2.5}$ concentration.

If a QC check exceeds the Quality Control Limits specified in **Table B5-1**, corrective action is initiated. Data are not invalidated unless the QC check exceeds the MQOs as defined in the Measurement Quality Objectives **Table A6-1** and is deemed uncorrectable.

At least twice per year, each BAM is subjected to a performance evaluation. These are performed by Performance Evaluation group staff and are based on the requirements developed by ARB. If the results of a performance evaluation exceed the audit acceptance criteria specified in **Table C1-2**, then corrective action is initiated. Findings of the resultant investigation and any corrective actions taken are formally documented following procedures outlined in QA SOP 705. For detailed information on performance evaluations and corrective actions consult QA SOP 702 and 703.

Every three to five years, the Performance Evaluation group conducts a Technical Systems Audit on Air Monitoring sites. The purpose of this audit is to ensure that ambient air monitoring stations meet 40 CFR Part 58 siting criteria, QA/QC standards, and all documentation requirements of EPA, ARB and this Air Monitoring QAPP.

Any data corrections identified by the Air Monitoring review process are noted prior to final review by the MQA staff performed on a monthly basis. This review includes the confirmation of changes or invalidations made by the Air Monitoring section, reviewing performance evaluations and QC checks, evaluating data for spatial consistency with meteorological conditions, investigating anomalies, and qualitatively checking diurnal patterns at each site between pollutants and with other local pollutant data. Any problems uncovered by this review are reported to both the Air Monitoring and MQA Managers. Once this review is completed, data are submitted to EPA via AQS. The target for AQS submittal is no later than 75 days after the end of the month in which data were generated.

Both quarterly and annually, the achieved data quality is compared to Measurement Quality Objectives listed in **Table A6-1**. This is accomplished through the use of the precision checks in conjunction with the precision and bias statistics defined in 40 CFR Part 58 Appendix A. Until the AQS AMP 255 report is expanded to include non-criteria pollutants, the Air District will track these statistics internally. The results are analyzed to determine if the completeness and measurement uncertainty requirements were met. Any discrepancies are reported to the Division management who will determine the appropriate course of action to correct the problem.

An overview of the Continuous $PM_{2.5}$ Program activities, responsible personnel, and references for more detailed procedures are included in **Table A6-7**.

Table A6-7. Continuous $PM_{2.5}$ program activities, personnel, and references.

Activity	Frequency	Responsible Personnel	Reference
Site Selection	Ongoing as needed	Technical Division Management	QAPP Appendix B QAPP Sections A7, B1
Site Setup/ Operations	Once upon setup/ Ongoing	Air Monitoring Section Staff	QAPP Sections B1-3 SOP 207 MetOne $PM_{2.5}$
Quality Control Checks	Biweekly instrument flow, leak, temp, and pressure checks	Air Monitoring Section Staff	QAPP Section B5-6 SOP 207 MetOne $PM_{2.5}$
Performance Evaluations	Quarterly	Performance Evaluation Staff of MQA Section	QAPP Section B5 SOP 710 BAM Audit SOP 701-703 Station Audits SOP 705 ODAMN
Data Retrieval	Hourly	Air Monitoring Staff and MQA Staff	SOP 101 Station Operator QAPP Section B10
Preliminary Data Review	Daily	Air Monitoring Section Staff	QAPP Section D1 SOP 101 Station Operator SOP 102 Strip Chart Review SOP 604 BAM Data Mgt
Final Data Review, Reporting, and Archiving	Monthly and Quarterly	Data Management Staff of MQA Section	QAPP Sections B10, D1-2 SOP 604 BAM Data Mgt. AQS AMP 403 Completeness

A6.4 LEAD PROGRAM

In 1979, the Bay Area attained the national lead standard of 1.5 $\mu g/m^3$ which had been established by EPA in 1978, a few years after unleaded gasoline was introduced in 1975 for catalytic converter equipped vehicles. After the complete phase out of leaded gasoline in California in the early 1990s, Bay Area ambient lead levels dropped to less than 1 percent of the original lead standard.

The Air District had been sampling for lead since 1970 using a Total Suspended Particulate sampler. When EPA lead monitoring regulations were enacted in 1978, TSP samplers were listed as the required sampling method. The non-lead TSP NAAQS were rescinded in 1987 when new PM_{10} ambient air quality standards were enacted. Lead sampling using TSP samplers discontinued in the Bay Area in 1994 when the Air District shut down its last TSP samplers. Lead sampling using PM_{10} samplers began in 1988 and continued through 1998. Although the use of PM_{10} samplers did not meet the recommended EPA sampling method for lead, the Air District believed that using a PM_{10} sampler would give similar results to using TSP sampling because lead particles are generally smaller than 10 microns. Lead concentrations on the PM_{10} filters showed the same low ambient levels as on the TSP filters, and in 1998, EPA allowed the Air District to stop monitoring for lead.

EPA promulgated a new lead standard on July 1, 2008 which lowered it from 1.5 $\mu g/m^3$ to 0.15 $\mu g/m^3$, making it 10 times as stringent as the old standard. The revised standard is based on a "rolling" three-month average; attainment is based on a three-year average. The regulation requires the use of TSP filter-based samplers. Filter-based, low-volume PM_{10} samplers may be used to demonstrate attainment of the revised standard if the three-month average is less than 0.10 $\mu g/m^3$, or two-thirds of the standard.

The revised lead standard requires ambient monitoring for lead in urban areas with more than 500,000 people, and near industrial facilities that emit a ton or more of lead per year. In the Bay Area, the San Francisco/Oakland and San Jose/Santa Clara areas may require monitors. There are no identified facilities that emit a ton or more of lead per year. The Air District will work with EPA to determine the best methodology to determine compliance with the revised lead NAAQS. If monitoring is needed, then a separate QAPP will be developed for this program.

A6.5 NATTS PROGRAM

As part of EPA's National Air Toxics Trends Station (NATTS) program, the Air District operates a NATTS monitoring site at its downtown San Jose air monitoring station. **Figure A6-4** shows the location of the site within the Air District. NATTS pollutants can be grouped into three categories: Hazardous Air Pollutants (HAPs), continuous measurements, and Polycyclic Aromatic Hydrocarbons (PAHs).

Hazardous Air Pollutants (HAPs) Measurements. The Air District measures the 14 NATTS pollutants listed in **Table A6-8** on a 1-in-6 day schedule. The fifteenth NATTS pollutant, hexavalant chromium, is not sampled for by the Air District at this time because of sampling method problems due to the reduction of hexavalant chromium to the more stable trivalent state. Total chromium is measured instead as an indicator of hexavalant chromium concentrations.

The Air District uses a Xontec 910a sampler to collect ambient air in an evacuated SUMMA canister continuously at a constant flow rate over a 24-hour sample period. Then the canister contents are analyzed in the laboratory using a Gas Chromatograph (GC) or Gas Chromatograph/Mass Spectrometer (GC/MS) to measure individual compounds. Carbonyl compounds are collected using a cartridge on one sampling channel of a Xontec 924 toxics sampler. In the Air District laboratory, exposed cartridges are analyzed for carbonyls using a High Pressure Liquid Chromatograph (HPLC). Consult section A6.8 for more details on laboratory VOC and carbonyl measurements.

NATTS metals (except hexavalant chromium) are measured using a quarter section of a standard PM_{10} filter. Ambient air is continuously pulled through the filter for 24 hours using an Anderson Hivol 1200 sampler on the NATTS 1-in-6 day sampling schedule. Consult section A6.2 for details on the PM_{10} sampling. The exposed quarter filter sections are sent to the ERG contract laboratory for analysis using X-Ray Fluorescence (XRF). These data are submitted directly to the EPA AQS database by ERG.

Figure A6-4. Map of the NATTS location at the San Jose air monitoring station.

Table A6-8. List of the 15 NATTS HAPs monitored by the Air District.

Hazardous Air Pollutant or Species	AQS Param No.	Year Measurements Began	Parameter Type	Sample Source	Analyzing Lab	Analysis equipment
Benzene	45201	1986	VOC	SUMMA canister	BAAQMD	GC
1,3-Butadiene	43218	1994	VOC	SUMMA canister	BAAQMD	GC
Carbon tetrachloride	43804	1986	VOC	SUMMA canister	BAAQMD	GC
Chloroform	43803	1986	VOC	SUMMA canister	BAAQMD	GC
Tetrachloroethylene	43817	1986	VOC	SUMMA canister	BAAQMD	GC
Trichloroethylene	43824	1986	VOC	SUMMA canister	BAAQMD	GC
Acrolein	43505	2008	VOC	SUMMA canister	BAAQMD	GC/MS
Formaldehyde	43502	2006	Carbonyl	cartridge	BAAQMD	HPLC
Acetaldehyde	43503	2006	Carbonyl	cartridge	BAAQMD	HPLC
Antimony	82102	2008	metal	¼ PM_{10} filter	ERG	XRF
Arsenic	82103	2008	metal	¼ PM_{10} filter	ERG	XRF
Cadmium	82110	2008	metal	¼ PM_{10} filter	ERG	XRF
Manganese	82132	2008	metal	¼ PM_{10} filter	ERG	XRF
Nickel	82136	2008	metal	¼ PM_{10} filter	ERG	XRF
Chromium*	82112	2008	metal	¼ PM_{10} filter	ERG	XRF

* chromium measurements provide an indicator of the hexavalant chromium concentrations

Continuous Measurements. The NATTS program requires continuous measurements of carbon monoxide and black carbon. Hourly averages of carbon monoxide are measured using a high sensitivity analyzer that have EPA reference or equivalent method designations as defined in 40 CFR Part 53. Monitor operation must follow the same requirements as the Criteria Gaseous Program described in section A6.1.

Hourly averages of black carbon are measured using an aethalometer. The Air Monitoring field staff operates the aethalometer according to an SOP based on User Manual procedures and any guidance available from ARB and EPA. Five-minute black carbon data are recorded digitally by the aethalometer. On a monthly basis, Air Monitoring field staff saves these data on network file servers for access by MQA staff. MQA uses the Data Masher program authored by Dr. Jay Turner at Washington University to help detect data irregularities and generate hourly averages for submission to AQS. MQA aethalometer data validation procedures are documented in Data Management SOP 605.

Polycyclic Aromatic Hydrocarbons (PAHs) Measurements. EPA recognized the importance of developing sampling and analytic methodologies to quantify PAHs that could be utilized uniformly throughout the nation. As a result, NATTS participants were invited to sample for and, under specific circumstances, analyze for PAHs utilizing these methods. Beginning with 2007-08 EPA grant funding for NATTS, the Air District began sampling for PAHs as part of this program. The Air District did not have the equipment to meet the specific requirements to perform the analysis, so ERG, EPA's designated contract laboratory, provides the filter media and analysis for the compounds listed in **Table A6-9**.

PAH compounds are collected on a special PUF-XRF-PUF filter provided by ERG. Ambient air is continuously pulled through the filter for 24 hours using a standard PUF hivol sampler on the NATTS 1-in-6 day sampling schedule. Exposed filters are sent to the ERG laboratory for analysis using EPA's TO13a method using a GC/MS. ERG submits selected PAH data directly to the EPA AQS database where AQS parameter numbers are available. A copy of these data are also reviewed by the Air Monitoring manager.

Table A6-9. List of 22 NATTS PAH compounds measured by the Air District.

PAH Analyte	CAS number	AQS Param no.
9-Fluorenone	486-25-9	17159
Acenaphthene	83-32-9	17147
Acenaphthylene	208-96-8	17148
Anthracene	120-12-7	17151
Benzo (a) anthracene	56-55-3	17215
Benzo (a) pyrene	50-32-8	17242
Benzo (b) fluoranthene	205-99-2	17220
Benzo (e) pyrene	192-97-2	17224
Benzo (g,h,i) perylene	191-24-2	17237
Benzo (k) fluoranthene	207-08-9	17223
Chrysene	218-01-9	17208
Coronene	191-07-1	17211
Cyclopenta[cd]pyrene	27208-37-3	17160
Dibenz (a,h) anthracene	53-70-3	17231
Fluoranthene	206-44-0	17201
Fluorene	86-73-7	17149
Indeno(1,2,3-cd)pyrene	193-39-5	17243
Naphthalene	91-20-3	17141
Perylene	1985-5-0	17212
Phenanthrene	85-01-8	17150
Pyrene	129-00-0	17204
Retene	483-65-8	17158

An overview of the NATTS Program Activities, responsible personnel, and references for more detailed procedures are included in **Table A6-10**.

Table A6-10. NATTS program activities, personnel, and references.

Activity	Frequency	Responsible Personnel	Reference
Site Selection	Ongoing as needed	Technical Division Management	40 CFR Pt. 58, Appendix D, E QAPP Appendix B QAPP Sections A7, B1
Site Setup/ Operations	Once upon setup/ 1 in 6 days ongoing	Air Monitoring Section Staff	40 CFR Pt. 58, Appendix D, E QAPP Sections B1-3 SOP 201-203 PM_{10} ops SOP 208 Aethalometer SOP 210 910a (HAP) sampler SOP 214 CO analyzer
Quality Control Checks	One collocated 910a sampler run quarterly	Air Monitoring Section Staff	QAPP Section B5-6 SOP 210 910a sampler ops
Laboratory Operations	After sample collection	Laboratory Section Staff	QAPP Section B4-5 SOP 301 PM_{10} Filter Mgt SOP 303-304, 307 Ion ops SOP 306 HPLC SOP 308 GC Toxics
Performance Evaluations	Annually	Performance Evaluation Staff of MQA Section	QAPP Section B5 SOP 707-708 PM_{10} Audit SOP 7xx 910a Audit (draft)
Preliminary Data Review	Approximately Weekly	Laboratory Section Staff	QAPP Section B3-5 SOP 301 PM_{10} SOP 307 Ion data SOP 306, 308 HPLC, GC
Final Data Review, Reporting, and Archiving	Monthly and Quarterly	Data Management Staff of MQA Section	QAPP Sections B10, D1-2 SOP 605 Aethalometer data SOP 606-8 Toxics, NATTS AQS AMP 403 Completeness

A6.6 CSN PROGRAM

Currently the only Air District site that is part of the Chemical Speciation Network (CSN) is the San Jose Air Monitoring Station. There are, however, three additional sites where speciation samplers are run. While these sites are not officially part of the CSN, they are run using the same equipment, procedures, and standards. These sites are generally located in areas of high population density and are held to both the 40 CFR Part 58 Appendix D network design criteria, and the 40 CFR Part 58 Appendix E siting criteria. **Figure A6-5** shows the geographical locations of these sites.

Only samplers approved by EPA for use in the CSN are used. A list of approved samplers is available in section 5.3 of EPA's Quality Assurance Project Plan: Speciation Trends Field Sampling. All samplers are co-located with $PM_{2.5}$ Federal Reference Method samplers for comparison of the particulate chemical composition and $PM_{2.5}$ mass.

Preweighed filter media arrive from the contract laboratory and are installed and run by the Air Monitoring section every 6 days. The instrument collects a 24 hour integrated sample

after which the filter is removed and stored in a freezer at below 4°C until ready for shipping. In the case of the San Jose CSN site, the samples are shipped along with the Chain of Custody to RTI. For non-CSN speciation sites, the samples are shipped to the Desert Research Institute laboratory. In between the runs the samplers are cleaned, and prepared for the next sample run.

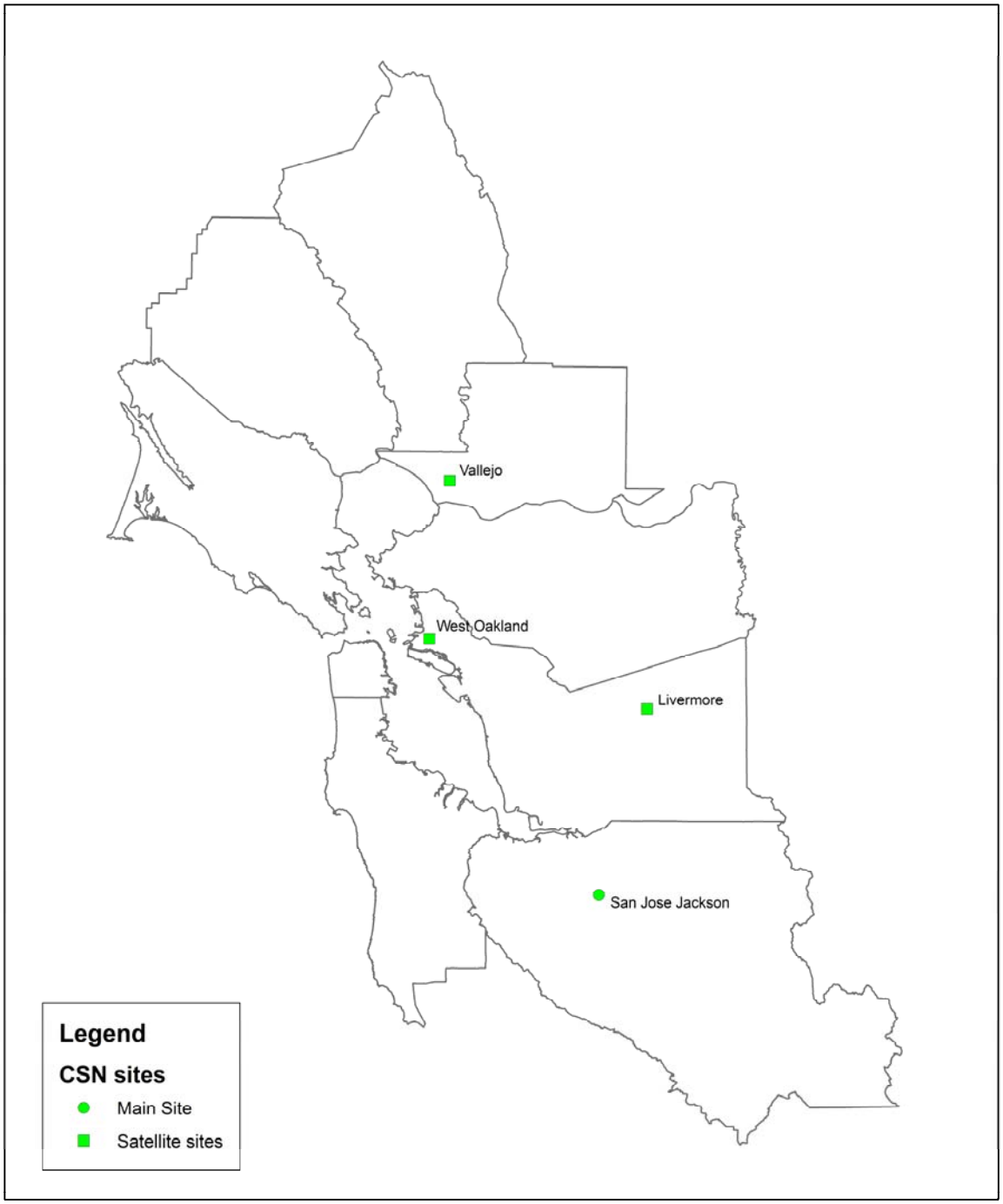

Figure A6-5. Map of Air District CSN and CSN-related monitoring sites

On a monthly basis, the samplers are subjected to an operational check of their flow rate, temperature sensor, and pressure sensor by Air Monitoring section staff. If the results of the checks exceed the limits in **Table 14-1** of AirMon SOP 206a SASS $PM_{2.5}$ Speciation Trend Network, then corrective action is initiated.

The Performance Evaluation group conducts a flow rate, temperature, and pressure audit of the samplers every quarter. Audit acceptance criteria are listed C1-2. If these criteria are exceeded then corrective action is initiated. Findings of the resultant investigation and any corrective actions taken are formally documented following the procedures outlined in QA SOP 705.

The contract laboratories perform a variety of analyses and quality control procedures on the received samples. **Table A6-11** lists the primary measurements and analytical methods used by the support laboratories in their analyses. For further detail on CSN laboratory operations please consult EPA's Quality Assurance Project Plan: Speciation Trends Field Sampling, as well as the respective laboratories own SOPs.

Table A6-11. Support laboratory analyses and methodology.

Measurement and/or Analyte	Methodology
Temperature, shipment cooler	Digital Thermometer
Mass, $PM_{2.5}$ (Teflon filter)	Balance, microgram
Elements (Teflon filter)	Energy-dispersive X-ray fluorescence (EDXRF)(Na through Pb)
Cations(various filters)	Ion Chromatography(IC)(NH_4^+,Na^+,K^+)
Anions(various filters)	IC(nitrate, sulfate, chloride)
Carbon Species	Thermal/optical analysis (total, organic, elemental, and carbonate carbon)

The initial data review of the sample analysis results is done by the contract laboratory, as are all initial QC related tasks. In the case of the San Jose CSN site, these data are submitted by the EPA contract laboratory to AQS and are also sent to the Air District's Laboratory Manager. For the non-CSN speciation sites, data are sent directly to the Air Monitoring Manager. Once data are received, they are subjected to a final data review by the respective section managers and are archived.

A summary of Chemical Speciation Network Program activities, their frequency, responsible personnel, and references to more detailed information is found in **Table A6-12**.

Table A6-12. Chemical Speciation Network Program schedule of activities.

Activity	Frequency	Responsible Personnel	Reference
Site Selection	Ongoing	Technical Division Management	QAPP Section A6 QAPP Section B1 SOP 206a SASS $PM_{2.5}$
Site Setup and Operations	Every 6 days	Air Monitoring Section Staff	QAPP Section B1-B10 SOP 206a SASS $PM_{2.5}$
Quality Control Checks	Monthly	Air Monitoring Section Staff	QAPP Section B5 SOP 101 Station Operator SOP 206a SASS $PM_{2.5}$
Performance Evaluations	Quarterly	Performance Evaluation Group Staff	QAPP Section C1 EPA MetOne SASS Field Audit SOP
Laboratory Analysis	Ongoing	EPA Contract Laboratory (CSN) District Contract Lab (non-CSN)	EPA QAPP for STN
Preliminary Data Review	As analyses are completed	EPA Contract Laboratory (CSN) District Contract Lab (non-CSN)	EPA QAPP for STN
Final Data Review and archival	As received from contract laboratories	Laboratory Manager (CSN) Air Monitoring Manager(non-CSN)	QAPP Section D1

A6.7 NON-CRITERIA GASEOUS PROGRAM

Monitoring for the non-criteria gaseous pollutants takes place at 18 sites in the Bay Area. Of those 18 sites, 15 monitor for NO/NOx, 6 for methane and non-methane hydrocarbons, and 3 for hydrogen sulfide. This monitoring is continuous and ongoing, with no defined stop date. **Figure A6-6** shows the geographic locations of these sites. In general the NO/NOx and methane/non-methane hydrocarbon monitoring is performed in areas of high population density, highest expected concentration, or both. Hydrogen sulfide monitoring takes place in the communities surrounding the local refineries and is specifically designed to measure source impact on the local population, as well as provide enforcement data in support of the Air District's Regulation 9 Rule 2 which limits hydrogen sulfide emissions. The Air District has adopted 40 CFR Part 58 Appendix E siting criteria for all non-criteria gaseous pollutant monitors.

Equipment selection, purchasing, and acceptance testing is performed by the Air Monitoring Section. NO/NOx monitoring is accomplished by capturing the NO/NOx output of a nitrogen dioxide monitor. Only automated analyzers with EPA reference or equivalent method designations as defined in 40 CFR Part 53 are used for this purpose. Methane and non-methane hydrocarbon monitors are selected based on the best available technology. These are generally automated FIDs capable of level of detections in the sub ppm range. Hydrogen sulfide

measurements are made by coupling a hydrogen sulfide converter to the input of an equivalent method designated sulfur dioxide monitor. For specific monitors and methods, consult Sampling Methods section **Table B2-1** of this document.

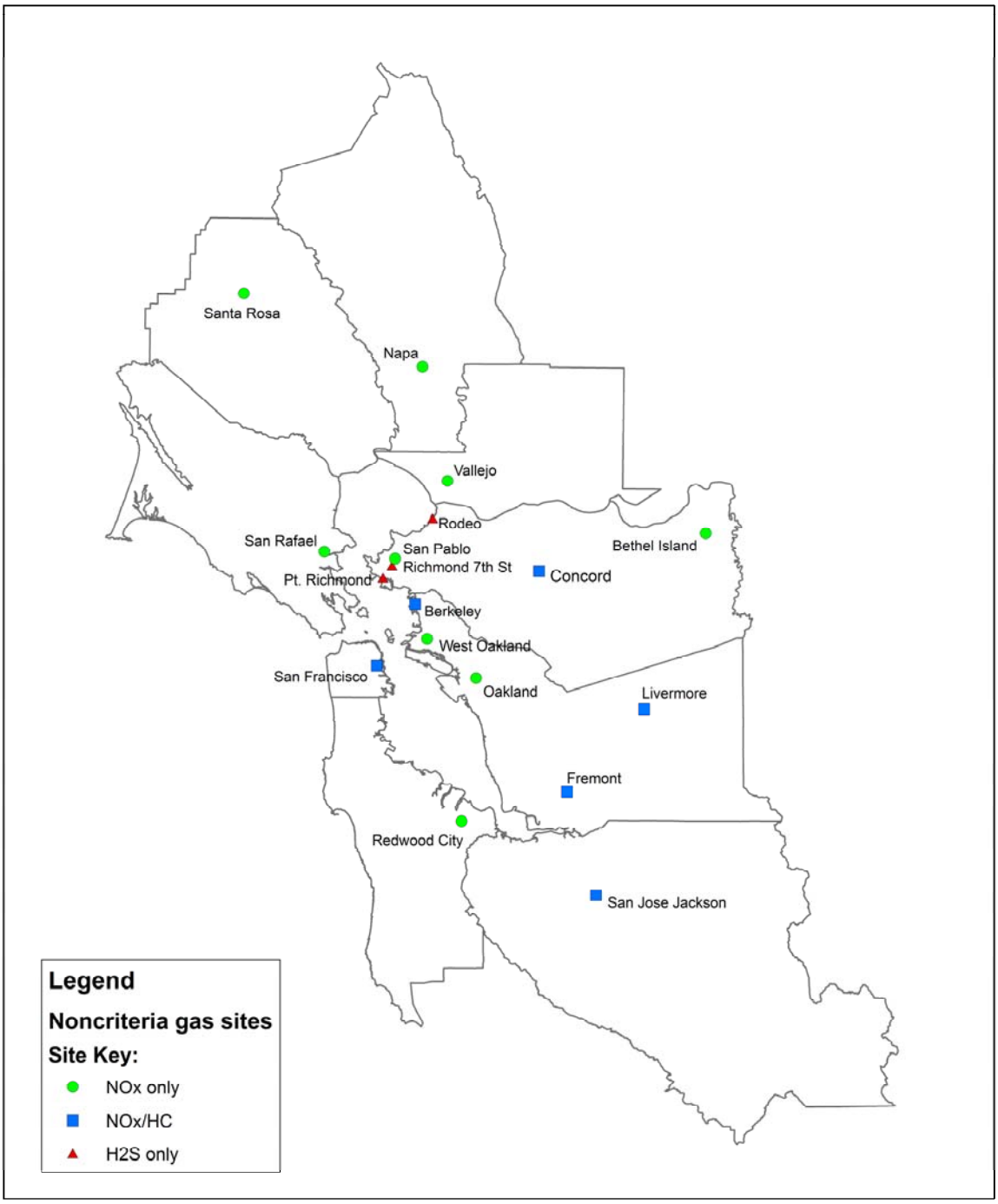

Figure A6-6. Map of Air District non-criteria gaseous monitoring sites.

Air quality measurements are collected automatically by data loggers into 1-minute averages which are used to construct hourly averages for reporting purposes. A central polling system automatically transfers this data to the District Office where it is stored, as well as being sent to a District run website for access by the public. Air Monitoring Section staff perform a daily review of data collected the day before, as well as any strip charts produced. This includes checking for typical signs of malfunction, environmental conditions that may affect data (e.g. station temperature control out of range), and flagging data recorded during periods of malfunction, maintenance, or outside interference. These daily reports are collected monthly and reviewed by a Supervising AQIS before being sent to the MQA Section for further review.

For NO/NOx and methane/non-methane monitors QC checks are automated and run nightly and routinely reviewed by Air Monitoring staff to ensure, to the extent possible, proper response and instrument operation. These QC Checks alternate between a precision check, and a zero/span check. For hydrogen sulfide monitors the QC checks are run manually on a weekly basis. These checks also alternate between precision and zero/span so that a precision check is run once every two weeks and are also routinely reviewed by Air Monitoring staff as described above.

If a QC check exceeds the Quality Control Limits specified in **Table B5-1**, corrective action is initiated. Data are not invalidated unless the QC check exceeds the MQOs as defined in the Data Quality Objectives and Criteria section **Table A6-1** and is deemed uncorrectable. The results of precision checks are sent to the District Office once per week (once every other week for hydrogen sulfide) for review and submittal to AQS.

At least twice per year, each analyzer is subjected to a performance evaluation. These are performed by Performance Evaluation group staff and are based on the requirements in 40 CFR Part 58 Appendix A, if applicable. Actual audit gas concentrations are chosen to represent the measurement range of the subject monitor, and often approximate the QC check concentrations to provide a solid comparison with the Air Monitoring Sections QC system. If the results of a performance evaluation exceed the audit acceptance criteria specified in **Table C1-2**, then corrective action is initiated. Findings of the resultant investigation and any corrective actions taken are formally documented following procedures outlined in QA SOP 705. For detailed information on performance evaluations and corrective actions consult QA SOP 702 and 703.

Every three to five years, the Performance Evaluation group conducts a Technical Systems Audit on Air Monitoring sites. The purpose of this audit is to ensure that ambient air monitoring stations meet 40 CFR Part 58 siting criteria, QA/QC standards, and all documentation requirements of both EPA and this Air Monitoring QAPP.

Any data corrections identified by the Air Monitoring review process are made by the TSD secretary prior to final review by the MQA staff. On a monthly basis, data undergoes a final review by MQA staff. This review includes the confirmation of changes or invalidations made by the Air Monitoring section, reviewing performance evaluations and QC checks, evaluating data for spatial consistency with meteorological conditions, investigating anomalies, and qualitatively checking diurnal patterns at each site between pollutants and with other local pollutant data. Any problems uncovered by this review are reported to both the Air Monitoring

and MQA Managers. Once this review is completed, data are submitted to EPA via AQS. The target for AQS submittal is no later than 75 days after the end of the month in which data were generated.

Both quarterly and annually, the achieved data quality is compared to Measurement Quality Objectives listed in **Table A6-1**. This is accomplished through the use of the precision checks in conjunction with the precision and bias statistics defined in 40 CFR Part 58 Appendix A. Until the AQS AMP 255 report is expanded to include non-criteria pollutants, the Air District will track these statistics internally. The results are analyzed to determine if the completeness and measurement uncertainty requirements were met. Any discrepancies are reported to the Division management who will determine the appropriate course of action to correct the problem.

