Quality Assurance Project Plan (QAPP)

for AB 617 Community Air Monitoring Program

South Coast Air Quality Management District

September 2020

Version 1

LIST OF ACRONYMS	
AM	Atmospheric Measurements
AMT	Advanced Monitoring Technologies
AQ Chemist	Air Quality Chemist
AQIS	Air Quality Instrument Specialist
AQIS I	Air Quality Instrument Specialist I
South Coast AQMD	South Coast Air Quality Management District
AQS	Air Quality System
AQ-SPEC	Air Quality Sensor Performance Evaluation Center
BC	Black Carbon
BM	Baseline Monitoring
CAAQS	California Ambient Air Quality Standards
CAR	Corrective Action Request
CARB	California Air Resources Board
CEE	Community Engagement and Education
CFR	Code of Federal Regulations
CH4	Methane
CHBI	Compliance and Health-Based Information
CM	Concentration Mapping
CO	Carbon Monoxide
COC	Chain-of-Custody
CPC	Condensation Particle Counter
CSN	Chemical Speciation Network
DEO	Deputy Executive Officer
DMS	Data Management System
DQI	Data Quality Indicator
DQO	Data Quality Objective
EE	Emissions Estimation
EO	Executive Officer
FEM	Federal Equivalent Method
FID	Flame Ionization Detector
FRM	Federal Reference Method
GC	Gas Chromatograph
GLP	Good Lab Practice
H2S	Hydrogen Sulfide
HPLC	High Performance Liquid Chromatography
IC	Ion Chromatography
ICP-MS	Inductively Coupled Plasma – Mass Spectrometry
IO	Inorganic
IoT	Internet of Things
LAN	Local Area Network

LIMS	Laboratory Information Management System
LS	Laboratory Services
M&A	Monitoring and Analysis Division
MM	Mobile Monitoring
MN	Monitoring Network
MQO	Measurement Quality Objectives
MS	Mass Spectrometer
NAAQS	National Ambient Air Quality Standards
NATTS	National Air Toxics Trends Station
NIST	National Institute of Standards and Technology
NMHC	Non-Methane Hydrocarbon
NO	Nitrogen Oxide
NO2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
O3	Ozone
OAG	Operation Assistance Guide
ORS	Optical Remote Sensing
PAMS	Photochemical Assessment Monitoring Stations
Pb	Lead
PC	Precision Check
PM	Particulate Matter
PM2.5	Particulate Matter with Diameter Below 2.5 µm
PM10	Particulate Matter with Diameter Below 10 µm
QA	Quality Assurance
QA Branch	Quality Assurance Branch
QAA	Quality Assurance Alert
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
SASS	Speciation Air Sampling System
SC	Source Characterization
SI	Source Identification
SOP	Standard Operating Procedures
SQL	Structured Query Language
STA	Science and Technology Advancement
STE	Source Testing Engineering
TO	Toxic Organics
TSP	Total Suspended Particulate
UHPLC	Ultra High Performance Liquid Chromatography
U.S. EPA	United States Environmental Protection Agency
UFP	Ultrafine Particles
VOC	Volatile Organic Compounds

WAN	Wireless Area Network
XRF	X-ray Florescence

CONTENTS

FIGURES

TABLES

1.1 Program Organization

The South Coast AQMD (South Coast AQMD) organizational structure and the general description of the administrative, management, and staff responsibilities are outlined in the Quality Management Plan for Environmental Measurement Programs (QMP). At the South Coast AQMD, the Special Monitoring/AB 617 Community Air Monitoring group is part of the Advanced Monitoring Technologies (AMT) Branch within the Monitoring and Analysis Division (M&A) under the Office of Science and Technology Advancement (STA); see organization chart below. AMT works with the other M&A Branches: Monitoring Network (MN), Laboratory Services (LS), Source Test Engineering (STE), and QA. The roles and responsibilities of M&A are outlined in the QMP. Table 1.1 below shows the responsibilities and upward lines of communication for staff involved in Special Monitoring and AB 617 Community Air Monitoring projects.

Table 1.1 Positions and Responsibilities

Position	Responsibilities	Upward Lines of Communication
Deputy Executive Officer (DEO): STA	Accountable for the accomplishment of project objectives	Chief Operating Officer, Executive Officer (EO), Executive Council, and Governing Board
Assistant Deputy Executive Officer (ADEO): Chief Information Officer	Accountable for computer, software, hardware, and communications support	Chief Operations Officer, Executive Officer, Executive Council, and Governing Board
Assistant Deputy Executive Officer (ADEO): STA	Responsible for the accomplishment of project objectives	DEO: STA
Laboratory Services Manager	Responsible for laboratory oversight, including preparation of sampling media and sample analysis, timely data reporting consistent with data quality requirements and program objectives, laboratory documentation, training and safety	ADEO: STA
Advanced Monitoring Technologies Manager	Responsible for Special Monitoring and AB 617 Community Air Monitoring projects, monitoring related to rule compliance, testing and deployment of low-cost sensors, and the implementation of remote sensing and other advanced monitoring technologies	ADEO: STA
Atmospheric Measurements Manager	Responsible for establishment, operation and maintenance of South Coast AQMD's air monitoring network	ADEO: STA
Monitoring Operations Manager	Responsible for establishing, operating and maintaining monitoring equipment and stations, and for managing the field	Advanced Monitoring Technologies Manager

Position	Responsibilities	Upward Lines of Communication
	operations for Special Monitoring and AB 617 Community Air Monitoring projects	
Quality Assurance Manager	Responsible for reviewing, developing, documenting, and overseeing implementation of quality assurance and quality control (QA/QC) practices and procedures, implementation of performance and technical systems assessments, and coordinating audits with U.S. EPA and CARB	ADEO: STA
Program Supervisor	Responsible for the development and implementation of CAMPs, the preparation of evaluations, analyses, and other forms of quantitative assessment of air quality data, reports, scientific papers, and communicating the results to the CSC and other stakeholders as appropriate	Advanced Monitoring Technologies Manager
Air Quality Specialist	Responsible for conducting advanced monitoring (e.g. mobile measurements, special projects), data analysis and interpretation, development of reports and presentation slides for Special Monitoring and AB 617 Community Air Monitoring projects	Program Supervisor
Principal Air Quality Chemists	Responsible for laboratory operations of the compliance/enforcement, advanced spectroscopic methods, ambient toxics, and aerosol analysis work groups, data validation and database submittals, maintenance of Operation Assistance Guides (OAGs), Standard Operating Procedures (SOPs) and QAPPs	Laboratory Services Manager
Senior Air Quality Chemists	Responsible for supporting, compliance, advanced spectroscopic methods, ambient VOC, toxics and aerosol analysis work group operations, and 2nd level data review/validation, submittal of data into program database; point of contact for relevant Senior AQIS; also, QA oversight of laboratory operations and safety (QA Branch)	Principal AQ Chemist; QA Manager for QA Branch

Position	Responsibilities	Upward Lines of Communication
Air Quality Chemists and Assistant Air Quality Chemists	Responsible for following SOPs, OAGs and general GLP in the analysis of samples; 1st level data validation; submittal of data into Element LIMS	Principal AQ Chemist
Laboratory Technician	Responsible for following SOPs, OAGs and general GLP for the preparation of samples or sampling media	Principal AQ Chemist
Principal Air Quality Instrument Specialist	Responsible for station operations and deployment and oversight of Data Management/Validation and/or coordinating repair and calibrations	Monitoring Network Manager
Senior Air Quality Instrument Specialist	Responsible for supporting Special Monitoring and AB 617 Community Air Monitoring operations and performing 3rd level data validation, repair and calibration, and/or QA audit function	Principal Air Quality Instrument Specialist; QA Manager for QA Branch
Meteorological Technician	Responsible for providing meteorological support to Special Monitoring and AB 617 Community Air Monitoring operations.	Principal Air Quality Instrument Specialist
Air Quality Instrument Specialist I and II	Responsible for following instrument manuals, SOPs and OAGs used in the collection of samples from the field sites, Level 1 & Level 2 (Data Management/Validation Group) continuous data validation, maintaining the station site and instruments, repair and calibration, and/or QA audits	Principal Air Quality Instrument Specialist; QA Manager for QA Branch

1.2 Identify Information Inputs

Information inputs required for the AB 617 Community Air Monitoring program include:

- Measurements, with appropriate averaging periods, time frames and proximity to sources, sufficient to satisfy AB 617 Monitoring objectives and assess compliance with South Coast AQMD rules and other regulations, if applicable;
- CAMP that demonstrates that the monitoring strategy, approach, methods, and implementation strategy meet the requirements of the AB 617 program;
- Air pollutant spatial and temporal changes;
- Air pollution historical trends;
- Community and stakeholders' feedback;
- Periodic and real time reporting of air quality data to the public;
- Environmental factors such as meteorology and topography;

- Budget, instrumentation, staffing and other available resources;
- Maintenance Plan and State Implementation Plan (SIP) requirements, if applicable;
- Timely near real-time data reporting; and
- Point source, community scale, or regional air pollutant modeling requirements and objectives.

1.3 Develop the Plan for Obtaining Data

In order to support the air quality management work indicated in the basic air monitoring objectives, AB 617 Community Air Monitoring projects must be designed to include a variety of stationary monitoring equipment, mobile monitoring platforms (e.g. vehicles and aircraft), or a combination of both. Stationary and mobile measurements must be capable of informing managers about air pollution emissions from the sources of interest, potential impacts in nearby communities, typical levels of the pollutants of interest in the study area, and other important aspects of the monitoring project. Also, the design objectives of the AB 617 Community Air Monitoring program should meet one or multiple basic requirements depending on the monitoring purpose:

- Support compliance and planning activities for emission source or community emissions reduction strategies. Data from monitors of various types can be used in the development of strategies and rule development. In monitoring locations near major air pollution sources, source-oriented monitoring data can provide insight into how well industrial sources are complying to air emission rules and regulations;
- Provide air pollution data to the community in a timely manner;
- Support air pollution research studies. Air pollution data can be used to supplement data collected by researchers working on health effects assessments and atmospheric processes, or for monitoring methods development work;
- Look at levels of pollution at the community level for providing information on further action, if necessary; and
- Provide information on when a monitoring study can be considered complete so that resources can be reallocated to a different project.

Table 1.2 summarizes how different monitoring approaches can be used to achieve specific monitoring objectives.

Table 1.2 Monitoring Approaches for Satisfying Specific Monitoring Objectives

Air Monitoring Purpose	Air Monitoring Approach			
	Stationary Air Monitoring			Mobile Air Monitoring
	Established and Regulatory Monitors	Research-grade Monitors	Low-cost Sensors and Sensor Networks	Mobile Measurement Platforms
Baseline Monitoring (BM)	Established and regulatory monitors can be installed in air monitoring stations or in trailers to conduct measurements at specific locations in targeted communities to provide the basis for comparing against standards and known health thresholds, assessing regional air quality and community impact, and tracking the progress of emission reduction strategies with a high level of confidence	Research-grade monitors can be installed in air monitoring stations or in trailers to conduct measurements at specific locations in targeted communities to provide the basis for comparing against standards and known health thresholds, assessing regional air quality and community impact, and tracking the progress of emission reduction strategies	N/A	N/A
Concentration Mapping (CM)	N/A	N/A	Low-cost sensor networks can be used to characterize the spatial and temporal variability of certain particle and gaseous pollutants within a community or a wide geographical area, and to identify pollution hotspots for certain particle and gaseous pollutants	Mobile platforms can be equipped with established and regulatory monitors and/or research-grade monitors for continuous measurements of particulate and gaseous pollutants for conducting wide area and targeted surveys, pollution hotspot Identification, or concentration mapping

Air Monitoring Purpose	Air Monitoring Approach			
	Stationary Air Monitoring			Mobile Air Monitoring
	Established and Regulatory Monitors	Research-grade Monitors	Low-cost Sensors and Sensor Networks	Mobile Measurement Platforms
Source Identification (SI)	When applicable, fixed/stationary battery-operated portable monitors can be deployed near (e.g. upwind and downwind) of a potential emission source to determine the contribution to the observed ambient levels	N/A	Low-cost sensors can be deployed at the fenceline of a facility to better characterize the spatial and temporal variability of certain particle and gaseous pollutants and help identify potential sources of emissions	Mobile platforms are powerful tools that can "chase" air pollution plumes and conduct investigative monitoring to identify the specific source(s) of emission
Source Characterization (SC)	Established and regulatory monitors can be deployed at the fenceline or near a facility (e.g. downwind) to characterize the temporal variability of targeted pollutants and gather insight into the specific process(es) that are leading to those emissions	Research-grade monitors enable simultaneous real-time measurement of various analyte groups that can be deployed near a facility (e.g. downwind) to characterize the temporal variability of targeted pollutants and gather insight into the specific process(es) that are leading to those emissions	Low-cost sensors can be deployed at the fenceline of a facility to better characterize the temporal variability of certain particle and gaseous pollutants and gather insight into the specific process(es) that are leading to those emissions	Mobile monitoring can help improve our understanding of the composition and variability of known emission sources and determine emission source signatures

Air Monitoring Purpose	Air Monitoring Approach			
	Stationary Air Monitoring			Mobile Air Monitoring
	Established and Regulatory Monitors	Research-grade Monitors	Low-cost Sensors and Sensor Networks	Mobile Measurement Platforms
Compliance and Health-Based Information (CHBI)	Established and regulatory monitors used for measurements conducted at specific locations (e.g. upwind and/or downwind of an emission source) can provide the basis for comparing against known health thresholds and/or rules limits and requirements with a high level of confidence	Research-grade monitors used for measurements conducted at specific locations (e.g. upwind and/or downwind of an emission source) can provide the basis for comparing against known health thresholds and/or can be used in monitoring investigations to provide information in support of compliance and enforcement activities	N/A	Mobile measurements can provide the basis for more robust monitoring, onsite measurements, and supplemental air monitoring in support of compliance and enforcement investigations
Community Engagement and Educational (CEE)	N/A	N/A	Low-cost sensors for measuring particle and gaseous pollutants are excellent education and outreach tools, and can be used alone or within a network to engage citizen scientists and community members in different aspects of the air monitoring process	N/A

Air Monitoring Purpose	Air Monitoring Approach			
	Stationary Air Monitoring			Mobile Air Monitoring
	Established and Regulatory Monitors	Research-grade Monitors	Low-cost Sensors and Sensor Networks	Mobile Measurement Platforms
Emissions Estimation (EE)	N/A	N/A	N/A	One of the mobile platforms is equipped with remote sensing instruments that can be used to estimate emission rates using gas column measurements conducted by driving the mobile platform upwind and downwind of the source during multiple passes

1.4 Training

South Coast AQMD general training practices are documented in the South Coast AQMD QMP. The South Coast AQMD makes every effort to ensure the appropriate training of all staff involved in the AB 617 Community Air Monitoring program, as well as laboratory personnel, field operations and support personnel, QA personnel, temporary and contract personnel, and supervisory and management personnel that help support the AB 617 community air monitoring efforts. This ensures that staff has sufficient knowledge for adequately performing assigned duties, including the ability to satisfy programmatic and agency QA requirements. Mandatory QA training is conducted within the first year of being hired and periodically thereafter.

Staff working on AB 617 Community Air Monitoring projects must satisfy class specifications for each position performing a function related to any of these programs. The class specifications identify the job duties for each position and the minimum requirements for education and experience, knowledge, skills and abilities necessary to be able to perform those job duties. Temporary staff assigned tasks under these programs are required to meet the minimum requirements of the classification specification typically assigned to these tasks.

Staff performing AB 617 Community Air Monitoring functions are required to be trained for the tasks to which they are assigned. Newly hired or assigned staff are required to be trained in the basic measurement and sample collection techniques relevant to the tasks that they are expected to perform. A staff member experienced in the methods being used serves as a mentor to the trainee. Typically, a trainee is assigned to a study of the relevant portions of instrument manuals, SOPs, QAPPs and other relevant documentation. The mentor trains the trainee on operations methodology and practices, including performance of good work techniques with an emphasis on avoiding contamination of equipment, samples, and supplies. The mentor instructs and queries the understanding of the trainee on the basic requirements of their assigned tasks, instrument operation, and the contents of relevant SOPs, OAGs, and other relevant documents before commencing “hands on” training. The mentor trains the trainee on the task(s) to be performed and whom to contact for assistance.

After training is complete, the mentor observes the trainee perform the assigned tasks including evaluating performance of procedures such as pre-sampling media preparation, sample collection, post-sampling media preparation, sample analysis, instrument operation, instrument calibration, data treatment, data review, system maintenance, and record keeping. Once the trainee has mastered the assigned tasks (i.e. can successfully and independently perform the monitoring activities), the mentor completes a Training Record Form and submits it to the branch secretary or office assistant for review and filing. The supervisor or trainer is responsible for assessing proficiency before signing the Training Record Form. The training document is filed as a PDF in a centralized location and a hard copy is also retained on file. On an annual basis, or more frequently, the QA Branch will periodically review training records for completeness of covered topics and relevant staff.

Even after training is complete, the trainee works under the direction of the mentor and supervisor until the mentor has established that the trainee is ready to work without supervision. Ongoing performance is monitored by the work group senior and/or principal level staff through review of analytical data from samples, as well as the results of internal and external audits. Project staff are encouraged to attend

courses such as the statewide Primary Quality Assurance Organization (PQAO) training, U.S. EPA courses, manufacturer's training sessions, or method-specific courses that are relevant to the assigned tasks.

For training involving field and laboratory analytical instrumentation under the direction of the mentor, the trainee is typically required to analyze reference samples including, when available, samples that have been previously analyzed by the mentor. The trainee is required to demonstrate acceptable Measurement Quality Objectives (MQOs) for recovery (or bias), accuracy, and precision before being deemed ready to perform analysis independently. For AB 617 Community Air Monitoring field staff, routine training sessions are held in conjunction with regular working group meetings. These meetings occur quarterly or as needed to address issues that occur while conducting AB 617 Community Air Monitoring activities.

Data reviewers are trained and mentored as per above in the operational properties and expectations of monitoring instrumentation, data acquisition systems, and calibration and maintenance procedures. The ability to review data for quality and completeness is critical for staff involved in the review and validation of data. The data reviewers are trained on all data collection, analysis, review, visualization, and reporting software tools used for data management, validation and data submission to South Coast AQMD or CARB AB 617 data repositories. Their primary expertise resides in their ability to review and validate data for quality as per Data Quality Objectives (DQOs).

All new or newly assigned South Coast AQMD field and laboratory staff receive basic safety training. This training covers safety issues, including, but not limited to, the South Coast AQMD Injury and Illness Prevention Plan (IIPP), hazard recognition, and proper cylinder handling, as well as a general orientation to the South Coast AQMD and performing work at air monitoring stations or platforms. Field and laboratory staff are provided with safety information through the South Coast AQMD Administrative Policies & Procedures #28: Safety and Health Guidelines Policy, South Coast AQMD IIPP, South Coast AQMD Chemical Hygiene Plan, South Coast AQMD Laboratory Safety Manual, South Coast AQMD Monitoring Station Safety Manual, and in SOPs and OAGs, as appropriate, and attend additional safety or first aid training relevant to their job duties.

2.1 Measurement Method and Design

The measurement method and design used in any AB 617 Community Air Monitoring project depend upon the project and monitoring objectives. A targeted Project Plan may be developed to respond to the objectives of a particular project. The measurement method used may consist of a mixture of *established and regulatory monitors*, *research-grade monitors, low-cost sensors or sensor networks*, and *mobile measurement platforms*.

South Coast AQMD establishes local DQOs based upon the federal and state data quality requirements if the objective is intended that the data be comparable to the NAAQS, CAAQS or to data measured by other federal programs (e.g. NATTS, CSN, PAMS). However, certain monitoring activities under the AB 617 Community Air Monitoring programs may be for different objectives that prioritize other criteria that would be more appropriate for the purpose of the study such as faster measurements or measuring many areas within a community rather than just a fixed location. Design considerations such as pollutant levels and proximity of the ambient concentrations to the standards, instrument reliability, and special studies objectives may affect the level of data quality requirements.

Data quality indicators (DQIs) describe the general framework for ensuring that monitoring data are of known and documented quality and available in a timely manner to meet the DQOs. These indicators include precision, bias, accuracy, completeness, representativeness, sensitivity, comparability, and other related criteria, as appropriate. MQOs are the acceptance or performance criteria for individual DQIs. They are designed to evaluate and control various phases of the measurement process (e.g. sampling, preparation, and analysis) to ensure that the total measurement uncertainty is within the range prescribed by the DQOs.

Having established project DQOs, the quality of the data must be evaluated to ensure it is within established acceptance criteria. Controlling and assessing data quality requires the development of MQOs in order to provide a framework for ensuring that data is of a known and documented quality for the purposes they are intended for. MQOs can be defined in terms of the following DQIs:

Precision - Precision is a measure of the degree of repeatability of data collection activities. This step is important for determining whether the measurement system is under control. Precision can be assessed using duplicate or collocated measurements, sampling, duplicate filters, a number of laboratory-based techniques, and other established procedures.

Bias - This is 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.

Accuracy - Accuracy is a measure of the closeness of an individual measurement or the average of a number of measurements to the true value. It includes a combination of random error (precision) and systematic error (bias) components.

Comparability - This is a measure of the confidence with which one data set or method can be compared to another, considering the units of measurement and applicability to standard statistical techniques. Comparability of datasets is critical to evaluating their measurement uncertainty and usefulness.

Completeness - Completeness is a measure of the fraction of sampling events that provide useable data. A sufficient number of the planned samples must yield valid data to ensure that the DQOs have been achieved. In other words, completeness describes 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 (or Detection Limit) – This is the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. It can also be defined as a measure of the minimum quantified concentration achievable, with some level of certainty, given the data collection activities (e.g., sampling/analysis).

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

When appropriate, MQOs/DQI for AB 617 Community Air Monitoring projects will be consistent with those of more established Federal programs mandated by the U.S. EPA, but due to the diverse and sometimes experimental nature of the monitoring activities conducted under AB 617 Community Air Monitoring projects, staff may need to develop project specific MQOs/DQIs. If issues are found, actions will be documented and followed to completion through the corrective action process, utilizing Corrective Action Requests (CARs) with subsequent follow-up (see "Data Review, Verification and Validation" in the QAPP for more details).

The most common monitoring strategies that are used for AB 617 Community Air Monitoring applications include: *Established and regulatory monitors*, *research-grade monitors*, *low-cost sensors and sensor networks*, and *mobile platforms*. The specific DQOs and MQOs for these four air monitoring types are discussed in the following sections.

2.2 Stationary Air Monitoring with Established and Regulatory Monitors

South Coast AQMD currently samples criteria pollutant air quality at over 40 stationary air monitoring stations, meeting both NAAQS-related and non-NAAQS objectives. In addition, South Coast AQMD monitors and conduct laboratory analyses for VOCs, PM chemical speciation, and toxic compounds for both federal (e.g., PAMS, NATTS, and CSN) and non-federal programs. This includes collection of time-integrated samples (often followed by subsequent chemical analysis, depending on the monitoring purpose), as well as operation of continuous monitors pertaining to Federal Reference Method (FRM) and Federal Equivalent Method (FEM) requirements. This experience and the requirements and guidelines from these other programs will provide a basis for developing the criteria to assure appropriate data quality for the programs discussed in this QAPP.

Sampling locations for fixed sites, including probe and monitoring path siting criteria, will generally be selected according to guidance and requirements provided in *Network Design and Site Exposure Criteria for Selected Non-criteria Air Pollutants (U.S. EPA, 1984)*, and "40 CFR Part 58 Appendix E", but will focus on project objectives. Therefore, sampler siting may deviate from these general guidelines although samples and data still are required to satisfy data quality and measurement needs for the intended use.

This flexible sampling design is necessary to meet the requirements of some AB 617 Community Air Monitoring projects. However, sample handling, chain of custody, laboratory analytic methods, field instrument methods, sensors and sensor network deployment, mobile measurements, and data management processes will follow well-established procedures to meet the specific data quality objectives for all AB 617 Community Air Monitoring projects and related activities.

2.2.1 Sample Handling and Custody

Chain of Custody (COC) is a method of identifying each sample (e.g., filter, bag or canister sample) and documenting who has had possession of it (i.e., who handled it) throughout its life cycle, in order to demonstrate the sample's integrity. Samples are generally hand-delivered from the field stations or other monitoring platforms by the station operators (typically AMT Branch Assistant Air Quality Instrument Specialist (AQIS) I or II) to the laboratory at South Coast AQMD headquarters in Diamond Bar. COC is facilitated using unique sample identification numbers (Lab Number; Lab No.) and sample custody forms, both essential aspects of any COC system.

AB 617 Community Air Monitoring projects include many types of sampling media. Table 2.1 summarizes specific hold times and handling procedures for the most common sample media types used in AB 617 Community Air Monitoring projects.

Table 2.1 Typical Sampling Media Holding Times

Media	Holding Time	From	To	Reference
High-Volume Filters	No Limit	N/A	N/A	IO 3.5
VOC Canister	<30 days	Completion of sampling	Analysis	TO-15 Compendium Section 9.4.2.1
DNPH Cartridge Filter	<14 days	Sample end date/time	Analysis	TO-11 Compendium Section 11.1.2
Cellulose Filters used for metals sampling	1 day	Sample end date/time	Analysis	South Coast AQMD SOP00096
Cellulose Acetate Sodium Bicarbonate Impregnated filters used for hexavalent chromium sampling	1 day	Sample end date/time	Analysis	South Coast AQMD SOP00046 OAG QA0048

2.2.2 Sampling Analytical, and Monitoring Methods

The specific sampling and analytical methods employed for AB 617 Community Air Monitoring projects is dependent upon the project objectives and is described in the specific project's monitoring work plan.