A summary of Non-Criteria Pollutant Monitoring Program activities, their frequency, responsible personnel, and references to more detailed information are contained in **Table A6-13**.

Table A6-13. Non-Criteria Gaseous Pollutant Program schedule of activities.

Activity	Frequency	Responsible Personnel	Reference
Site Selection	Ongoing	Technical Division Management	QAPP Section A6 QAPP Section B1 QAPP Appendix B
Site Setup and Operations	Daily	Air Monitoring Section Staff	QAPP Section B1-B10 SOP 101 Station Operators SOP 211,218,219 Instruments
Quality Control Checks	Nightly; except H_2S weekly	Air Monitoring Section Staff	QAPP Section B5 SOP 101 Station Operators SOP 211,218,219 Instruments
Performance Evaluations	Semiannual minimum	Performance Evaluation Group Staff	QAPP Section C1 SOP 701-703 Audits SOP 705 ODAMN
Data Retrieval	Hourly	Air Monitoring Staff and MQA Staff	QAPP Section B10 SOP 101 Station Operator
Preliminary Data Review	Daily	Air Monitoring Section Staff	QAPP Section D1 AirMon SOP 101-102 SOP 601 Gas Poll Data Mgmt
Final Data Review and archival	Monthly	MQA Staff	QAPP Section D1 SOP 601 Gas Poll Data Mgmt

A6.8 TOXICS PROGRAM

The goal of the toxics monitoring program is to measure the concentrations of toxic air contaminants in the Bay Area. In 2009, the Air District operated 19 toxics samplers in the Bay Area; 18 of samples were analyzed by the Air District laboratory, and one sample by the ARB

laboratory. ARB also analyzes samples from two sites which are collocated with Air District samplers. **Figure A6-7** shows the locations of the Bay Area toxics monitoring sites. The toxics monitoring program has no scheduled end date.

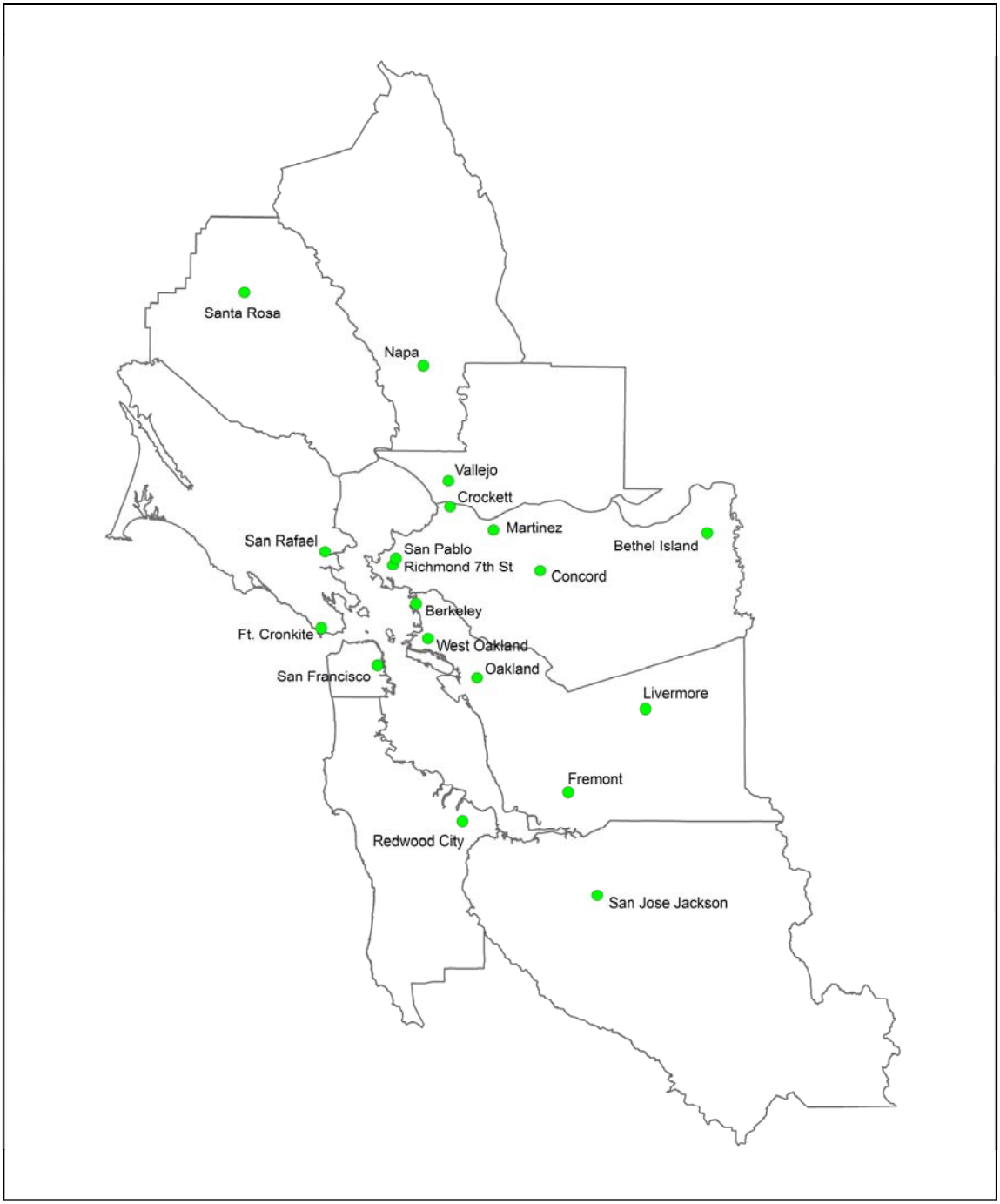

Figure A6-7. Map of the Air District toxics monitoring sites

Toxic pollutants are emitted daily by industrial and chemical manufacturing processes, commercial activities, refinery operations, gasoline marketing, and motor vehicles within the Bay Area. Ambient concentrations vary by proximity to sources, meteorology, and transport. The monitoring program has been designed to obtain a wide geographical coverage of the toxic contaminant levels throughout the Bay Area. Most sites are located in major population centers, although some sites are located downwind of major industrial sources such as refineries. Because the Air District maintains a monitoring network around the Bay Area for criteria pollutants which have similar monitoring goals, the toxics samplers have generally been placed at existing air monitoring stations. In addition, one toxics monitoring site has been placed near the Pacific Ocean away from any development to provide background toxics concentrations.

All sites in the Air District toxic monitoring network collect samples on a one in twelve day schedule. A one in twelve day schedule allows samples to be taken on a different day of the week over the course of months. This is the same schedule EPA and ARB use for their toxics monitoring program. This allows Bay Area concentrations to be compared to toxic concentrations measured elsewhere across the country.

EPA has listed 188 HAPs, or air toxics, in the Clean Air Act that have been associated with a wide variety of adverse human health and ecological effects. Because there are so many air toxics listed in the Clean Air Act, the Air District's toxics measurement program has focused on the pollutants expected to cause widespread exposure and risk to the public. The toxics compounds selected for laboratory analyses were chosen after assessment of the health risk each toxic poses to the public. Compounds chosen for analyses were those that had either high emissions or high toxicity, or some high combination of the two. Other elements that went in the decision were whether measurements from earlier ARB studies had been able to detect the compound, and if the compound was difficult or expensive to detect. Additionally, some toxics were chosen because they have defined concentration ratios to other toxics and could be used to validate laboratory results. Currently, the Air District analyzes for 19 different toxics as shown in **Table A6-14**.

Table A6-14. Toxics VOCs measured by the Air District in the Bay Area.

1,3-Butadiene	Ethylene Dibromide
1,1,2 Trichlorotrifluoroethane	Perchloroethylene
Trichlorofluoromethane	Toluene
O-Xylene	Vinyl Chloride
Methyl Ethyl Ketone	Methylene Chloride
M/P Xylene	Chloroform
Ethylbenzene	Ethylene Dichloride
Acetone	Methyl Chloroform
Trichloroethylene	Carbon Tetrachloride
Benzene	

In 1986, the toxics monitoring network used Tedlar bags to collect and store the ambient air samples, which were filled using a District designed and constructed sampler. This methodology had several problems including leaks, contamination, and the requirement to complete the laboratory analysis within 48 hours of sample collection. Between 1993 and 1996, the Air District changed the entire sample methodology by phasing in 6-liter SUMMA stainless steel canisters to replace the Tedlar bags, and replacing the District sampler with a commercially available Xontech sampler. This was the same system that ARB had been successfully using for a few years. The change was made primarily due to doubts concerning the validity of data collected from Tedlar bags. Another reason for the change was that samples stored in canisters could be analyzed up to 30 days after sample collection. The switch to SUMMA canisters provided more confidence in the resulting data. It also provided more flexibility in scheduling sample days, conducting the laboratory analysis, and for transportation of the samples.

At Air District toxic monitoring sites, the station operator connects the canister to an instrument delivering a continuous steady flow of air to the canister. No special personnel, equipment, or extra ordinary training is required to operate this equipment. The canister continuously collects ambient air for 24 hours to obtain a sufficient volume of air for the subsequent laboratory analyses. After the sample is collected, the canister is sealed and taken to the Air District laboratory for analysis. After analysis, each canister is cleaned with nitrogen gas and evacuated by the Air District laboratory chemist before being returned to the field for use.

The collected sample is analyzed using a gas chromatograph (GC) by a chemist in the Air District laboratory within 30 days of the sample date. The instrument uses capillary gas chromatography employing photoionization and electron capture detectors to measure each of the 19 different toxic compounds in a sample. The Galaxie data management system generates a report in a spreadsheet format.

ARB has requested the Air District to measure Acetonitrile and Acrylonitrile; and UC Berkeley requested the Air District to measure Ethanol. Air samples are taken from the toxics canister at San Jose and analyzed using a gas chromatography mass spectrometry (GC/MS) instrument as part of the NATTS program. The Air District may expand the analysis to more stations in 2009 if new instrumentation is purchased. Data are exported from the instrument into the Galaxie data management system.

All data are reviewed by the laboratory manager. Toxic measurements are entered to the EPA AQS database quarterly by staff in the Meteorology and Data Analysis section. The primary tasks for operating the toxic monitoring program are listed in **Table A6-15** below.

Table A6-15. Schedule of critical air toxic activities.

Activity	Frequency	Responsible Personnel	Reference
Site Selection	Ongoing	Technical Division Management	QAPP Appendix B QAPP Section A6 QAPP Section B3
Site Setup and Operations	Once upon initial site setup Replacement units as needed	Air Monitoring Section Staff	QAPP Sections B1,3-5 SOP 101 Appendix N Station Operator
Quality Control Checks (Field)	2 days prior to sample date	Air Monitoring Section Staff	QAPP Appendix A SOP 101 Appendix N Station Operator
Performance Evaluations (Field)	Annually	Performance Evaluation Staff of MQA Staff	QAPP Section C1
Quality Control Checks (Lab)	Daily	Laboratory Section Staff	QAPP Section B3 QAPP Section B4 SOP 308 GC Toxics
Performance Testing (Lab)	Annually	Performance Evaluation Staff of MQA Section	QAPP Section B6
Laboratory Analysis	Daily	Laboratory Section Staff	QAPP Section B3 SOP 308 GC Toxics
Preliminary Data Review	Twice per month	Laboratory Section Manager	SOP 308 Lab Analysis SOP 606 Toxics 910
Final Data Review and Archival	Quarterly	Meteorology and Data Analysis Section Staff	QAPP Section B10 SOP 606 Toxics 910

A6.9 METEOROLOGICAL PROGRAM

The goal of the Air District's meteorological monitoring program is to provide accurate measurements of ambient meteorological parameters to meet the requirements of programs of the Air District, and to make these data available to the public in a timely manner. Air District programs which use meteorological data are air quality forecasting, photochemical modeling, source modeling, and data analysis. There are no regulatory standards for meteorological data, but the Air District follows EPA recommendations for siting, instrumentation, data accuracy, and quality assurance of the meteorological network.

Meteorological monitoring locations are selected based on the intended uses of the data sets. Sites chosen for air quality forecasting are located in areas that show the general wind and temperature patterns within the Air District. Photochemical modeling sites are chosen to show

boundary conditions, general conditions, and upper air measurements. Source modeling sites are chosen to be representative of the source and receptor domain to be modeled. Sites used for data analysis are usually located near high pollution areas to collect data used to determine the trajectories between sources areas and downwind high concentration area, as well as the general atmospheric conditions occurring during the episodes.

Because most air monitoring stations are located in urban or suburban neighborhoods where multistory buildings and trees are located, it has not been possible to place meteorological systems at many of the Air District's air monitoring stations and still meet meteorological siting recommendations. EPA's siting criteria recommendations are contained in *Ambient Monitoring Guidelines for Prevention of Significant Deterioration (1980); Meteorological Monitoring Guidance for Regulatory Modeling Applications (2000); and Quality Assurance Handbook for Air Pollution* Measurement *Systems: Volume IV: Meteorological Measurements (1994)*. These documents recommend that wind systems be located at a height of 10 meters or at plume height if the use is source oriented modeling. Also the wind system should be at least 10 times the height of any obstruction away from the obstruction.

The current meteorological network includes 22 sites. **Figure A6-8** shows the locations of the sites in 2009. Seven of these sites are located at or adjacent to air monitoring stations (Bethel Island, Suisun, Concord, Vallejo, Livermore, Gilroy, and San Martin). The other air monitoring stations have obstructions to air flow nearby, necessitating placement of the meteorological sites further away. Additionally, to meet forecasting or photochemical modeling needs, some meteorological sites have been placed on ridge tops or mountain tops, such as Pt. San Pablo, Mt. Tamalpais, and Kregor Peak.

Sensors used in the Air District's meteorological network are:

- Wind speed and direction
- Temperature
- Relative humidity (at some sites)
- Solar radiation (at some sites)
- Rainfall (at some sites)
- Ambient pressure (at one site)

The Air District uses meteorological instruments that meet EPA recommended response characteristics as listed in the EPA documents above. **Table A6-16** lists EPA's recommended response characteristics. EPA documents also list system accuracies and resolutions, which the Air District also follows, and can be found in **Table A6-17**.

Instruments operate continuously and a Campbell data logger is used to collect data. The logger has been programmed to output both one minute and one hour averaged data. The loggers are polled hourly and data are sent to a central computer at the main offices in San Francisco. Hourly-averaged raw data are made available to District staff and the public on the Air District's web page, and are archived in the Technical Service's database.

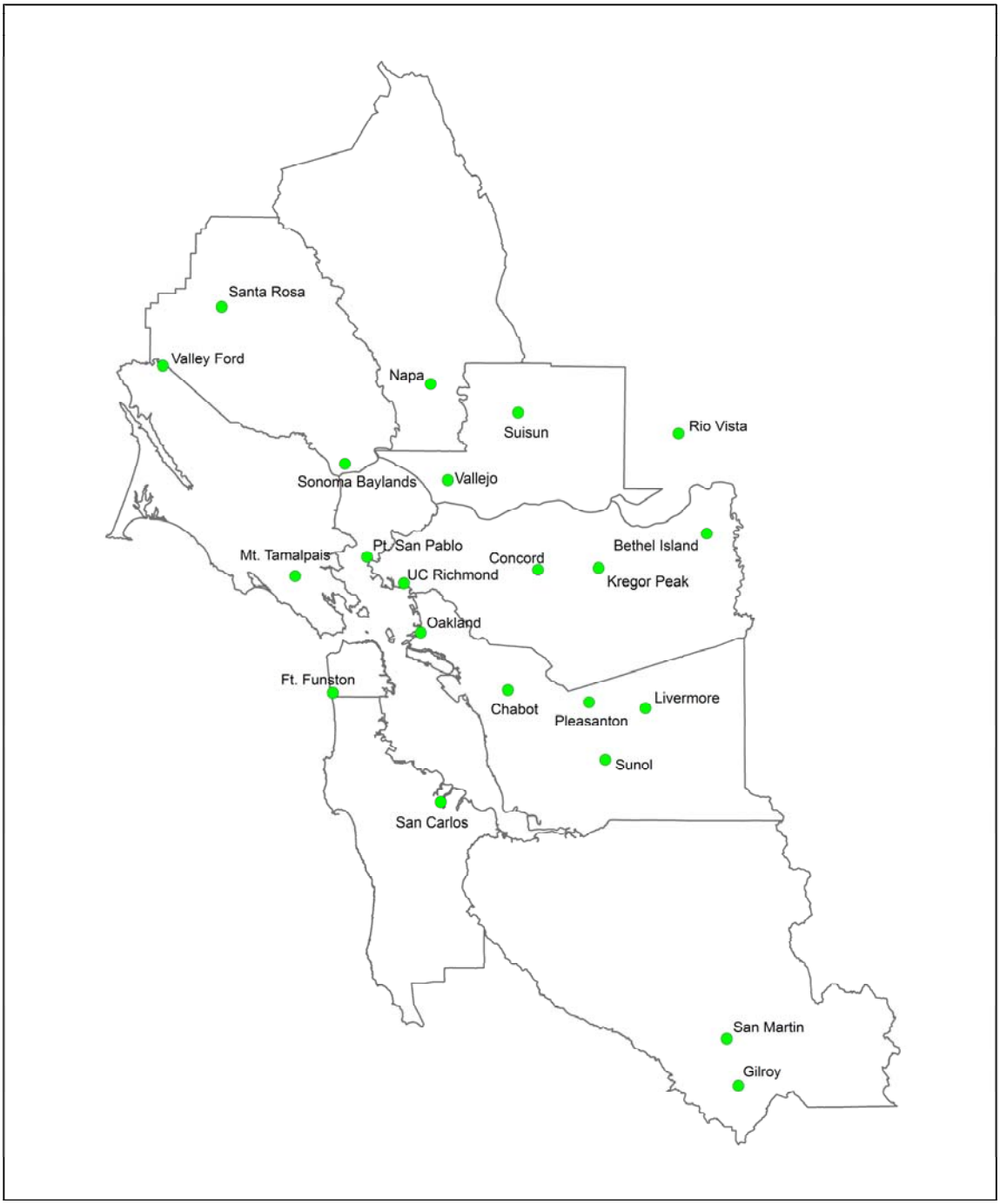

Figure A6-8. Map of the Air District meteorological stations

Table A6-16. Recommended response characteristics for meteorological sensors.

Meteorological Variable	Sensor Specifications	
Wind Speed – horizontal	Starting Speed	≤ 0.5 m/s
	Distance Constant	≤ 5 m
Wind Speed – Vertical	Starting Speed	≤ 0.25 m/s
	Distance Constant	≤ 5 m/s
Wind Direction	Starting Speed	≤ 0.5 m/s @ 10 deg.
	Damping Ratio	0.4 to 0.7
	Delay Distance	≤ 5 m
Temperature	Time Constant	≤ 1 minute
Dew Point Temperature	Time Constant	≤ 30 minutes
	Range	-30° C to +30° C
Solar Radiation	Time Constant	5 sec
	Operating Range	-20° C to +40° C
	Spectral Response	285 nm to 2800 nm

Table A6-17. Recommended meteorological system accuracies and resolutions.

Meteorological Variable	System Accuracy	Measurement Resolution
Wind Speed	± (0.2 m/s + 5% of observed)	0.1 m/s
Wind Direction	± 5 degrees	1.0 degree
Ambient Temperature	± 0.5 °C	0.1 °C
Vertical Temp Difference	± 0.1 °C	0.02 °C
Dew Point Temperature	± 1.5 °C	0.1 °C
Precipitation	± 10% of observed or ± 0.5 mm	0.3 mm
Pressure	± 3 mb	0.5 mb
Solar Radiation	± 5% of observed	10 W/m^2

An electronic report is generated daily that checks for out of range values, constant values, missing values, or rate of change problems. If problems are seen, a technician visits the site to investigate. As part of the quality assurance program, each site is visited four times per year, twice for calibrations and twice for audits, and reports are generated for management review. At the end of each quarter, data are reviewed and edited as needed. After editing, data are ready for uploading into the EPA AQS database, and the raw data on the web page are overwritten with final data.

The MQA Section is responsible for the operation and maintenance of the meteorological system. Most of the day to day work is done by a meteorological technician who reports directly to the MQA Section Manager. The technician is responsible for installation and maintenance of the meteorological systems; for performing semi-annual calibrations of the instruments and assisting during the semi-annual audits; and is responsible for record keeping, repairing instruments, and maintaining a spare parts inventory. Other MQA staff write data logger software, review data, maintain the polling system, as well as assist the technician as needed.

Data collected at airports by the National Weather Service, at refineries as required under Air District regulations, at sewage treatment plants, at universities, and at private companies are also included in the Technical Services Division database if they meet EPA recommended specifications. If requested by organizations, Air District staff will advised them where to best place their meteorological stations and how to operate the equipment such that data can be used for regulatory purposes.

All archived meteorological data are available to state, local, and governmental agencies and to private agencies and individuals upon request and can be put into model-ready format. SOPs for maintaining the meteorological network have been written and approved by the MQA Section Manager and the Quality Assurance Officer, and can be found in **Appendix A** of this QAPP. Other documentation for this project, such as maintenance records, calibration reports, audit reports, and purchase orders are kept by the meteorological technician.

The Air District's meteorological monitoring program is an on-going project designed to continue indefinitely. Normal program activities, responsible personnel, and references to procedures are listed in **Table A6-18**.

Table A6-18. Activities of the Meteorological Program.

Activity	Frequency	Responsible Personnel	Reference
Select sites	As needed	Technical Division Management	QAPP Section B1
Site Setup and Operations	Once upon initial site setup Replacement units as needed	MQA Staff	QAPP Section B1 QAPP Section B6
Quality Control Checks	Twice per year	Meteorological Technician	QAPP Section B7 SOP 501-510 Met Sensors
Performance Evaluations	Twice per year	MQA Staff	QAPP Section C1 SOP 501-510 Met Sensors
Data Retrieval	Hourly	MQA Staff	QAPP Section B10
Preliminary Data Review	Daily	Meteorological Technician	QAPP Section D1 SOP 609 Met Data Mgmt
Final Data Review and archival	Quarterly	Planning Division and MQA Staff	QAPP Section B10 QAPP Section D1 SOP 609 Met Data Mgmt

A7. DATA QUALITY OBJECTIVES AND CRITERIA

Data Quality Objectives are qualitative and quantitative statements derived from a planning process that are intended to clarify the purpose of the study, define the most appropriate type of information to collect, determine the most appropriate conditions from which to collect that information, and specify tolerable levels of potential decision errors. The DQO process is a seven-step process based on the scientific method to ensure that data collected by EPA meet the needs of its data users and decision makers in terms of the information to be collected and, in particular, the desired quality and quantity of data. It also provides a framework for checking and evaluating the program goals to make sure they are feasible and that data are collected efficiently. The seven steps are usually labeled as:

- State the Problem
- Identify the Decision
- Identify the Inputs to the Decision
- Define the Study Boundaries
- Develop a Decision Rule
- Specify Tolerable Limits on the Decision Errors
- Optimize the Design for Obtaining Data

After the DQO is established, the quality of data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (i.e., sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. The MQOs can be defined as below:

Precision - a measure of mutual agreement among individual measurements of the same property usually under prescribed similar conditions. This is the random component of error. Precision is estimated by various statistical techniques using some derivation of the standard deviation.

Accuracy (or Bias) - the systematic or persistent distortion of a measurement process which causes error in one direction. Bias will be determined by estimating the positive and negative deviation from the true value as a percentage of the true value.

Representativeness - a measure of the degree which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Comparability - a measure of confidence with which one data set can be compared to another.

Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.

Detectability- the determination of the low range critical value of a characteristic that a method specific procedure can reliably discern.

The elements of the DQO Process are discussed within each of the following monitoring program sections, as well as the respective MQO tables for each monitoring program.

A7.1 CRITERIA GASEOUS PROGRAM

State the Problem

The Air District needs to:

a) determine the attainment status of the Bay Area for the applicable national ambient air quality standards (NAAQS) for gaseous pollutants;
b) report the Air Quality Index for each applicable pollutant to the public;
c) declare an air pollution health advisory, air pollution alert, air pollution warning, or air pollution emergency when ambient air pollutant levels reach or exceed the corresponding levels for ozone, sulfur dioxide and carbon monoxide specified in Regulation 4 – Episode Plan, Table 1 - Episode Stage Criteria; and
d) implement the air pollution abatement actions specified in Regulation 4 – Episode Plan, Section 4-303 – Abatement Actions when an air pollution alert is declared as specified in Regulation 4 – Episode Plan;
e) determine the transport of pollutants to and from the Bay Area; and
f) determine the background level of pollutants entering the Bay Area.

Attainment of the gaseous NAAQS is determined by comparing monitoring results for the most recent three year period for ozone and for the most recent one year period for nitrogen dioxide, sulfur dioxide and carbon monoxide with the applicable NAAQS, as specified in 40 CFR Part 50. The U S EPA uses a formal process to designate the Bay Area as attainment, non-attainment, or unclassifiable for the gaseous NAAQS, which includes reviewing the recommendations made by California and the monitoring data.

Gaseous criteria pollutant data are also used for trend analyses, to assess the effects of national, state and local emission control programs and to assess population weighted exposure to levels above the SAAQS for ozone to track progress toward attaining the California state ozone standards as required by the California Clean Air Act.

Identify the Decision

The primary decision that gaseous criteria pollutant monitoring is intended to inform is the Bay Area's attainment status for the applicable NAAQS. Other decisions include declaring an air pollution health advisory, alert, warning or emergency and implementing air pollution abatement actions. Monitoring is performed to provide data of sufficient quantity and quality to determine the Bay Area's attainment status for the applicable NAAQS, particularly for 8-hour ozone NAAQS.

Identify the Inputs to the Decision

Inputs required for the decision for 8-hour ozone NAAQS, include:

- Annual Monitoring Network Plan that demonstrates the monitoring network meets the requirements of 40 CFR 58
- three years of one-hour average monitoring data
- three year average of the 4th highest 8-hour average ozone value for each monitoring site
- annual average nitrogen dioxide values for each monitoring site
- annual 2nd highest 24-hour average and annual average sulfur dioxide values for each monitoring site
- annual 2nd highest 1-hour and 2nd highest 8-hour carbon monoxide levels for each monitoring site

Define the Study Boundaries

The criteria pollutant monitoring network should meet all of the requirements of 40 CFR 58 for the nine Bay Area Counties or portions thereof, as defined in the California Health & Safety Section 40200.

Develop a Decision Rule

Attainment / Non-attainment / Unclassifiable

- **Ozone 8-hour NAAQS:**

Attainment
If the most recent three years of data for all monitoring sites show that the three year average of the 4th highest 8-hour average is less than or equal to the 8-hour ozone NAAQS, then the Bay Area attains the 8-hour ozone NAAQS.

Non-Attainment
If the most recent three years of data for any monitoring site show that the three year average of the 4th highest 8-hour average is greater than the 8-hour ozone NAAQS, then the Bay Area does not attain the 8-hour ozone NAAQS.

Unclassifiable
If there are not three complete years of ozone data then the Bay Area is unclassifiable for the 8-hour ozone NAAQS.

- **Nitrogen Dioxide annual NAAQS:**

Attainment
If most recent year of data for all monitoring sites shows that the annual average is less than or equal to the annual nitrogen dioxide NAAQS, then the Bay Area attains the annual nitrogen dioxide NAAQS.

Non-Attainment
If most recent year of data for any monitoring site is shows that the annual average is greater than the annual nitrogen dioxide NAAQS, then the Bay Area does not attain the annual nitrogen dioxide NAAQS.

Unclassifiable
If there is not one complete year of nitrogen dioxide data then the Bay Area is unclassifiable for the annual nitrogen dioxide NAAQS.

- **Sulfur Dioxide 24-hour NAAQS:**

Attainment
If the most recent year of data for all monitoring sites shows that the 2nd highest 24-hour average is less than or equal to the 24-hour sulfur dioxide NAAQS then the counties or portions thereof in which the monitoring sites are located attain the 24-hour sulfur dioxide NAAQS.

Non-Attainment
If the most recent year of data for any monitoring site shows that the 2nd highest 24-hour average is greater than the 24-hour sulfur dioxide NAAQS then the county or portion thereof in which the monitoring site is located does not attain the 24-hour sulfur dioxide NAAQS.

Unclassifiable
If there is not one complete year of sulfur dioxide data then the county or portion thereof in which the monitoring site is located is unclassifiable for the 24-hour sulfur dioxide NAAQS.

- **Sulfur Dioxide annual NAAQS:**

Attainment
If the most recent year of data for all monitoring sites shows that the annual average is less than or equal to the annual sulfur dioxide NAAQS then the counties or portions thereof in which the monitoring sites are located attain the annual sulfur dioxide NAAQS.

Non-Attainment
If the most recent year of data for any monitoring site shows that the annual average is greater than the annual sulfur dioxide NAAQS then the county or portion thereof in which the monitoring site is located does not attain the annual sulfur dioxide NAAQS.

Unclassifiable
If there is not one complete year of sulfur dioxide data then the county or portion thereof in which the monitoring site is located is unclassifiable for the annual sulfur dioxide NAAQS.

- **Carbon Monoxide 1-hour NAAQS:**

Attainment
If the most recent year of data for all monitoring sites shows that the 2nd highest 1-hour average is less than or equal to the 1-hour carbon monoxide NAAQS then the Bay Area attains the 1-hour carbon monoxide NAAQS.

Non-Attainment
If the most recent year of data for any monitoring site shows that the 2nd highest 1-hour average is greater than the annual NAAQS then the urbanized portions of the Bay Area do not attain the 1-hour carbon monoxide NAAQS.

Unclassifiable
If there is not one complete year of carbon monoxide data then the Bay Area is unclassifiable for the 1-hour carbon monoxide NAAQS.

- **Carbon Monoxide 8-hour NAAQS:**

Attainment
If the most recent year of data for all monitoring sites shows that the 2nd highest 8-hour average is less than or equal to the 8-hour carbon monoxide NAAQS then Bay Area attains the 8-hour carbon monoxide NAAQ

Non-Attainment
If the most recent year of data for any monitoring site monitoring site shows that the 2nd highest 8-hour average is greater than the 8-hour carbon monoxide NAAQS then the urbanized portions of the Bay Area do not attain the 8-hour carbon monoxide NAAQS.

Unclassifiable
If there is not one complete year of carbon monoxide data then the Bay Area is unclassifiable for the 8-hour carbon monoxide NAAQS.

If the monitoring data for the gaseous NAAQS show that the Bay Area is non-attainment for a specific NAAQS, then EPA will designate the Bay Area as non-attainment for that NAAQS. If the Bay Area is designated as non-attainment for one of the gaseous NAAQS, then the Bay Area is required to prepare and submit a non-attainment plan (NAP) to the U S EPA that demonstrates how the Bay Area will attain the specified NAAQS by the required attainment data. If the Bay Area is designated as attainment for one of the gaseous NAAQS, then the Bay Area is required to prepare and submit a maintenance plan to the U S EPA that demonstrates how the Bay Area will remain in attainment with the specified NAAQS. If there is not sufficient data to determine the Bay Area's attainment status for a specified NAAQS, then the U S EPA will designate the Bay Area as unclassifiable for the specified NAAQS, and the Bay Area is required to collect more data.

Specify Tolerable Limits on the Decision Errors

The acceptable limits for measurement uncertainty for ozone are an upper 90 percent confidence limit for the coefficient of variation of 7 percent for precision and an upper 95 percent confidence limit for the absolute bias of 7 percent for accuracy. The acceptable limits for measurement uncertainty for nitrogen dioxide, sulfur dioxide and carbon monoxide are an upper 90 percent confidence limit for the coefficient of variation of 10 percent for precision and an upper 95 percent confidence limit for the absolute bias of 10 percent for accuracy.

Optimize the Design for Obtaining Data

The primary design objective of the gaseous criteria pollutant monitoring network is to meet the requirements of 40 CFR 58 Appendix C, including areas of high population, highest concentrations, downwind of major point sources and in transport corridors. Secondary considerations include: a) at least one, gaseous criteria pollutant monitoring station in the major population center in each of the nine counties, or portions thereof, that comprise the BAAQMD,

b) source oriented monitoring stations in locations where emissions from specific sources can be expected to occasionally impact air quality, and c) monitoring stations to assess pollutant transport to and or from the Bay Area or to assess background pollutant levels.

DQOs

If the following criteria are met, data will be considered of sufficient quantity and quality for use in determining the Bay Area's attainment status for the applicable NAAQS or any other use:

- Data are representative of the area for which it will be used.
- The control checks show that the gaseous criteria pollutant monitors are operating within the quality control limits specified in Table B5-1. When the gaseous criteria pollutant monitors are not operating within the specified quality control limits, data will be reviewed and corrected or invalidated as appropriate;
- Data completeness is 85% or better by calendar quarter, except for ozone monitors that are shut down under an EPA approved waiver during the low ozone season of December 1st through March 31st;
- Data have been quality assured by Technical Services Division staff.

Once a DQO is established, the quality of data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (i.e., sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. The MQOs for the gaseous criteria pollutant monitoring program are listed below in Table A7-1:

Table A7-1. Criteria Pollutant Measurement Quality Objectives.

Gaseous Criteria Pollutant	Reporting Units	Precision (CV)[1]	Accuracy	Representativeness	Comparability/ Method Selection	Completeness	Minimum Detection Limits
Ozone	ppb	≤ 7% at the 90 % CI	≤ ±7% at the 95 % CI	Neighborhood, Urban, and/or Regional Scale	FRM or FEM	85% by Quarter [2]	1 ppb
Nitrogen Dioxide	ppb	≤ 10% at the 90 % CI	≤ ±10% at the 95 % CI	Neighborhood, Urban and/r Regional Scale	FRM or FEM	85% by Quarter	1 ppb
Sulfur Dioxide	ppb	≤ 10% at the 90 % CI	≤ ±10% at the 95 % CI	Micro, Middle, and/or Neighborhood Scale	FRM or FEM	85% by Quarter	1 ppb
Carbon Monoxide	ppm	≤ 10% at the 90 % CI	≤ ±10% at the 95 % CI	Micro and/or Middle Scale	FRM or FEM	85% by Quarter	0.1 ppm
Trace Level Carbon Monoxide	ppm	≤ 10% at the 90 % CI	≤ ±10% at the 95 % CI	Micro and/or Middle Scale	Trace Level	85% by Quarter	0.01 ppm

[1]coefficient of variation
[2]except for ozone monitors that are not operating during the low ozone period of December 1st through March 31st

A7.2 PM_{10} PROGRAM

State the Problem

The problem is to determine if ambient air levels of PM_{10} in the Bay Area are at concentrations which could cause respiratory problems to humans. The U.S. EPA and California have published regulations for PM_{10} and the levels at which these effects become significant. Beginning in the 1950's a criteria pollutant air monitoring program was developed to measure Bay Area ambient pollution levels and provide staff with useful data for developing strategies to improve air quality. As the population of the Bay Area continued to increase, emissions from vehicles and industry grew, which led to increased air pollution levels. As recently as 1991, exceedances of the PM_{10} NAAQS were recorded at locations in the Bay Area, and exceedances of the stringent State standard continue to occur.

Identify the Decision

The primary question that will be answered by the Air District's PM_{10} program is whether the Bay Area is attaining the PM_{10} national and State ambient air quality standards. By looking at the current measurements and the trends, the decision then becomes whether a plan for additional emissions reductions is required for the Bay Area to attain and maintain the PM_{10} NAAQS.

The monitored air quality data will also be used to decide if the public should be notified of an air pollution health advisory, alert, warning, or emergency.

Identify the Inputs to the Decision

Inputs required for the decision of whether a plan for additional emissions reductions are needed include:

- A monitoring plan that demonstrates the monitoring network meets appropriate sampling and analysis methods, as described in 40 CFR Part 58.
- Three years of 24-hour average monitoring data.
- Meteorological data collected within the Bay Area.
- Criteria pollutants and precursors emission inventory trends over the last three years, and expected future emissions reductions, if any, due to current regulations.

Define the Study Boundaries

The study boundaries of the gaseous criteria pollutant monitoring program include the area bounded by nine Bay Area counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southwestern Solano, and southern Sonoma. The current air monitoring stations are listed in the Air District's Annual Monitoring Network Plan.

PM_{10} has 24-hour State and national air quality standard as well as an annual average standard. Samples will be collected every 6th day in order to minimize potential bias associated

with the day of the week. Specific attainment determinations will be made using PM_{10} values calculated from the most recent 3-year period using the techniques specified in 40 CFR Part 50.

Develop a Decision Rule

For PM_{10}:

- If the most recent data for all monitoring sites show that the design value is less than or equal to the NAAQS, then the Bay Area is determined to be in attainment of the NAAQS. If the pollutant trends do not show an upward slope, then State and Air District regulations are likely to be adequate to maintain attainment and no new plan is needed.
- If the most recent three years of data for any monitoring site show that the design value is greater than the NAAQS, then all or a portion of the Bay Area will not be in attainment of the NAAQS. Areas of the Bay Area classified as non-attainment will then need a plan to sufficiently reduce emissions which will result in attainment of the NAAQS.
- If there are not three complete years of data then additional data will need to be collected.
- The public will be notified, and related actions will be taken as specified in the Air District's Regulation 4 - Air Pollution Episode Plan, when PM_{10} concentrations reach 350 $\mu g/m^3$.

Specify Tolerable Limits on the Decision Errors

EPA has published acceptable limits for PM_{10} sampling in 40 CFR Part 58, Appendix A specifying collocation precision requirements as well as flow rate audit standards. The Air District will also adhere to recommendations listed in EPA's draft document *Quality Assurance Handbook for Air Pollution Measurement Systems Volume II - Ambient Air Quality Monitoring Program, Final Draft, August 2008.*

Optimize the Design for Obtaining Data

Ambient air monitoring at Air District stations is intended to meet one or more of the following monitoring objectives:

- A determination of typical concentrations in areas of high population density.
- A determination of the highest concentrations expected to occur in the area covered by the network.
- A determination of impacts from significant sources.
- A determination of general background concentration levels.
- A determination of the extent of regional pollutant transport.

However, PM_{10} monitoring is focused on population exposure with a scale of representativeness that is defined as 100 meters to a few kilometers.

<u>Population Oriented</u>

As the primary purpose of air quality standards is to protect the public health, air monitoring stations have been placed in areas with high population density to determine the air pollution levels to which the majority of the population is exposed. To meet this objective, nine of the Air District's air monitoring stations are located in the largest city

in each of the nine Bay Area counties and have PM measurements. If these sites are classified as non-attainment for PM_{10}, then the attainment plan will most likely need to reduce local emission sources.

Highest Concentration
For PM_{10}, there are no specific requirements to locate samplers in unpopulated areas that may see higher concentrations than populated areas.

Source Impact
With the exception of defined special studies, there are no PM_{10} samplers in the Air District operating with the specific purpose of measuring impacts from sources. However, there are samplers that operate within a sphere of influence of major sources with the intent of measuring how the source impacts air quality over a larger area. An example of this is the San Pablo Air Monitoring Station that is located near the Chevron refinery.

General Background
Background sites are generally located in areas that have no significant emissions from mobile, area, or industrial sources, and do not experience transport from other air basins. The Air District does not operate any background sites for PM_{10}.

Regional Transport
The Air District shares a common boundary with six other air districts: Monterey Bay Unified APCD, San Joaquin Valley APCD, Sacramento Metropolitan AQMD, Yolo-Solano AQMD, Lake County AQMD, and Northern Sonoma County APCD. When upwind areas have significant air pollution sources, PM_{10} transported into the Bay Area may result in overall higher air pollution levels in the Bay Area. The Air District operates monitoring stations near the borders of the Air District to determine how much of the air pollution is transported into and out of the Bay Area Air District. If these sites are classified as non-attainment, then the attainment plan would need to address how adjacent air districts will reduce air pollution being carried into the Bay Area.

Data Quality Objectives (DQOs)

If the following criteria are met, data will be considered of sufficient quantity and quality for use in determining the Bay Area's attainment status for the applicable NAAQS or any other use:

- Data are representative of the area for which it will be used.
- The quality control checks show that PM_{10} samplers are operating within the quality control limits specified in Table B5-1. When PM_{10} samplers are not operating within the specified quality control limits, data will be reviewed and corrected or invalidated as appropriate;
- Data completeness is 75% or better by calendar quarter;
- Data have been quality assured by Technical Services Division staff.

Once a DQO is established, the quality of data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (i.e., sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. The MQOs for the PM_{10} monitoring program are listed below in Table A7-2:

Table A7-2. PM_{10} Measurement Quality Objectives.

Gaseous Criteria Pollutant	Reporting Units	Precision (CV)[1]	Accuracy	Representativeness	Comparability/ Method Selection	Completeness
PM_{10}	µg/m^3	≤ 10%	≤ 10% (flow rates)	Middle, Neighborhood, Urban	FRM or FEM	75% by Quarter

[1]precision for collocated samplers

A7.3 $PM_{2.5}$ PROGRAM

State the Problem

The problem is to determine if ambient air levels of $PM_{2.5}$ in the Bay Area are at concentrations which could cause respiratory problems to humans. The U.S. EPA and California have published regulations for $PM_{2.5}$ and the levels at which these effects become significant. Beginning in the 1950's a criteria pollutant air monitoring program was developed to measure Bay Area ambient pollution levels and provide staff with useful data for developing strategies to improve air quality. As the population of the Bay Area continued to increase, emissions from vehicles and industry grew, which led to increased air pollution levels. The 24-hour NAAQS for $PM_{2.5}$ was lowered from 65 µg/m^3 to 35 µg/m^3 in 2006. In December of 2008, the Air District was designated as nonattainment for the 35 µg/m^3 standard, which was to take effect 90 days after the designation. Since a freeze was put on all federal rules before the 90 day time period had expired, the date of designation did not take effect until November 13, 2009. The Air District is currently in attainment for the annual $PM_{2.5}$ standard.

Identify the Decision

The primary question that will be answered by the Air District's $PM_{2.5}$ program is whether the Bay Area is attaining the $PM_{2.5}$ national and State ambient air quality standards. By looking at the current measurements and the trends, the decision then becomes whether a plan for additional emissions reductions is required for the Bay Area to attain and maintain the $PM_{2.5}$ NAAQS.

The monitored air quality data will also be used to decide if the public should be notified of an air pollution health advisory, alert, warning, or emergency.

Identify the Inputs to the Decision

Inputs required for the decision of whether a plan for additional emissions reductions are needed include:

- A monitoring plan that demonstrates the monitoring network meets appropriate sampling and analysis methods, as described in 40 CFR Part 58.
- Three years of 24-hour average monitoring data.
- Meteorological data collected within the Bay Area.
- Criteria pollutants and precursors emission inventory trends over the last three years, and expected future emissions reductions, if any, due to current regulations.

Define the Study Boundaries

The study boundaries of the gaseous criteria pollutant monitoring program include the area bounded by nine Bay Area counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southwestern Solano, and southern Sonoma. The current air monitoring stations are listed in the Air District's Annual Monitoring Network Plan.

$PM_{2.5}$ has 24-hour and national air quality standard as well as a State and national annual average standard. Samples will be collected as defined on an annual basis and determined by proximity to the standard. Specific attainment determinations will be made using $PM_{2.5}$ values calculated from the most recent 3-year period using the techniques specified in 40 CFR Part 50.

Develop a Decision Rule

For $PM_{2.5}$:

- If the most recent data for all monitoring sites show that the design value is less than or equal to the NAAQS, then the Bay Area is determined to be in attainment of the NAAQS. If the pollutant trends do not show an upward slope, then State and Air District regulations are likely to be adequate to maintain attainment and no new plan is needed.
- If the most recent three years of data for any monitoring site show that the design value is greater than the NAAQS, then all or a portion of the Bay Area will not be in attainment of the NAAQS. Areas of the Bay Area classified as non-attainment will then need a plan to sufficiently reduce emissions which will result in attainment of the NAAQS.
- If there are not three complete years of data then additional data will need to be collected.
- The public will be notified, and related actions will be taken as specified in the Air District's Regulation 4 - Air Pollution Episode Plan. Although levels for $PM_{2.5}$ are not specifically set in this regulation, the Air District has worked with local health officials in the past when conditions warranted public notification.

Specify Tolerable Limits on the Decision Errors

EPA has published acceptable limits for $PM_{2.5}$ sampling in 40 CFR Part 58, Appendix A specifying collocation precision requirements as well as flow rate checks and audit standards. The Air District will also adhere to recommendations listed in EPA's draft document *Quality*

Assurance Handbook for Air Pollution Measurement Systems Volume II - Ambient Air Quality Monitoring Program, Final Draft, August 2008.

Optimize the Design for Obtaining Data

Ambient air monitoring at Air District stations is intended to meet one or more of the following monitoring objectives:

- A determination of typical concentrations in areas of high population density.
- A determination of the highest concentrations expected to occur in the area covered by the network.
- A determination of impacts from significant sources.
- A determination of general background concentration levels.
- A determination of the extent of regional pollutant transport.

However, $PM_{2.5}$ monitoring is focused on population exposure with a scale of representativeness that is defined as 100 meters to a few kilometers.

Population Oriented
As the primary purpose of air quality standards is to protect the public health, air monitoring stations have been placed in areas with high population density to determine the air pollution levels to which the majority of the population is exposed. To meet this objective, nine of the Air District's air monitoring stations are located in the largest city in each of the nine Bay Area counties and have PM measurements. If these sites are classified as non-attainment for $PM_{2.5}$, then the attainment plan will most likely need to reduce local emission sources.

Highest Concentration
For $PM_{2.5}$, there are no specific requirements to locate samplers in unpopulated areas that may see higher concentrations than populated areas.

Source Impact
With the exception of defined special studies, there are no $PM_{2.5}$ samplers in the Air District operating with the specific purpose of measuring impacts from sources. However, there are samplers that operate within a sphere of influence of major sources with the intent of measuring how the source impacts air quality over a larger area. An example of this a special study being performed at a cement facility in Cupertino.

General Background
Background sites are generally located in areas that have no significant emissions from mobile, area, or industrial sources, and do not experience transport from other air basins. The Air District does not operate any background sites for $PM_{2.5}$.

Regional Transport
The Air District shares a common boundary with six other air districts: Monterey Bay Unified APCD, San Joaquin Valley APCD, Sacramento Metropolitan AQMD, Yolo-Solano AQMD, Lake County AQMD, and Northern Sonoma County APCD. When

upwind areas have significant air pollution sources, $PM_{2.5}$ transported into the Bay Area may result in overall higher air pollution levels in the Bay Area. The Air District operates monitoring stations near the borders of the Air District to determine how much of the air pollution is transported into and out of the Bay Area Air District. If these sites are classified as non-attainment, then the attainment plan would need to address how adjacent air districts will reduce air pollution being carried into the Bay Area.

Data Quality Objectives (DQOs)

If the following criteria are met, data will be considered of sufficient quantity and quality for use in determining the Bay Area's attainment status for the applicable NAAQS or any other use:

- Data are representative of the area for which it will be used.
- The quality control checks show that $PM_{2.5}$ samplers are operating within the quality control limits specified in Table B5-1. When $PM_{2.5}$ samplers are not operating within the specified quality control limits, data will be reviewed and corrected or invalidated as appropriate;
- Data completeness is 75% or better by calendar quarter;
- Data have been quality assured by Technical Services Division staff.

Once a DQO is established, the quality of data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (i.e., sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. The MQOs for the $PM_{2.5}$ monitoring program are listed below in Table A7-3:

Table A7-3. $PM_{2.5}$ Measurement Quality Objectives.

Gaseous Criteria Pollutant	Reporting Units	Precision (CV)[1]	Accuracy	Representativeness	Comparability/ Method Selection	Completeness
$PM_{2.5}$ FRM	µg/m^3	≤ 2%	≤ 5% (flow rates)	Middle, Neighborhood, Urban	FRM	75% by Quarter
$PM_{2.5}$ FRM	µg/m^3	≤ 2%	≤ 5% (flow rates)	Middle, Neighborhood, Urban	FRM	75% by Quarter

[1]measured flow rate

A7.4 LEAD PROGRAM

A separate, newly revised Lead Program QAPP will be developed and adopted if lead sampling operations are required in 2011.

A7.5 NATTS PROGRAM

State the Problem

Currently, EPA does not have a sufficient amount of data of known and needed quality or quantity to understand the spatial and temporal characteristics of the monitoring area at a neighborhood scale. EPA has evidence that a number of the hazardous air pollutants (HAPS) regulated under the Clean Air Act is being emitted in the air shed of the San Francisco Bay Area. BAAQMD has been funded to participate in the National Air Toxics Trends Study (NATTS) program, specifically at the San Jose Air Monitoring Site, whose initial ambient air monitoring focus is to:

- characterize ambient concentrations and deposition in representative monitoring areas;
- provide data to support and evaluate dispersion and deposition models, and;
- establish trends and evaluate effectiveness of HAP reduction strategies.

EPA feels that if it can characterize ambient concentrations and deposition at the San Jose Air Monitoring Site with adequate data quality, data will support the modeling and trends analysis goals. This is consistent with the NATTS goal of initially focusing on characterization (community wide concentrations in urban areas and ecosystem impacts, and to quantify conditions in the vicinity of localized hot spots or specific areas of concern like schools).

Initial new monitoring, together with data analysis of existing measurements, will be needed to provide a sufficient understanding of ambient air toxics concentration throughout the country in order to decide on the "appropriate quantity and quality of data needed." Therefore the BAAQMD study objective is consistent with this initial goal.

On a national scale, EPA will develop a monitoring network to characterize HAPS, determine how much monitoring is needed and where to place the monitors. EPA does not have an adequate understanding of the spatial and temporal characteristics of its monitoring area, sampling will be done at the neighborhood scale to ensure adequate characterization of the annual average concentrations.

The BAAQMD has been provided with a grant from EPA to participate in the NATTS program, over a specified period, which is intended to partially cover equipment and consumable purchases, data collection, and assessment costs. BAAQMD must determine the appropriate tradeoffs (i.e., quality, quantity, instrument sensitivity, precision, bias) to produce the desired results within the resource constraints. These tradeoffs will be documented in order to help the BAAQMD determine the best monitoring design within budgets and data quality constraints.

Though the primary goal for BAAQMD is to provide data to EPA to assist in meeting the goals of the NATTS program, BAAQMD also uses the generated data as a comparator with other sites within the District.

Identify the Decision

The decision that must be made once data are evaluated is whether or not EPA feels it can provide a meaningful annual HAP concentration estimate of the San Jose Air Monitoring Site that adequately represents the spatial and temporal characteristics of the region at an every 6-day sampling frequency. Possible actions could be that data from the study appears to adequately represent San Jose and that the Air District continues to participate in the program; or the results indicate that the estimate provides an inordinate amount of uncertainty that would need to be corrected by increasing the number of monitors in the region, increasing the sampling frequency, stratifying the monitoring boundaries or correcting sampling or analytical errors.

Identify the Input to the Decision

For this pilot study the important inputs are:

- The actual 24-hour concentration estimates of HAPS;
- Measurements of overall precision and bias to quantify the source of measurement error,
- The location information of each sampling site (latitude and longitude). Several supporting inputs are available that helped in
- Initial monitoring results which indicate that certain HAPs have been measured in San Jose;
- A review of the emission inventory indicates that there are a number of pollutants being generated within the city that are of concern. EPA has location data on the emission sources.
- Meteorological data (i.e., wind rose information);
- Technical staff expertise in development of ambient air monitoring networks for criteria pollutants
- Sampling instruments that can meet EPA's requirements for sampling time, contamination, precision, durability , and ease of use;
- Analytical instruments and methods that can meet EPA's requirements for, contamination, detectability, repeatability, and bias.

Should EPA funding for this program be discontinued, Engineering and Planning Divisions would be contacted to determine what, if any, analyses should continue at the NATTS site given the data value and budget constraints. Executive management would make the final decision.

Define the Study Boundaries

The spatial and temporal boundaries will be based upon what can reasonably be achieved within BAAQMD's current and predicted resources for an ambient air monitoring network. The spatial boundary, San Jose, is in Santa Clara County. Within this boundary, pollutant gradients have been subjectively identified based upon proximity to known HAP emitters. These gradients will differ depending on the HAP.

The temporal condition is one year. Data are collected with the intent of providing an annual average. These averages are based on the collection of 24 hour samples collected once every 6-days.

Develop a Decision Rule

Given the objective to characterize sources of variability the most straightforward representation that both characterizes a major endpoint and separates out the magnitude of the distinct sources of variability (error) associated with that characterization, is the following equation which was described in an EPA technical report titled: *Data Quality Objective Guidance for the Ambient Air Toxics Characterization Pilot Study.*

$$Y(ijk) = \mu + \alpha(i) + \beta(j) + \gamma(ij) + \varepsilon(ijk)$$

(i.e., Measurement = Truth + Spatial Variability + Temporal Variability + Spatial-Temporal Interaction Variability + Sampling/Analytical Error)

Where Y(ijk) is the measured concentration, μ characterizes the major endpoint of concern (e.g., an area's true annual average), $\alpha(i)$ characterizes spatial variability, $\beta(j)$ characterizes temporal variability, $\gamma(ij)$ characterizes spatial-temporal interaction variability and $\varepsilon(ijk)$ characterizes sampling/analytical variability. The first three sources of variability can be considered as population variability while the last ($\varepsilon(ijk)$) can be considered measurement uncertainty. In addition, EPA's major concern with measurement error is those errors that do not affect all sites equally (i.e., systematic bias in one sampler) . Since the site will be operated by one field technician and samples of any particular pollutant will be sent to one laboratory, measurement errors effecting any particular site, sampler, or sample will be minimized. Therefore, the difference in concentration from each of the monitoring sites on any given day can be considered the spatial and temporal variability. However, each value will contain measurement uncertainty that must be minimized as well as quantified in order to separate it from the population variability.

Specify Tolerable Limits on Decision Errors

Since this study's objective is to characterize spatial and temporal variability, there are no intolerable limits on population variability. What is initially important is that the sampling site provides a true estimate of what it represents (boundary condition), therefore, the goal is to establish an adequate estimate of the boundary. EPA must feel comfortable that it will be able provide reasonable annual estimates of HAPs. Since "risk-based concentrations" have been established for some HAPs, the EPA planning team decided it was important to have an established and adequate level of confidence in concentrations that were reported at these levels.

The EPA planning team has established a baseline condition that can be found in detail in EPA's Quality Assurance Guidance Document/ Quality Assurance Project Plan for Air Toxics Monitoring Program 7.1.2.(6).

Optimize the Design

In order to achieve optimum design, EPA gathered preliminary information from other monitoring programs monitoring HAPS to provide some information on the total uncertainty (population +measurement). The goal was to reduce total uncertainty through an appropriate choice of sample design and data collection (sampling/analysis) techniques. Based upon the number of samples taken in the proposed design, EPA estimated total variability around the mean at the 95% confidence limits to be <20%. Based upon EPA's initial estimates of variability and the resources available to perform the study, a sampling frequency of every six days was used in order to determine the adequacy of an annual estimate (~60 samples).

A7.6 CSN PROGRAM

State the Problem

The CSN is a component of the National $PM_{2.5}$ monitoring network and the Air District performs sampling as part of its EPA $PM_{2.5}$ program at the San Jose Air Monitoring Site. The Air District also performs CSN-like monitoring through out the region with its own funds. All analysis is performed at EPA designated laboratories and procedures and methodologies are developed and implemented by EPA. The CSN is intended to complement the activities of the much larger gravimetric $PM_{2.5}$ measurements network component (whose goal is to establish if NAAQS standards are being attained). CSN data will not be used for attainment or nonattainment decisions. The programmatic objectives of the CSN network are

- Annual and seasonal spatial characterization of aerosols;
- Air quality trends analysis and tracking the progress of control programs;
- Compare the chemical speciation data set to data collected from the IMPROVE network; and,
- Development of emission control strategies.

Identify the Decision

Once data are evaluated by the EPA and the Air District, EPA will determine if the CSN should continue at the San Jose Air Monitoring site by making grant funds available. The Air District will determine if data provide adequate characterization of aerosols and allow for trends analysis and tracking of control strategies to continue the program at San Jose or other Air District locations. In addition, the Air District may evaluate whether additional locations need to be added to improve spatial and/or temporal understanding of $PM_{2.5}$ formation and deposition.

Identify the Inputs to the Decision

Inputs required for the decision of whether a plan for additional/reduction in the Air District CSN network are needed include:

- A monitoring plan that demonstrates the monitoring network meets appropriate sampling and analysis methods.
- Three years of 24-hour average monitoring data.

- Meteorological data collected within the Bay Area.
- $PM_{2.5}$ pollutants and precursors emission inventory trends over the last three years, and expected future emissions reductions, if any, due to current regulations.

Define the Study Boundaries

The study boundaries of the CSN monitoring program include the area bounded by nine Bay Area counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southwestern Solano, and southern Sonoma. The current air monitoring stations are listed in the Air District's Annual Monitoring Network Plan.

The EPA currently outlines the CSN sampling schedule through its $PM_{2.5}$ grant. For the Air District's San Jose location which is designated as an EPA site, the current schedule runs on an every sixth day schedule for carbon species and on an every third day schedule of all other species. For Air District locations that are not required to adhere to the EPA schedule by grant conditions, the Air District will evaluate whether resources allow sampling to occur on the same EPA schedule. If resources do not allow adherence to EPA's schedule, the Air District will sample every sixth day at a minimum to minimize potential bias associated with the day of the week and to match PM_{10} and $PM_{2.5}$ sample days.

Develop a Decision Rule

If the Air District is out of attainment with the $PM_{2.5}$ NAAQS, an understanding of the compounds involved and applicable atmospheric chemistry will enable the Air District to develop strategies to reduce $PM_{2.5}$ concentrations. The use of models is critical to these strategies and CSN data can be used in and compared with numerous models.

Use in and comparisons of CSN data with Air District $PM_{2.5}$ modeling will be the basis of proposing an increase or decrease in the number of sites using CSN protocols. The Air District Planning Division will provide input on whether data are adequate enough to use in and/or validate applicable models. The Technical Services Division will determine if it has adequate resources to provide requested data.

For CSN:

- If the most recent data for all monitoring sites show data are adequate to use in and/or validate existing models and there are enough resources to maintain the current network, no new plan is needed.
- If the most recent data are not adequate to use in and/or validate existing models in specific areas of the region, additional locations will be considered based on available resources and population exposure of the areas where the models and CSN data diverge.
- If the most recent data are adequate to use in and/or validate existing models or adequate resources are no longer available, the Air District may consider reducing the size of the network. In doing so, consideration will be given to maintaining sites that represent larger areas so that trends and model validations will be maintained.

Specify Tolerable Limits on the Decision Errors

EPA has published acceptable limits for CSN equipment operation in the $PM_{2.5}$ Speciation Trends Network Field Sampling QAPP. The Air District will adhere to these recommendations.

Optimize the Design for Obtaining Data

EPA chose the San Jose Air Monitoring Site based on parameters stated in the $PM_{2.5}$ Speciation Trends Network Field Sampling QAPP. CSN monitoring at Air District stations is intended to meet one or more of the following monitoring objectives:

- A determination of typical concentrations in areas of high population density.
- A determination of the accuracy of available models.
- A determination of the species contributing to $PM_{2.5}$ make up.
- A determination of impacts from significant sources.
- A determination of general background concentration levels.
- A determination of the extent of regional pollutant transport.

Population Oriented
As the primary purpose of air quality standards is to protect the public health, air monitoring stations have been placed in areas with high population density to determine the air pollution levels to which the majority of the population is exposed. To meet this objective, nine of the Air District's air monitoring stations are located in the largest city in each of the nine Bay Area counties and have PM measurements. The Air District Planning Division will provide input into which population areas would benefit from CSN sampling.

$PM_{2.5}$ Species
Samplers may be placed in areas without large populations if it is likely that the information provided by speciation will further the understanding of $PM_{2.5}$ formation and/or deposition.

Source Impact
With the exception of defined special studies, there are no CSN samplers in the Air District operating with the specific purpose of measuring impacts from sources. However, there are samplers that operate within a sphere of influence of major sources with the intent of measuring how the source impacts air quality over a larger area.

General Background
Background sites are generally located in areas that have no significant emissions from mobile, area, or industrial sources, and do not experience transport from other air basins. The Air District does not operate any CSN background sites.

Regional Transport
The Air District shares a common boundary with six other air districts: Monterey Bay Unified APCD, San Joaquin Valley APCD, Sacramento Metropolitan AQMD, Yolo-

Solano AQMD, Lake County AQMD, and Northern Sonoma County APCD. When upwind areas have significant air pollution sources, $PM_{2.5}$ transported into the Bay Area may result in overall higher air pollution levels in the Bay Area. The Air District operates monitoring stations near the borders of the Air District to determine how much of the air pollution is transported into and out of the Bay Area Air District. If these sites provide a better understanding of how other areas contribute to Bay Area $PM_{2.5}$ concentrations, CSN sampling may be conducted there.

Data Quality Objectives (DQOs)

If the following criteria are met, data will be considered of sufficient quantity and quality for use in determining the usefulness of any CSN location:

- Data are representative of the area for which they will be used.
- The quality control checks show that CSN samplers are operating within the quality control limits specified in Table B5-1. When CSN samplers are not operating within the specified quality control limits, data will be reviewed and corrected or invalidated as appropriate;
- Data completeness is 75% or better by calendar quarter;
- Data have been quality assured by Technical Services Division staff.

Once a DQO is established, the quality of data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (i.e., sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. The MQOs for the CSN monitoring program are listed below in Table A7-4:

Table A7-4. Measurement Quality Objectives for the CSN monitoring program.