AB 617 Community Air Monitoring operations can require sample collection and monitoring for a large diverse suite of pollutants. Table 2.1 presents a representative list of common analytes collected or monitored during AB 617 Community Air Monitoring projects and their analysis/measurement methods. This is not meant to be a comprehensive list of all methods used in AB 617 Community Air Monitoring operations. Each monitoring plan contains project specific sampling and monitoring methods. Table 2.2 and 2.3 contain the corresponding South Coast AQMD SOP ID numbers for time-integrated and continuous measurements, respectively.

Table 2.2 SOPs for Common Time-integrated Sampling and Analytical Methods

Ambient Species	Sampling Method	Laboratory Analysis-Measurement Method	South Coast AQMD SOP
Volatile Organic Compounds (VOCs)	Sampling into Summa /Silonite Canisters using Xonteck 910 sampler	Gas Chromatograph – Mass Spectrometer (GC-MS), Gas Chromatograph – Flame Ionization Detector (FID)	Analytical SOP00008B Sampler SOP00080
Carbonyls	Sampling in a sorbent cartridge coated with DNPH using an ATEC sampler	High Performance Liquid Chromatography (HPLC), Ultra High-Performance Liquid Chromatography (UHPLC)	Analytical SOP under revision Sampler SOP under revision
TSP Metals	TSP particulate sampling using Xonteck 924 sampler	Inductively Coupled Plasma – Mass Spectrometry (ICP-MS)	Analytical SOP00096 Sampler SOP00094
Hexavalent Chromium	TSP particulate sampling using Xonteck 924 sampler	Ion Chromatography (IC)	Analytical SOP00046 Sampler SOP00094
Hexavalent Chromium	TSP particulate sampling using BGI Omni sampler	Ion Chromatography (IC)	Analytical SOP00046 Sampler SOP00170 OAG QA0048
Hexavalent Chromium	TSP particulate sampling using BGI PQ100 sampler	Ion Chromatography (IC)	Analytical SOP00046 Sampler SOP00146
PM2.5 Metals	PM2.5 Teflon Filter using a SASS Sampler	X-Ray Florescence (XRF)	Analytical SOP00004 Sampler SOP00086
PM10 Mass	High-Volume SSI Filter sampling	Analytical Balance	Analytical SOP00112 Sampler SOP00081

Table 2.3 SOPs for Common Continuous Measurement Instruments

SOP #	Topic		Pollutant(s)
SOP00075	Thermo 42i NO/NOx Analyzer Operations		NO/NOx
SOP00116	General AMS Station Operations		N/A
SOP00117	Calibration Systems Operation		N/A
SOP00118	Data Collection System Operations		N/A
SOP00123	MET One Instruments E-Bam Mass Monitor Operation		PM
SOP00129	Thermo 5014i Beta Continuous Particulate Monitor Operation		PM
SOP00130	Condensation Particle Counter (CPC) Operation		Ultrafine Particles (UFP)
SOP00138	Operation of Baseline-Mocon NMHC Instrument		Non-methane Hydrocarbon (NMHC)
SOP00141	Operation of TSI DustTrak™ DRX Aerosol Monitor		PM
SOP00142	Magee Scientific Aethalometer Operation		Black Carbon (BC)
SOP00143	Teledyne Model 651 CPC Operation		UFP
SOP00145	Thermo Model 55i NMHC analyzer Operation		NMHC
SOP00147	ATEC Model 8000 Carbonyl Sampler Operation		Carbonyls
SOP00157	Picarro CH4-H2S Analyzer Operation		CH4 and H2S
SOP00169	URG-3000N Sequential Particulate Speciation System Operation		PM
SOP00177	Cooper XACT 625 and 625i Multi Metals Monitor Operation		Metals

Preparation of sampling manifolds, media and other components is a critical component for ensuring the established data measurement needs and quality are satisfied. Below is a list of common preparative needs that are performed before and during AB 617 Community Air Monitoring activities (Table 2.4). This list also contains the corresponding South Coast AQMD SOP ID numbers.

Table 2.4 Common Sampling and Collection Media Preparative Activity

Analytic Target(s)	Collection Hardware or Media	Preparative Process	South Coast AQMD SOP
Volatile Organic Compounds (VOCs)	1. Summa Canisters 2. Silonite Canisters	1. Pre-Sampling - Canister Cleaning, Canister Blanking	1. Summa Canister SOP00092 2. Silonite Canisters SOP00091
Carbonyls	DNPH Cartridges	1. Pre-Sampling – Acceptance Testing, Sampling Media Preparation 2. Post-Sampling – Sample Extraction	SOP00105
TSP Metals	Filters	1. Pre-Sampling - Visual Inspection & Acceptance Testing of Cellulose Acetate Filters, Sampling Media Preparation 2. Post-Sampling – Sample Extraction	1. SOP00095 2. SOP00113
Hexavalent Chromium	Filters	1. Pre-Sampling - Sodium Bicarbonate Impregnation, Visual Inspection & Acceptance Testing of Cellulose Acetate Filters, Sampling Media Preparation 2. Post-Sampling – Sample Extraction	SOP00102
PM2.5 Metals	Filters	1. Pre-Sampling – Visual Inspection, Conditioning, Tare Weight, Sampling Media Preparation 2. Post-Sampling – Final Weight, Metals Analysis	1. SOP00065 2. SOP00101 3. SOP00102 4. SOP00113 5. QA0044
PAHs	PUF Filter	1. Pre-Sampling - PUF Filter Module Assembly 2. Post-Sampling - PUF Disassembly	QA0029
VOCs	Manifold	Manifold & Probe Cleaning	QA0056
VOCS/NMOC	Bulbs and canisters	Cleaning and Preparation of Bulbs and Canisters	QA0050
VOCS, carbonyls, metals, carbon, metals, cations and anions	NATTS and PAMs Samplers	Sampler Certification	QA0055 procedure

Analytic Target(s)	Collection Hardware or Media	Preparative Process	South Coast AQMD SOP
Criteria, VOC, metals, carbon, metals, cations and anions	Stations and platforms	Station Preparation	SOP00116
Criteria, VOC, metals, carbon, metals, cations and anions	Samplers and continuous monitors	Calibrations	SOP00117
Criteria, VOC, metals, carbon, metals, cations and anions	Mobile platforms	Platform preparation	SOP00134
Criteria	Criteria pollutant instruments	Instrument Performance Evaluation	SOP00135
Criteria	Criteria pollutant instruments	Continuous instrument calibrations	SOP00156

2.2.3 Purposes of Stationary Air Monitoring with Established and Regulatory Monitors and DQIs

The stationary air monitoring with established and regulatory monitors follow recommendations and procedures outlined in the Criteria Pollutant Monitoring Program QAPP (South Coast AQMD, 2019) for bias and precision, with the exception of the annual Bias Audit that may be performed by AB 617 Community Air Monitoring staff.

2.3 Stationary Air Monitoring with Research-Grade Monitors

South Coast AQMD continuously evaluate the most advanced air monitoring technologies and methods to enhance its capability for air quality investigations. These efforts are focused on real-time or near real-time measurement of short-term variations in concentrations of compounds of interest, particularly the air toxics. This is necessary for achieving accurate characterization of potential for acute exposure health effects and can significantly enhance the identification and apportionment of emission sources. Established and regulatory monitors generally collect 24-hour integrated average samples, which will be analyzed in the laboratory, and as a result sampling data make take days or weeks to process. Moreover, the 24-hour average concentration samples do not fully account for shifts in the environment, such as short-term spikes in ambient concentrations. Air quality is a dynamic and complex environmental parameter exhibiting large temporal and spatial variations due to changes in meteorological conditions, local topography, and source emission rates, which contribute to variations in emissions, transport and deposition of air pollutants. Advances in measurement technology provide reliable and practical instruments for quantification of gaseous and particulate air pollutants over averaging times ranging from seconds to hours. The new generation of high-time resolution monitors can capture the temporal variability of air pollutants in real- or near real-time.

The goals and objectives of air monitoring and DQOs must be clearly defined. Through the definition of monitoring purpose and DQOs, the key components to make the monitoring program technically

defensible can be systematically addressed. Some of the core components include such topics as identifying the target pollutants, the desired averaging time, and other parameters that must be measured to achieve the monitoring purpose (e.g. meteorological, PM mass, total VOCs, etc.). Through this process the appropriate monitoring protocols and instrumentation, as well as data telemetry approach, data processing and QC procedures, data reporting formats and frequency, and monitoring system calibration protocols are determined.

2.3.1 Monitoring Methods

Table 2.5 presents a representative list of some of the research-grade monitors for measuring a large diverse suite of pollutants that may be employed in AB 617 Community Air Monitoring projects. This is not meant to be a comprehensive list of all methods used in AB 617 Community Air Monitoring operations and is expected to expand as the South Coast AQMD continues to evaluate the most advanced monitoring technologies and enhance its air monitoring capabilities.

Table 2.5 Research-Grade monitors and methods

Ambient Species	Instrumentation	Analytical Method	South Coast AQMD SOP
VOCs	Tricorn Tech (MiTAP P310)	Gas Chromatograph – Mass Spectrometer (GC-MS), Gas Chromatograph	SOP under development
Metals and Elements	Cooper Environmental LLC. Xact 625 and 625i	X-Ray Florescence (XRF)	SOP00177

Preparation of manifolds, media and other components, which is a critical component for ensuring the established data measurement needs and quality are satisfied, is in accordance the associated SOPs. For SOPs that are under development, field staff operating this equipment will use available user and operating manuals, guidance documents, and other related material as a source for QC procedures. These procedures will be listed in project-specific work plans as needed.

2.3.2 Purposes of Stationary Air Monitoring with Research-grade Monitors and DQIs

Research-grade monitors can be utilized for different purposes in AB 617 Community Air Monitoring projects (Table 2.1). These monitors are usually employed when monitoring goals and objectives require simultaneous measurement of various analyte groups in real- or near real-time. This type of monitoring can be useful to provide the basis for comparing against acute health thresholds or to establish the baseline. As such, stationary air monitoring with research-grade monitors in AB 617 Community Air Monitoring projects is conducted for Baseline Monitoring (BM), Source Characterization (SC), or Compliance and Health-Based Information (CHBI) purposes.

Table 2.6 presents DQIs of accuracies, completeness, and representativeness for the monitoring objectives of monitoring using *research-grade monitors*. It should be noted that all DQI values reported in this Table are preliminary and will be refined as measurement data for AB 617 Community Air Monitoring projects are collected and analyzed. The detection limit, precision, bias and, thus, the overall accuracy of

the instruments for particle and gaseous measurements varies widely and will be provided in project specific work plans and determined/verified annually or as appropriate.

Table 2.6 DQIs of accuracies, completeness, and representativeness for various objectives of Research Grade Monitors

Monitoring Purpose	Bias Percentile*	Precision*	Data Completeness (%)	Representativeness (Time resolution) **
BM	25^{th}, 75^{th}	15^{th}	>80	Seconds to hour
SC	25^{th}, 75^{th}	15^{th}	>70	Seconds to minutes
CHBI	20^{th}, 80^{th}	25^{th}	>50	Seconds to hour

** Precision calculations will be performed monthly. Bias will be compiled at least once every 365 days through an audit.*

*** Time resolution of the measurements, which is dependent upon the pollutant(s) to be monitored and/or the measurement technology used.*

2.4 Stationary Air Monitoring with Low-Cost Sensors and Sensor Networks

For the purpose of most AB 617 Community Air Monitoring projects, air quality sensors will be used as stationary monitors to characterize the spatial and temporal variability of the pollutant(s) of interest. Stationary sensors may also be used for community near-source monitoring, community education and outreach, hotspot identification, and incident response. In some cases, low-cost sensors can be installed on a mobile platform to supplement other monitoring methods.

Public education and outreach are important to increase the public's awareness and knowledge of air quality in their communities. Low-cost sensors and sensor networks are excellent tools to engage and empower local community members in the various aspects of air pollution monitoring, while gathering hyper local air quality information in the area(s) of interest.

South Coast AQMD has extensive experience working with communities in Southern California in the development, deployment, operation and maintenance of sensor networks for air quality measurements. For various AB 617 Community Air Monitoring programs and applications, sensor selection will be based on performance testing information as provided by South Coast AQMD's AQ-SPEC. Additional details on the development and deployment of low-cost sensor networks for projects related to the AB 617 Community Air Monitoring programs will be included in future versions of the QAPP and in project specific plans. The two types of sensors selected for AB 617 Community Air Monitoring so far, are the Aeroqual AQY v1.0 and Clarity Node sensors (Table 2.7) for stationary air monitoring. These were chosen based on prior AQ-SPEC field and laboratory performance evaluation results, and on the successful field deployment of these sensor devices.

Table 2.7 Air quality sensors that have been selected for AB 617 Community Air Monitoring applications*

Monitor		Measured Pollutant	South Coast AQMD SOP
Sensor #1	Aeroqual AQY v1.0	PM2.5 Mass NO_2 and O_3 Temperature and Relative Humidity	SOP under development**
Sensor #2	Clarity Node	PM2.5 Mass NO_2 Temperature and Relative Humidity	SOP under development**

**Other particle and gaseous sensors that will be used in future AB 617 Community Air Monitoring projects will be described in future versions of the QAPP.*

***For SOPs that are under development, field staff operating this equipment will use available user and operating manuals, guidance documents, and other related material as a source for QC procedures. These procedures will be listed in project-specific work plans as needed.*

Both the Aeroqual AQY and Clarity Node sensors are Internet of Things (IoT) connected devices that send measurement data to a remote cloud-based data storage via a Wi-Fi or cellular connection. This data is then ingested and processed and can be displayed on a publicly available data interface or website.

2.4.1 Purposes of Stationary Air Monitoring with Low-Cost Sensor Monitoring and DQIs

Air quality low-cost sensors will be used as stationary monitors in AB 617 Community Air Monitoring projects for a variety of monitoring purposes. This includes concentration mapping (CM) to characterize the spatial and temporal variability of the pollutant(s) of interest. Sensors can be used for Source Identification (SI) and Source Characterization (SC) purposes when deployed near an emission source (or potential emission source) to better characterize the temporal variability of particulate matter concentrations and gather more information to identify process(es) that may lead into those emissions.

Table 2.8 describes DQIs of accuracies, completeness, and representativeness for various objectives of sensor monitoring. It should be noted that all DQI values reported in this Table are preliminary and will be refined as measurement data for AB 617 Community Air Monitoring projects are collected and analyzed. The detection limit, precision, bias and, thus, the overall accuracy of the sensors for particle and gaseous measurements varies widely and will be provided in project specific work plans and determined/verified annually or as appropriate. Different sensor units use different technologies or methods to measure the same pollutant and the comparability of multiple data sets reporting similar air pollution measurements will be evaluated to determine measurement uncertainty and usefulness. When deployed in a sensor network, sensors will also be deployed at the nearest regulatory monitoring station to compare sensor and regulatory instrument with collocation testing.

Table 2.8 - DQIs of accuracies, completeness, and representativeness for various objectives of sensor monitoring

	DQI			
Monitoring Purpose	**Collocation Testing***		**Data Completeness (%)**	**Time Resolution**
	R^2	**Measurement Error**		
CM	> 65	PM2.5 < 10 µg/m^3 O_3 / NO_2 < 12 ppb	> 50	5-min or less
SI	> 75	PM2.5 < 5 µg/m^3 O_3 / NO_2 < 7 ppb	> 75	5-min or less
SC	> 75	PM2.5 < 5 µg/m^3 O_3 / NO_2 < 7 ppb	> 75	5-min or less
CEE	> 65	PM2.5 < 10 µg/m^3 O_3 / NO_2 < 12 ppb	> 50	5-min or less

** Collocation testing is performed over an extended time period (i.e. 4-8 weeks) with the sensors compared to regulatory-grade instrumentation. R^2 is the coefficient of determination and measurement error is the calculated mean absolute error between sensor and regulatory grade instrument. Instrument sensors will be evaluated annually.*

2.5 Mobile Air Monitoring

Ambient levels of air pollutants can vary substantially within short distances in areas with multiple sources of air pollution. One of the strategies employed by the South Coast AQMD to capture the spatial variability of air pollutants and identify/quantify the major emission sources in communities involves the deployment of high-time resolution instruments on mobile platforms. This provides an effective methodology to survey vast areas in a relatively short period of time. The ability of the mobile measurement platforms to drive in and around a community and follow the emission plumes as they are transported through the neighborhood by wind can be critical for hotspot identification. Typically, measurements from a mobile platform at a given location are relatively short, ranging from seconds to a few minutes when the platform is moving. Therefore, given the high temporal variability of most air pollutants, mobile survey measurements do not necessarily capture the typical air quality conditions of a specific location. One way to address this limitation is to increase the number of measurements runs (passes or transects) to obtain a more representative and consistent map of the spatial and temporal variability of the measured air pollutants. Moreover, mobile measurement platforms are capable of providing stationary measurements for a relatively short period of time, when appropriate (e.g. for source characterization purposes). Mobile monitoring also provides guidance on where to redirect focus and resources for subsequent and more detailed stationary monitoring. More information about the representativeness of mobile monitoring is provided in the following sections.

Mobile measurement platforms can be equipped with *established and regulatory monitors* and/or *research grade monitors* for continuous measurements of particulate and gaseous pollutants. The South Coast AQMD currently owns three mobile platforms, each equipped with different instrumentation for the measurement of particulate and gaseous pollutants including air toxics. Mobile Platform #1 is equipped with a mix of *established and regulatory* and *research-grade monitors* to measure the mass and

number concentrations of particulate matter (PM) of various sizes, BC, CO, NO_2, O_3, and CH_4. Mobile Platform #2 (mobile optical remote sensing (ORS) laboratory) is equipped with a number of *research-grade monitors* including multiple advanced ORS monitors that are capable of measuring the ambient concentration (and in some cases the emission rate) of a wide range of gaseous pollutants, including air toxics (e.g., methane, non-methane VOCs, NO_2, SO_2, NH_3, formaldehyde, benzene, toluene, ethylbenzene and xylenes). A third mobile Platform (the multi-metals mobile platform - currently under development) is equipped with a mix of *established and regulatory monitors* and *research-grade monitors* for the measurement of particulate metals and elements, including several air toxic metals, as well as mass and number concentrations of PM of various sizes, BC, CO, and NO_2. This mobile platform is being developed in a modular way, allowing the replacement of certain monitors for targeting specific air pollutants.

South Coast AQMD is also in the process of developing another mobile platform that will be equipped with a state-of-the-art *research-grade monitor,* Proton Transfer Reaction – Mass Spectrometer (PTR-MS), capable of in-situ analysis of a broad suite of VOCs such as acetone, acetaldehyde, methanol, ethanol, benzene, xylenes and many others present in ambient air. Tables 3-4 in the main CAMP and Appendix A of the CAMP document for each community, summarize the air quality monitors and measured pollutants in each mobile platform. Their respective SOPs are currently under development or in revision.

For SOPs that are under development, field staff operating this equipment will use available user and operating manuals, guidance documents, and other related material as a source for QC procedures. These procedures will be listed in project-specific work plans as needed.

During mobile monitoring, all real time data is collected using a data logger that synchronizes data from the GPS and air monitoring instruments into a central file with a common time base in a predefined format that can be used for real-time data visualization, for data quality control and subsequent data analysis for data interpretation and reporting. The central data logger is synchronized within two seconds on a monthly basis. The unified data collection with a data logger has the advantage of providing a direct overview for all measured data, allowing field staff to modify the measurement strategy as needed while monitoring. The actual recorded sampling times are determined by correcting for the pollutants residence time in the inlet system.

2.5.1 Purposes of Mobile Monitoring and DQIs

Mobile air quality monitoring can be conducted for different purposes, including Concentration Mapping (CM), Source Identification (SI), Source Characterization (SC), Compliance and Health-Based Information (CHBI), and Emissions Estimation (EE), as explained in Table 2.1 and below.

The mobile platforms can be used for CM of target air pollutants along the driving route in the AB 617 communities or specific target areas. The main applications of CM include, but are not limited to, finding hotspots of air pollution, and assessing the community exposure levels near known emission sources. For these applications, the survey area should include sufficient spatial range to illustrate changes in pollutants' concentrations.

For CM applications, the measured pollutants levels and their spatial variability may vary substantially depending on the time of measurement (e.g. morning rush hour vs late afternoon) and meteorology (e.g. atmospheric boundary layer height and wind speed/direction in different times of the day and seasons).

In addition, if the emissions from the potential sources are periodic in time, they may not be detected during a single drive-by inspection even under favorable wind conditions. Therefore, in order to produce stable and representative maps of air pollutants, repeated monitoring passes during different times of the day under a variety of meteorological conditions are required. Moreover, to correct for temporal biases that result from the slowly varying background concentrations over the course of a day, data from background fixed-site monitors may be used to develop a time-of-day adjustment factor.

In some cases, mobile monitoring is conducted to identify the potential source(s) of a potential air pollution hotspot, by "chasing" the plume. The mobile measurements for this purpose do not require accounting for temporal biases and therefore may be achieved by a single pass. The procedures for identifying the location(s) of previously unknown or specific sources of emissions (e.g., leaks from oil/gas production and drilling activities, fugitive emissions from metal processing facilities) are designed for source identification. If a potential source of emission is identified, mobile measurements can be used to characterize the emission source to improve the understanding of the location, variability and composition of known or previously unidentified emission sources, either through direct measurement using in-situ monitors on the mobile platforms or acquisition of secondary data/information (e.g. infrared camera video, canister grab samples, etc.) while chasing the pollution plume originated from that source, or during follow-up investigations. The mobile platforms can also conduct stationary measurements at an appropriate location (e.g., downwind of the emission source) for an extended period of time (e.g., minutes to a few hours) to better characterize the emissions from the identified sources.

Emissions estimation is the approach used to estimate source emission rates usually from a remote vantage point. In this approach, the emission rates are estimated using gas column measurements by remote sensing instruments (e.g., SOF and SkyDOAS in Mobile Platform #2) combined with wind data integrated across plume transects at various locations. For more accurate source emissions estimations, atmospheric conditions must allow the emission plume from the source to be carried to the observation location with reasonable transport properties. If the wind speed is very low (typically below 1.5 m/s), the emission plume evolves vertically and there may be too little advected transport towards the perimeter of the area being measured, which may result in less accurate emission estimate. Favorable meteorology includes stable atmospheric conditions with moderate and steady wind speeds and directions. For emissions estimation applications, the basic premise is usually to characterize the source by encircling or "boxing" the source (i.e. moving the mobile platform upwind and downwind of the source during multiple passes).

Table 2.9 describes DQIs of accuracies, completeness, and representativeness for various objectives of mobile monitoring. It should be noted that all DQI values reported in this Table are preliminary and will be refined as measurement data for AB 617 community monitoring projects are collected and analyzed. The detection limit, precision, bias and, thus, the overall accuracy of the instruments for particle and gaseous measurements installed inside South Coast AQMD's mobile platforms varies widely and will be provided in project specific work plans and determined/verified annually or as appropriate. Different mobile platforms use different technologies or methods to measure the same pollutant or set of pollutants (e.g., Benzene is measured by multiple remote sensing techniques on board of South Coast AQMD's remote sensing vehicle) and the comparability of multiple data sets reporting similar air pollution measurements will be evaluated to determine measurement uncertainty and usefulness.

Table 2.9 DQIs of accuracies, completeness, and representativeness for various objectives of mobile monitoring

	DQI					
Monitoring Purpose	**Bias Percentile**	**Precision CV**	**Route Completeness (%)***	**Data Completeness (%)**	**Representativeness (Time resolution)****	**Representativeness (Measurement Frequency)*****
CM	15th, 85th	30th	>70	>75	10 sec or less	>1 pass
SI	20th, 80th	20th	>80	>75	10 sec or less	>1 passes
SC	20th, 80th	20th	>90	>80	10 sec or less	>5 passes or stationary monitoring
CHBI	20th, 80th	20th	>90	>80	10 sec or less	>5 passes or stationary monitoring
EE	20th, 80th	20th	>95	>90	10 sec or less	3-5 passes

** Precision calculations will be either every 20 surveys or quarterly, whichever is more frequent. Bias will be performed at least once every 365 days through an audit.*

***Time resolution of the measurements, which is dependent upon the pollutant(s) to be monitored and/or the measurement technology used*

****Number of valid measurement runs (passes) throughout the area / community to be surveyed, or near the facility / potential emission source to be monitored. Multiple passes allow to obtain a more representative and consistent map of the spatial and temporal variability of the air pollutants of interest*

3.1 Quality Control Procedures for Samples and Continuous Measurements

For AB 617 Community Air Monitoring projects, day-to-day QC is implemented through various checks on the samplers and monitors being used. These checks allow field staff to verify that the sampling and monitoring equipment is operating properly and as described in the respective instrument's SOPs. If SOPs are not available or are being developed, the instrument's operation manual is cited as a source for QC procedures, and these procedures are listed in the project-specific work plans as needed, while South Coast AQMD staff develops the SOP. QC measures may include, but are not limited to, trip blanks and field blanks for time-integrated samples; duplicate and collocated measurements and samples; calibrations; National Institute of Standards and Technology (NIST[1]) Traceability; Inspection/Acceptance of Supplies and Consumables; and QC checks for samples and continuous measurements. Detailed QC procedures are defined in each respective analysis and/or method SOP.

3.1.1 Calibrations of Samplers and Continuous Monitors

In general, calibration is defined as the comparison of a measurement standard or instrument with another standard or instrument to report, and/or eliminate by adjustment, any variation (deviation) in the accuracy of the item being compared. In ambient air monitoring, calibrations are considered a type of quality control procedure and have been included in the earlier quality control section. Air monitoring instrumentation requires calibration work at regular intervals. Specific calibration requirements for field equipment are found in the respective SOP. In general, calibration activities for air samplers follow a two-

[1] https://www.nist.gov/

step process, certifying the calibration standard and/or transfer standard against an authoritative standard, and comparing the calibration standard and/or transfer standard against the routine sampling/analytical instruments.