Measurement	**Frequency**	**Acceptance Criteria (MQO)a**	**Corrective Action if Out of Specification**	**Samples or Channels**
Filter visual checks	before and after each exposure	free of visible defects	record in lab database and/or field data form; filter may be discarded prior to use; flagged or invalidated after use	all filter types
Temperature:				
check	monthly	+/-2 °C of a certified transfer standard	note on QC data form; troubleshoot; recalibrate sensor and conduct recheck; note on QC data form	all temperature sensors
audit	quarterly	+/-2 °C of **independent standard**	note on data form; recalibrate sensor and conduct recheck	all temperature sensors
Pressure:				
check	monthly	+/-10 mmHg vs. certified transfer standard	note on data form; recalibrate sensor and conduct recheck	barometric pressure sensor
audit	quarterly	+/-10 mmHg vs. **independent certified** transfer standard	note on data form; recalibrate sensor and conduct recheck	barometric pressure sensor
Flow rate:				
one-point operational check	monthly	+/-10 percent of working standard	troubleshoot (e.g., perform leak check)	all flow channels
one-point audit	quarterly	+/-10 percent vs. **independent transfer** standard	same as above	all flow channels

A7.7 NON-CRITERIA GASEOUS PROGRAM

Ambient noncriteria gasses include Nitric Oxide (NO), Methane (CH_4), Nonmethane Hydrocarbons (NMHC - the collective name for all non-methane, hydrogen-carbon compound gasses), and Hydrogen Sulfide (H_2S). Ambient concentrations of these gasses are measured by the Technical Division using continuous monitors and fall under the jurisdiction of this Quality Assurance Program Plan. The Air District's Planning Division is the primary consumer of nitric oxide, methane, and nonmethane hydrocarbon data and is responsible for photochemical analysis, modeling, and Air District ozone attainment plans. Hydrogen sulfide data are used by the Planning Department to determine if the State ambient standard is met, and by the Air District's Enforcement Division to determine if permitted facilities have exceeded allowed emission limits.

State the Problem

Ozone (O_3) is a naturally occurring gas in the atmosphere that becomes a public health problem when concentrations exceed national and State ozone air quality standards and may cause human respiratory problems or deterioration in plants or manmade materials. Exceedances occur when oxides of nitrogen (NO_x) and Volatile Organic Compound (VOC) precursor gas concentrations exist in the right balance and composition during meteorological conditions favoring photochemical ozone formation. The Air District measures ambient NO and NMHC because they are major components of NOx and VOC gasses, respectively, and provide staff with useful modeling data for developing strategies to reduce peak ozone concentrations. NO and NMHC are emitted into the atmosphere primarily from sources such as combustion (industrial and transportation) and industrial processes such as dry cleaning and refining.

Methane (CH_4) is measured as a byproduct of NMHC measurements and is not relevant to the goals and objectives of this Quality Assurance Project Plan. However, at concentrations measured in the Bay Area, methane is of some interest in climate change assessments. Therefore, methane concentrations are reported along with NMHC concentrations measured with the same instrument.

Hydrogen Sulfide (H_2S) is a naturally occurring gas in the atmosphere that becomes a nuisance "rotten egg" odor at low concentrations and a public health problem when concentrations exceed State or Air District H_2S air quality standards. At or above the standards, hydrogen sulfide can cause coughing and throat irritation, and more acute respiratory irritations or even death at higher concentrations depending on the exposure duration. Natural hydrogen sulfide sources include bacterial processes in swamps, volcanic gasses, and natural hydrocarbon seeps. Man-made sources include refineries, bacterial action in sewers and water treatment facilities, and water, gas, or oil wells.

Identify the Decision

NO and NMHC are important precursor gasses that contribute to photochemical formation of ozone. These ambient concentration data are used to model ozone exceedances of the State and National Air Quality Standards and to determine if:

- a plan to further reduce gas emissions is needed;
- changes in the NO and NMHC monitoring networks are needed;
- improved photochemical modeling results are needed to better understand photochemical formation of ozone.

Methane is typically measured along with NMHC. At the high concentrations typically measured in the Bay Area, methane is a minor factor in ozone modeling analysis. No decisions are based on methane concentration data.

Ambient hydrogen sulfide concentrations are measured near sources at locations where maximum pollutant concentrations are expected in or near populated areas. These data are used to determine whether the Air District is attaining the State and Air District air quality standards and adequately protecting health. The monitored air quality data will also be used to decide if the public should be notified of an air pollution health advisory, alert, warning, or emergency.

The state and local H_2S air quality standards are based upon the threshold at which most people can detect the 'rotten egg' odor and first adopted in 1969 under the 1967 Mulford-Carrell Air Resources Act. These regulations were adopted to control nuisance odors at threshold concentrations, and prevent acute health consequences (or even death) at higher levels.

Identify the Inputs to the Decision

Inputs required for NO and NMHC decisions include:

- Air District ozone attainment status;
- Existing NO and NMHC monitoring networks;
- Locations and emission levels of precursor gas sources;
- Meteorological and geographic data;
- Photochemical modeling performance predicting ozone exceedance events.
- Inputs required for source-oriented hydrogen sulfide decisions include:
- The exceedance history of potential emission sources;
- The type of emission sources monitored;
- The existing hydrogen sulfide sampling network;
- Local meteorological data collected near the emission source;
- The exposure of populations near the source.

Define the Study Boundaries

The NO and NMHC study area includes the entire Air District. Current monitoring locations are listed in the Air District's Annual Monitoring Network Plan. Because State and National ozone air quality standards are based on 1-hour averages and most modeling input data are available at this averaging interval, ambient NO and NMHC concentrations are also

measured in this manner. The Air District monitors ozone and precursor gas NO and NMHC concentrations continuously throughout the year.

Ambient hydrogen sulfide concentrations are measured within Air District boundaries in close proximity to emission sources adjacent to or within populated areas where public health impacts are most likely. State hydrogen sulfide air quality standards are based on a 1-hour average and Air District standards are based on rolling 3-minute and 60-minute averages, so hydrogen sulfide concentrations are measured continuously as 1-minute averages throughout the year.

Develop a Decision Rule

If photochemical modeling results show that ozone exceedance events could be reduced through reductions in NO and/or NMHC precursor gas concentrations, then the Air District will need a plan to reduce these gas emissions. If the NO and/or NMHC monitoring networks do not adequately measure representative concentrations to meet ozone photochemical modeling performance standards, then adjustment to the monitoring networks are required.

If the average hydrogen sulfide concentration for one hour exceeds 0.03 ppm, the State hydrogen sulfide air quality standard has been exceeded. If the 1-minute hydrogen sulfide concentration averaged over any 60 consecutive minutes exceeds 0.030 ppm, or averaged over any 3 consecutive minutes exceeds 0.060 ppm, the Air District Regulation 9, Rule 2 Limit has been exceeded and a Violation Notice (VN) will be issued against the source facility.

Specify Tolerable Limits on the Decision Errors

Unlike criteria pollutant measurements used to determine attainment of air quality standards, NO and NMHC have no numeric decision thresholds. These ozone precursor gas concentrations are measured specifically to analyze ozone exceedances using EPA photochemical models. The model results are then used to develop strategies to control (reduce) ozone exceedances to attain state and national air quality standards. Part of a control strategy may include reductions in NO and NMHC source emissions.

Ozone modeling performance is very sensitive to ozone data quality, and much less sensitive to precursor gas model inputs such as NO and NMHC. Modelers have indicated that precision check and bias tolerances to within 10% for NO and 15% for NMHC is adequate for ozone modeling purposes and evaluation of possible emission reduction plans.

The California ARB has not rigorously evaluated statistical hydrogen sulfide Decision Errors concerning Data Quality Requirements for attainment of the 1-hour, 0.03 ppm state ambient air quality standard. Instead, California specifies Measurement Quality Objectives in the Volume I of the ARB Air Monitoring Quality Assurance document, Section 1.0.4.2 (9c), supported by further analysis. The objectives state that monitor performance must be within 10% of true values and data are not corrected until errors exceed 15% - a possible precision error of 4.5 ppb. The state 1-hour H_2S standard is exceeded when concentrations of 35 ppb or higher

are measured, just slightly higher than the nominal 30 ppb standard plus the allowed 4.5 ppb error.

The Air District also has not rigorously evaluated statistical hydrogen sulfide Decision Errors with regard to local ambient air quality standards. Instead, the Air District specifies that monitor performance must be within 10% of true values, allowing for a 3 ppb error and a decision threshold of 33 ppb for the 60-minute average. Similarly, a 6 ppb error and a decision threshold of 66 ppb is allowed for the 3-minute average. In keeping with these thresholds that account for Decision Errors, the Air District has established Tolerance Limits for determining exceedances of the standards outlined in a Division management policy memo dated Dec 16, 1997. The memo states that 1-hour exceedances up to 0.035 ppm and 3-minute exceedances up to 0.070 ppm are considered marginal. Both of these limits are higher than the thresholds-based monitor performance errors. Higher concentration levels are considered enforceable violations of the Air District H_2S standard as specified in Bay Area AQMD Regulation 9, Rule 2 (9-2-301).

The Air District targets for acceptable measurement uncertainties for NO and H_2S are ≤10% at the 90% confidence interval for coefficient of variation, and ≤10% at the 95% confidence interval for absolute bias. For NMHC and methane, acceptable measurement uncertainties are ≤15% at the 90% confidence interval for coefficient of variation, and ≤15% at the 95% confidence interval for absolute bias.

Optimize the Design for Obtaining Data

Ambient nitric oxide concentrations are measured at approximately 15 air quality monitoring stations in the district where nitrogen dioxide and ozone criteria gas concentrations are also measured. Since there are no health-related monitoring objectives for NO, the network design is based on the need to measure concentrations on a neighborhood or larger scale as ozone photochemical modeling inputs. By necessity, NO concentration is automatically measured wherever NO_2 data are collected, so an extensive monitoring network is active by default in urbanized locations where the largest concentrations of NO precursor gas emissions are located. Atmospheric modeling staff indicate that current NO network measurements are adequate for use in ozone exceedance modeling.

NMHC concentrations are measured in five urban locations where sources from transportation and industrial sources are concentrated or where ozone exceedances have been recorded (see the Annual Network Monitoring Plan for details). Hydrocarbon measurements are more expensive that other types of gaseous monitoring and generally have higher precision and bias limits. HC species vary in reactivity, so measuring the different HC concentrations is useful for modeling ozone exceedances. While NMHC is measured every hour, gas canister samples are periodically analyzed in a laboratory to further characterize NMHC concentration data. If staff time and funding become available, enhanced HC measurements using field gas chromatograph instruments can provide additional information on transport and photochemical reactions. Until that time, atmospheric modeling staff indicate that current continuous NMHC network measurements are adequate for use in ozone exceedance modeling.

Hydrogen sulfide monitors are located at expected maximum concentration locations near sources where population exposure poses a health risk. Measurement sites are not always downwind from sources as some of the highest concentrations are often recorded during light-winded reversals of typical prevailing winds. Location of H_2S monitors are periodically reviewed as emission volumes and locations change, and as populations near emission sources change.

Consult the Air District Annual Network Monitoring Plan for specific details on each NO, NMHC, and H_2S measurement site located within the study boundary.

Data Quality Objectives

If the following criteria are met, data will be considered of sufficient quantity and quality for use in determining the Bay Area's attainment status for the State H_2S AQS or any other Air District use:

- Data are representative of the area for which it will be used.
- The quality control checks show that the gaseous noncriteria pollutant monitors are operating within the quality control limits specified in Table B5-1. When the gaseous criteria pollutant monitors are not operating within the specified quality control limits, data will be reviewed and corrected or invalidated as appropriate;
- Data completeness is 85% or better by calendar quarter;
- Data have been quality assured by Technical Services Division staff.

Once a DQO is established, the quality of data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (i.e., sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. The MQOs for the gaseous noncriteria pollutant monitoring program are listed below in Table A7-5:

Table A7-5. Measurement Quality Objectives for gaseous noncriteria pollutants.

Gaseous Noncriteria Pollutant	Reporting Units	Precision (CV)*	Accuracy (Absolute Bias)	Representativeness	Comparability/ Method Selection	Completeness	Minimum Detection Limits
Nitric Oxide	ppb	≤ 10% at the 90 % CI	≤ 10% at the 95 % CI	Neighborhood, Urban, and/or Regional Scale	FRM or FEM	85% by Quarter	1 ppb
Methane	ppb	≤ 15% at the 90 % CI	≤ 15% at the 95 % CI	Neighborhood, Urban and/or Regional Scale	FRM or FEM	85% by Quarter	1 ppb
Nonmethane hydrocarbons	ppb	≤ 15% at the 90 % CI	≤ 15% at the 95 % CI	Neighborhood, Urban, and/or Regional Scale	FRM or FEM	85% by Quarter	1 ppb
Hydrogen Sulfide	ppb	≤ 10% at the 90 % CI	≤ 10% at the 95 % CI	Micro and/or Middle Scale	FRM or FEM	85% by Quarter	1 ppb

A7.8 TOXICS PROGRAM

State the Problem

The problem is to determine if ambient air levels of certain Hazardous Air Pollutants (HAPS) in the Bay Area are at concentrations which could increase health risk to humans. Beginning in 1986 the BAAQMD Ambient Air Toxics Program was developed to measure certain HAPS in order to:

- Characterize ambient concentrations and deposition in representative monitoring areas;
- Provide data to support and evaluate dispersion and deposition models, and;
- Establish trends and evaluate effectiveness of HAP reduction strategies.

BAAQMD must determine the appropriate tradeoffs (i.e., quality, quantity, instrument sensitivity, precision, bias) to produce the desired results within resource constraints. These tradeoffs will be documented in order to help the BAAQMD determine the best monitoring design within budgets and data quality constraints.

Identify the Decision

The primary question that will be answered by the Air District's toxic pollutant monitoring program is whether the enforcement of many strategies adopted by BAAQMD in order to reduce HAPS in ambient are obtaining the desired results. By evaluating the current measurements and the trends, the decision then becomes whether a plan for additional reductions of HAPS is practical for the Bay Area.

Identify the Inputs to the Decision

For this study the important inputs are:

- The actual 24-hour concentration estimates of HAPS;
- Measurements of overall precision and bias to quantify the source of measurement error,
- The location information of each sampling site (latitude and longitude);
- A review of the emission inventory indicates that there are a number of pollutants being generated within the city that are of concern;
- Meteorological data (i.e., wind rose information);
- Technical staff expertise in development of ambient air monitoring networks for HAPS
- Sampling instruments that can meet EPA requirements for sampling time, contamination, precision, durability, and ease of use;
- Analytical instruments and methods that can meet EPA requirements for, contamination, detectability, repeatability, and bias.

Define the Study Boundaries

The study boundaries of the BAAQMD Ambient Toxics program include the area bounded by nine Bay Area counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southwestern Solano, and southern Sonoma. The current air monitoring stations are listed in the Air District's Annual Monitoring Network Plan.

The temporal condition is ongoing. Data are collected with the intent of providing an annual average. These averages are based on the collection of 24 hour samples collected once every 12 days.

Develop a Decision Rule

The primary usage of data obtained as part of the toxics program is trend analysis. As such, the study is ongoing.

State of California Office of Environment Health Hazard Assessment (OEHHA) assigns health risk values associated with exposure to potentially toxic compounds. The BAAQMD utilize these values along with accepted methodologies to determine risk associated with concentrations of these compounds in ambient air. If the individual concentrations of compounds measured as part of this program are above the OEHHA risk factors of 1 in million, or above 10 in a million for all compounds measured, or above 100 in a million for the combined risk of all quantifiable air contaminants, then the BAAQMD will implement Federal, state and local regulatory programs to reduce the concentrations of compounds below these thresholds.

Specify Tolerable Limits on the Decision Errors

The tolerable limits are set by the accuracy of the analytical method. The sampling and analytical TO-15 methodologies are complex and concentrations are typically low compared to analytical detection limits. As a result, the BAAQMD has set error limits at +/-30% for each compound of interest, which is typical for ambient air results. Since data are primarily used for risk assessments that frequently have associated errors of orders of magnitude, accuracies of +/-30% are well within an acceptable range.

Optimize the Design for Obtaining Data

Ambient air monitoring at Air District stations is intended to meet one or more of the following monitoring objectives:

- A determination of typical concentrations in areas of high population density;
- A determination of impacts from significant sources;
- A determination of general background concentration levels.

Based upon estimates of variability and the resources available to perform the study, a sampling frequency of every twelve days was used in order to determine the adequacy of an annual estimate (~30 samples per station, and as many as 600 samples per year overall).

Data Quality Objectives

If the following criteria are met, data will be considered of sufficient quantity and quality for use in developing trends and aiding in the determination of risk:

- Data are representative of the area for which it will be used;
- The quality control checks show that the toxics compound samplers are operating properly as determined by Technical Division staff;

- Data completeness is 75% or better by calendar quarter;
- Collocated precision for all compounds is +/- 30%;
- Replicate precision for all compounds is +/- 10% (at 5 times the MDL);
- MDLs are sufficiently low to assess cancer risk contributions;
- Data have been quality assured by Technical Services Division staff.

Once a DQO is established, the quality of data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (i.e., sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. For the toxics program, instrumentation limits the MDLs that can be achieved, and therefore the accuracy of risk evaluation for toxics compounds measured. The Air District strives to achieve the lowest MDLs possible for all compounds with the equipment on hand, since lowering all MDLs does not require significant effort compared to lowering an MDL for a single compound. As resources allow, instrumentation will be considered for purchase that will provide the means to lower all MDLs to quantify risk at or below 1 and 10 in a million as described earlier in this section. The MDLs required to meet the 1 and 10 in a million levels discussed previously are calculated based on available OEHHA unit risk factors and will be reviewed and updated along with other portions of this QAPP on a regular basis. Additional compounds will also be considered for inclusion into the program, based on data user needs and the ability to provide the additional information as part of the TO-15 analysis.

MDL requirements based on current OEHHA unit risk factors are listed below in Table A7-6 along with current laboratory MDLs and typical measurement results. The first six compounds in the table have measurement MDLs below the 1-in-a-million MDL risk requirement, and meet all detection DQOs. 1,1,2-trichlorotrifluoroethane, benzene, carbon tetrachloride, and formaldehyde all have measurement MDLs above one or both of the risk MDLs, but are regularly measured and so provide reliable risk assessment contributions as well. Vinyl chloride and acrylonitrile MDLs are above the OEHHA detection objectives and are consistently undetected. However, regional concentrations of these compounds are known to be very low and so is the cancer risk contribution. The last compound on the list is 1,3 butadiene with a measurement MDL well above OEHHA objectives. The laboratory occasionally measures concentrations above the MDL, so this compound represents the largest unquantified cancer risk above the single-compound OEHHA measurement requirements. The Air District is installing new laboratory equipment to lower the 1,3 butadiene measurement MDL in accordance with our DQOs.

Table A7-6. MQOs for toxics represented by MDLs and Cancer Risk.

Air Toxic Compound	Current MDL ($\mu g/m^3$)	Typical Bay Area detection*	OEHHA Unit Risk Factor $(\mu g/m^3)^{-1}$	Required MDL to Meet 10 in a Million Risk ($\mu g/m^3$)	Required MDL to Meet 1 in a Million Risk ($\mu g/m^3$)
methylene chloride	0.35	often	1.00E-06	10	1.0
trichloroethylene	0.05	sometimes	2.00E-06	5.0	0.50
ethylbenzene	0.17	often	2.50E-06	4.0	0.40
acetaldehyde	0.03	often	2.70E-06	3.70	0.37
chloroform	0.05	sometimes	5.30E-06	1.89	0.19
perchloroethylene	0.03	often	5.90E-06	1.69	0.17
1,1,2-trichlorotrifluoroethane	0.08	often	1.50E-05	0.67	0.067
benzene	0.06	often	2.90E-05	0.34	0.034
carbon tetrachloride	0.06	often	4.20E-05	0.24	0.024
vinyl chloride	0.26	never	7.80E-05	0.13	0.013
1,3 butadiene	0.11	sometimes	1.70E-04	0.059	0.0059
acrylonitrile	0.41	never	2.90E-04	0.034	0.0034
formaldehyde	0.10	often	2.10E-02	0.0005	0.00005

* Frequency of concentration measurements reported above the MDL for Air Toxics samples collected throughout the Bay Area Air District.

A7.9 METEOROLOGICAL PROGRAM

Stating the Problem

Meteorological data are needed in many Air District programs. Technical Services use these data when making daily air quality forecasts, as well as post-analyses of air pollution episodes; Planning Division use these data for regional ozone and particulate modeling; and Engineering Division use these data for source modeling. Each of these uses may require different variables to be measured, or upper air data as well as surface data, or data from multiple sites. All require reasonable data accuracy. Consequently, the Air District's meteorological program has been designed to meet the needs of all of the above programs.

Identifying the Decision

Meteorological data are used daily by forecasters to make decisions about expected air quality levels. Forecasters review historical meteorological and air quality data to determine relationships. Then, using these relationships, the forecaster extrapolates current and future meteorological conditions into future air quality levels. For these decision makers, the decision becomes which meteorological variables are highly correlated with air quality concentrations, and at what levels will the variables indicate the potential for unhealthy air.

Modelers normally use worst case meteorological conditions in air quality modeling applications to determine emission limits of sources. Worst case meteorological conditions are usually found on days with the highest ambient pollution levels, or determined by modeling various combinations of meteorological inputs and selecting those that produce the highest concentrations. Once worst case meteorology is agreed upon, decision makers can run the

models to determine the effects of emission reductions or emission increases on ambient air quality levels. Model results are then compared with the applicable NAAQS, or cancer risk levels, or PSD increments to decide if the permit should be granted or if new regulations are needed to meet the applicable NAAQS.

Identify the Inputs to the Decision

When an air quality forecast is to be the decision, inputs are historical air quality, temperature, and wind data from Air District sites; current air quality, temperature, and wind data from Air District sites; and forecasted temperatures, an atmospheric dispersion parameter, and winds from models from other sources. These sources include the National Weather Service, US Navy, European Center for Medium range Weather Forecasting, and California and Nevada Smoke and Air Committee (CANSAC).

Inputs needed for the modeling include source emissions, wind and temperature fields, an estimate of atmospheric dispersion or turbulence, background pollutant levels, transported pollutant levels, and chemical reaction rates. These inputs do not lead to the decision directly, but provide input to models used to predict possible future outcomes.

Define the Study Boundaries

Meteorological data need to be collected in all parts of the Bay Area. For large-scale modeling, meteorological data are needed in valleys, elevated sites, transport areas, and areas of expected high concentrations. For source modeling, meteorological data are needed near facilities to be modeled. For forecasting, meteorological data are needed at areas that show the low-level air flow, upper-level air flow, and high pollution areas.

Meteorological variables must be measured 365 days per year, 24 hours per day. The current need for modelers and forecasters is hourly-averaged meteorological data, so hourly meteorological data will be archived.

Develop a Decision Rule

The decision rule for the use of meteorological data by other programs is: if the meteorological data are determined to be valid and complete, and if the meteorological data are representative for that use, then data may be used for that program application.

Specify Tolerable Limits on the Decision Errors

Meteorological data collected by the Air District is used for the most part as an input to regulatory modeling and forecasting programs. The purpose of these programs is to quantify the effects of meteorology and emissions on ambient air pollution levels. Because it is an input to other Air District programs, meteorological data collection has no regulatory decisions to be made. The only issues for meteorological data collection are whether data are representative of the domain of interest, and whether data are sufficiently accurate. Due to cost constraints, the Air District does not perform precision checks, which would require setting up and operating a second set of sensors next to the primary sensors for multiple hours on a regular schedule.

Consequently, statistics on bias and precision can not be computed. The accuracy of data are ensured by comparing each sensor against a sensor standard, on site, four times per year. Sensors that do not meet the measurement accuracies recommended by EPA in the document Meteorological *Monitoring Guidance for Regulatory Modeling Applications, February 2000* are re-calibrated or replaced. Data are reviewed daily using software that checks for out of range values, missing data, constant values, and an excessive rate of change. By providing very accurate meteorological data for input to the other programs, decision-making errors for those programs will be reduced.

Optimize the Design for Obtaining Data

Meteorological monitoring locations are selected based on the intended uses of the data sets. Sites chosen for air quality forecasting are located in areas that show the general wind and temperature patterns within the Air District. Photochemical modeling sites are chosen to show boundary conditions, general conditions, and upper air measurements. Source modeling sites are chosen to be representative of the source and receptor domain to be modeled. Sites used for data analysis are usually located near high pollution areas to collect data used to determine the trajectories between sources areas and downwind high concentration area, as well as the general atmospheric conditions occurring during the episodes.

Technical Services has concluded that 30 – 50 meteorological sites are adequate to characterize the low-level temperature and wind patterns in the Bay Area. About half of these will be operated and maintained by the Air District. Other meteorological data that the Air District receives comes from airports, refineries, sewage treatment plants, universities, and private companies. Upper-level meteorological data comes from the National Weather Service's vertical sounding site in Oakland which measures winds and temperature twice a day using a tracking device carried aloft by a balloon. Additionally, the Air District also receives data from two vertical profilers that measure winds and temperature on an hourly basis up to heights of 3500 meters; one site is operated by NOAA in Livermore, and the other in Denverton by CARB. New meteorological sites may be added for special studies, or as new air monitoring stations are added to the Air District network.

Data Quality Objectives

If the following criteria are met, data will be considered of sufficient quantity and quality for use in modeling or any other use:

- Data are representative of the area for which it will be used. This decision is usually made in consultation with Air District meteorologists and modelers;
- The quarterly calibrations/audits show that the sensors are operating within EPA specifications. When sensors are not operating with specifications, data will be reviewed and edited, and sometimes invalidated, as needed;
- Data completeness is 90% or better by calendar quarter;
- Data have been quality assured by Planning Division staff, in the case of District operated sites, or Technical Division staff in the case of non-District operated sites.

Once a DQO is established, the quality of data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (i.e., sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. The MQOs for the meteorological program are listed below in Table A7-7.

Table A7-7. Measurement Quality Objectives for the meteorological program.

Meteorological Parameter	Reporting Units	Precision (CV)[1]	Accuracy	Representativeness	Comparability/ Method Selection	Completeness	Detectability
Wind Speed	m/s	N/A	±0.2 m/s +5% obs	Micro, Middle, and/or Neighborhood Scale		90% by Quarter	0.1 m/s
Wind Direction	Degrees	N/A	±5 deg	Micro, Middle, and/or Neighborhood Scale		90% by Quarter	1.0 deg
Temperature	°C	N/A	±0.5°C	Micro, Middle, and/or Neighborhood Scale		90% by Quarter	0.1 °C
Dew Pt Temperature	°C	N/A	±1.5°C	Micro, Middle, and/or Neighborhood Scale		90% by Quarter	0.1 °C
Precipitation	Inches	N/A	±10% of observed	Micro, Middle, and/or Neighborhood Scale		90% by Quarter	0.01 inches
Pressure	Millibars	N/A	±0.5 mb	Micro, Middle, and/or Neighborhood Scale		90% by Quarter	0.2 mb
Solar Radiation	W/m^3	N/A	±5% of observed	Micro, Middle, and/or Neighborhood Scale		90% by Quarter	10 W/m^2

[1] Precision data are not measured for meteorological variables. Two calibrations and two audits are performed annually at each site.

A8. STAFF TRAINING AND CERTIFICATION

The Technical Services Division staff typically require some specialized training that depends on particular job duties. **Table A8-1** indicates the minimum qualifications for the position, and possible specialized training or certification after hiring.

Table A8-1. Staff positions requiring specialized training or certifications.

Position	Minimum Job Qualifications	Useful Specialized Training or Certifications
Air Quality Technical Assistant	California Drivers License	APTI Course SI-422: Air Pollution Control Orientation Course
Air Quality Instrument Specialist I/II/Senior/Supervisor	AA Electronics	APTI Course 435: Atmospheric Sampling APTI Course SI-409: Basic Air Pollution Meteorology (Meteorology and Quality Assurance Section) Monitoring equipment training by manufacturers and ARB ARB Air Monitoring Technical Advisory Committee (AMTAC) meetings EPA and Air and Waste Management Association (AWMA) conferences Repair and maintenance of meteorological and ambient air quality equipment in-house training
Air Quality Chemist I/II	BS Chemistry	Laboratory equipment training by manufacturers McCrone Research Institute: Course in Identification of Asbestos Fibers
Air Quality Meteorologist I/II/Senior	BS Meteorology	APTI Course SI-409: Basic Air Pollution Meteorology AQS data input and report generation training Air Pollution forecast training
Principal and Senior Air Quality Chemist	BS Chemistry	Laboratory equipment training by manufacturers McCrone Research Institute: Course in Identification of Asbestos Fibers

The Air District has recruitment and screening procedures to ensure that station operators; auditors; chemists; and senior, principal, and supervisory level staff and managers have the required experience and qualifications. Most of the people hired to be air quality instrument technicians have little to no experience in the field and must be trained by in-house staff because the number of experienced technicians is small. As part of the hiring process, the Air District specifies that all applicants must have electronics knowledge, problem solving

abilities, and at least the equivalent of an AA degree in a technical field. Detailed information about job descriptions is provided in the QMP. Procedures for filling positions are contained in the Memorandum of Understanding between the Bay Area Air Quality Management District and the Bay Area Air Quality Management District Employees' Association, Inc. (January 2006) for non-management positions and the Bay Area Air Quality Management District Administrative Code (October 2004) for management positions.

All employees complete on-the-job training before they are allowed to independently perform required duties. Prior to installation of new instruments in the field or the laboratory, staff attend manufacturer provided training sessions typically arranged by the managers when purchasing the new instruments. In these sessions, technical support staff familiarize the operators with the function, maintenance, and troubleshooting of the new equipment. Managers may require that staff members attend these sessions. Information from these sessions is incorporated into subsequent SOPs and guidance. Prior to installation of new instruments by meteorological technicians, staff set up test equipment that is checked by the MQA Manager and the Principal Air and Meteorological Monitoring Specialist.

All laboratory analysts are routinely tested to evaluate their proficiency and to ensure reliable analytical data. The tests may include procedural reviews, analysis of reference materials, blanks and previously tested samples, or participation in inter-laboratory testing programs. The results of all quality assurance analyses, including corrective action are documented in the SOPs in **Appendix A**.

The Air District makes available and encourages training through EPA, ARB, and manufacturer's courses. In addition, the Air District offers reimbursement to employees who attend outside courses related to performance of their duties. The program manager is responsible for assuring that training policies are enforced. Records related to these courses are maintained by the Air District's Human Resources Office for the duration of an employee's tenure at the Air District. The manager for each section is responsible for ensuring that training policies are enforced.

A9. DOCUMENTATION AND RECORDS

A9.1 QUALITY DOCUMENTATION

The Technical Services Division quality system includes the QMP, this QAPP, SOPs, and Air District policy directives from management.

Quality Management Plan (QMP): The QMP describes the quality system; identifies staff and managers responsible for quality assurance; describes their responsibilities, qualifications, and training; and describes how the system produces quality data including project management responsibilities, data generation and acquisition, assessment and oversight, and data validation and usability.