South Coast AQMD follows 40 CFR Part 58 Appendix A or defers to instrument manufacturer recommendations with regard to calibration frequency. Before deploying equipment to the field, the equipment is inspected and tested. Regular maintenance/calibration schedules are in-place to verify that all instruments and equipment (including those used for mobile monitoring and air quality sensors) are maintained in sound operating condition and are capable of operating at acceptable performance levels. Instrument maintenance and calibration procedures are detailed in the equipment SOPs and the equipment manufacturer's operating /maintenance manual. These documents are cited as needed in the project specific work plans along with a table detailing the equipment calibration schedule. Table 3.1 presents the criteria pollutant monitoring sampler and instrumentation calibration schedule, including acceptance criteria for acceptable calibration and associated activity such as zero air generation cleanliness. The calibration requirements for non-criteria pollutants are defined in the respective instrumentation SOPs. The frequencies for activities stated in the table are the minimum required. Additional calibration activity occurs after major repairs or when controls, checks or audits indicate.

Table 3.1 Calibration Schedule for Samplers and Continuous Monitors

Instrument or Equipment	Calibration Item	Frequency	Acceptance Criteria
Zero Air Generator System	Zero air cleanliness verification	Annually	SO2 < 0.5 ppb NO < 0.5 ppb NO2 < 0.5 ppb O3 < 0.5 ppb CO < 0.025 ppm HC < 0.02 ppm
Gas Dilution System	Flow controller	6 months	Accuracy < ±2.1%
O3 Single Analyzer	Verification/Calibration	Upon receipt/ adjustment/repair/ installation/moving and repair and recalibration of standard of higher level; Every 182 day and 2/ calendar year if manual zero/span performed biweekly; **Every 365 day and 1/ calendar year if continuous zero/span performed daily**	All points < ±2.1% or < ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± 0.05
CO Single Analyzer	Verification/Calibration	Upon receipt/ adjustment/repair/ installation/moving;	All points < ±2.1% or < ±0.03 ppm difference of best-fit straight line,

Instrument or Equipment	Calibration Item	Frequency	Acceptance Criteria
		Every 182 days and twice per calendar year if manual zero/span performed biweekly; **Every 365 days and 1/ calendar year if continuous zero/span performed daily**	whichever is greater and Slope 1 ± 0.05
NO2 Single Analyzer	Verification/Calibration	Upon receipt/ adjustment/repair/ installation/moving; Every 182 day and 2/ calendar year if manual zero/span performed biweekly; **Every 365 day and 1/ calendar year if continuous zero/span performed daily**	Instrument residence time < 2 min.; Dynam. Parameter > 2.75 ppm-min; All points < + 1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 + 0.05
	NO2 Converter Efficiency	During multipoint calibrations, span, audit, and every 14 days	≥ 96% (96%-104.1%)
SO2 Single Analyzer	Calibration	Upon receipt/adjustment/repair/ installation/moving; Every 182 day and 2/ calendar year if manual zero/span performed biweekly; **Every 365 day and 1/ calendar year if continuous zero/span performed daily**	All points < ±2.1% or < ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± 0.05
PM10 Continuous Sampler	**System Leak Check**	During precalibration check	Method Specific. See operator's manual.
	Flow Rate Multi-Point Verification/Calibration	Every 365 days and once a calendar year	3 of 4 cal points within < ± 10.1% of design flow
PM2.5 Continuous Sampler	**External Leak Check** ***(Critical Criteria)***	Before each flow rate verification/calibration and before and after PM2.5 separator maintenance	Method Specific. See operator's manual.
	Internal Leak Check ***(Critical Criteria)***	If failure of external leak check	Method Specific. See operator's manual.
	Design Flow Rate Adjustment ***(Critical Criteria)***	After multi-point calibration or verification	< ±2.1% of design flow rate

Instrument or Equipment	Calibration Item	Frequency	Acceptance Criteria
	Temperature Multi-point Verification/Calibration	On installation, then every 365 days and 1/ calendar year	< + 2.1oC
	Pressure Verification/Calibration	On installation, then every 365 days and 1/ calendar year	< ±10.1 mm Hg
	Flow Rate Multi-Point Verification/Calibration	After electromechanical maintenance or transport or every 365 days and once per calendar year	< ±2.1% of transfer standard
	Design Flow Rate Adjustment	After multi-point calibration or verification	< ±2.1% of design flow rate (16.67 LPM)
	Other Monitor Calibrations/Checks (e.g., annual zero test on Met One BAM 1020 and BAM 1022)	Per manufacturers' operations manual	Per manufacturers' operations manual
	Monitor Maintenance PM2.5 WINS Separator PM2.5 VSCC Separator Inlet Cleaning Downtube Cleaning Filter Housing Assembly Cleaning Circulating Fan Filter Cleaning Manufacturer-Recommended Maintenance	 Every 5 sampling events Every 30 days Every 30 days Every 90 days Every 30 days Every 30 days Per manufacturer's manual	 Cleaned/Changed Cleaned/Changed Cleaned Cleaned Cleaned Cleaned/Changed Per manufacturer's manual
	Additional instrument-specific operational criteria for the TEOM-FDMS, GRIMM, Thermo BAM and Met One BAM, please refer to the PM2.5 Validation Template in the QA Handbook Volume II, Appendix D.		

Due to relatively short duration of some AB 617 Community Air Monitoring projects, the calibration schedules detailed in the equipment operation and maintenance manuals or established SOPs may be altered to achieve a high level of confidence in instrument operation and data. For example, Omni filter samplers used at compliance sites for collection of hexavalent chromium may be calibrated before each sample is collected whereas, in other instances such as collection of multi-metals, these samplers are calibrated bi-annually. Note that calibration frequency for advanced monitoring technologies such as optical remote sensing equipment, mobile-based continuous monitors and low-cost sensors vary widely and will be described in detail in the corresponding SOPs and user manuals.

3.2 Quality Control Checks for Continuous Measurements

General QC checks for some commonly used continuous monitors for stationary monitoring are listed in Table 3.2 to3.4.

Table 3.2 Acceptance Criteria for Gaseous Criteria Pollutant Weekly Span Checks

Pollutant	Warning Limit	Acceptance Criteria
O_3	5%	< ±7.1%
CO	7%	< ±10.1%
NO2	7%	< ±10.1%
NO	7%	< ±10.1%
NOx	7%	< ±10.1%
SO_2	7%	< ±10.1%

Table 3.3 Acceptance Criteria for Gaseous Non-Criteria Pollutant Weekly Span Checks

Pollutant	Warning Limit	Invalidating Limit
H_2S	10%	15%
CH_4	10%	15%
VOC	10%	15%
Non-methane Hydrocarbons	10%	15%

Flow checks are performed on continuous PM monitors as shown in Table 3.4.

Table 3.4 Continuous PM2.5 and PM10 Flow Tolerances

Variable	Frequency	Flow	Acceptance Criteria
PM10 Continuous	Monthly	16.67 L/Min	< ±7.1% of transfer standard and < ±10.1% from design
PM2.5 Continuous	Monthly	16.67 L/Min	4% of transfer standard 5% of design
UFP Continuous	Monthly	3 L/Min	7% of standard 10% of design

3.3 Quality Control Procedures for Mobile Measurements

Mobile monitoring defined as air quality measurements while driving, is one of the strategies employed by the South Coast AQMD to capture the spatial variability of air pollutants and identify/quantify the emission sources in AB 617 Community Air Monitoring projects. The requirements of QC procedures for mobile platforms provide data confidence for the deployment of high time-resolution instruments in a cost-effective method to survey vast areas and investigate a large number of potential emitters in a relatively short period of time. Applying the accepted QC procedures from established and regulatory monitors installed at stationary AM stations as guidance and then realigning these procedures for mobile monitoring provides valuable tools. One example is confidence in the data when the mobile platform is used as a source identification tool through critical assessments for the potential air quality impacts. In

this scenario, the mobile platform identifies a hotspot/emission source determines the wind direction, then chases the plume that is transported through the communities.

In addition to standard QC issues, mobile monitoring must have confidence in the representativeness of the sample and the corresponding timing between multiple instruments and manifolds. The sampling duration at a given measurement location is relatively short, ranging from seconds to a few minutes. Therefore, considering the temporal variability of air pollutants under different meteorological conditions, the exact timing of the measurement using mobile platforms does not necessarily allow to generalize the measurements as typical characteristics for that location in the study area. The development of the mobile platform QC standards addresses this issue through varying the number of measurement collection periods over the same day, week, season, or year (depending on the study objectives) to obtain a more representative and consistent map of the spatial variability of the measured air pollutants depending on the purpose of mobile monitoring. The residence time (time for a plume to pass the inlet until introduced into the monitor) in stationary network AM Stations is tightly controlled and these differences between monitors are insignificant compared to the minimum 1-minute averaging time stamp. For mobile monitoring the time stamp is addressed in the same manner as stationary AM Stations through a centralized data logger, but for Mobile Monitoring QC the time stamp for each pollutant must include both residence time and response time since the response time of each monitoring technology varies and is generally much greater than 1 to 3 seconds. Through data logger delayed response adjustments, the QC process is reduced from time consuming from level 2 edits to level 1 automatic data logger adjustments.

3.4 Quality Control Procedures for Low-Cost Sensors

Low-cost sensors may be used to locate pollution hotspots, identify sources of pollution, supplement stationary-monitoring data, evaluate personal exposure to pollutants, educate and enhance air quality awareness, and engage community members in air pollution monitoring. The low-cost, portability, and ease of use of sensor technology make it possible for citizens to participate in air quality monitoring within their communities. AB 617 Community Air Monitoring programs rely on South Coast AQMD's AQ-SPEC program for evaluation of sensors selected for these projects, as well as for QC checks, data review, validation, and verifications. More information can be found on the AQ-SPEC website (www.aqmd.gov/aq-spec).

3.5 Quality Control Procedures for Laboratory Equipment

The South Coast AQMD Laboratory utilizes a diverse range of QC procedures to ensure data meets and/or exceeds the quality defined by the QAPPs and SOPs. Laboratory QC includes technical activities that measure the performance of an analysis and/or method against defined standards, helps identify problems, and initiate corrective action. QC measures may include, but are not limited to, reagent and method blanks; calibrations, calibration checks, secondary source calibration verification; replicate analysis; laboratory control samples; and matrix spikes, and matrix spike duplicates. Detailed quality control procedures are defined in each respective analysis and/or method SOP.

4.0 Data Management and Reporting

The sections that follow (4.1 - 4.5) describe standard data management procedures and equipment used to acquire, process, compile, store, retrieve, and analyze analytical data and data collected from time-integrated and continuous instruments. It discusses standard record keeping, data handling procedures, and the equipment and software used for data management. It also addresses procedures for detecting, flagging, and correcting errors and data loss during data processing as well as procedures for ensuring that applicable information resource management requirements are satisfied, including the identification of the location of spreadsheets, databases, and reports.

4.1 Measurement and Data Acquisition

4.1.1 Field Communication

South Coast AQMD field and office desktop and laptop PCs, servers, data telemetry network, internet and email systems are managed by the South Coast AQMD Information Management (IM) Division in accordance to the South Coast AQMD QMP (South Coast AQMD, 2016) which provides systems support for:

- Operating system and software updates and testing;
- Redundancy to minimize downtime;
- Daily incremental backups with weekly full backups that are also sent monthly to offsite storage; and
- Security, including email and software control, updated antivirus and spyware protections.

IM has dedicated staff to support the AB 617 Community Air Monitoring program, and the development of dedicated databases and website data displays.

Data management for the South Coast AQMD AB 617 Community Air Monitoring program is a joint effort between the AMT, LS and QA Branches, along with IM. Their respective roles are summarized in Table 4.1.

Table 4.1 Four Branches of Data Management

AMT	LS	QC	IM
Who: **Operations and Support Staff and Supervisors** **What:** Oversee data flow processes Identify issues Repair Reviews data Prepares data and reports	**Laboratory Services Staff** Prepares sample media Analyzes time-integrated sample data Maintains Chain-of-Custody documentation and communications with field staff Enters data / QC information into EDS (Electronic Data System) Reviews and validates data Prepares data and reports	**Quality Control Staff** Periodic Audits Coordination and oversight with outside auditors Review and oversite of instrumentation Review and oversite of documentation	**Dedicated Information Management Staff** Maintains computer and data telemetry hardware Maintains software for validating, analyzing, and displaying data Responsible for on-site and cloud-based servers, websites, data display tools Responsible for all hardware that interacts with IT infrastructure

IM supports the other branches with the following resources related to data management and reporting:

- Laptop computers used for mobile platforms and fixed station deployments, and for retrieving data from sensor networks. These may include dedicated computers to control and monitor instruments or sample analyses, as well as computers assigned to field staff to download data from certain continuous instruments;
- Dedicated computers for analytic instruments accessible via LAN (as necessary), to control and monitor sample analyses; acquire and store analytical sample and QC data; enter/import field and analytical data into the Laboratory database to calculate concentrations of analyzed species; perform data review; and generate reports;
- Laboratory workstation computers accessible via LAN, to enter/import field and analytical data into the LS database to calculate concentrations of analyzed species; perform data review; generate reports; and submit data to AQS and/or other required data portals via internet (as applicable);
- Laboratory server (designated shared drive), accessible via LAN, maintained by Information Management to store and transfer files and reports;

- Laboratory information management system (Promium Element® LIMS), maintained by the LS Branch staff;
- Laboratory Structured Query Language (SQL) Server for SQL databases, maintained by Information Management;
- Document scanner, including most internal copy machines, to convert paper documents into digital form for electronic storage in Element LIMS and OnBase;
- Monitoring workstation computers for electronic field data placement in the Laboratory shared network drive;
- Environmental System Corporation (ESC) 8832® or Agilaire 8872® Data Loggers, Telemetry, Agilaire AirVision® data collection system, Sonoma Technology Inc. (STI) Data Management System (DMS)®;
- Logbooks, Instrument Maintenance Sheets, Downtime Logs;
- Appropriate software to review collected data on personal computers such as Excel, Matlab, or other software used to review data.
- Cloud-based platform to manage data generated by the AB 617 Community Monitoring programs Laboratory server, accessible via Wireless Area Network (WAN), maintained by Information Management to store and transfer files and reports; and
- Dedicated webpages to inform members of the public on past, ongoing, and upcoming AB 617 Community Monitoring activities, and to display data summaries and results.

4.1.2 Data Dissemination

All data collected as part of the AB 617 Community Air Monitoring programs is reported to the public on dedicated webpages. Typically, these include a description of the specific project goals and objectives, and all related measurement activities; graphs, maps or other display tools to visualize the data; a report to summarize the monitoring results; and information on how to access real-time and/or historical data.

Results of AB 617 Community Air Monitoring activities are posted periodically in the form of progress reports and/or data summaries and/or reports, on the South Coast AQMD webpage dedicated to the AB 617 Community Air Monitoring program at:
http://www.aqmd.gov/nav/about/initiatives/community-efforts/environmental-justice/ab617-134/ab-617-community-air-monitoring

A comprehensive data display tool for acquiring, validating, analyzing and mapping air measurement data has been developed for the AB 617 Community Air Monitoring program. The primary goal of the data display tool is to share the monitoring data with the public to the extent feasible and as quickly as possible, so that it can be used to evaluate and adaptively manage the impacts of various emission reduction strategies in the community. The data display tool provides data analysis and visualization options which allow users to create simple customized graphs and plots (e.g. time series of measured pollutants) and display air quality information on a map. The AB 617 Community Air Monitoring data display tool can be accessed through the following web link:
http://xappprod.aqmd.gov/AB617CommunityAirMonitoring/Home/Index

The South Coast AQMD Records Retention Policy governs minimally how long data and supporting information needs to be maintained. Raw data and data sheets are retained on file as per the South Coast

AQMD Records Retention Policy for a minimum of five years after collection and are available for audits and data verification and validation activities. Where a discrepancy with programmatic requirements is suspected or demonstrated, a longer data retention time is used.

4.2 Data Review, Verification, and Validation Process

This section explains the process by which data is deemed usable for their intended purpose, that is, whether the agency has met its overall goals and the resulting data can be used with confidence. When feasible, the AB 617 Community Air Monitoring program follows data review, verification and validation methods as described in Section 17 of U.S. EPA Quality Assurance Handbook, Volume II (U.S. EPA, 2017). These are the techniques used to accept, reject, or qualify data in an objective and consistent manner. Verification is the confirmation that specified requirements have been fulfilled (e.g., single-point QC checks were performed on schedule), and validation is the confirmation that the particular requirements for a specific *intended use* are fulfilled (e.g., QC checks are within the limits specified in the QAPP). Data review, validation and verification are necessary for identifying data errors, biases, and unrealistic values before they are used for data assessments, trend analysis, source characterization, modeling, or other uses.

The methods and procedures that South Coast AQMD uses when reviewing, verifying and validating data, includes a multi-level, tiered approach to data review that involves multiple staff. This hierarchy ensures a thorough investigation of the data and applicable procedures, with varying perspectives. Data review involves reviewing field operations and laboratory analyses procedures, including calibrations, QC checks, COC records, maintenance and repair records, and data processing and reduction. Data verification includes both self-review and peer-review of data and records followed by senior staff review after peer review. Some review and verification processes are partially or fully automated using data loggers, AirVision, DMS, LIMS or other programs. These systems may provide out-of-range warnings, daily single-point precision and zero QC checks, and 7-day span checks for continuous gaseous criteria data. This information is also reviewed and verified by staff. Data validation provides a final certification that the data generation process is satisfying programmatic objectives through an in-depth review and examination of the entire data ensemble.

As appropriate, data is corrected, flagged, or invalidated, and corrective action performed to address issues, identify root causes, and implement reoccurrence minimization procedures. The data review, verification, and validation process can identify operational deviations, sampling issues, analysis issues and data quality issues. The goal of this process is to produce and maintain a database with values that are acceptable to a level of precision and bias that meets or exceeds the corresponding AB 617 Community Air Monitoring programs requirements and goals, by: (1) evaluating the spatial, temporal, and physical consistency of the data; and (2) assessing the data to identify errors, biases, or outliers.

4.2.1 Data Qualifier Codes

For federal monitoring programs, South Coast AQMD employs U.S. EPA AQS null value codes and QA qualifier flags. Where appropriate, these codes will also be used for the Special Monitoring and AB 617 Community Air Monitoring programs. Qualifier codes are identified through the review, verification and

validation process but may also be recommended by field staff and are included when reporting data. Qualifier classifications are provided in Appendix D.

4.2.2 Data Review, Verification and Validation Procedures for Established and Regulatory Monitoring Methods

Data is initially reviewed by the analyst performing the analysis, typically a Laboratory Technician, Assistant Chemist, or Chemist (Level 0). The data then undergoes peer review by an Assistant Chemist or Chemist (Level 1), followed by Senior Chemist review (Level 2), and additional review by a Principal Chemist (Level 3). Data review occurs in Element LIMS, where sample and QC data is automatically flagged based on defined QC criteria. Additional qualifiers are applied to data as appropriate. Data review may include additional tools for graphical data presentations, spatial geographic data visualization, and statistical assessment. Finalized data is stored in a SQL database via Element LIMS. Data is retained for a period of time specified in the South Coast AQMD Record Retention Policy. This process is illustrated in Table 4.2.

Table 4.2 Laboratory Data Review and Validation Process

Level 0 review	AQ Laboratory Technician, Asst. AQ or AQ Chemist peer review
Level 1 review	Senior AQ Chemist
Level 2 and Level 3 review	Principal AQ Chemist

The data review, verification and validation procedures for time-integrated sampling methods are follows:

- **Level 0 Validation** is performed by AMT Branch field operations staff who checks the COC sheet envelope for accuracy and conformance to sampling and transport criteria as samples are collected and transported to the laboratory. Examples of representative Level 0 Validation criteria include:
    - Sample number;
    - Date;
    - Station;
    - Sample collection Start and Stop times;
    - Sample collection elapsed time;
    - Sampler flow rate (average rate, CV);
    - Observation of location and sampling conditions; and
    - Sample handling, storage and transport parameters and filter/media condition observations.

- **Level 1 Validation** is performed by designated laboratory staff as the samples are accepted, conditioned and weighed. This process includes, but is not limited to:
    - Review and verify the Level 0 Validation information when the samples are received and before the start of analytic activity;
    - Filter condition and appearance;
    - Field staff COC records on sampling conditions and other observations;

- Review preliminary filter weights for values inconsistent with that for similar samples; and
- Communicate concerns to AMT Branch field operations staff or the QA Branch as appropriate.

- **Level 2 and Level 3 Validation** are performed by the relevant Senior Air Quality Chemist and Principal AQ Chemist responsible for the particular analytic process prior to reporting results, and include:

    - Review of the process, issues and resolutions identified in Level 0 and 1 Validation steps;
    - Check for data completeness;
    - Check flow rate acceptance information;
    - Check calibration coefficients;
    - Check Laboratory Analysis QC data;
    - Compare collocated samples;
    - Check for exceptional events in coordination with Planning, Rule Development and Area sources (PRA)/Air Quality Assessment Group and with STA/AMT Branch Data Validation staff and the results of corrective action from QA Branch;
    - Check data for consistency with normal data ranges (including seasonal, day-of-week, and time-of-day variability), investigate and flag data as necessary;
    - Compare suspect data to meteorological conditions (wind direction, wind speed, weather conditions such as rain, cloud cover, etc.), coordinating with PRA/Air Quality Assessment Group as needed;
    - Compare collocated data or data from nearby sites, including federal program data;
    - Compare to historical data as appropriate;
    - Communicate sampling concerns with appropriate AMT Branch Operations staff and the QA Branch as appropriate;
    - Investigate and invalidate or flag data that are outside the acceptance criteria; and
    - Review all invalidated data and the rationale for invalidation.

4.2.3 Data Review, Verification and Validation Procedures for Research-Grade Monitoring Methods

There are four data review, verification and validation levels within the South Coast AQMD continuous monitoring data screening process. After an automated data screening (Level 0 Validation), first level (Level 1) data validation is performed by Special Monitoring and AB 617 Community Air Monitoring staff. In cases where data is expected to be submitted to outside agencies (e.g. CARB) and/or provided as reports to the members of the public, a second (Level 2) or higher level (Level 3) validation and submittal may be performed, as illustrated in Table 4.3 and described in more details below.

Table 4.3 Data Review Process for Continuous Measurements

Level 1 review	AQIS I and/or AQIS II
Level 2 review	Principal and/or Senior AQIS and/or AQS
Level 3 review	Special Monitoring and AB 617 Community Air Monitoring Program Supervisor

- **Level 0 Validation** is automated screening that may be performed by data loggers, AirVision, or DMS, which can provide data or single-point QC check warnings and indicators to inform Level 1 through 3 reviewers and may impact data that is reported in near-real-time on websites (e.g., South Coast AQMD or CARB websites). Examples of possible Level 0 Validation include, but are not limited to:

    - Times that the instrument was offline due to power outage, calibration, repair or auditing activity;
    - Hourly data containing less than 45 minutes;
    - Negative values that are below acceptable threshold;
    - Data ranging above typical maximum ambient values;
    - Filter handling issues; and
    - Flow rate (average rate, CV) issues.

- **Level 1 Validation** is performed each workday by AMT Branch field operations staff, and includes, but is not limited to, the following activities:

    - Meteorology sensor checks;
    - Maintenance sheet checks and observations;
    - Fill out downtime log;
    - Telemetry data review;
    - Shelter temperature observations;
    - Notable or exceptional event observations (e.g., fireworks, rain, strong winds, nearby construction, etc.); and
    - Warning and acceptance criteria limits data review; and
    - Review of data warning indicators for issues from any Level 0 automated screening.

- **Level 2 Validation** is performed as needed, by designated AMT Branch staff. Examples of Level 2 Validation include, but are not limited to:

    - Review issues identified during Level 1 Validation;
    - Review of suspect information or data (e.g., repeated or “sticking” values);
    - Review of plotted data to identify extreme values and outliers, constant values, block of zeros, or missing values and investigate the validity of all suspect values;
    - Flag data, as necessary, for exceptional events or other informational reasons;
    - Investigate and invalidate data that are outside acceptance criteria;
    - Invalidate data for shelter temperature criteria exceedances; and
    - Check for consistency with expected data ranges (e.g. typical seasonal, day-of-week, and time-of-day values), and investigate and flag data as necessary.

- **Level 3 Validation** is performed quarterly, or more often if needed, by designated AMT Branch staff. This process includes, but is not limited to:

    - Review issues identified during Level 2 validation and apply additional informational or invalidation flags, as necessary;

- Correlate suspect pollutant data to meteorology (wind direction, wind speed, weather conditions such as rain, cloud cover, etc.);
- Compare data from nearby sites, including those that are part of Federal, Special Monitoring, and AB 617 Community Air Monitoring programs;
- Review all invalidated data and the rationale for invalidation; and
- Compare to historical data as appropriate.

AMT Branch staff assigned to data validation reviews graphs of tabular and raw data in DMS or other data repositories, including supporting information when data is suspect. Anomalies or indications of systematic issues (e.g., low completeness, unusual data points, etc.) are reported to the QA Branch, typically as a Quality Assurance Alert (QAA). This may result in issuance of a Corrective Action Request (CAR) to document the issue and implement a subsequent corrective action.

4.2.4 Data Review, Verification and Validation Procedures for Low-cost Sensors

There are four data review, verification and validation levels within the South Coast AQMD's continuous monitoring data screening process for low-cost sensors. After an automated data screening (Level 0 Validation), first level (Level 1) data validation is performed by staff. In cases where data is expected to be submitted to outside agencies (e.g. CARB) and/or provided as reports to the members of the public, a second (Level 2) or higher level (Level 3) validation may be performed before submittal, as illustrated in Table 4.4 and described in more details below.