Quality Assurance Project Plan (QAPP): The Air Monitoring QAPP documents the planning, implementation, and assessment of data using effective methodologies and thorough QA/QC activities that groups within the Technical Services Division conduct to ensure that data monitoring objectives are met.

The QMP shall undergo annual, informal reviews by the Quality Assurance Officer and Division Management to correct discrepancies and modify the document to reflect changes in Division organization, management, and responsibilities. Each Program Manager is primarily responsible for maintaining current QAPP content for programs that they manage. Every 5 years, the QAPP shall undergo a comprehensive, formal review by the QA Officer and Management to determine if the document is fulfilling its function and determine if any major QAPP changes are needed. All QAPP changes resulting from the formal review shall be completed with the following 12 months.

Standard operating procedures (SOPs): SOPs document how a project is to be carried out, ensure consistent results over time and through staff turnovers, and ensure compliance with EPA and ARB regulations. If an SOP does not exist for a particular procedure, a new procedure is developed using the Admin SOP 002 Template as a guidance document. SOPs that undergo revision will also follow SOP 002 guidance. All older SOPs not following the SOP 002 format will eventually be revised into the new format. The Template is designed to include all possible aspects of an SOP, prompting the author to take a comprehensive, structured approach to the procedure. Template topics that do not apply will be briefly noted.

SOPs are procedural guides that apply to Division Program activities across a specific range of workplaces and equipment. They are intended to provide consistent results when followed by multiple staff members executing the same procedure, and by new staff. Division staff using SOPs must have the equipment familiarity, training, and experience required to execute the procedure. SOPs are intended as procedural guidelines or checklists that are not overly detailed. For example, parts of SOPs that are explicitly covered in the equipment Owners Manuals should be included by reference and not copied verbatim into the SOP. At the other extreme, SOPs must be complete enough to prevent variation in the desired procedure results.

All SOPs shall undergo annual, informal reviews for technical content correctness by the Program (Section) Manager in charge of the SOP. The QA Officer will also review the SOP for relevancy and format. Every 5 years, all SOPs shall undergo comprehensive, formal reviews by the QA Officer and Management along with the QAPP reviews to determine if the SOPs are collectively fulfilling all standard operating procedure documentation needs. Any gaps or duplication in SOP coverage identified during the formal review process shall be corrected within the following 12 months.

As part of the 5-year comprehensive QAPP/SOP reviews, senior staff are responsible for evaluating program data quality and altering or establishing new policy objectives concerning quality assurance activities. These changes shall be incorporated into Quality System documents and distributed to all System subscribers during the next notification cycle.

Policy Directives: Policy directives are memos (emails) from management to staff concerning management of internal staff activities. Directives might concern things like staff time management priorities, optional staff activities (time permitting), informal task deadlines, exploratory equipment evaluations, etc. Policy directives are not technically part of the Quality System, but may be utilized to manage Quality System related work. Section Managers may request that the QA Officer include selected Policy Directives as part of the non-public document management available to staff.

A9.2 DOCUMENT TRACKING AND DISTRIBUTION

The official version of the Technical Division Quality System documentation is published on the Air District web site. The Quality System documentation includes the current versions of the QMP, QAPP, and SOPs. Quality System users are encouraged to access these documents electronically and avoid using paper copies that may be dated.

The Quality Assurance Officer maintains Quality System documentation and a file archive on an Air District network file server. Documentation includes 5-year and annual reviews, revisions numbers, approvals, original files, user notifications, and past documents superseded by revision. All documentation is accessible by Technical Division staff. During the final year of a 5-year review cycle, the QA officer shall notify Section Managers and the Director of the review requirement, and coordinate a document review. Likewise, the Officer shall notify each Manager of SOPs that require annual reviews before the year is out. Any SOP that has been revised within the past year will not require further review.

The QMP, QAPP, and SOPs are living documents that are continually revised to improve the Quality System and respond to Program changes. Revisions (and new SOPs) are undertaken by, or under the direction of, the responsible Program or Section manager. Revisions always start with the document used to generate the published web document. After changes are made and approved by the Manager, the QA officer will update the revision number, generate a web document for digital signatures, and publish the document on the web page during the next Quality System notification sent to the Distribution List (see Section A3). Records of all notifications are maintained as part of the Quality System.

QMP/QAPP sections and SOPs are tracked using a unique revision number and date. All Quality System documentation revisions are tracked and documented by the Quality Assurance Officer and become a part of the Quality System. Old versions of revised documents, as well as review/revision documentation itself will be retained according to the Air District Records Retention Policy. The specific procedure used to change Quality System documentation is documented in Admin SOP 001 Quality Document Changes. In general, minor changes are made to Quality System documentation by the Quality Assurance Officer after informal (email) concurrence by Division management. Major changes require that a document is reissued under new Division signatures. All changes to SOPs are typically signed off by the responsible Program Manager and the Quality Assurance Officer.

The QA Officer maintains the Distribution List as an e-mail (and/or FAX) distribution list of all staff members and other stakeholders who require access to these documents. A template for this list is included at the beginning of the QAPP. The actual list will be maintained privately by the QA Officer to protect those recipients that wish to remain anonymous. When the QMP, QAPP, or an SOP is revised, an e-mail note (or FAX) is sent to the distribution list that specifies the revised document, briefly summarizes the revision, and instructs staff members who have printed a paper copy of the document to recycle the printed copy.

A9.3 DOCUMENT RETENTION

The storage and retention of documents and records are subject to the Air District Records Retention Policy. In general, documents and records produced by each Division in the course of its work are stored and controlled by that Division. Similarly, documents and records produced by each Section in the course of its work are stored and controlled by that Section.

Table A9-1 lists the retention period and disposition for documents and records related to the collection, handling, analysis, auditing, assessment, management, and reporting of ambient air monitoring data.

All air quality data and related precision and accuracy data produced by the Air District are stored in databases on file servers that are backed up daily. In addition, these data are loaded into EPA's AQS database.

Table A9-1. Ambient air monitoring records retention period and disposition.

Record Type	Retention Period	Disposition/Notes
Air Monitoring		
Ambient Air Monitoring Data – Strip Charts	5 yrs.	Delete
Ambient Air Monitoring Data – Data Logger Data	Permanent	None
Ground Level Monitoring Data	Permanent	None
Ground Level Monitoring Audit Reports	Permanent	None
Calibration Records	5 yrs.	Delete
Equipment Location Forms	3 yrs.	Delete
Instrument Log Books	Life of equipment + 5 yrs.	Delete

Record Type	Retention Period	Disposition/Notes
$PM_{2.5}$ Filters	3 yrs.	Delete
PM_{10} Filters and Envelopes	5 yrs.	Delete
QA/QC Records	3 yrs.	Delete
Station Log Books	5 yrs.	Delete
Work Orders and Repair Orders	3 yrs.	Delete
Equipment Documentation and QA/QC		
10% Quality assessment Analysis Reports	Life of equipment + 3 yrs.	Delete
Additional Records Required by National Voluntary Laboratory Accreditation Program	Life of equipment + 3 yrs.	Delete
Audit Records	Life of equipment + 3 yrs.	Delete
Blind Sample Analysis Reports	Life of equipment + 3 yrs.	Delete
Interlab Analysis Reports	Life of equipment + 3 yrs.	Delete
Maintenance and Calibration Reports	Life of equipment + 3 yrs.	Delete
Manuals and Maintenance Records	Life of equipment	Delete
Proficiency Test	Life of equipment + 3 yrs.	Delete
Quality Assurance Manual	Superseded by revision + 7 yrs.	Delete
Quality Control Charts and Data	Life of equipment + 3 yrs.	Delete
Requisitions and Purchase Orders	Life + 3 yrs.	Delete
Laboratory		
Calibration Records	5 yrs.	Delete
Chain of Custodies for Samples	Permanent	None
Laboratory Approval Program Files	Life of equipment + 2 yrs.	Delete 2 years after closure of facility
Laboratory Notebooks	Permanent	None
Laboratory QA/QC Records	5 yrs.	Delete
Raw Data from Laboratory Instrumentation	Permanent	None
Laboratory Final Results	Permanent	None
Methods of Analysis	Permanent	None
Non-asbestos Samples Submitted for Analysis	Until Analysis Completed	Delete
Asbestos Samples Submitted for Analysis	5 yrs.	Delete
Standard Operating Procedures	Permanent	None
Meteorology		
Forecasts	Permanent	None
Meteorological Monitoring Data	Permanent	None
Meteorological Reports	1 yr.	Delete
Quality System Documents		
Quality Management Plan revisions	20 yrs.	Delete
Quality Assurance Project Plans	20 yrs.	Delete
Standard Operating Procedures	20 yrs.	Delete

SECTION B. DATA GENERATION AND ACQUISITION

B1. AIR MONITORING SAMPLING PROCESS DESIGN

The Air District air monitoring network comprises roughly 50 sites. All sites measure air quality compounds and some sites also measure meteorological parameters. This section describes the process that goes into designing the air monitoring network and the specific considerations that must be given to locating sites that measure one or more compounds and/or meteorological parameters.

The Air District's air monitoring program is designed to ensure that sampling procedures, instrument operation procedures, and siting criteria are met; that all equipment is standardized; that EPA- or ARB-approved equipment is used throughout the Air District where applicable; and that final data quality meet Air District objectives. Detailed information on air monitoring sample design can be found in the Annual Network Plan contained in **Appendix B**.

The air monitoring network design incorporates all data collection and sampling components including actual station or monitor design, sampling methods, sample handling and custody, analytical methods, instrument testing, maintenance and inspection, calibrations, quality control activities, and data management. Detailed information on air monitoring sample design can be found in the Annual Network Plan contained in **Appendix B**.

B1.1 AIR QUALITY MEASUREMENT SITES

The primary goal of Air District siting of air quality monitoring stations is to meet or exceed EPA network design requirements as specified in 40 CFR Part 58 and effective on December 18, 2006. Under federal guidelines, State regulations may exceed EPA requirements and the Air District would then follow the more stringent State rules, if possible. The Air District maintains a SLAMS station (as described below) in each represented county. Stations are also located near industrial facilities where SO_2, H_2S, or toxics may be emitted at higher levels and/or local community health concerns warrant such attention. The Air District operates additional equipment, as needed, to provide accurate air quality forecasts, meet special monitoring needs, or provide data to other divisions or interested parties.

The Air District conducts numerous special monitoring projects to identify and quantify compounds of concern. Such projects are typically directed by Air District staff outside of the Technical Division with a particular data need. For example, the Engineering Division might request air toxics pollutant concentration data near a permitted facility to conduct a risk analysis. In this way, the air monitoring aspects of any project are defined by Air District staff using the data. In all special monitoring projects, Air Monitoring staff attempt to employ siting guidelines specified in 40 CFR Part 58, if possible. When a new air monitoring site is added to the network, a location that meets EPA (and ARB, if applicable) siting criteria specified in 40 CFR Part 58 is identified and investigated to ensure its suitability. Should a location meet all applicable siting criteria, the Air District enters into negotiations to obtain the longest lease term possible to ensure continuity. All efforts are made to ensure compliance with EPA and ARB criteria

regardless of intended use. In some cases, based on the goal of quantifying pollutant concentrations in a particular area, some of the siting criteria may not be met. For locations that provide data that are required by EPA or ARB, if any siting criteria can not be met, notification and approval will be obtained prior to negotiations. For special purpose monitoring not requiring EPA or ARB involvement the rationale for not adhering to siting criteria is documented, approved by the Director of Technical Services, and placed in the project file.

Once a new monitoring site has been established and becomes operational, the appropriateness of the location is reviewed during each audit. Should any site not meet requirements, the situation will be rectified as soon as possible as outlined in the SOPs in **Appendix A**. If data from the site are used to meet EPA or ARB requirements and the problem cannot be corrected, the appropriate agency will be informed of the deficiency to determine if the site can remain viable. If not, a new location that meets the siting criteria will be identified so that the new station meets the objective of the original station. If the location is a special purpose site, the issue is brought to the Director of Technical Service's attention, his direction is followed, and the rationale for any decisions made is documented in the project file.

Should a station be identified as duplicative or unnecessary to meet program objectives, proper notification of its closure is provided to EPA and ARB. Their input is sought and their recommendations are taken into consideration. Any proposed changes or changes made are noted in the Air Monitoring Network Plan (**Appendix B**).

QA activities are performed at every site as outlined in the SOPs in **Appendix A** on a schedule that at a minimum meets EPA and ARB requirements. These activities include, but are not limited to, conducting performance evaluations of instrumentation, auditing of equipment and probe location, auditing of site conditions, and auditing of systems and procedures. Should deficiencies be identified, they are brought to the attention of operators, supervisors, and management, as outline in this QAPP and corrective action is taken as soon as practical.

B1.2 METEOROLOGICAL MEASUREMENT SITES

The siting of Air District meteorological stations is designed to meet three purposes: collecting meteorological data needed for air quality and burn forecasting, permit modeling, and collecting data needed for photochemical modeling. Siting criteria for each of the three purposes can be different, although there is some overlap. Permit modeling requires meteorological data that are representative of both the sources to be modeled and the downwind receptor areas. Consequently, meteorological monitors are located near major industries. Preferred meteorological sites for use in photochemical modeling are at the modeling domain boundaries, in areas representative of low elevation and high elevation, in major air flow gaps, and in a network that is spaced uniformly within the modeling domain. Sites used for air quality and burn forecasting need to be representative of the Air District air monitoring stations, the major valleys, and the overall prevailing air flow over the Bay Area.

All meteorological monitoring locations record wind speed, wind direction, and temperature. Depending on the particular monitoring purpose for the site, relative humidity, solar radiation, precipitation, and pressure may also be collected.

Air District meteorological sites are located to meet EPA recommended siting criteria defined in the Meteorological Monitoring Guidance for Regulatory Modeling Applications (EPA, 2000). These include locating the site at least 10 times the height of nearby obstructions away from the obstruction, mounting wind sensors at least 1.5 times the building height above the building roof, and locating the site at least 30 meters from large paved areas.

The equipment used at Air District stations is chosen to meet EPA monitoring recommendations. Wherever possible, standardized monitoring equipment and data acquisition systems are used. This helps avoid mistakes during calibrations and audits, but also means spare parts can be used for any station.

Quality control and quality assessment procedures are followed at all Air District stations. QA activities are performed at every site as outlined in the SOPs in **Appendix A** and on a schedule that at a minimum meets EPA requirements. These activities include, but are not limited to, auditing of instrumentation and calibration equipment, auditing of sensor location, auditing of site conditions, and auditing of systems and procedures. Any deficiencies identified are brought to the attention of the meteorologist and MQA Manager and corrective action is taken as soon as practical.

B1.3 TYPES OF AIR MONITORING SITES

The design strategy at all Air District air monitoring sites incorporates the following:

- Use of standardized and EPA approved air monitoring equipment, where possible, such as reference or equivalent method analyzers and samplers
- Use of standardized sampling components (inlet, manifold, flow components, calibration system)
- Use of standardized data acquisition systems at all sites collecting hourly data (with the exceptions of PM_{10}, $PM_{2.5}$, toxics, and other parameters which are collected on a 24-hour or longer schedule)
- Standardized QA/QC activities
- Use of established EPA, ARB, and Air District standard operating procedures and methods, where possible. Should no SOP exist, an SOP is developed prior to the beginning of the project based on best industry practices and recommendations from the manufacturer or other authoritative source.

The Air District operates two types of air monitoring sites that are designed based on the Air District's design strategy:

- SLAMS air monitoring sites that measure and sampler for criteria, non-criteria and toxic pollutants

- Special purpose sites that are only intended to operate for a limited period of time depending on the goal. In most cases, the Air District strives to maintain special purpose monitoring sites for a minimum of one year to collect data that represent all seasonal variations in meteorology but do not remain at any given site for more than two years.

Meteorological parameters are measured at or near most air monitoring sites. These data may be from equipment operated by the Air District or by outside agencies that provide high quality data to the Air District.

B1.4 SLAMS MONITORING SITES

SLAMS air monitoring sites may monitor for all or some of the following criteria pollutants and/or non-criteria pollutants: CO, SO_2, NO_2, NO, NO_x, O_3, Total Hydrocarbons (THC), CH_4, Non-Methane Hydrocarbon (NMHC), H_2S, PM_{10}, $PM_{2.5}$, and toxics. A schematic of the air quality portion of a SLAMS air monitoring station is shown in **Figure B1-1**. SLAMS sites typically include the following components:

- Inlet probe - Teflon
- Sample lines and manifold include only Teflon tubing and borosilicate manifolds located between the inlet and monitoring instruments. The use of a 'kicker' pump to maintain EPA required residence times for criteria pollutants may be utilized on sampling manifolds.
- Criteria pollutant and non-criteria pollutant EPA approved reference or equivalent method analyzers
- Flow control components-pumps, etc.
- Station calibrator for performing automatic or manual zero, span, and precision checks
- Data Acquisition System (DAS)
- Chart recorders
- EPA G1 Protocol gases or ultra-precision NIST traceable gas cylinders
- Zero-air supply
- Any other peripheral equipment used for the purpose of air sampling (i.e., relays, automated flow control solenoids, etc.)

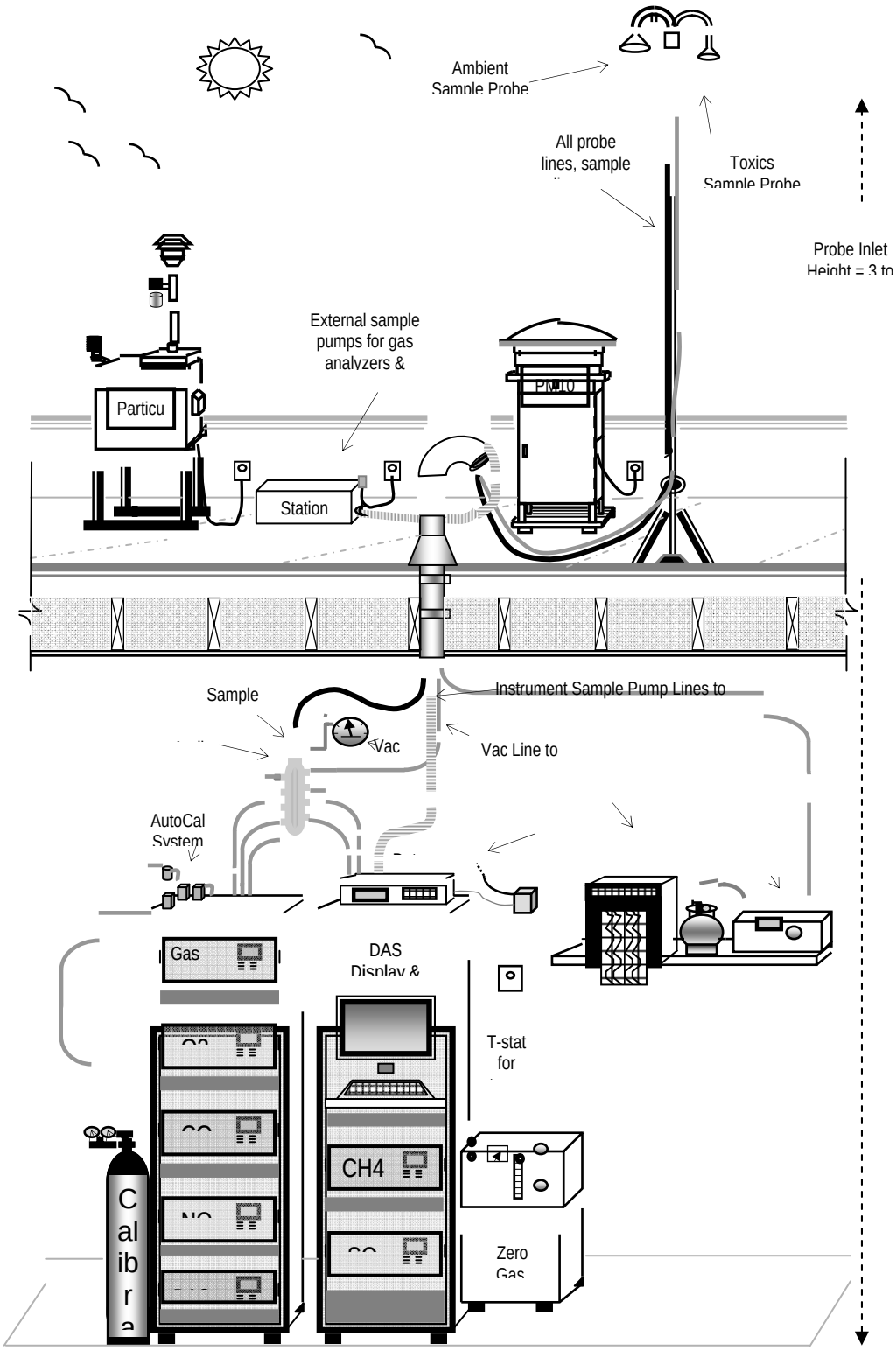

Figure B1-1. Schematic of air quality portion of SLAMS station.

B1.5 SPECIAL PURPOSE MONITORING SITES

Special purpose monitoring sites (SPM), by their nature, require unique instrumentation. **Figure B1-2** shows a schematic of the air quality portion of a special purpose monitoring system. Special purpose monitoring sites may measure the same criteria pollutants and/or non-criteria pollutants that SLAMS sites measure but remain in any given location for less than two years. If available, equipment having Federal Reference Method or equivalent designation is used to measure specific compounds. If EPA or ARB procedures, practices, or methodologies exist, they are employed. Should none exist, other recognized professional organizations or agencies are queried to determine if applicable procedures exist, or best professional practice is employed. Special purpose monitoring sites may include the following components.

- Teflon inlet probe
- Sample lines and manifold using only Teflon tubing and any borosilicate manifolds situated between the inlet and any instruments present. This may include the use of a 'kicker' pump in order to maintain the EPA required residence times for criteria pollutants.
- Criteria pollutant and non-criteria pollutant EPA approved reference or equivalent method analyzers
- Flow control components such as pumps, relays, automated flow control solenoids, etc.
- Calibrator for performing automatic or manual zero, span, and/or precision checks
- Data Acquisition System (DAS)
- Chart recorders
- Ultra-precision NIST traceable gas cylinders
- Zero-air supply

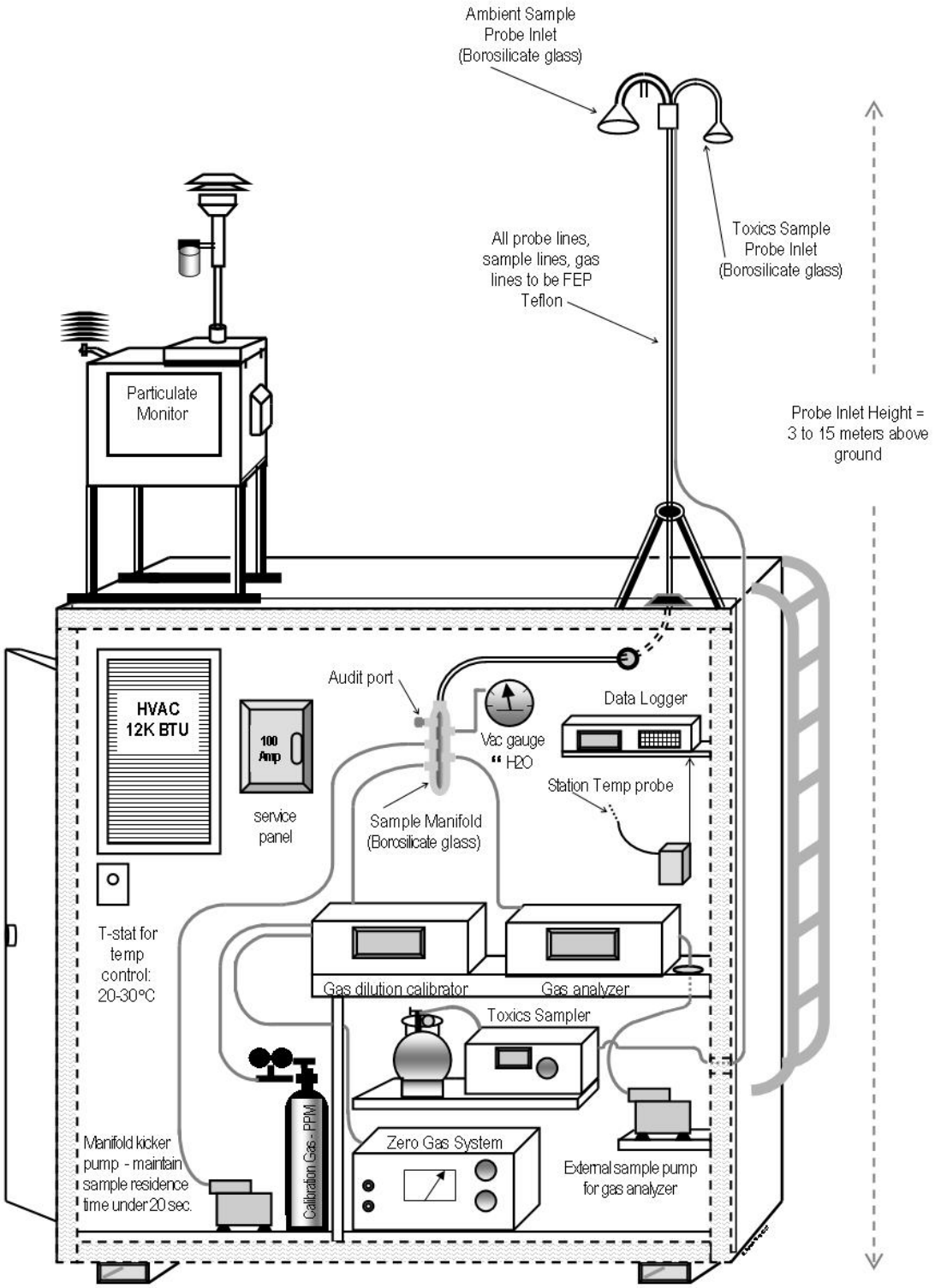

Figure B1-2. Schematic of special purpose monitoring station.

B2. SAMPLING METHODS

B2.1 AIR MONITORING MEASUREMENTS

All Air District sites use EPA and ARB approved reference or equivalent methods for the measurement of criteria (O_3, NO_2, SO_2, CO, PM_{10}, and $PM_{2.5}$) and non-criteria (CH_4, NMHC, H_2S, BC, and toxics) pollutants. The Air Monitoring Network Plan in **Appendix B** describes air monitoring measurements collected by monitoring sites in the Air District's network. Instrumentation and associated accuracy requirements are described in **Table B2-1**.

Table B2-1. Acceptance criteria for data accuracy.

Measurement	Manufacturer/ Model	Frequency	Method	Acceptance Criteria for Data Accuracy
Ozone (O_3)	Thermo Andersen (TECO) 49	Measurement: 60-120 sec averaging time Data Collection: Hourly average, ppb	UV Absorption	% Difference between reference concentration, ppm, and response value, ppm $\pm$ 7%
Carbon Monoxide (CO)	TECO 48	Measurement: 60-120 sec averaging time Data Collection: Hourly average, ppm	Gas Filter Correlation	% Difference between reference concentration, ppm, and response value, ppm $\pm$ 10%
Sulfur Dioxide (SO_2)	TECO 43	Measurement: 60-120 sec averaging time Data Collection: Hourly average, ppb	Pulsed Florescence	% Difference between reference concentration, ppm, and response value, ppm $\pm$ 10%
PM_{10}	GMW or Tisch Hi-Vol	Measurement: 24-hr on a six-day schedule Data: 24-hr average, $\mu g/m^3$	Filter collection	Flow $\pm$ 7%
$PM_{2.5}$	Andersen RAAS	Measurement: 24-hr on a six-day, three-day, or daily schedule Data: 24-hr average, $\mu g/m^3$	Filter collection	Flow $\pm$ 4% and $\pm$ 5% of design flow rate
NO, NO_2, NO_x	TECO 42	Measurement: 60-120 sec averaging time Data Collection: Hourly average, ppb	Chemiluminescence	% Difference between reference concentration, NO_2, and response value, ppm $\pm$ 10%
Hydrogen Sulfide (H_2S)	TECO 43 (with 340 H_2S to SO_2 converter) or TECO 45	Measurement: 60-120 sec averaging time Data Collection: Hourly average, ppb	Pulsed Florescence	% Difference between reference concentration, ppm, and response value, ppm $\pm$ 10%

Measurement	Manufacturer/ Model	Frequency	Method	Acceptance Criteria for Data Accuracy
Total Hydrocarbon (THC)/ Methane (CH_4), or Non-Methane Hydrocarbon (NMHC)/CH_4	TECO 55	Measurement: continuous sampling with 1-hr averaging time Data Collection: Hourly average, ppb	Flame Ionization	% Difference between reference concentration, ppm, and response value, ppm $\pm$ 15%
Black Carbon	Magee Scientific Aethalometer	Measurement: Semi-continuous sampling with 1-hr averaging time Data Collection: Hourly average, $\mu g/m^3$	Absorption	Flow 5.0 $\pm$ 0.3 lpm Leak Check – Less than 2.5 lpm
Continuous $PM_{2.5}$	MetOne Beta Attenuation Monitor (BAM)	Measurement: Semi-continuous sampling with 1 hr averaging–time Data Collection: Hourly average, $\mu g/m^3$	Beta Attenuation	Flow 16.67 $\pm$ 4% lpm Leak Check - Less than 1.0 lpm

B2.2 STANDARD OPERATING PROCEDURES

All sampling methods used by the Air District follow established Air District, ARB, and EPA standard operating procedures. All instruments are operated according to these procedures, manufacturer's guidelines, and operating manuals. In addition, SOPs are utilized to appropriately check initial operation to ensure that new and repaired instrumentation meet all applicable EPA, ARB, Air District, and manufacturer's guidelines. Regular maintenance guidelines and minimum acceptable performance parameters are also contained within the SOPs. The Air District has also developed SOPs for regular maintenance of sampling systems, peripheral equipment, and computer storage of data. Air District SOPs are included in the appendices of this QAPP.

B3. SAMPLE HANDLING AND CUSTODY

All samples (toxics, particulate filters) collected by the site operators are stored, transported, and maintained under strict handling and preservation methods and procedures in order to avoid any possible contamination. All site operators use Air District chain of custody (CoC) and follow sample control guidelines and methods. All samples are transported for analysis under chain of custody.

All toxics and particulate filters are handled in a manner that is compliant with EPA and ARB requirements. The Air District makes all efforts and takes all measures to ensure that sample degradation is kept at an absolute minimum and that this process is documented where possible. For example, $PM_{2.5}$ and PM_{10} samples are transported in coolers equipped with "blue ice" to maintain required temperatures. In addition, temperature measuring equipment is also placed in the cooler to record, log, and document that sampler temperature requirements are met. This information is maintained in the Air District database.

Prior to any new sampling program, the Air Monitoring, Laboratory, and MQA Managers research and discuss the potential sources for contamination and identify causes for sample degradation. Preventative measures are identified and utilized. This review also occurs on a regular basis for all current sampling programs. An example of such a study is the PM_{10} filter volatilization study that evaluates the loss of semi-volatile compounds from filters that are stored at ambient temperature vs. filters that are stored at or below 4°C (Appendix A, Air Monitoring SOP 204).

B3.1 CHAIN OF CUSTODY PROCEDURES

Chain of Custody (CoC) forms are found within SOPs in **Appendix A** and differ according to the sampling medium. Laboratory SOPs 306 and 308 refer to carbonyl and toxics canister and cartridge laboratory samples, respectively, and SOPs 201, 206 and 208 refer to PM_{10}, $PM_{2.5}$, and SASS $PM_{2.5}$ speciation filter-based samples, respectively. Procedures have been developed to ensure that responsibility for any sample can be tracked by the documentation of the chain of custody. Each time a sample is transferred to another person, that person must note the time, date, and condition in which they received the sample. In addition, the Air Monitoring Manager regularly reviews its sample transport and custody procedures to ensure that they adhere to the latest industry standards and meet the requirements of each monitoring network.

B3.2 TRACKING SAMPLES IN THE LABORATORY

Incoming samples are evaluated by appropriate laboratory staff to ensure that the applicable standards, equipment, staff, facilities, and procedures necessary to perform the analyses are available. Procedures for reviewing all incoming work are maintained in laboratory SOPs 301-308.

Prior to analyzing a sample, laboratory staff informs the submitter and, if appropriate, their supervisor, of any significant abnormalities including

- Departures from required standard conditions and necessary preparations;
- Doubt as to the sample's suitability for analysis;
- Nonconformity of the test sample with the description provided by the person submitting the sample; and
- Failure of the submitter to meet documentation requirements of the CoC forms.

The laboratory handles, prepares, and stores samples in its custody in a safe manner to protect them from loss, deterioration, and damage, and ensures required CoC forms remain intact. Documented procedures for the receipt and retention of the samples are maintained in the laboratory SOPs in **Appendix A**.

B3.3 LABORATORY FACILITIES

The laboratory facilities are kept clean and orderly; the laboratory design supports good laboratory practices. The laboratory accommodations, test areas, energy sources, lighting, heating, and ventilation facilitate proper performance of analyses and calibrations. Laboratory staff ensure that dust, electromagnetic interference, humidity, line voltage, temperature, sound, and vibration level are appropriate for the specific measurements performed by

- Verifying that lighting, heating, and ventilation are maintained at the levels needed for each type of test,
- Maintaining good housekeeping practices to promote a clean, uncluttered laboratory,
- Ensuring that there is sufficient space to minimize the risk of injury to staff and/or damage to standards or equipment,
- Maintaining a convenient and efficient work environment with effective separation of incompatible activities, and
- Limiting the amount of paper products used or stored to prevent dust contamination of clean and sensitive areas.

The temperature and humidity of the laboratory are continuously recorded by a recording device. Laboratory staff document deviations and corrective actions when environmental conditions are outside of specified limits.

B3.4 LABORATORY SECURITY

The laboratory is located within the Air District office in San Francisco. Security of the facility is the responsibility of the building manager and an Air District-contracted security service. The Laboratory Services Manager is responsible for security directly related to the laboratory and designates the specific duties of on-site security to the laboratory staff. Securing the laboratory premises includes the following:

- Locking laboratory doors in specific areas, when not in use;
- Securing all laboratory doors and the perimeter of the laboratory at the end of each day;
- Notifying building security of disturbances and suspicious activity as appropriate;
- Securing entrances to the laboratory when disturbances during analyses could affect analytical integrity; and
- Securing all areas where standards and equipment are stored or maintained.

Access to and use of all analytical areas are controlled and defined by the Laboratory Services Manager who maintains a list of authorized staff members. Building and Laboratory access are actually controlled by building maintenance personnel through a photo ID employee badge and electronic door locks.

B3.5 LABORATORY SAFETY

Safe working conditions are prerequisites to good laboratory practices. Laboratory managers provide safe working conditions, comply with safety regulations, and along with supervisors, assure that staff comply with these regulations. Laboratory personnel are instructed in safe working practices and are encouraged to look for hazardous conditions as well as recommend and implement accident prevention practices.

Subject to approvals by Management, the Air District Safety Committee is responsible for maintaining a Safety Manual (Bay Area Air Quality Management District Injury & Illness Prevention Program, 1995) that applies to all employee conduct while at work. This manual also applies to overall Laboratory operations and staff safety while working in the lab. It is the responsibility of the Laboratory Services Manager to ensure that all staff members are familiar and comply with all safety guidelines and requirements.

B4. ANALYTICAL METHODS

Analytical methods used by the Air District include analysis of ambient air toxics sample canisters, gravimetric analysis of PM filters, elemental carbon/organic carbon (OC/EC) of PM filters, Ion Chromatography Analysis of PM_{10} filters as well as post-analysis of 2, 4-dinitrophenyl hydrazine (DNPH) cartridges. All analyses are covered under specific SOPs included in **Appendix A**.

In addition, the Air District currently participates in a number of cooperative sampling arrangements with both ARB and EPA. In these arrangements, the Air District is responsible for the collection of filter media, the shipping of the media to the contract laboratory under chain of custody, and review of data from the contract laboratory. These agreements include the collection of canisters, DNPH cartridges, and filter media for analysis by the ARB laboratory, and the collection of filter media for analysis by EPA contract laboratories for the determination of metals for the Chemical Speciation Network (CSN) and National Ambient Toxic Tends Stations (NATTS) program. All methods used by the Air District's laboratory for air monitoring purposes are included in **Appendix A**.

B4.1 LABORATORY METHODS

Whenever possible, Air District Laboratory operations use industry and regulatory agency recognized analytical methods from source documents published by agencies such as EPA, ARB, American Society of Testing and Materials (ASTM) and the National Institute for Occupational Safety and Health (NIOSH) as described in Laboratory SOPs in **Appendix A**.

Some SOPs may include modifications to the published methods. Significant modifications to the published methods are described in the SOP. If an operation for a particular project is performed in an alternate manner from that described in the SOP, it is documented in the project file.

The laboratory performs calibrations and tests within its documented capability. On occasion, analyses beyond Air District laboratory capabilities are required. This work is subcontracted to an outside laboratory with the appropriate capabilities. The Air District subcontracts only to laboratories with accreditation that is appropriate for the analysis to be performed.

The laboratory also has policies and methodologies to ensure high quality data and the successful attainment of DQOs and associated DQIs, including methodologies to ensure errors and inaccuracies are identified and corrected.

The laboratory conducts all analyses under conditions specified in the Laboratory SOPs in **Appendix A** by using techniques that are conducive to a high degree of reliability. The Air District laboratory follows generally recognized good laboratory practices. Quality in our services is a constant effort and focus.

B4.2 ANALYSIS, INDEPENDENCE, ACCREDITATION, AND RECORDKEEPING

The laboratory conducts analyses listed in accordance with the procedures, practices, and conditions required, recommended, and/or approved by the EPA and/or its affiliated departments, agencies, and organizations. The techniques used for specific analyses ensure the accuracy, tolerance, precision, traceability, and/or uncertainty required for the analyses and are within the applicable Air District administrative guidelines and associated safety and cost-effective considerations.

Management ensures that the laboratory is independent of any commercial, financial, or other pressures which might adversely affect the quality of analyses and resulting reports.

The laboratory maintains the confidentiality and proprietary rights of all information including type of work performed and results of tests. All laboratory personnel and staff are informed of this policy.

B5. QUALITY CONTROL

Quality assurance is composed of two activities: quality control and quality assessment. Quality control is a set of internal tasks performed to provide accurate and precise measurement of ambient air quality data. Quality control tasks address sample collection, handling, analysis, and reporting. Examples include periodic calibrations, routine service checks, instrument specific monthly quality control maintenance checks, and duplicate analyses on split and spiked samples.

Quality assessment is a set of external tasks to provide certainty that the quality control system is satisfactory. These external tasks are performed outside of normal routine operations. For example, independent performance audits, on-site system audits, inter-laboratory comparisons, and periodic evaluations of internal quality control data comprise such tasks. This section describes in detail the quality control activities of the Technical Services Division. Quality assessment activities are described in Sections C1-3.

B5.1 ATTAINMENT OF QUALITY CONTROL FOR CRITERIA AND NON-CRITERIA POLLUTANTS

The following items contribute to the attainment of quality control and provide for accurate and precise measurement of ambient air data.

- Methods, analyzers, or samplers are EPA reference or equivalent methods, where applicable.
- Equipment is installed to conform to 40 CFR Part 58 requirements, the manufacturer's operations manual, and any guidelines set forth in **Appendix A** for each specific analyzer.
- Analyzers and/or samplers are operated in accordance with the recommended SOPs, the manufacturer's operations manual, and the Air District SOPs in **Appendix A**. Routine service checks and maintenance procedures are performed on a regular basis and noted in the instrument logbooks.
- Quality control is further enhanced at selected SLAMS stations by the use of a gas calibration system. The gas calibration system consists of three components: (1) a calibrator; (2) a Pure Air Generator, SO_2; (3) bottled gas cylinder blends consisting of above-ambient, stable concentrations of NO, CO, SO_2, and CH_4 in a nitrogen balance. The gas calibration system is used to perform automated daily through-the-manifold zero and span checks, and precision checks. Special calibration checks may also be remotely initiated through the modem/phone DAS system. The daily checks enable analyzer malfunctions to be detected promptly and enable preventative action to reduce instrument malfunction.
- Calibrations are performed in accordance with ARB or EPA approved standard procedures.

- Air District quality control procedures require the use of frequent zero, span, and precision checks. However, caution is exercised before zero or span adjustments are performed. Often, problems causing analyzer response shifts are due to analyzer malfunctions. Consequently, zero and span adjustment procedures are developed to compensate only for normal expected variations in analyzer response. These procedures are instrument specific; as such, uniform control limits for zero and span adjustments, when applicable, are developed based on instrument stability, gas standards, reliability, and time required to perform the adjustments. The timing of automated checks does not coincide with times of the day when pollutant concentrations are at or near peak levels.
- Technical Services Division staff obtain air quality QC data for each gaseous criteria pollutant using results from precision checks performed at least three times each week on each automated analyzer. Automated precision checks are performed by challenging the analyzer with a test gas of known concentration between 0.01 and 0.10 ppm for SO_2, NO_2, and ozone analyzers and between 1 and 10 ppm for CO analyzers. These levels are based on localized ambient conditions and EPA recommendations and are reviewed on a regular basis and adjusted if necessary to remain within recommended EPA ranges. Air monitoring personnel perform analyzer precision checks by passing the test gas through filters, scrubbers, conditioners, or other components used during normal ambient sampling and as much of the ambient air inlet system as possible. Specific analyzers may be temporarily modified during the check to vent flows to prevent over-pressurization. The test atmosphere may enter the analyzer at a point other than the normal ambient sample inlet, provided that the analyzer's response will not be altered. These analyzers may be equipped with automatic zero and span systems and sample pumps installed between the analyzer sample inlet and the manifold have the test gas injected upstream of the pump and the automatic zero and span systems. The precision checks are conducted prior to any zero and span adjustments.
- Flow checks and verifications of sampling equipment are performed, as required, to ensure that reliable, accurate flow rates and total flow are obtained. In addition, additional parameters may be checked, such as temperature and barometric pressure, that are used to calculate standard flow.
- Instrument logbooks are used to document instrument performance and maintenance.

Quality control limits are set, reviewed and adjusted as necessary to represent improvements, changes, or adjustments in instrumentation. Current quality control limits are listed in **Table B5-1**.

Table B5-1. Quality control limits.

Parameter	Requirement	Frequency	Acceptance Criteria
Ozone	Precision Check	Every 2 days	≤ ± 5%
	Zero/Span Check	Every 2 days	≤ ± 3 ppb Zero ≤ ± 3% Span diff
	Bias Validation	Annual	95% of PE points fall within 95% PL for QC Checks
Carbon Monoxide	Precision Check	Every 2 days	≤ ± 7%
	Zero/Span Check	Every 2 days	≤ ± 0.2 ppm Zero ≤ ± 2% Span diff
	Bias Validation	Annual	95% of PE points fall within 95% PL for QC Checks
Carbon Monoxide (Trace level)	Precision Check	Every 2 days	≤ ± 10%
	Zero/Span Check	Every 2 days	≤ ± 0.05 ppm Zero ≤ ± 5% Span diff
	Bias Validation	Annual	95% of PE points fall within 95% PL for QC Checks
Nitric Oxide, Nitrogen Dioxide, Nitrogen Oxides	Precision Check	Every 2 days	NO_2: ≤ ± 7% NO, NOx:≤ ± 10%
	Zero/Span Check	Every 2 days	≤ ± 3 ppb Zero NO_2: ≤ ± 3% Span diff NO, NOx: ≤ ± 5%
	Bias Validation	Annual	95% of PE points fall within 95% PL for QC Checks
Sulfur Dioxide	Precision Check	Biweekly	≤ ± 5%
	Zero/Span Check	Biweekly	≤ ± 3 ppb Zero ≤ ± 3% Span diff
	Bias Validation	Annual	95% of PE points fall within 95% PL for QC Checks
Hydrogen Sulfide	Precision Check	Biweekly	≤ ± 5%
	Zero/Span Check	Biweekly	≤ ± 3 ppb Zero ≤ ± 3% Span diff
Total Hydrocarbon, Methane, Non-Methane Hydrocarbon	Precision Check	Every 2 days	≤ ± 15%
	Span Check	Every 2 days	≤ ± 4% Span diff for CH_4 ≤ ± 7% for NMHC
$PM_{2.5}$ FRM	Flow Rate Verification	Monthly	≤ ± 3% of std. ≤ ± 4% of design
	Leak Check	Monthly	≤ 0.08 L/min
	Pressure Verification	Monthly	≤ ± 10 mmHg
	Temperature Verification	Monthly	≤ ± 2 °C
	Flow CV	Each Run	≤ ± 2%
$PM_{2.5}$ Beta Attenuation	Flow Rate Verification	Biweekly	≤ ± 3% of std. ≤ ± 4% of design
	Leak Check	Biweekly	≤ 1.0 L/min
	Pressure Verification	Biweekly	≤ ± 10 mmHg
	Temperature Verification	Biweekly	≤ ± 2 °C
PM_{10} Hi-Vol	Flow Rate Verification	Quarterly	≤ ± 7% of std. ≤ ± 10% of design
Aethalometer	Flow Rate Verification	Monthly	≤ ± 7% of std. ≤ ± 7% of design
	Dynamic Zero Test	Monthly	≤ ± 0.1 $\mu g/m^3$

Quality control limits are developed to provide an early warning of instrument problems prior to the exceedance of an MQO. If a QC measurement is outside the specified quality control limit, the source of the problem is to be investigated and corrected. Violation of a quality control limit does not require data action as long as an MQO is not also exceeded. If a limit is not specified for a particular QC check then the default limit will be determined in the following order: EPA specified limits, ARB specified limits, or best industry practice. For specific corrective action procedures refer to the SOPs in **Appendix A**.

Reports to management are provided as required to ensure that adaptations to improve data quality can be incorporated and that attainment of DQIs and associated DQOs are maintained. Annual statistical reports involving many of the parameters measured and/or collected at Air District monitoring sites are provided to the Director of Technical Services and discussed with the involved managers. Monthly reports that summarize ozone zero/span, precision checks and calibrations, and voided $PM_{2.5}$ filters are also reviewed by the Director of Technical Services.

B5.2 LABORATORY QUALITY CONTROL

The QC protocols specified by the laboratory's methods and standard operating procedures shall be followed (see **Appendix A**). The essential requirements outlined below and in **Table B5-2** are to be incorporated in the protocols, if applicable:

1. Initial Calibration Verification (ICV) – Used to evaluate the initial accuracy of the analytical curve. Comprised of a midpoint concentration of the curve materials.
2. Initial Calibration Blank (ICB) – Used to evaluate the accuracy of the analytical zero reading and to ensure the instrument is operating without possible contamination. Also known as a 'method blank'. A method blank is a gaseous, organic, or aqueous solution that is as free of the analyte as possible and contains all the reagents in the same volume as used to process the sample. The blank is performed to assure cleanliness of the system. The source of method blank contamination shall be investigated and measures taken to correct, minimize, or eliminate the problem.
3. Continuing Calibration Verification (CCV) – Used to evaluate the accuracy of the analytical curve during a batch run and to close out a batch. Comprised of a midpoint concentration of the curve materials, and is run after every ten sample runs or to close out the batch.
4. Continuing Calibration Blank (CCB) - Used to evaluate the accuracy of the analytical zero during a batch run and to close out a batch.
5. Secondary Source ICV (Sec Source ICV) - Used to evaluate the initial accuracy of the analytical curve. Comprised of a midpoint concentration of the curve materials. Made from primary standards procured from a different vendor, or if another vendor is not available, a different lot. Ensures that materials obtained and used to generate the analytical curve are as stated from the vendor.

6. Laboratory Control Sample (LCS) - A laboratory control sample may be referred to as a laboratory fortified blank or quality control check sample. It shall be analyzed at 1 per batch of 20 or less samples per matrix type or preparation method. The acceptability of the LCS results within any preparatory batch shall be based on the method specified limits. The LCS assures that the preparation and analysis are effective for a particular analyte and that the method can detect values as close to the "truth" as possible without matrix interference.
7. Matrix Spikes (MS) and Matrix Spike Duplicates (MSD) - A matrix spike is a sample that is fortified with a known concentration of analyte for recovery measurements. A matrix spike shall be performed at a frequency of 1 in 20 samples per matrix type. Like the LCS, the MS assures that the preparation and analysis are effective for a particular analyte and that the method can detect values as close to the "truth" as possible without matrix interference.
8. Detection Limits - The analytical methods utilized for sample analyses shall provide a detection limit that is appropriate or relevant for the intended use of data.
   - Method Detection Limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is determined from analysis of a sample in a given matrix containing the analyte. Requirements are established in EPA 40 CFR Part 136B.
   - Limit of Detection (LOD) or Lower Limit of Detection (LLD) is the analyte concentration in the matrix that produces a signal that is two to three times above the mean of blank analyses.
   - Limit of Quantitation (LOQ) is the lowest amount or concentration of analyte in the sample that can be reliably quantified with an acceptable level of precision and accuracy.

Table B5-2. Quality control checks per analyses.

Analysis	ICB/CCB	ICV/CCV	Sec Source ICV	LCS	MS	MSD	Replicates	SOP
Air Toxics (VOC)	X	X	-	-	-	-	X	LAB SOP 308
Carbonyls	X	X	X	X	X	X	X	LAB SOP 306
PM_{10}	X	X	X	N/A	N/A	N/A	X	LAB SOP 301
$PM_{2.5}$	X	X	X	N/A	N/A	N/A	X	LAB SOP 302
Ion Chrom	X	X	-	X	X	-	X	LAB SOP 303/304
OC/EC	X	X	N/A	-	N/A	N/A	X	LAB SOP 305

B6. EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

All Air District air monitoring instrumentation is thoroughly and completely checked prior to installation at any air monitoring. Any time major repair or maintenance activities are performed on instrumentation pertinent operational parameters are checked and documented in each instrument's logbook to conform to manufacturer's guidelines and requirements. Where applicable, maintenance schedules are outlined and operational parameters are checked and documented on a routine basis to ensure proper instrumentation operation. These procedures are described in the SOPs in the 200 series in **Appendix A** and are contained in the Air Monitoring Network Plan (**Appendix B**) in tabular form.

B6.1 INSTRUMENT PERFORMANCE AND REPAIR

The Air District developed procedures and policies to ensure that all equipment performs to manufacture specifications. Each night, at air monitoring stations, continuous air monitoring gaseous equipment is subjected to a known concentration of gas and each morning the monitoring station operator checks to ensure that the results are as expected. If the results do not meet the standards presented above, the operator will begin to access the problem and determine appropriate corrective action.

Diagnostic information available through the instrumentation will be recorded and made available through the DAS; it will also be recorded in the new Data Management System (DMS). The DMS will be programmed to notify operators, supervisors, and managers depending on performance criteria, diagnostic information, and other operating parameters.

Air monitoring instruments are also operated by the PE group, part of the MQA Section. The PE group is responsible for conducting performance evaluations of the instruments at air monitoring stations on a predetermined schedule. To perform these evaluations, the PE group maintains air monitoring instruments which are used to test the instruments at the air monitoring stations. Instrument/equipment testing and inspection and maintenance operations on these instruments are performed by PE personnel according to standard operating procedures. See **Table B6-1**. Testing of instrumentation generally consist of an inter-comparison with another instrument designated for laboratory use only, and an evaluation of the instruments operating parameters to ensure that they meet the manufacturer's specifications. Critical spare parts are maintained in the Performance Evaluation Laboratory, and where applicable, at the same locations as the Air Monitoring Section's spare parts inventory. Personnel assigned to the Performance Evaluation Laboratory are responsible for maintaining the required supply of spare parts as well as performing the majority of testing and repair.

Table B6-1. PE Group testing, inspection, and maintenance of equipment.

Equipment/ Instrument	Maintenance Activity	Testing Activity	Inspection Activity	Responsible Person	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
Ozone calibrators		Performance Evaluation		PE Lab Personnel	Twice per Quarter	+/- 1% D_i between any two instruments	Diagnosis and repair, followed by recertification	QA SOP 714
Ozone calibrators	Replace filters			PE Lab Personnel	Annually			QA SOP 714
Zero Air Generators		Performance Evaluation		PE Lab Personnel	Annually	Must not produce upscale zero response on calibrated lab instrumentation	Diagnosis and repair	QA SOP 715
Zero Air Generators	Replace Charcoal and Purafil scrubbers			PE Lab Personnel	Biannually			QA SOP 715
Sensidyne Gilibrator II Bubble Flow Meters			Inspect for damage and cleanliness	PE Auditors	Before each use		Clean flow cell as required	See users manual.
Audit filters for particulate samplers			Inspect for damage	PE Auditors	Before each use		Replace as necessary	QA SOP 708
Teflon audit lines			Inspect for damage and cleanliness	PE Auditors	Before each use		Replace as necessary	QA SOP 702
External audit scrubbers	Replace scrubber material			PE Lab Personnel	Annually			QA SOP 702

Meteorological data are processed through a data checking program daily. A report is generated daily and reviewed by the meteorological technician. If data appear suspicious, after consultation with the MQA manager or the PAMM specialist, the technician visits the meteorological site and inspects the sensors. If the sensors can be repaired on site, then the technician does so. If not repairable, then the sensor is replaced with another sensor. In addition, each meteorological site is inspected monthly by either a station operator or technician to determine if the tower is still standing and if the wind sensors are operating.

B6.2 SPARE PARTS AND INSTRUMENT REPAIRS

Both the Air Monitoring Section and the PE Group maintain a well stocked spare parts inventory and tracks that inventory with a computer database to ensure that parts are available when needed. Senior AQIS staff receive training from the equipment manufacturers to ensure their ability to repair instrumentation down to the component level.

The Air Monitoring Section has two locations with equipment and facilities that allow for instrument repair. However, policies have been developed to aid AQIS staff in the field to identify and troubleshoot instrumentation suspected of malfunction. In many cases, a malfunctioning instrument is repaired on site. If further repair is required, the Air District maintains spare instruments that can replace the malfunctioning equipment. The malfunctioning equipment is brought to one of the two repair sites where further troubleshooting and repair occurs. If a spare part is required that is not in the inventory, the required part is obtained as quickly as possible. Instrument repair manuals and schematics are obtained as a condition of purchase to aid in troubleshooting and repair. If the Senior AQIS can repair the instrument, the instrument is performance tested prior to being returned to service to ensure that it is able to attain manufacture specification. The instrument is returned to service upon completion of the performance testing.

In the event that the required repairs are beyond the ability of the Senior AQIS, the instrument is returned to the original manufacturer, if possible, or other qualified service provider. Upon return to the Air District repair sites, performance testing takes place to ensure the repairs have returned the instrument to manufacturer specifications. The instrument may be returned to service upon completion of the performance testing.

The PE Group operates similarly to the Air Monitoring Section in that minor instrument repairs are made by the field auditors on site if needed. More complex instrument repairs are performed at the Performance Evaluation Laboratory by the Senior AQIS, where an inventory of spare parts is kept.

The Air District Laboratory is furnished with all equipment and reference material required for correct performance of all tests performed. Each significant item of test equipment and reference material required is permanently and uniquely identified. All equipment is properly maintained as required by standard industry practice and manufacturer recommendations. Gas chromatographs, ion chromatograph, high performance liquid

chromatograph, and balances are under service contract with the manufacturer and adjustments and/or repairs are performed if calibration results, as presented in the Equipment and Instrument Calibration **Table B7-1**, are not within stated specifications. Maintenance procedures are documented in the appropriate electronic logbook. Each item of equipment including reference material, where appropriate, is identified to indicate its calibration status. Any item of equipment which has been shown to be defective will be clearly identified until it has been repaired and shown by calibration, verification, or test to perform satisfactorily. The current status of reference materials is identified in a manner that allows the user to determine its validity.

The meteorological technician maintains a full inventory of replacement parts for the meteorological network. A parts inventory spreadsheet is kept, and as parts are used, the inventory is updated. If meteorological sensors can not be repaired, they are sent to the factory for repair.

B6.3 INSTRUMENT REPAIR AND PERFORMANCE PARAMETERS DOCUMENTATION

Each instrument logbook contains measurement parameters, benchmarks, and performance guidelines that are to be measured on a routine basis. The minimum time periods that these measurements are to be performed are contained in the various instrument logbooks, however, maintenance and repair activities will be undertaken if nightly auto-calibration results are not within acceptable limits as listed in the Equipment and Instrument Calibration **Table B7-1**. Any adjustments are noted in logbooks and instrument performance is monitored to ensure that adjustments have corrected the problems. Should the adjustments not correct the problems, additional troubleshooting techniques are employed as described in the specific instrument SOPs and troubleshooting guidelines.

In addition to logbooks and SOPs, the Air Monitoring Section, the PE Group, and the meteorological technician may follow policy memos issued by Managers that direct operators to perform maintenance on a regular basis. For station operators this could include probe cleaning, and PM_{10} head cleaning. These policy memos are stored on Air District file servers available to Technical Division staff. They are simple and short, and intended for immediate implementation and updating. At the Manager's discretion, policy memo directives may be incorporated into SOP revisions. Though not listed explicitly as part of the Air Monitoring QAPP, policy memos are considered part of this document.

B7. INSTRUMENT/EQUIPMENT CALIBRATION/FREQUENCY

A table of all instrumentation in use at air monitoring stations is included in the Air Monitoring Network Plan in **Appendix B**. All supporting instrumentation, such as flow, temperature, and pressure measurement equipment is maintained at individual stations and tracked by AQIS staff. A master inventory sheet is maintained in the Air District office, updated on a regular basis, and audited every two years as part of a District-wide capital equipment program. Senior, supervising, and journey-level AQIS are responsible for ensuring that support instrumentation maintains adherence with all certification and calibration requirements and that all work on instrumentation is recorded in associated logbooks. All documentation, as described, is held for the period of time as specified in Air Monitoring Records Retention **Table A9-1**.

Each night all gaseous analyzers at air monitoring stations are challenged with a NIST traceable standard gas concentration to check and document adherence to regulatory and Air District guidelines. On an alternating basis, analyzers are challenged with a concentration that either represents expected ambient concentrations or concentrations between 75% and 85% of the analyzer's full scale. This is accomplished with the use of a commercially available gas dilution/ozone generation system activated by the DAS system at times when ambient gaseous concentrations are expected to be near minimum daily levels. Gases flow to the analyzers through the station manifold system that also handles ambient sampling. The DAS records instrument responses and sends them to the DMS. Responses are reviewed by monitoring station operators each morning. This methodology is employed to mirror conditions encountered by ambient samples. These procedures and timelines are described in the SOPs in **Appendix A**.

At least annually, the gaseous instruments are checked over a minimum of three points of known concentration plus zero to ensure that the instruments perform linearly. Any non-linearity will be investigated to determine if it is within manufacturer specifications; if it is outside manufacturer specifications, the instrument is removed from service and further troubleshooting is performed to determine the cause as described above.

All efforts are taken to balance the goal of minimizing data and making accurate measurements. Trends are also used to measure possible performance degradation over time. Corrective actions, further described in the attached SOPs, are taken to ensure that all data precision and accuracy goals are met and maintained. For example, a flow meter in an instrument that is not measuring flow accurately would be replaced or an ozone lamp that is no longer meeting manufacturer performance specifications would be replaced.

Documentation is also reviewed on a monthly basis by AQIS Supervisors to ensure adherence to all requirements and goals and to further determine possible trends that may indicate instrument degradation. These procedures are further described in the SOPs in **Appendix A**.

For filter based instrumentation, flows are measured using certified measurement flow standards on a bi-weekly basis, at a minimum. As described above, every effort is made to strike a balance between minimizing loss of data and ensuring precision and accuracy. These

procedures are further described in the SOPs in **Appendix A.** All calibration or performance evaluations are documented in the logbooks maintained with each piece of equipment.

For instrumentation for which calibration may not be required or possible, such as toxic samplers, instrument specific guidelines have been developed to ensure that all data quality goals are met. These procedures are further described in the SOPs in **Appendix A**. Calibration or certification information is documented in associated equipment or station logbooks.

In the Laboratory, all measurement operations and testing equipment that affect the accuracy or validity of analyses are calibrated and/or verified before being put into service, and on a continuing basis. The Laboratory has a program for the calibration and verification of its measuring and analytical equipment. This includes gas chromatographs, ion chromatograph, balances, thermometers and control standards.

The overall program of calibration and/or verification and validation of equipment is designed and operated so as to ensure that, wherever applicable, measurements made by the Laboratory are traceable to national standards of measurements (if available).

Calibration certificates indicate the traceability to national standards of measurement and provide the measurement results and associated uncertainty of measurement and/or a statement of compliance with an identified specification. Records of certification are maintained in the Laboratory.

Where traceability to national standards of measurement is not applicable, the Laboratory provides satisfactory evidence of correlation of results (e.g., by participation in a suitable program of inter-laboratory comparisons, proficiency testing, or independent analysis).

Reference standards of measurement held by the laboratory (e.g., standard weights) are used for calibration only and no other purpose. Reference standards of measurements are calibrated by a body that can provide traceability to a national standard of measurement.

Where relevant, reference standards and analytical/measuring equipment are subjected to in-service checks between calibrations and verifications. Reference materials are traceable to national or international standard reference materials.

The Laboratory also has several pieces of support equipment. Support equipment consists of devices that may not be actual analytical instruments, but additional instruments necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, water baths, temperature measuring devices such as thermometers, thermal/pressure sample preparation devices such as pressure gauges, and volumetric dispensing devices such as pipettes (if quantitative results are dependent on their accuracy). All support equipment are maintained in proper working order. The Laboratory keeps records of all repair and maintenance activities, including service calls. Support equipment are also calibrated or verified periodically, using NIST-traceable references when available. The equipment are kept in service only if the calibration is within the specifications required of the application.