Table 4.4 Data Review Process for Low-Cost Sensors

Level 0 review	Automatic QA/QC (On Device and/or Data System)
Level 1 review	AQIS I/II
Level 2 review	AQIS II and/or AQS
Level 3 review	AQS and/or AQ-SPEC Program Supervisor

- **Level 0 Validation** is either performed automatically by the device using the factory presets, or during the data ingestion into the South Coast AQMD data system. Typically, sensors can be set with factory defined calibration equations to output a concentration value from the raw sensor readings. Factory settings can automatically flag data as valid/invalid based on the collected metadata. Additionally, the device may have offsets that can be applied to the concentration data with a scaling factor, or default slope and offset. For sensors that will be used for the Special Monitoring and AB 617 Community Air Monitoring programs, Level 0 validation is performed automatically during data ingestion with data subjected to a pre-defined set of rules. At this stage flags are also added if data exceeds any pre-set concentration limits. After Level 0 validation, data is available either with the calculated slopes and offsets applied, or without in the form of pre-scaled data. Level 0 validation is performed daily and includes, but is not limited to:

    - Time instrument was offline due to a power outage, calibration, repair or auditing activity;
    - Hourly values containing less than 75% of the collected 1-minute data;
    - Negative values that are below acceptable thresholds;
    - Data ranging above typical maximum ambient values;
    - Meta data review for parameters out of range (e.g. flow rate, temperature, pressure, and humidity).

- **Level 1 Validation** is performed each workday by South Coast AQMD field staff to ensure that the sensors are operating correctly according to specifications defined in the "Quality Control Checks for Low-cost Sensors" section of this QAPP. Level 1 validation includes, but is not limited to, the following activities:
    - Checks for extreme meteorological conditions;
    - Collocation and calibrations, and sensor replacements checks;
    - Maintenance sheet and downtime logs observations;
    - Other notable or exceptional event observations (e.g., fireworks, rain, strong winds, nearby construction, etc.);
    - Review of data warning indicators for issues from any Level 0 automated screening.

- **Level 2 Validation** (Manual QA/QC) is performed quarterly, or more often if needed, by designated AQ-SPEC staff. Examples of Level 2 validation include, but are not limited to:
    - Review issues identified during Level 0 and Level 1 validations;
    - Review of plotted data to identify extreme values and outliers, constant values, block of zeros, or missing values and investigate the validity of all suspect data points;
    - Flag data, as necessary, for exceptional events or other criteria that were not accounted for during Level 0 and Level 1 validation;
    - Check for consistency with expected data ranges (e.g. typical seasonal, day-of-week, and time-of-day values), and flag as necessary;
    - Apply batch processing network calibrations as appropriate.

- **Level 3 Validation** is performed quarterly, or more often if needed, by designated AQ-SPEC staff. This process includes, but is not limited to:
    - Review issues identified during Level 2 validation;
    - Correlate suspect pollutant data to meteorology (wind direction, wind speed, weather conditions such as rain, cloud cover, etc.);
    - Compare data from nearby sites, including those that are part of Federal, Special Monitoring, and AB 617 Community Air Monitoring programs;
    - Compare to historical data as appropriate;
    - Review all invalidated data and the rationale for invalidation.

South Coast AQMD staff assigned to data validation reviews graphs of tabular and raw data and reviews supporting information when data is suspect. Anomalies or indications of systematic issues (e.g., low completeness, unusual data points, etc.) are reported to the QA Branch, typically as a Quality Assurance Alert (QAA). This may result in issuance of a Corrective Action Request (CAR) to document the issue and implement a subsequent corrective action.

4.2.5 Data Review, Verification and Validation Procedures for Mobile Monitoring Methods

The air monitoring equipment deployed on the mobile platforms are continuous monitors that follow data review, verification and validation procedures similar to those for continuous stationary monitors.

However, this entire process needs to be performed by more experienced AMT branch staff. For mobile measurements, after the automated data screening (Level 0), first level (Level 1) data validation is performed by Special Monitoring and AB 617 Community Air Monitoring staff that is most familiar with the use and operation of the mobile platforms. In cases where data is expected to be submitted to outside agencies (e.g. CARB) and/or provided as reports to the members of the public, a second (Level 2) or higher level (Level 3) validation may be performed. This process is illustrated in Table 4.5.

Table 4.5 Data Review Process for Mobile Measurements

Level 1 review	AQIS II and/or AQS
Level 2 review	Principal and/or Senior AQIS and/or AQS
Level 3 review	Special Monitoring and AB 617 Community Air Monitoring Program Supervisor

Additional details on the acquisition, review, validation, verification, storage and overall management of the data for each mobile platform (e.g. optical remote sensing instruments and other advanced monitoring methods) are provided on dedicated SOPs that are currently under development.

4.3 Reconciliation with User Requirements

This section describes how the monitoring and sample results obtained from the South Coast AQMD AB 617 Community Air Monitoring programs will be reconciled with data quality objectives (DQOs), after having been reviewed, verified, and validated against the MQOs. The DQOs are the qualitative and quantitative statements that describe the intended use of the data, the types of data needed, and set tolerance limits on the amount of uncertainty in the data sets such that decision makers can use the resulting data with a knowledge of data limitations. The goal of this effort is to determine whether the programmatic goals have been achieved and how on-going reassessment and improvement in data quality can be achieved.

The reconciliation with DQOs occurs, in part, during the data quality assessment process. It includes the review of DQOs in consideration with the sampling design and configuration, and data collection methodology to ensure these are consistent with DQO needs. Findings indicating that programmatic objectives have not been met trigger further review of the impacted sampling and measurement methodology, with concurrent initiation of appropriate corrective action to correct outstanding issues. Criteria is adopted, as appropriate, from U.S. EPA federal monitoring programs since it generally exceeds South Coast AQMD criteria required for non-federal reporting purposes. Data quality criteria under this QAPP not found to meet its intended purpose is revised according to appropriate DQOs and MQOs.

The South Coast AQMD evaluation and reconciliation of monitoring program DQOs addresses the following questions:

- Was the data within the QC limits for the intended purpose of the measurements?
- Do the results from mobile monitoring indicate that the study area has been properly surveyed (i.e., enough representative monitoring data for the project has been collected, and adequate information is available to recommend longer term stationary monitoring at locations that may be impacted by specific emissions sources?)

- Is the data more or less variable (e.g., coefficient of variation) either in time or in space than expected? This could imply that the monitoring or sampling frequency and/or the sampling locations may need to be increased or decreased;
- Do the monitoring results indicate a measured concentration consistently far above, far below, or near the thresholds of concern? This assessment is conducted by comparing data to NAAQS, CAAQS, OHHEA RELs or other established levels, as appropriate. Levels near a NAAQS standard and/or ambient air health threshold may indicate the need for a more appropriate method evaluate those health thresholds or additional and/or more frequent monitoring;
- Do the monitoring data indicate that a change of strategy, which may include ending the project?

The South Coast AQMD QAPP implementation and oversight for the AB 617 Community Air Monitoring programs is designed to be proactive and to prevent or address potential issues before they evolve into larger ones, such as a measured pollutant not meeting its measurement DQOs. Problems growing into larger issues can result in loss of agency credibility and trigger an internal root cause analysis and investigations. Outcomes of these investigations could result in remedial or advanced staff training, stressing the importance of adhering to SOPs, OAGs and other written protocols, as well as developing processes for addressing equipment operational and maintenance problems. These investigations could also result in SOP and/or OAG revisions, as well as changes in hardware configuration, as determined by the QA branch. The corrective actions could include, for example, increased training of the operators or laboratory analysts if they did not adhere to protocols or selecting a more appropriate monitoring method or a combination of monitoring methods to achieve the air monitoring objectives.

4.4 Data Display

In an effort to integrate and manage data display from various distinct monitoring and laboratory analysis programs (including AB 617 Community Air Monitoring) South Coast AQMD is developing a cloud-based platform for building interactive data visualizations and dashboards for web-based viewing. The data management scope includes the cloud-based data management to allow for the ingestion, validation/verification, processing, analysis and storage of data collected by all continuous and time-integrated air monitoring and analysis instruments used by South Coast AQMD staff. The platform for building interactive data visualizations and data dashboards will provide custom data analysis workflows and visualizations. These dashboards will include both internal administrative dashboards designed for program management, and community-based data dashboards designed for public viewing with interactive web visualizations customized for each monitoring program. This system includes a back-end cloud platform infrastructure and a front-end application for the visualization of air monitoring data. The system will be able to perform QA/QC on streaming data sets and provide functionality for alerting when threshold values have been met or exceeded.

The development of this cloud-based platforms is split into three phases. Phase I focuses on the development of the back-end cloud computing architecture required for ingesting, processing, analyzing, visualizing, and storing the data. The key tasks of Phase I are to design an overall system architecture to handle the functional and future capacity requirements of the District's expanding monitoring programs, develop and implement a database strategy, develop data processing procedures for QA/QC checks, and provide a platform for building real-time interactive data analytics for public interfacing websites.

The second phase of the project (Phase II) is designed to integrate the data from all of the District's air monitoring programs into the platform, including that from the South Coast AQMD ambient air monitoring network, all mobile monitoring and low-cost sensor measurements, and laboratory data. During this second phase, pathways for visualizing the data stream from these multiple sources into one common platform will also be developed. The third phase of this work (Phase III) is designed to enhance the platform development by integrating complementary environmental data (e.g., meteorological data) and building a batch data analysis workflow for implementing batch processes and machine learning approaches. A schematic of the three phases for the South Coast AQMD cloud-based data platform development is shown in Figure 4.1.

Figure 4.1 Schematic showing the three phases of the South Coast AQMD cloud-based data platform development

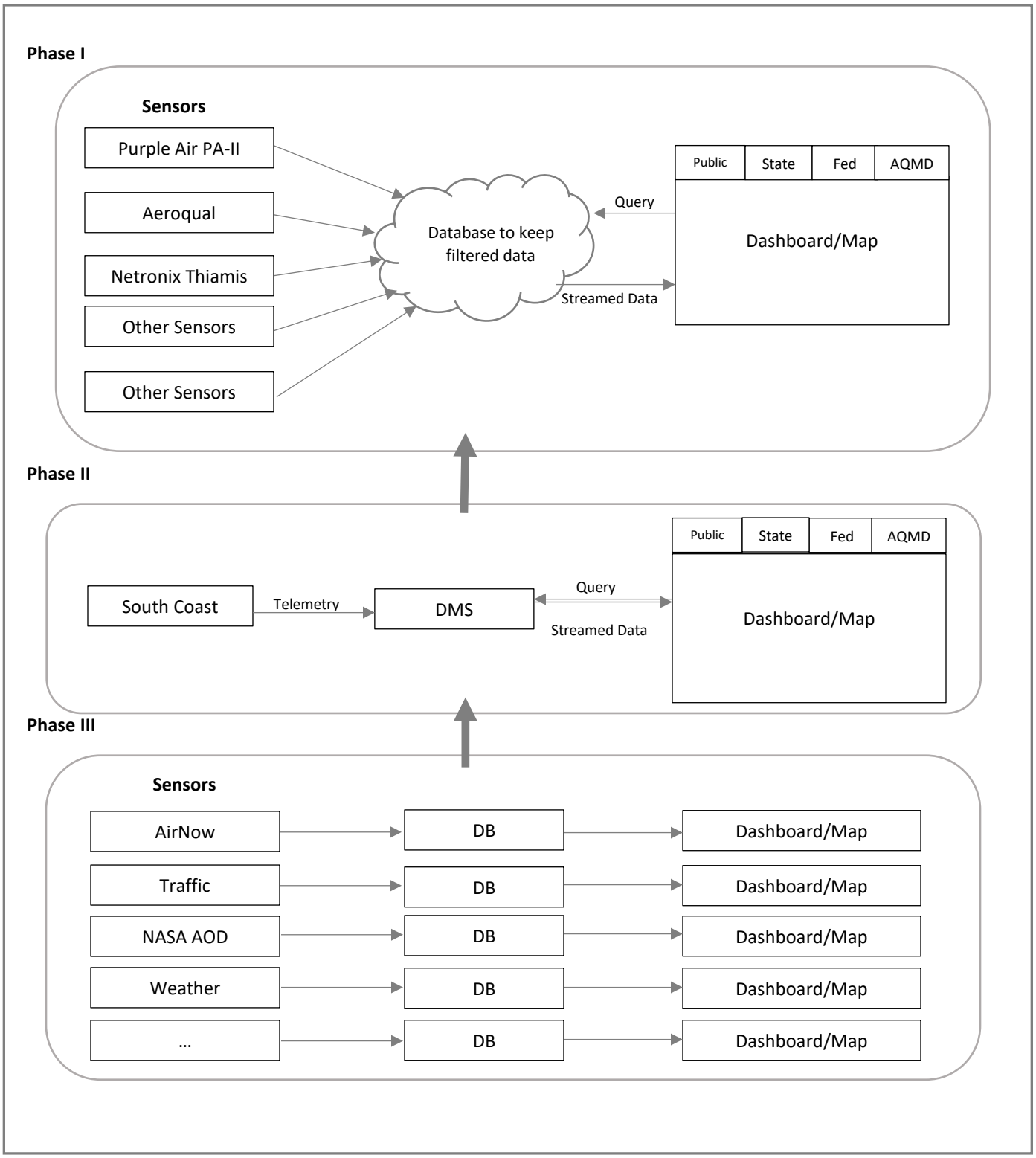
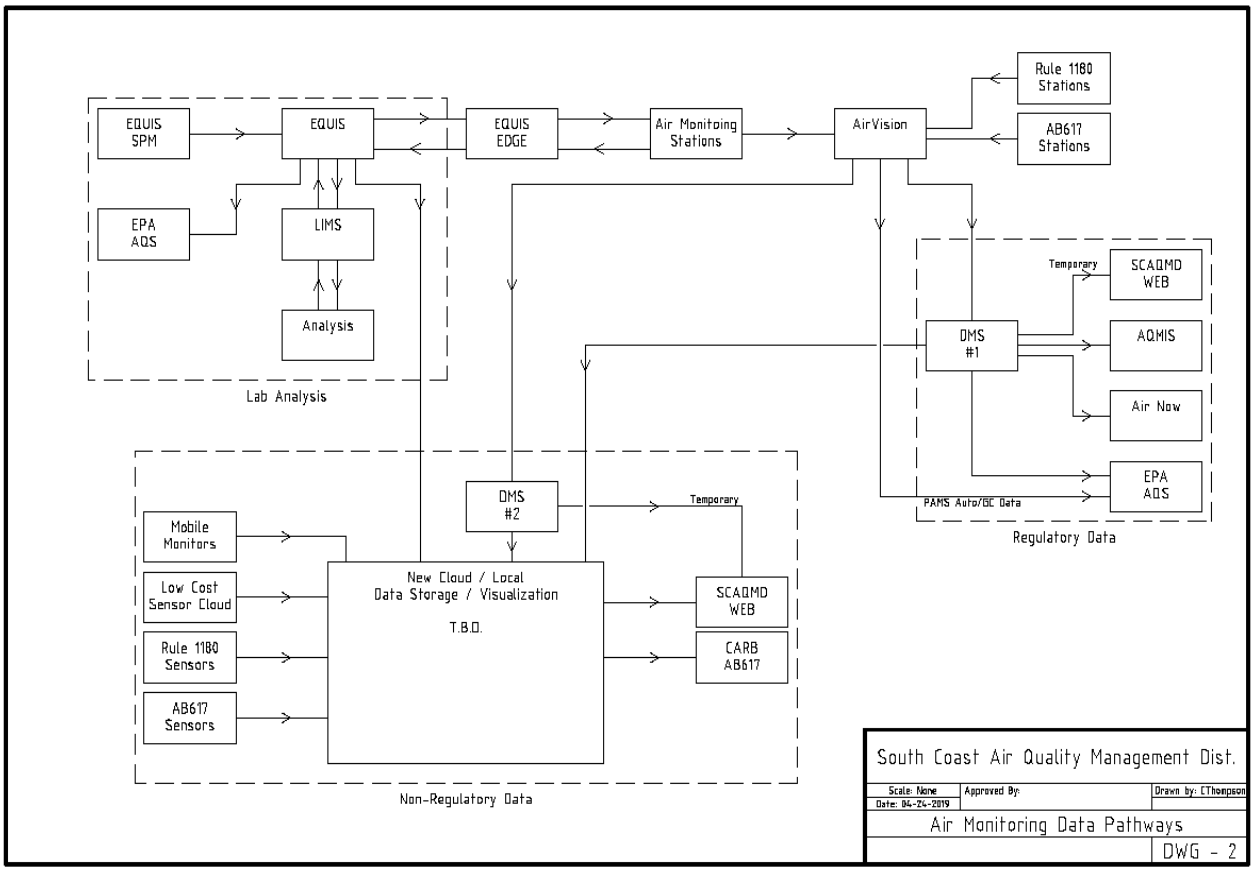