Instruments used for quantitative analysis are initially calibrated prior to being put into service. The details of the initial calibration procedures, calculations, integrations, calibration curves, and associated statistics are kept with the instrument. Thereafter, continuing calibration of the instruments is performed, as needed.

When appropriate, each item of equipment is labeled, marked, or otherwise identified to indicate its calibration status. Procedures for setting and changing analytical instrument calibration intervals are maintained in the Laboratory files. Calibrations of equipment are conducted at a frequency that ensures that the items remain in tolerance during their use in the Laboratory. Frequency of calibration is based on a review of calibration, maintenance, and repair history. Reviews are conducted by the technical/program manager and records are maintained with internal audit records in the Laboratory files.

The Performance Evaluation group is responsible for ensuring that the standards used for performance evaluations are NIST traceable and that the certifications are current. Vital equipment and their respective calibration frequency are listed in **Table B7-1**. Equipment used as comparative standards for performance evaluations are sent to various metrology labs for direct comparison to primary standards. Less critical equipment such as DPI 705 digital pressure meters and Tegam 840A thermometers are calibrated in the Air District Laboratory. All equipment calibration and certification is maintained in equipment logbooks.

Meteorological sensors are calibrated quarterly by the meteorological technician and assisted by the AQ Technical Assistant. Calibration standards are based on EPA accuracy requirements as specified in Table 5-1 of EPA's Meteorological Monitoring Guidance for Regulatory Modeling Applications (EPA, 2000). If manufacturers' standards are more stringent, then Air District calibration standards are based upon them.

Table B7-1. Equipment and instrumentation calibration.

Equipment/ Instrument	Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Ozone (O_3)	Automated Calibration	Nightly	% Difference between reference concentration, ppm and response value, ppm $\pm$ 5%	As required	Station Operator	SOP 101, Instrument Logbook, SOP 216
Carbon Monoxide (CO)	Automated Calibration	Nightly	% Difference between reference concentration, ppm and response value, ppm $\pm$ 7%	As required	Station Operator	SOP 101, Instrument Logbook, SOP 213
Sulfur Dioxide (SO_2)	Automated Calibration	Weekly	% Difference between reference concentration, ppm and response value, ppm $\pm$ 5%	As required	Station Operator	SOP 101, Instrument Logbook, SOP 212
PM_{10}	Flow Measurement	Quarterly	Flow $\pm$ 7%	As required	Station Operator	SOP 101, Instrument Logbook, SOP 201
$PM_{2.5}$	Flow Measurement	Monthly	Flow $\pm$ 3% and $\pm$ 4% of design flow rate	As required	Station Operator	SOP 101, Instrument Logbook, SOP 205
NO, NO_2, NO_x	Automated Calibration	Nightly	% Difference between reference concentration, ppm and response value, ppm $\pm$ 7%; NO, NOx: $\pm$ 10%;	As required	Station Operator	SOP 101, Instrument Logbook, SOP 211
Hydrogen Sulfide (H_2S)	Automated Calibration	Weekly	% Difference between reference concentration, ppm and response value, ppm $\pm$ 5%	As required	Station Operator	SOP 101 Instrument Logbook, SOP 219

Equipment/ Instrument	Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Total Hydrocarbon (THC)/ Methane (CH_4), or Non-Methane Hydrocarbon (NMHC)/CH_4	Automated Calibration	Nightly	% Difference between reference concentration, ppm and response value, ppm $\pm$ 15%	As required	Station Operator	SOP 101, Instrument Logbook, SOP 218
Black Carbon	Flow Measurement	Monthly	Flow 5.0 $\pm$ 0.35 lpm Leak Check – Less than 2.5 lpm	As required	Station Operator	SOP 101, Instrument Logbook, SOP 208
Continuous $PM_{2.5}$	Flow Measurement	Biweekly	Flow 16.67 $\pm$ 3% lpm Leak Check - Less than 1.5 lpm	As required	Station Operator	SOP 101, Instrument Logbook, SOP 207
Ozone Calibrators	Sent to ARB for comparison with SRP	Quarterly	$\pm$ 1% change from previous calibration	Repair and 6 day recertification	PE Lab Personnel and ARB	[QA SOP 714]
Sensidyne Gilibrator II – Flow	Sent to manufacturer for calibration	Annually	$\pm$ 1% of reading	Calibration and/or repair	Sensidyne	QA SOP 702
BGI Delta Cal – Flow	Sent to BGI for calibration	Annually	$\pm$ 0.75% of reading	Calibration and/or repair	BGI	QA SOP 008
Hart Scientific 1504 Thermometer and RTD Probe	Sent to GE Sensing for calibration	Annually	$\pm$ 0.02 degC	Calibration and/or repair	GE Sensing	QA SOP 717
DPI 740 – Flow	Sent to Druck for calibration	Annually	$\pm$ 0.02% of full scale	Calibration and/or repair	Druck	QA SOP 717
Fluke 8840 – DVM	Sent to EECS for calibration	Annually	$\pm$ 0.005% DC	Calibration and/or repair	PE Lab Personnel	QA SOP 717
TEGAM 840A – Temperature	Compared to Hart Scientific 1504	Annually	$\pm$ 0.5 degC	Diagnosis and repair	PE Lab Personnel	QA SOP 717
DPI 705 – Pressure	Compared to DPI 740	Semi-annually	$\pm$ 3 mmHg	Calibration and/or repair	PE Lab Personnel	QA SOP 717
BGI Variable Orifice – Flow	Sent to ARB for calibration	Annually	Calibration slope <= $\pm$ 3 standard deviations from the mean of all prior slopes	Repair and recertification	PE Lab Personnel and ARB	QA SOP 717

Equipment/ Instrument	Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Gas Chromatograph	Automated calibration	As needed	70%-130%	As required	analyst	SOP 308
Ion Chromatograph	Automated calibration	As needed	70%-130%	As required	analyst	SOP 303, SOP 304
HPLC	Automated calibration	As needed	70%-130%	As required	analyst	SOP 306
Balances	Certified weights	Every weighing session	5 µg	As required	analyst	SOP 301, SOP 302
OC/EC Analyzer	Automated calibration	As needed	70%-130%	As required	analyst	SOP 305
Meteorological Sensors	Manual calibration	Semi-annually	Meets criteria in Table A7-3	Calibration and/or repair	Meteorological Technician	SOP 501 - 510

B8. INSPECTION/ACCEPTANCE OF SUPPLIES/CONSUMABLES

Air Monitoring Section supplies and consumables are directed to the Air Monitoring Senior AQIS for inspection, acceptance, and inventorying. Parts and supplies are inventoried and tracked in a computer database available on the Air District's network drives to ensure continuous operation of the air monitoring network. After any equipment is repaired, a thorough evaluation is performed to ensure that the equipment performs to manufacturer standards as described in previous sections of this QAPP.

The Air Monitoring Manager determines the primary person responsible for inspection and acceptance during the ordering process by directing parts/supplies/consumables to that person through the Purchase Order (PO) process.

Filter media are ordered and supplied to the AQIS in the field. The filter media are checked to ensure they meet all ARB and EPA requirements.

The Laboratory follows standard guidelines as referenced in EPA methodologies with regard to acceptance of standard materials. These practices are described in the SOPs in **Appendix A**. All calibration standards are certified by the vendor. New standards are compared with existing standards and any discrepancies are corrected as per the SOP. Other supplies such as eluents, carrier gases, and SUMMA canisters are blank checked for target compounds. Spare parts for laboratory equipment and instrumentation are kept in a clean area until ready for use.

The Performance Evaluation group maintains a set of certified gases for performance evaluations and equipment verification. These gases are supplied by Scott-Marin, Inc. and are certified by the vendor in accordance with Procedure G1 of the EPA Traceability Protocol (EPA-600/R-97/121 Titled: EPA Traceability Protocol for Assay and Certification of Gaseous Calibrations Standards, September 1997). Gas cylinder information, including bottle number, gas composition and concentration, certification expiration date, and location are entered and maintained in the Gas Cylinder Inventory Database. This database is maintained by the Performance Evaluation group's Air Quality Technical Assistant (AQTA). Upon receipt of a new gas standard, an inter-comparison is made between the new standard and the one it is to replace. This inter-comparison typically involves calibration of an instrument utilizing the old standard and then measuring the response of that instrument to the new standard. If the response to the new standard is not within 1% of the predicted concentration value, then the test is repeated. A third standard may be brought in to determine whether the problem lies with the new standard or the old. If the new standard falls outside of the acceptance range, it is rejected and returned to the vendor.

Equipment for the meteorological network is sent to the meteorological technician to inspection, acceptance and inventorying. After the equipment is found to be acceptable, the meteorological technician notifies the MQA manager that the order has been received and accepted, and that the invoices may be paid. The PE Group does the same for their new or repaired equipment.

B9. NON-DIRECT MEASUREMENTS

Any data or other non-direct measurement utilized for decision making must meet the highest quality. These data are only used to augment and enhance existing methodologies already employed by the Air District. Such non-direct measurements may include, but not be limited to, the use of non-District meteorological information to determine if an air monitoring site is representative of a particular area, non-District monitoring data similar to data collected in the air monitoring network, outside laboratory work, etc. Air monitoring sites may be evaluated using traffic counts provided by state, county, or city traffic engineering departments.

Prior to the use of any non-direct measurement for program use, data are reviewed by staff having expertise in the specific type of data generated. This may require review by staff outside of the Technical Services Division. Once these data are reviewed, staff and the associated Technical Division manager with sufficient knowledge and understanding in the area, usually the Air Monitoring or Laboratory Services Manager, will discuss these data with the staff expert. The MQA Manager reviews overall data quality and all Technical Services Division managers discuss their recommendations for use of these data with the Director of Technical Services who is responsible for determining if these data are of high enough quality to be used; the decision is documented in the project file.

B10. DATA MANAGEMENT

B10.1 DATA COLLECTION

The Air Monitoring Section maintains Environmental Systems Corporation (ESC) 8800 dataloggers to collect data at air monitoring sites. The 8800s have 8 or 16 analog channels plus limited digital control capability. Continuous analog signals typically are measured every second to generate 1-minute averages. At least 45 1-minute averages are required to calculate a valid hourly average value. Hourly data are collected by an ESC Central Station data management computer that polls each datalogger in the network every hour. Strip chart recorders are also installed at all air monitoring sites to record a continuous paper record of pollutant data as well as automated quality control actions such as nightly zero/span, and precision checks. Any data corrections or other operational notes are written on the charts by Air Monitoring staff, reviewed by supervisors, and forwarded to the Air District Office for data correction. Meteorologists in the MQA Section provide a second level of data review before data are archived in the Air District database and the EPA AQS. The strip charts are archived as the official data record for the Air District. SOPs governing datalogger operation, strip chart documentation, data editing and review procedures and timelines, and responsible parties are provided in **Appendix A**.

The Air District has developed a set of data handling and review SOPs included in **Appendix A**. The procedures are reviewed and updated as data production, handling, and review needs and goals change.

Meteorological data are collected and managed through a separate network of CR-10 (X) dataloggers and Loggernet data management software manufactured by Campbell Scientific, Inc. Dataloggers measure sensor values every second and generate hourly and sub-hourly averages. Every hour, Loggernet is used to poll all loggers and to export real-time hourly data to web pages and other data users. Sub-hourly data are typically retained for Air District modeling and diagnostic purposes.

Meteorological data are polled hourly and checked daily using an error check program that produces a report which is reviewed daily by a meteorologist. The error check report lists values out of range, periods of constant values, large changes over each hour, incorrect clock times, and missing values. If the report shows a potential error, the meteorological technician schedules a visit to the site to investigate the problem. After the problem is resolved, bad data are corrected or invalidated in the database.

Meteorological data are also reviewed quarterly by staff in the Planning Division. Because the meteorologists in the Research and Modeling Section of the Planning Division use data for modeling, they have agreed to perform an independent review of data before it is considered final. When potential errors are found, Planning staff discuss the problems with the meteorological technician in the Technical Division to resolve the problem, or with the MQA manager. Data are then corrected or invalidated as needed. After correction, data are loaded into

the EPA AQS database and the Air District database. Meteorological data review procedures are contained in Data Mgt SOP 609, Meteorological Data Management, in **Appendix A**.

The Air District applied for and received an EPA 103 Grant from Region IX and an EPA National Environmental Information Exchange Network Challenge Grant to replace the current ESC data acquisition and management system. The new system replaces dataloggers with PC-based Data Acquisition Systems (DAS) capable of collecting serial 1-minute data from a very wide range of instruments and includes instrument meta-data used for real-time QC checks. DAS data are collected in a central Data Management System (DMS) database using "push" data transfers through the Internet. After importing DAS data, the DMS executes a set of programmable data QC checks every hour to filter out suspect data. Data passing all QC checks are automatically sent to AIRNow and posted on the Air District web page.

The DMS also provides a robust multi-user database with tools for further data review and analysis by Air District staff on a state-of-the-art server. The DMS will make it possible to report air monitoring data and related precision and accuracy data to EPA's AQS within the anticipated EPA future requirement of 45 days of the end of each month. Meteorological data will also be imported from the Campbell system into the DMS. The new DAS/DMS system is scheduled for completion by June 30, 2009 and full operation within six months.

Before the new data collection/management system becomes operational, extensive QA testing will be conducted to ensure that the new and old systems produce equivalent data sets. Staff will be trained on the use of the new system and data collection and management SOPs will be modified.

The Laboratory electronically submits analytical data to the appropriate sections through the data management system. Raw analytical files are electronically stored.

B10.2 DATA ARCHIVAL AND RETRIEVAL

After data (both air quality and meteorological) have been reviewed and corrected they are archived into a number of Air District databases. That will change shortly when the DMS becomes operational and it becomes the main archival location. That change is expected to occur by the end of 2009. The Air District data are also stored in the EPA AQS database.

Under the current archival system, only MQA staff have the knowledge and rights to access the Air District air quality and meteorological databases. Requesters need to request these data from MQA staff. However, after the DMS becomes operational, all Air Monitoring and MQA staff will be able to view, edit, and retrieve data. Selected staff in Planning Division will also have viewing and retrieval rights. Data requests from outside the Technical Services Division will continue to be processed through MQA staff.

Data residing in the AQS database are available nationwide to anyone with either an AQS ID and password or an ID and password for EPA's DataMart.

The easiest place to view Air District air quality and meteorological data are on the Air District web page. These data may be viewed by anyone with a computer and Internet access. Viewable data contain both validated and unchecked data. Initially unchecked data are uploaded to the web page in real time and shown with a yellow background and a cautionary header telling the viewer that data are unchecked. After 90 days, and data have passed through the validation procedures, the web page data are overwritten with the validated data. Validated data have an orange background and have a header indicating data are validated. Validated data for the web site are retrieved from the official Air District databases and loaded into the web database once per month after the QC process is finalized. Currently, data files cannot be downloaded; however, the Air District plans to make the validated data available for downloading in the future.

After final review, ambient data are archived in various ways depending on the data type. All ambient air quality data of a regulatory nature such as ozone, CO, NO_2, SO_2, and particulate matter (PM) are submitted to AQS. Other data collected in support of the Air Monitoring Program such as hydrocarbons, NO, air toxics, continuous PM, and PM speciation are also submitted to AQS. As the official EPA database for determining attainment of Federal Air Quality Standards, AQS provides an official, robust repository for ambient Air District data. Users are encouraged to access AQS or an AQS data service to retrieve these data.

Some ambient data collected in support of local Air District or state monitoring objectives may not be submitted to AQS. These data are typically collected and archived in databases or other storage formats on file servers maintained by IT staff at the Air District Office. Access to this data are available by submitting a data request through the Air District web page, by mail, or by fax. In a timely manner, MQA staff will respond to the request.

SECTION C. ASSESSMENT AND OVERSIGHT

C1. ASSESSMENTS AND RESPONSE ACTIONS

Quality Assessment functions include review and approval of program planning documents, auditing of sample collection, sample analysis, and data handling procedures, and evaluating the effectiveness of implemented Quality Control (QC) procedures. Quality Assessment (QA) takes two forms. Internal QA is conducted or arranged within the Division as directed by senior management. External QA is provided by ARB and EPA. By California state law, ARB must provide oversight/audit services to all local air monitoring districts through annual performance and laboratory audits as well as program review audits on a less frequent basis. As part of grant funding and regulatory requirements, EPA provides similar oversight/audit services. The following is a list of internal and external assessment tools utilized by the Air District:

Internal

Data quality assessments - as requested by Senior Management
Performance Evaluations - semiannual
Flow rate audits – quarterly
Internal technical system audits - 3 to 5 yrs
Meteorological performance audit by MQA staff – annually
Meteorological performance audit by contractor – annually

External

Toxics performance audits by ARB - annual
Toxics comparison audits by ARB - annual
Performance audits by ARB - annual
Program review audits by ARB - 7 to 10 yrs
Technical systems audits by EPA - 3 yrs
PEP audit by EPA – annual
NATTS Performance audit for carbonyl analysis on the HPLC – semiannual
NATTS Performance audit for toxic analysis by GC - quarterly
Technical systems audit for NATTS Program by EPA headquarters – annual

C1.1 INTERNAL ASSESSMENTS

C1.1.1 Data Quality Assessments

Internal data quality assessments may be conducted by the Quality Assurance Officer at the request of senior management. These assessments may include data management and review procedures, completeness, quality control/review procedures, and statistical evaluations. Assessment reports will be prepared and submitted to the Division Director with recommendations.

At the request of senior management, independent data assessments are also conducted by a statistician in the Air District's Planning Division. These assessments are usually conducted using final pollutant data that have gone through the normal, complete data review process and been submitted to AQS. If irregularities are discovered, MQA staff are notified and causes or explanations for data irregularities are identified. As a result of the findings, data may be invalidated, adjusted, or confirmed through this process. Corrective actions by Air Monitoring staff may be required if data were invalidated or adjusted. If a systemic problem is identified, recommendations for Quality System changes are submitted to the Division Director.

C1.1.2 Performance Evaluations and Flow Rate Audits

Performance evaluations and flow rate audits are the responsibility of Performance Evaluation Group staff. This group reports directly to the MQA Manager which ensures it's independence from the Air Monitoring Section. Performance evaluations on both criteria and non-criteria pollutant gaseous analyzers are made by challenging an analyzer with an EPA G1 Protocol gas of known concentration at three consecutive concentration levels falling within the analyzer's measurement range. Concentration levels for performance evaluations are selected from **Table C1-1** and comply with EPA requirements found in 40 CFR Part 58 Appendix A.

Table C1-1. Audit concentration ranges.

Concentration Range, ppm				
Audit Level	O_3	SO_2	NO_2	CO
1	0.02 – 0.05	0.0003 – 0.005	0.0002 – 0.002	0.08 – 0.10
2	0.06 – 0.10	0.006 – 0.01	0.003 – 0.005	0.50 – 1.00
3	0.11 – 0.20	0.02 – 0.10	0.006 – 0.10	1.50 – 4.00
4	0.21 – 0.30	0.11 – 0.40	0.11 – 0.30	5 - 15
5	0.31 – 0.90	0.41 – 0.90	0.31 – 0.60	20 - 50

Performance evaluations are conducted on a semiannual basis for both criteria and non-criteria gaseous pollutant analyzers. Detailed procedures can be found in QA SOPs 702, 703, and 706.

The Performance Evaluation Group also performs flow rate audits of all district particulate matter samplers. These flow rate audits typically consist of flow rate verification with an independent NIST traceable flow standard, as well as a verification of the sampler's temperature and pressure sensors. Flow rate audits are conducted quarterly on all Air District particulate matter samplers. More details can be found in QA SOPs 708-711, and 718.

If the results of a performance evaluation or flow rate audit exceed the acceptance criteria listing in **Table C1-2** then an Operations Data Action Notification (ODAMN) report is issued.

This report identifies the instrument in question, the date of the failure, the exact nature of the failure, the acceptance criteria exceeded, and the personnel involved. This notice is sent in turn to the Station Operator, the Station Supervisor, the Air Monitoring Manager, the MQA Manager, and the QA Supervisor. The Station Operator and or Station Supervisor must provide detailed results of the investigation, and any repairs or corrective actions taken. A follow up audit will be scheduled no later than three weeks after the corrective action has been taken. This is to provide independent verification that the issue has been resolved. The results of the investigation may indicate that data needs to be corrected or possibly invalidated by the MQA Section. Details about the ODAMN procedure can be found in QA SOP 705.

Table C1-2. Internal audit acceptance criteria.

Parameter	Frequency	Acceptance Criteria
Ozone	Semi-Annual	≤ ± 7%
Carbon Monoxide	Semi-Annual	≤ ± 10%
Carbon Monoxide (Trace Level)	Semi-Annual	≤ ± 15%
Nitric Oxide, Nitrogen Dioxide, Nitrogen Oxides	Semi-Annual	≤ ± 10% Conv. Eff. ≥ 96%
Sulfur Dioxide	Semi-Annual	≤ ± 10%
Hydrogen Sulfide	Semi-Annual	≤ ± 10%
Total Hydrocarbon, Methane, Non-Methane Hydrocarbon	Semi-Annual	≤ ± 15%
$PM_{2.5}$ Flow Rate Audit	Quarterly	≤ ± 4% of std ≤ ± 5% of design
$PM_{2.5}$ Temperature Audit	Quarterly	≤ ± 2 °C
$PM_{2.5}$ Pressure Audit	Quarterly	≤ ± 10 mmHg
$PM_{2.5}$ Audit Leak Check	Quarterly	≤ 0.08 L/min
$PM_{2.5}$ Continuous Flow Rate Audit	Quarterly	≤ ± 4% of std ≤ ± 5% of design
$PM_{2.5}$ Continuous Temperature Audit	Quarterly	≤ ± 2 °C
$PM_{2.5}$ Continuous Pressure Audit	Quarterly	≤ ± 10 mmHg
$PM_{2.5}$ Continuous Audit Leak Check	Quarterly	≤ 1.0 L/min
PM_{10} Flow Rate Audit	Quarterly	≤ ± 7% of std. ≤ ± 10% of design
Aethalometer Flow Rate Audit	Quarterly	≤ ± 7% of std. ≤ ± 7% of design
Aethalometer Dynamic Zero Audit	Quarterly	≤ ± 0.1 $\mu g/m^3$
MetOne SASS Flow Rate Audit	Quarterly	≤ ± 10% of std. ≤ ± 10% of design
MetOne SASS Temperature Audit	Quarterly	≤ ± 2 °C
MetOne SASS Pressure Audit	Quarterly	≤ ± 10 mmHg
MetOne SASS Audit Leak Check	Quarterly	≤ 0.1 L/min

C1.1.3 Technical System Audits

Every three to five years the Performance Evaluation group performs an internal system audit of the Air Monitoring Section. These audits look at station siting conditions as well as operational aspects of Air Monitoring such as logbooks, calibrations, standard certifications, and procedures. The results are evaluated against EPA standards contained in 40 CFR Part 58 Appendix A and E, as well as EPA Quality Assurance Handbook Volume II guidance. The audit results are reported to the MQA Manager, Air Monitoring Manager, and Division Director. If any deficiencies are found during the audit the Air Monitoring Manager is responsible for developing a corrective action plan. The MQA Manager is responsible for verifying the effectiveness of any corrective action taken. Details on TSA procedures can be found in QA SOP 701.

C1.1.4 Meteorological Performance Audits

Meteorological performance audits are performed twice a year, during the spring and fall months. The spring performance audit is conducted by Air District meteorologists from the Technical Services Division and the Planning Division, assisted by the MQA meteorological technician. For the fall audit, MQA hires an outside contractor, who is assisted by the MQA meteorological technician. Performance standards are measured against those listed in Table 5-1 of the EPA document "Meteorological Monitoring Guidance for Regulatory Modeling Applications". The audit findings and recommendations are submitted to the MQA Manager for review, and corrective action taken where needed. Data from sensors that fail the audit are reviewed and edited or invalidated by MQA staff and the Planning Division meteorologist.

C1.1.5 Review of EPA AQS Reports

The EPA maintains several standard AQS reports that provide data quality summary information. The AMP430 Completeness Report shows the percentage of valid data by month for all pollutants and other aerometric data submitted to AQS. The AMP246 and AMP247 Precision and Accuracy Reports list all submitted precision checks and performance evaluations, including those conducted by outside agencies, and provide a quick review for problems associated with a particular monitor or site. The AMP255 Quality Indicator Summary Report currently provides statistical information on all criteria pollutants for individual Air District sites and the entire network. This report also includes comparable statistics from other air monitoring agencies that provide another form of performance evaluation. Evaluation of non-criteria pollutant data not yet summarized in the AMP255 report is done using data quality assessment calculations listed in Section C1.1.6.

Data quality summary reports are reviewed quarterly by the MQA Manager, the Air Monitoring Manager, the Lab Manager, and the Quality Assurance Officer to ensure that data quality objectives are met. When data completeness or data quality objectives are not met, the Air Monitoring or Laboratory Manager determine the cause and notify the MQA Manager and the Division Director. At the end of the first quarter of the year, the MQA Manager, the Air

Monitoring Manager, and the Lab Manager brief the Division Direction on data completeness and data quality for the previous year.

C1.1.6 Quality Assessment Calculations

The following calculations are used by the Air District to calculate quality assessment data for precision and bias following the EPA 40 CFR Part 58 requirements for ambient air quality monitoring and for reporting ambient air quality data and information.

Percent Difference

All measurement quality checks start with a comparison of an audit concentration or value (flow rate) to the concentration/value measured by the analyzer and use percent difference ($\%d_i$) as the comparison statistic as described in the following equation:

$$\%d_i = \left(\frac{Y - X}{X}\right) * 100 \qquad \textbf{(C-1)}$$

where Y = analyzer's net indicated concentration, or flow rate
X = known concentration of audit test gas, or flow rate

Precision Estimate

The precision estimate is used to assess the precision checks for SO_2, NO_2, O_3, or CO. The precision estimator is the coefficient of variation (CV) upper bound and is calculated using the following equation:

$$CV = \sqrt{\frac{n \cdot \sum_{i=1}^{n} d_i^{\,2} - \left(\sum_{i=1}^{n} d_i\right)^2}{n(n-1)}} \cdot \sqrt{\frac{n-1}{X^2_{0.1,n-1}}} \qquad \textbf{(C-2)}$$

where d_i = the percent difference of the individual precision checks
n = the number of single point precision checks being aggregated
$X^2_{0.1,n-1}$ = the 10th percentile of a chi-squared distribution with n-1 degrees of freedom

Bias Estimate

The bias estimate is calculated using the precision checks for SO_2, NO_2, O_3, or CO. The bias estimator is an upper bound on the mean absolute value of the percent differences (|AB|) as calculated in the following equation:

$$|AB| = AB + t_{0.95,n-1} \cdot \frac{AS}{\sqrt{n}} \qquad \textbf{(C-3)}$$

where n = number of single point precision checks being aggregated
$t_{0.95,n-1}$ = the 95th percentile of a t-distribution with n-1 degrees of freedom
AB = the mean of the absolute values of the precision check d_i's and is calculated using the following equation

$$AB = \frac{1}{n} \cdot \sum_{i=1}^{n} |d_i| \qquad \textbf{(C-4)}$$

and the quantity AS is the standard deviation of the absolute value of the precision check d_i's and is calculated using the following equation:

$$AS = \sqrt{\frac{n \cdot \sum_{i=1}^{n} |d_i|^2 - \left(\sum_{i=1}^{n} |d_i|\right)^2}{n(n-1)}} \qquad \textbf{(C-5)}$$

Since the bias statistic as calculated uses absolute values, it does not have a tendency (negative or positive bias) associated with it. A sign is designated by rank ordering the percent differences of the precision check samples from a given site for a particular assessment interval. The 25th and 75th percentiles of the percent differences for each site are calculated. The absolute bias upper bound is flagged as positive if both percentiles are positive and negative if both percentiles are negative. The absolute bias upper bound is not flagged if the 25th and 75th percentiles are of different signs.

Validation of Bias Using the Precision Checks

The semi-annual performance evaluations for SO_2, NO_2, O_3, or CO are used to verify the results obtained from the precision checks and to validate those results across a range of concentration levels. Probability limits are calculated from the precision checks using the following equations:

$$\begin{aligned} Upper\,\mathrm{Pr}\,obabilityLimit &= m + 1.96 \cdot S \\ Lower\,\mathrm{Pr}\,obabilityLimit &= m - 1.96 \cdot S \end{aligned} \qquad \textbf{(C-6)}$$

where m is the mean and S is the standard deviation of the percent differences calculated using the following equations:

$$m = \frac{1}{k} \cdot \sum_{i=1}^{k} d_i$$

$$S = \sqrt{\frac{k \cdot \sum_{i=1}^{k} d_i^{\,2} - \left(\sum_{i=1}^{k} d_i \right)^2}{k(k-1)}} \qquad \textbf{(C-7)}$$

where k is the total number of precision checks for the interval being evaluated.

Percent differences for the performance evaluations are compared to the probability intervals for the respective site. Ninety-five percent of the individual percent differences (all audit concentration levels) should be captured within the probability intervals.

Precision Estimate from Collocated PM_{10} Samplers

Precision is estimated using measurements from collocated samplers of the same type. Precision data is considered valid only if both concentrations are greater than minimum values specified in EPA 40 CFR Part 58 Appendix A, section 4(c). For each collocated data pair, the percent difference ($\%d_i$) is calculated using the following equation:

$$\%d_i = \frac{X_i - Y_i}{(X_i + Y)/2} \cdot 100 \qquad \textbf{(C-8)}$$

where X_i is the concentration from the primary sampler and Y_i is the concentration value from the audit sampler. The coefficient of variation (CV) upper bound is calculated using the following equation:

$$CV = \sqrt{\frac{n \cdot \sum_{i=1}^{n} d_i^{\,2} - \left(\sum_{i=1}^{n} d_i \right)^2}{2n(n-1)}} \cdot \sqrt{\frac{n-1}{X^2_{0.1,n-1}}} \qquad \textbf{(C-9)}$$

where n is the number of valid data pairs being aggregated and $X^2_{0.1,n-1}$ is the 10th percentile of a chi-squared distribution with n-1 degrees of freedom. The factor of 2 in the denominator adjusts for the fact that each d_i is calculated from two values with error.

Bias Estimate for PM_{10} Using One-Point Flow Rate Verifications

For each monthly flow rate verification the percent difference in flow rate is calculated using Equation C-1. The absolute volume upper bound is then calculated using Equation C-3. The quantity AB is calculated using Equation C-4, and the quantity AS is calculated using Equation C-5.

Validation of PM_{10} Bias Using One-Point Flow Rate Verifications

Flow rate audits are used to assess the results obtained from the one-point flow rate verifications and to provide and estimate of flow rate acceptability. For each flow rate audit the percent difference in flow rate is calculated using Equation C-1. The 95% probability limits are then calculated from the one-point flow rate verification percent differences using Equations C-6, C-7, C-8, and C-9. The percent differences for the flow rate audits are then compared to the flow rate verification probability intervals. Ninety-five percent of the individual percent differences should be captured within the probability intervals.

Precision Estimate for $PM_{2.5}$

The precision estimate for collocated $PM_{2.5}$ instruments where one sampler is a Federal Equivalent method and the other is a Federal Reference Method are obtained using the same procedures that are used to obtain the precision estimate for SO_2, NO_2, O_3, or CO. In all other cases, the precision estimate is obtained using the procedures described for collocated PM_{10} samplers.

Bias Estimate for $PM_{2.5}$

The $PM_{2.5}$ bias estimate is calculated using the paired routine and the PEP monitor data described in EPA 40 CFR Part 58 Appendix A, section 3.2.6. The percent difference is calculated using Equation C-1, where *Y* is the measured concentration from the primary monitor, and *X* is the measured concentration from the PEP monitor. The data pair is considered valid only if both concentrations are greater than the minimum values specified in EPA 40 CFR Part 58 Appendix A, section 4(c). The average bias (D) is calculated using the following equation:

$$D = \frac{1}{n_j}\sum_{i=1}^{n_j} d_i \qquad \textbf{(C-10)}$$

where n_j is the number of pairs and $d_1, d_2, \ldots, d_{nj}$ are the individual percent differences to be aggregated.

Confidence intervals can be constructed for these average bias estimates using the following equations:

$$Upper90\%ConfidenceInterval = D + t_{0.95,df} \cdot \frac{s}{\sqrt{n_j}} \qquad \textbf{(C-11)}$$

$$Lower90\%ConfidenceInterval = D - t_{0.95,df} \cdot \frac{s}{\sqrt{n_j}} \qquad \textbf{(C-12)}$$

where $t_{0.95,df}$ is the 95th quantile of a t-distribution with degrees of freedom $df=n_j-1$ and s is an estimate of variability of the average bias calculated using the following equation:

$$s = \sqrt{\frac{\sum_{i=1}^{n_j}(d_i - D)^2}{n_j - 1}} \qquad \textbf{(C-13)}$$

C1.2 EXTERNAL ASSESSMENTS

C1.2.1 ARB Assessments

The ARB conducts annual performance evaluations and partial system audits on Air District monitoring stations. These audits consist of challenging the stations analyzers with known concentrations of EPA protocol gases. The gases are introduced to the sample train through the probe to ensure that the integrity of the entire system is tested. During these annual visits siting criteria, logbooks, calibrations, and standard certifications are also evaluated for regulatory compliance. EPA has certified ARB's audit system so that these audits fulfill the annual NPAP requirement.

Annually the ARB conducts both a performance audit and a comparison audit of the Air District Laboratory for gaseous toxic compounds. The performance audit consists of having the laboratory analyze a sample of know constituents and concentrations and comparing the results with the samples certified values. The comparison audit consists of having several laboratories analyze the same sample and comparing the results.

The ARB also conducts an annual audit of the $PM_{2.5}$ and PM_{10} filter weighing lab and documentation. This audit is designed to assess the weighing instrumentation accuracy, the weighing laboratory conditions (such as appropriate relative humidity), and appropriate certifications.

C1.2.2 EPA Assessments

40 CFR Part 58 Appendix A specifies that the EPA Regional Office will perform a Technical Systems Audit at least every 3 years. The TSA is an evaluation of the entire quality system and monitoring program for consistency with both regulatory requirements and EPA quality system guidance.

Annually the EPA conducts audits as part of the Performance Evaluation Program (PEP). These audits consist of co-locating a PEP certified and maintained FRM sampler next to one of

the Air Districts FRM samplers. A 24 hour integrated sample is then taken, the filters weighed and the results compared. This audit is conducted at a minimum of eight sites every year.

EPA audits the NATTS program on semiannual to quarterly basis. The laboratory operations part of NATTS is audited by conducting performance audit for carbonyl analysis by HPLC, and quarterly performance audits for toxics analysis by GC. They also conduct periodic TSAs for the NATTS program.

C2. REPORTS TO MANAGEMENT

To apprise management on the performance of quality assurance tasks, a number of reports will be generated. These reports consist of performance evaluations, summaries of precision checks, summaries of audit comparisons, EPA audits, ARB audits, and Technical Systems Audits performed by the Air District's QA Group. **Table C2-1** lists the QA management reports.

Table C2-1. QA management reports.

Type of Report	Frequency	Delivery Date	Person Responsible for Report Prep	Report Recipients
Gas Analyzer Performance Evaluation Reports	Monthly	30 days after the evaluation	QA Supervisor	Station Operator Air Monitoring Supervisors MQA Manager Air Monitoring Manager
PM sampler Flow Rate audit report	Monthly	30 days after the audit	QA Supervisor	Station Operator Air Monitoring Supervisors MQA Manager Air Monitoring Manager
Meteorological Audit Report	Quarterly	60 days after the audit	Meteorological Technician	MQA Manager
Laboratory Audit Reports	Annually	30 days after the audit	QA Supervisor	MQA Manager Lab Manager
Precision Report (AMP 246)	Quarterly	120 days after the end of each quarter	MQA Manager	Air Monitoring Manager Lab Manager Technical Services Director
Accuracy Report (AMP 247)	Quarterly	120 days after the end of each quarter	MQA Manager	Air Monitoring Manager Lab Manager Technical Services Director

Type of Report	Frequency	Delivery Date	Person Responsible for Report Prep	Report Recipients
Data Completeness Report (AMP 430)	Quarterly	120 days after the end of each quarter	MQA Manager	Air Monitoring Manager Technical Services Director
Quality Indicator Summary Data Extraction Standard Report (AMP 255)	Quarterly	120 days after the end of each quarter	MQA Manager	Air Monitoring Manager Technical Services Director
SASS Data Report	Monthly	45 days after the end of each month	RTI	Lab Manager
EPA NPAP Reports	Annually	Within 30 days of the audit	EPA	QA Supervisor Air Monitoring Manager
EPA NATTS Audit Report	Quarterly	30 days after the audit	EPA	Lab Manager Air Monitoring Manager
ARB $PM_{2.5}$ Laboratory Weight Room Audit Reports	Annually	90 days after the audit	ARB	Lab Manager
Technical Systems Audit Report	Every 5 years	90 days after the last system audit	QA Supervisor	MQA Manager Air Monitoring Manager Technical Services Director

SECTION D. DATA VALIDATION AND USABILITY

All data must be checked before release to the public or for use in planning, modeling, or making regulatory decisions. It is Division policy to review, verify, and validate all data to the highest level possible. The purpose of this chapter is to explain the data review process, identify the specific steps involved, quantify the review levels, and identify how these levels correspond with data user requirements

D1. DATA REVIEW, VERIFICATION, AND VALIDATION

Data are reviewed to different levels based on the type of data, the monitoring objectives, and the analysis tools available for data review. **Table D1-1** presents a summary of the process, the review levels, and the staff positions responsible for review of all ambient air quality data collected by the Technical Services Division. Specific manual data review procedures followed by staff are documented in **Appendix A** SOPs.

Table D1-1. Air quality data review levels.

Review Level	Data Reviewed	Data Review Qualifications	Staff Positions Responsible
0	Raw 1-minute data (or typically the highest time resolution available) collected in real time from field site sensors or analyzers into a TSD database	Data exists in TSD database; no quality control checks or data filtering applied	Automated procedure
0.5	Raw data; calibration data are segregated from ambient data and checked against operational limits; analyzer metadata reviewed per manufacturer specs; ambient data checked for reasonableness	Automatic Quality Checks applied; failed checks can filter ambient air quality data from real-time public viewing	Automated procedure
1.0	Selected raw data reviewed to level 0.5; all data from laboratory analysis of air sample canisters or filters	Manual data review; auto-QC failures are reviewed/confirmed; calibration and analyzer metadata reviewed; analyzers and lab equipment are performing normally and producing valid ambient air quality data; environmental conditions are within specs	AirMon AQIS I/II, Senior, or Supervisor; Lab Tech or Chemist I/II

Review Level	Data Reviewed	Data Review Qualifications	Staff Positions Responsible
2.0	All ambient air quality data reviewed to level 1.0 except selected Special Purpose Monitoring	Data verification across monitoring networks for internal consistency, meteorological conditions, and boundary condition data from neighboring air districts	MQA AQ Meteorologist I/II, Senior
2.5	All ambient air quality data reviewed to level 2.0	Data are exported from Technical Services Division databases and submitted to AQS; data passes validation and statistical checks; AQS Completeness Reports are reviewed quarterly	MQA AQ Meteorologist I/II, Senior
3.0	Criteria Pollutant air quality data submitted to AQS for which EPA Data Quality Objectives have been established and for which AMP 255 Precision and Accuracy Report CV and Bias values are available	CV and Bias values are compared with DQO targets to validate data against quality objectives; data quality evaluate for corrective actions and improvements	MQA AQ Met I/II, Senior; QA Officer and Division Management

Ambient air quality data are reviewed to **Table D1-1** levels depending on the type and intended use. Level 0.5 review is required for any real-time data released to the public. Analyzers at field sites typically produce a large quantity of performance data (metadata) documenting the analyzer conditions. Automatic checks screen these metadata for out-of-range conditions that may cause the analyzer to produce unreliable air quality data. Ambient air quality data are also subject to automatic checks that determine if values fall into expected ranges and respond appropriately for normal atmospheric conditions. Most analyzer metadata used in this process are only reviewed to Level 0.5. Generally, only a failed QC check will prompt further review by staff.

All ambient air quality data are reviewed to Level 1.0. This manual review level ensures that the instrumentation used to collect or analyze ambient data is operating normally and within manufacturer specifications. These data must also meet a 75% completeness requirement when sub-hourly data are aggregated to hourly averages. Depending on the monitoring objective, some experimental ambient data are considered “final” at this level.

Level 2.0 review involves all air quality and meteorological data typically used for planning, modeling, and analysis purposes within the agency. Ambient data reviewed to level 1.0 that meets EPA siting and duration criteria is validated to Level 2.0 to insure that pollutant concentration data are consistent across monitoring networks and with meteorological conditions, and that different types of monitoring data are consistent with one another. Level 2.0 data are considered “final” and released to the public within 90 days of collection.

As an Air District policy all Level 2.0 data are submitted to the EPA Air Quality System and undergoes validation and statistical checks before acceptance. AQS also provides completeness reports indicating whether data provided meets acceptable EPA reporting requirements for ambient air quality representativeness. Once accepted into AQS, air quality data has reached review level 2.5.

Level 3.0 data validation is performed on Criteria pollutants used for determining Air District attainment of the National Ambient Air Quality Standards (NAAQS) by EPA. This is the highest level of data review. Criteria pollutants are measured using Federal Reference Method (FRM), Federal Equivalent Method (FEM), or Approved Regional Method (ARM) equipment operated within certified limits and include ozone, $PM_{2.5}$, CO, SO_2, and NO_2. EPA has established (or is in the process of establishing) Data Quality Objectives (DQOs) for Criteria Pollutants in the form of measurement bias and confidence limits. In addition to completeness reports, AQS provides AMP 255 Precision and Accuracy Reports used to determine whether submitted data meets the required DQOs.

D1.1 DATA REVIEW

Ambient air quality data originates in two ways. One method involves placing sensors or analyzers at a monitoring location and, using instrumentation at the site, generates a continuous stream of numbers that represent pollutant concentrations at regular time intervals. In this method, the instrument in the field analyzes the air sample to produces concentrations. These are "real-time" measurements typically conducted by the Air Monitoring section. The other method involves collecting gas or filter samples that are transported to a laboratory for analysis. For this method, the instrument in the field only collects the sample, but does not analyze it. The samples are analyzed later in the laboratory to determine the concentration.

Real-time data collected from monitoring sites are subjected to automatic Quality Control checks specified by the Air Monitoring or MQA staff. The checks are site, parameter, and time-of-day specific and may include range (min/max), repeat value, rate-of-change, zero drift/correction, or comparison checks. QC checks can be used to monitor analyzer metadata for acceptable operating conditions. If conditions exceed threshold values, staff can receive electronic notification of the problem so that preemptive corrective action is taken before data become suspect. If metadata exceed normal ranges, QC checks automatically flag the associated ambient air quality data as suspect (not suitable for preliminary release to the public). QC checks operate directly on ambient data as well, invalidating or correcting data that is out of expected ranges (negative concentration data, for example) or is not responding as a "normal" atmospheric pollutant concentration should.

After automatic QC is complete, real-time data has reached review level 0.5 is ready for the first manual review by Air Monitoring AQIS staff. This manual review starts with examination of any automatic zero, span, or precision check data generated by the analyzer. If these data exceed operational thresholds, corrective actions are taken to restore the instrument within normal response limits. Depending on the deviations observed, data may be invalidated. Various instrument operating parameters such as flows, voltages, lamp conditions, internal

temperatures, pressures, enclosure temperature, etc., may also be consulted to determine if ambient data are valid. Staff may review local paper strip charts, data stored in the instrument or local datalogger, or central database information to establish data validity. Normally the station operator performs this review first followed by AQIS supervisor (and/or another designated staff member) confirmation in accordance with Standard Operating Procedures. At the conclusion of this review, data collected from monitoring sites has reached Level 1.0 review.

When analyzing samples from the field, whether air or filter sample, the Laboratory uses micro-balance (PM filter weights), ion chromatography (PM_{10} ions), GC/MS (toxics), and HPLC (carbonyls) analyses to measure compounds and, combined with sampling data, produce air pollutant concentrations. In the laboratory, the data review process proceeds in parallel with Air Monitoring. Instruments must be maintained within operating specifications to produce valid data in accordance with manufacturer specifications and the Laboratory SOPs. Data released by the Laboratory after this process has reached Level 1.0 review.

Meteorological data undergo a slightly different review process. Meteorological monitoring equipment is maintained by a meteorological technician (AQIS) in the MQA Section who is also responsible for Level 1 data review. Only data that pass a first-level range-checking filter are loaded into the raw Air District database. Later these raw data are subjected to a second, more comprehensive filter, which then creates an error report listing suspect data. This report is reviewed daily by the meteorological technician who then investigates the potential problem and makes repairs as needed. Later, the meteorological technician reviews and invalidates data affected by site operations such as quarterly calibrations or audits, battery maintenance, datalogger program changes, communication equipment repairs, etc. An MQA Air Quality Meteorologist, the Principal Air and Met Specialist, and the MQA Manager may also review data as part of Level 1.0 review procedures.

Regardless of the data source, all data certified to review Level 1.0 must meet the following requirements:

- Sub-hourly data was reviewed by automatic data quality checks and by staff responsible for sensor and instrument operation and maintenance;
- Instruments were operating within normal ranges as specified by the manufacturer, or per FRM, FEM, or ARM certification limits specified by EPA where appropriate;
- Automatic Quality Checks fall within operational limits;
- Data collected at sub-hourly intervals is aggregated to hourly averages with at least 75% data completeness for every valid hour;
- Local events affecting ambient air quality concentrations are noted in monitoring site logbooks or on sample chain-of-custody forms for recording during sample analysis by the laboratory.

D1.2 DATA VERIFICATION

Level 2.0 air quality and meteorological data verification is performed by MQA Air Quality Meteorologists. (Meteorological data are also verified by staff meteorologists from the Air District's Planning Division.) The first step is to confirm that all data identified at Level 1.0 has been reviewed by Air Monitoring, Laboratory, or meteorology AQIS staff, any data correction, invalidation, and adjustment was properly applied, and all sub-hourly data was aggregated correctly to hourly average values.

The second data verification step involves analyzing the entire data set from different perspectives or views. One view is to analyze the expected range and behavior of each parameter using diurnally or seasonally dependent range check or rates of change dependent on meteorological conditions and day-of-the-week. A second type of view is to consider the entire network of a single measured parameter at each point in time. Since the atmosphere is a continuously mixing and moving fluid, each measurement is spatially related to, and correlated with, neighboring measurements. Measurements that do not correlate well with neighbors should be investigated and may be affected by a temporary local condition such as construction or fires. A third view looks at measurement network boundaries and the impact of transport from outside the Air District. Pollution from events such as forest fires hundreds of miles outside Air District boundaries can be transported into our area and artificially elevate measurements. The final view analyzes for anomalies in the relationships between different measurement networks. Examples of this include 1) the exclusive relationship between NO_2 and ozone concentrations, 2) high afternoon ozone concentrations resulting from precursor concentrations, heat, sunlight, and light winds, or 3) high overnight PM concentrations resulting from light winds and strong surface temperature inversions.

All data anomalies or outliers identified from data verification should be investigated to explain the cause for maintaining or invalidating questionable data. Null codes or qualifiers may be inserted or added to explain missing or marginal data. The specific procedures to verify the various types of air quality data at Level 2.0 are specified in **Appendix A**, Data Management SOPs. After the verification is complete, data are available for regulatory purposes and public use. They are stored locally in an Air District database and are exported to AQS.

D1.3 DATA VALIDATION

Initial data validation begins with submission to AQS by MQA Air Quality Meteorologists, the Principal Specialist, and the MQA Manager. All submitted data must pass through AQS data validation and statistical checks before acceptance. AQS AMP 430 Data Completeness reports monthly and quarterly completeness that confirms sufficient data are accepted into the database to represent ambient conditions. All data that has undergone this level of validation has reached review Level 2.5.

Final data validation to level 3.0 involves quality check reviews, precision and accuracy reports, and confirmation that data submitted meets or exceeds Data Quality Objectives (DQOs). Criteria pollutants such as ozone, $PM_{2.5}$, CO, SO_2, and NO_2 used in determining Air District

attainment of the National Ambient Air Quality Standards are always reviewed to this level. The Air District (or ARB) may establish DQOs for other pollutants and evaluate data quality against these objectives in accordance with Policies established by the Director of Technical Services.

Precision and Accuracy data submitted routinely to AQS is reviewed quarterly using the AMP246 and 247 Precision and Accuracy Standard Reports listing all Precision and Accuracy checks. The number of submissions must meet or exceed the precision and accuracy requirements listed in 40 CFR Part 58. Next, the AMP255 Precision and Accuracy Standard Report provides a complete set of quality statistics for Criteria pollutants using the quality data previously reviewed. Among the results are coefficients of variation and bias estimates. These data are analyzed to determine whether quarterly pollutant data from each site meets Air District and EPA completeness and Data Quality Objectives. Except for toxics compounds, non-criteria pollutants are normally also reviewed to Level 3.0 to determine whether DQOs are being met.

Any data set failing to meet EPA Data Quality Objectives would be reviewed for possible flagging with a Data Qualifier or deletion from AQS at the discretion of the MQA Manager and with the agreement of the Division Director. Division Management would then decide on a course of action to determine what caused the failure to meet quality objectives and determine what steps are necessary to meet target DQOs.

D2. VERIFICATION AND VALIDATION METHODS

Level 2.0 air quality data verification is performed by MQA Air Quality Meteorologists. The specific procedures to be followed vary by pollutant and are specified in Data Management SOPs (600 series). The general method followed for verification includes reviewing data edits conducted by the Air Monitoring data review process and confirming that all changes were correctly recorded in the database and documented for chain-of-custody purposes. The next step involves converting pollutant data into a format for time-series graphical viewing using the Voyager program. Graphical data verification allows the reviewer to efficiently confirm acceptable pollutant levels between neighboring stations (and possibly neighboring air monitoring districts), between interactive pollutants such as NO_2 and ozone at the same station, and agreement with prevailing meteorological conditions. Verification requires further investigation and possible corrective action for any data anomalies and abnormal patterns that are detected.

Level 3.0 data validation is performed by MQA Air Quality Meteorologists. The first step is to submit air quality data to AQS. EPA has provided documentation, standard operating procedures, user training, and a call-in help line to assist users with data submission (EPA, 2005; 2006). Data submitted to AQS are subject to a set of acceptance criteria administered by the AQS data ingest procedure. Any data violating the database "business rules" are placed in a temporary Staging Table where the submitter can view error messages and correct problems. After all data are accepted, a statistical test is performed which evaluates how closely the new data meshes with the existing data for the same parameter. A preponderance of high data values among the new data suggests further investigation is warranted. Sometimes a problem submitting new AQS data reveals a problem with data already existing in AQS.

The second data validation step is to generate quarterly AQS Data Completeness, Precision, and Accuracy reports described in Section C1.1.5. If data completeness reported for any quarter falls below targets established by the Air District, reasons for the low figures must be explained to the satisfaction of the Division Director and, if within control of the Division, changes are implemented to increase the completeness level. Precision and Accuracy reports list all the single point Quality Checks conducted by the Division within the quarter. A quick review of all the checks quickly identifies tests that fall outside of acceptable limits. A pattern of failures at a particular site or instrument indicates a recurrent problem has not been solved. In all cases, the validation requires scrutiny of all precision and accuracy tests results that fall outside of the "normal" range.

With new 40 CFR Part 58 regulations adopted on October 17, 2006, the required quality of air pollution data are determined through the use of Data Quality Objectives (DQOs) and calculation of Coefficients of Variation (CV) and Bias targets. Currently CV and Bias targets are established by EPA for ozone and $PM_{2.5}$, and other EPA criteria pollutant DQOs are under development. The Technical Services Division also has established DQOs for internal use as part of this QAPP. The AMP 255 Precision and Accuracy Report CV and Bias values are compared with DQO targets to determine if data quality objectives are being met for both EPA and the Division. Failure to meet DQO targets must be reported to Division management for

further action. Either allowable precision and/or accuracy limits must be tightened, or the DQO requirements must be relaxed thorough changes to the Division Quality Plan.

D3. RECONCILIATION WITH USER REQUIREMENTS

Data reported by the Technical Services Division is always reviewed, verified, and validated to the highest possible Review Level indicated in **Table D1-1**. For Criteria pollutants, this requires data submission to AQS and a Level 3.0 review. For Division data that do not have established DQOs, review Level 2.5 applies. In all cases, these data are subject to unrestricted use by the air quality community for regulatory planning and attainment evaluation purposes and have met the following conditions:

- meets all completeness requirements for hourly, daily, monthly, quarterly, or yearly data collection
- where appropriate, data quality meet or exceed establish DQOs
- the air quality monitoring operations meet EPA siting and instrumentation guidelines,
- all QA/QC requirements have been followed,
- data are validated to Level 3.0 and meet data completeness requirements for the purpose of determining NAAQS attainment,
- data are validated to Level 2.5 and submitted to AQS as nonregulatory data by using the appropriate method codes,
- data are validated to at least Level 1.0 for any SPM of less than one year duration where data are not submitted to AQS.

Final air quality and meteorological data submitted to AQS are also made available to the general public through a public web site maintained by the Air District. Once these data are made public, their use is unrestricted.

Toxics air monitoring data are summarized in an annual report prepared by the Air District. The report lists concentrations for each pollutant for each site for every sampling day; as well as annual summaries by pollutant for each station of the mean, maximum, and minimum concentrations. Copies of the report can be downloaded from the Air District's website, under the title: *Toxic Air Contaminants Control Program Annual Report.*

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BAY AREA AIR QUALITY MANAGEMENT DISTRICT

QUALITY ASSURANCE PROJECT PLAN

APPENDIX A

STANDARD OPERATING PROCEDURES

OVERVIEW

The Standard Operating Procedures (SOP) in this Appendix define how the Air Monitoring Program sampling network is installed and operated, laboratory analyses are performed, data are collected and managed, and performance evaluations are performed. Administrative SOPs define how the Bay Area AQMD Quality Documents (QMP, QAPP, and SOPs) are managed. The purpose of SOPs is to standardize procedures used by many staff performing the same tasks for more consistent and higher quality results. They are an efficient training method for new staff and are reviewed at least annually for possible improvements. SOPs are organized into functional groups depending on the type of procedure. Though part of this QAPP Appendix, SOPs are maintained as separate documents named [<ID> + <Name>] from the SOP index below. For example, the document name for the first SOP is "Admin SOP 001 Quality Document Changes".

Numbering system for Technical Services Division SOPs.

SOP Series Number	SOP Group
0xx	Administrative
1xx	Air Monitoring Operations
2xx	Air Monitoring Instruments
3xx	Laboratory
4xx	(reserved)
5xx	Meteorology
6xx	Data Management
7xx	Performance Evaluation
800-999	(currently unassigned)

STANDARD OPERATING PROCEDURE INDEX

ID	Name	Rev. #	Date
Admin SOP 001	Quality Document Changes	001.1.01	2/26/2009
Admin SOP 002	Template for SOPs	002.1.02	2/26/2009
Admin SOP 003	Corrective Action Report	003.1.00	3/8/2010
Admin SOP 004	AirMon Instrument Startup and Shutdown	114.1.00	3/23/2010
AirMon SOP 101	Station Operator	101.1.01	5/8/2008
AirMon SOP 102	Strip Chart Review	102.1.00	5/23/2006
AirMon SOP 103	Probe Maintenance	103.1.01	12/8/2008
AirMon SOP 104	Residence Time Calculation	104.1.00	5/31/2007
AirMon SOP 201	PM10	201.2.00	10/20/2009
AirMon SOP 202	PM10 Calibration - DELETED	202.1.00	5/31/2007
AirMon SOP 203	PM10 Maintenance - DELETED	203.1.00	10/31/2006
AirMon SOP 204	PM10 Collocated Special Study	204.1.00	5/25/2007
AirMon SOP 205	RAAS PM25	205.1.01	5/30/2008
AirMon SOP 206	SASS PM25 Speciation	206.1.01	2/13/2009
AirMon SOP 207	MetOne PM25	207.1.01	5/30/2008
AirMon SOP 208	Magee Scientific Aethalometer	208.1.00	9/11/2005
AirMon SOP 209	RM Environmental 924	209.1.01	7/8/2008
AirMon SOP 210	RM Environmental 910a	210.1.00	1/21/2006
AirMon SOP 211	TECO 42	211.1.01	5/30/2008
AirMon SOP 212	TECO 43	212.1.01	5/30/2008
AirMon SOP 213	TECO 48	213.1.01	5/30/2008
AirMon SOP 214	TECO 48C TLE	214.1.01	5/30/2008
AirMon SOP 215	TECO 49	215.1.01	5/30/2008
AirMon SOP 216	TECO 49C PS	216.1.00	8/30/2007
AirMon SOP 217	TECO 49i PS	217.1.01	5/7/2008
AirMon SOP 218	TECO 55	218.1.01	5/30/2008
AirMon SOP 219	TECO 45	219.1.01	5/30/2008
AirMon SOP 220	TECO 146	220.1.02	9/14/2009
AirMon SOP 221	AADCO Zero Air Generator QC Check	221.1.00	3/23/2008
AirMon SOP 222	Particol 2025 PM2.5	222.1.00	2/26/2009
Lab SOP 301	PM10	301.1.01	1/8/2009
Lab SOP 302	PM25	302.1.00	1/29/2007
Lab SOP 303	PM10 Ion Chromatography	303.1.01	1/8/2009
Lab SOP 304	IC Cations - DELETED	304.1.00	1/29/2007
Lab SOP 305	OC-EC	305.1.00	2/23/2006
Lab SOP 306	HPLC	306.1.01	5/27/2008
Lab SOP 307	PM10 Ion Data - DELETED	307.1.00	1/30/2007
Lab SOP 308	GC Toxics	308.1.00	1/19/2006
Met SOP 501	Wind Speed	501.1.00	8/29/2007
Met SOP 502	Wind Direction	502.1.00	8/29/2007

ID	Name	Rev. #	Date
Met SOP 503	Temperature	503.1.00	8/29/2007
Met SOP 504	Temp/RH	504.1.00	9/13/2007
Met SOP 505	Solar Radiation	505.1.00	5/1/2006
Met SOP 506	Precipitation	506.1.00	8/29/2007
Met SOP 507	Barometric Pressure	507.1.00	8/29/2007
Met SOP 508	Site Safety	508.1.00	2/28/2008
Met SOP 509	Tilt Towers	509.1.00	8/29/2007
Met SOP 510	Battery Maintenance	510.1.01	2/28/2008
Met SOP 511	F460 Wind Direction Sensor Maint	511.1.00	2/24/2010
Data Mgt SOP 601	Gaseous Pollutants	601.1.00	8/24/2007
Data Mgt SOP 602	PM10	602.1.00	6/1/2007
Data Mgt SOP 603	PM25	603.1.01	6/2/2008
Data Mgt SOP 604	BAM 1020a	604.1.00	8/1/2005
Data Mgt SOP 605	Aethalometer	605.1.00	4/1/2005
Data Mgt SOP 606	Toxics910	606.1.00	6/1/2007
Data Mgt SOP 607	Toxics924	607.1.00	7/17/2007
Data Mgt SOP 608	NATTS	608.1.00	7/1/2007
Data Mgt SOP 609	Met Data	609.1.00	8/29/2007
QA SOP 701	Technical Systems Audit	701.1.00	6/1/2006
QA SOP 702	Full Station Performance Evaluation	702.1.01	5/20/2008
QA SOP 703	Partial Station Performance Evaluation	703.1.01	6/17/2008
QA SOP 704	GLM Performance Evaluation	704.1.01	6/17/2008
QA SOP 705	Operations Data Action Monitoring Notification	705.1.01	2/24/2010
QA SOP 706	O3 Performance Evaluation	706.1.01	6/17/2008
QA SOP 707	PM10 with Fixed Orifice	707.1.01	6/17/2008
QA SOP 708	PM10 with Variable Orifice	708.1.01	6/17/2008
QA SOP 709	Andersen RAAS PM2.5 Performance Audit	709.1.00	6/1/2006
QA SOP 710	BAM PM2.5 Performance Audit	710.1.00	6/1/2006
QA SOP 711	DIOXIN Flow Rate Audit	711.1.01	6/17/2008
QA SOP 712	TECO Analyzer Checklist	712.1.00	6/1/2006
QA SOP 713	Barometric Standards Quarterly Verification	713.1.00	6/1/2006
QA SOP 714	Ozone Lab Comparison	714.1.00	3/1/2008
QA SOP 715	API 701 Zero Air Generator Verification Test	715.1.00	9/5/2007
QA SOP 716	District Lab Audits	716.1.00	6/1/2006
QA SOP 717	QA Lab Standards	717.1.00	6/1/2006
QA SOP 718	Aethalometer Flow Rate Audit	718.1.01	6/17/2008
QA SOP 719	Xontech 910A Audit	719.1.00	2/24/2010
QA SOP 720	SASS Flow Rate Audit	720.1.00	2/24/2010

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

QUALITY ASSURANCE PROJECT PLAN

APPENDIX B

AIR MONITORING NETWORK PLAN

OVERVIEW

The Technical Services Division produces an annual Air Monitoring Network Plan that provides a comprehensive review of the Air District's Air Quality Monitoring Network. The latest version of this plan is included in the QAPP as Appendix B with a document name of "Air Monitoring Network Plan". The Plan is completed approximately 6 months after the end of the Plan year and incorporated into the QAPP on approval by Division Management.