Figure 4.2 shows the data paths for all air monitoring data that are anticipated to be collected and reported. Continuous data starts at the instruments and data loggers in the Air Monitoring Stations. That data is then collected by the AirVision data collection system and handed off to one of the two Data Management Systems (DMS). EPA regulatory data (if collected) will go to DMS #1 for Auto QC, manual QC and data storage. Real-time data is forwarded to South Coast AQMD's Air Quality Map, AirNow and AQMIS every hour. The AB 617 Community Air Monitoring program's data will go to DMS #2 for Auto QC, some manual QC, and data storage. The data is then sent to the new data cloud platform for higher level QC and Data Visualization, and integration with other types of data.

Time-integrated samples are collected at the Air Monitoring Stations and delivered to the Lab for analysis. Sample parameters will be collected by the Equis EDGE software for integration into the sample database. After analysis, the resulting concentration data and/or reports will be transferred to the cloud system for display and generating historical reports.

Figure 4.2 Schematic of the data paths for all air monitoring data collected within the AB 617 Community Air Monitoring Program



5.0 Assessment and Oversight

This section describes assessments in which South Coast AQMD participates or performs to ensure the AB 617 Community Air Monitoring programs activities are resulting in data of known and defensible quality which satisfies its intended use as described in this QAPP and its associated SOPs, OAGs and other documentation. South Coast AQMD is committed to maintaining staffing, hardware, and certifications needed for the adequate performance of air monitoring programs and related assessments.

An assessment is defined as an evaluation process used to measure the performance of the quality system or the suitability of monitoring sites, and effectiveness of various measurement phases of the data collection and analysis operation. Independent assessments of AB 617 Community Air Monitoring projects are performed or organized by the QA Branch staff based upon established QA procedures.

South Coast AQMD routinely participates in air monitoring and laboratory assessments or proficiency programs conducted, organized or reviewed by the QA Branch. This includes programmatic and technical systems audits (TSAs) administered or contracted for by the U.S. EPA or CARB. In some cases, auditors are contracted, or test samples purchased by the QA Branch. The QA Manager, or designee, performs or arranges for periodic performance and technical systems audits of South Coast AQMD activities. Performance or technical systems audits may be conducted in-house, contracted, or conducted by other stakeholder entities, such as CARB. Numerous audit activities occur throughout each year for the various monitoring programs managed by South Coast AQMD. Combined, these audits cover all aspects of South Coast AQMD's air monitoring activities, including: safety, siting, documentation, training, field operations, instrument/sampler performance, sample receipt, COC, calibration standards, conditioning, weighing, chemical/speciation analysis, shipping, data reduction, data management, data review, verification and validation, reporting, and QA oversight. These audits are intended to demonstrate that all South Coast AQMD monitoring and measurement systems are resulting in data which satisfies its intended use and capable of providing data of a known and defensible quality.

After a AB 617 Community Air Monitoring assessment is completed and the final report received, the QA Manager, or designee, summarizes the results in a memorandum or email to the AMT Branch Manager and the LS Manager. These memoranda or emails present audit findings and clearly specify areas in which corrective action is necessary. This report may precede or be accompanied by a CAR issued to appropriate staff and tracked by the QA Branch. The time expected for completion of a corrective action is based upon the severity of the issue, time needed to acquire hardware or perform training and other documented factors.

All corrective action activities follow the corrective action process as described in the QMP (South Coast AQMD, 2016) and in OAG QA0001 (Corrective Action Request Process). Any South Coast AQMD M&A staff, including those performing AB 617 Community Air Monitoring activities, can alert the QA Branch to the need for corrective action through the Quality Assurance Alert process (OAG QA0002). QAAs forms are used to inform the QA Branch of potential issues or changes that could impact the data or safety. These forms allow staff to categorize the submission as:

- For information only
- Work in progress
- Quality Assurance Branch requested/required involvement

The QA Branch evaluates QAA submissions and may issue CARs based upon QAA submission or upon QA investigative findings that data quality or safety is or may be impacted. QAAs may result in:

- Informing impacted personnel about the issue;
- Open discussion for determining whether corrective action is needed and the form this corrective action will take;
- Defining a resolution and determining a reasonable deadline for completion;
- Tracking progress in resolving the issue leading to a finding; and
- Documenting the problem, its resolution and reoccurrence minimization measures taken.

When an audit or inspection identifies a serious QA or safety issue requiring immediate action, the QA Manager or designee directly communicates the information to the responsible manager and impacted staff or designee verbally and through electronic mail. The initial notification is followed by issuance of a CAR for documentation and tracking, a plan for resolution, the resolution and the recurrence minimization plan. Staff may be called in after hours or on weekends if necessary, to assess and correct for critical issues, including those when data quality/quantity is seriously jeopardized and may have a sensitivity for a timely, if not immediate, resolution.

The QA Branch staff, and the Manager and senior staff of the impacted group will report on the assessment of the effectiveness of a corrective action. If a corrective action is disputed and/or unresolved, the QA Manager will mediate a resolution and may seek further advice and guidance from appropriate CARB or U.S. EPA Region 9 staff, if appropriate, and may elevate the issue to the STA/M&A ADEO, if necessary.

In addition to routine QC procedures described in Section 4.5, the QA Branch assists in the evaluation, auditing, and challenging of field and laboratory operations according to the applicable SOPs and OAGs listed in Table 5.1.

Table 5.1 QA Branch Oversight OAGs and SOPs

SOP #	Topic
SOP00154	Standard Operating Procedure for High-Volume SSI PM10 Sampler Performance Audit
SOP00155	Standard Operating Procedure for High Volume Total Suspended Particulate (TSP) Sampler Performance Audit
SOP00135	Standard Operating Procedure for Field Station Criteria Pollutant Ambient Air Instrument Performance Evaluation
SOP00160	Standard Operating Procedures for Performance Audit of Met One SASS Sampler
SOP00161	Standard Operating Procedures for Performance Audits of High-Volume Total Suspended Particulates (TSP) and PM10 Samplers
SOP00168	Standard Operating Procedure for Auditing Continuous PM2.5 and PM10 Met One Instruments (BAM 1020)
SOP00172	Standard Operating Procedure for Performance Audit of the Xontech 924 Toxic Air Sampler
SOP00173	Standard Operating Procedure for Performance Auditing of Xontech 910A Canister Sampler
SOP00176	Standard Operating Procedure for Performance Audit of the ATEC 8000 Sampler

5.1 Technical Systems Audits

Technical Systems Audits (TSAs) may be conducted by internal (QA Branch) or external auditors (contractors, CARB), to review and assess the various aspects of the South Coast AQMD air monitoring, analyses and data quality system. Internal systems audits are conducted during on-site visits by QA staff. The various aspects of the systems audit may be conducted by QA staff or under contract with an independent consulting firm working under the oversight of the QA Manager, or by an external entity such as CARB or the US EPA. When it is deemed necessary, technical system audits may be performed on long-term AB 617 Community Air Monitoring projects as part of a system-wide assessment. A system audit of AB 617 Community Air Monitoring projects may include all aspects of South Coast AQMD's work that is related to single, all, or a subset of AB 617 Community Air Monitoring projects, including sample receipt, custody, conditioning, weighing, chemical/speciation analysis, shipping, and data reduction and reporting. Prior to large systems audit performance, a checklist is prepared and distributed to impacted staff. For AB 617 Community Air Monitoring activities, this checklist is based upon this QAPP, SOPs, OAGs, work plans, and other applicable guidance documents.

5.2 Reports to Management

This section describes how the results of assessments are communicated up the management chain, so that all parties involved in AB 617 Community Air Monitoring related activities are aware of data quality issues or concerns. The management structure of these programs is described in Table 1.1.

The QA Branch routinely reports to South Coast AQMD management regarding quality system activities and issues. These communications to the management chain can range from meetings, to email or memo notifications, to internal or external reports. M&A Branch managers meet regularly to discuss project

status, plans and issues. This includes weekly meetings with the STA/M&A ADEO and every other week with the STA DEO. Topics of reports to management may include, but are not limited to, the following:

- Findings of systems and performance audits and their resolution;
- Successful audit results;
- Quality Assurance Alert (QAA) status;
- Corrective Action Request (CAR) status;
- Recommendations for non-critical quality assurance or safety improvements;
- Recommendations for critical quality assurance or safety improvements;
- Progress with developing QA methods and oversight;
- Training efforts;
- Relevant changes to QA or monitoring guidance, requirements or procedures;
- Quality or safety improvements implemented;
- Comparisons to DQOs;
- Station closures and new or relocated station siting;
- South Coast AQMD QA documentation progress and gaps (e.g., SOPs, QAPPs, QMP); and
- Summary statistic reports of monitoring and QA activities.

Reports from performance evaluations and systems audits are distributed to impacted staff including the manager(s) of the appropriate branch. CARS are prepared and issued as necessary followed by meetings to discuss findings and their resolution. CARS and associated documentation are retained by the QA Branch. Memoranda or e-mail summarizing annual assessment occurrence and results is prepared annually one month after the end of a South Coast AQMD fiscal year in accordance with the South Coast AQMD QMP Section 11.4 (South Coast AQMD, 2016).

APPENDIX A
GLOSSARY OF TERMS

(Note that these definitions are for the purposes of this document only and do not affect the use of the terms for other purposes.)

Acceptance Criteria — Address the adequacy of existing information proposed for inclusion into the project. These criteria often apply to data drawn from existing sources ("secondary" data). Specified limits placed on characteristics of an item, process, or service defined in requirements documents.

Accuracy — A measure of the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (imprecision) and systematic error (bias) components that are due to sampling and analytical operations; U.S. EPA generally recommends using the terms "precision" and "bias," rather than "accuracy," to convey the information usually associated with accuracy.

Ambient Air Quality Monitoring – This is the collection and measurement of samples of ambient air to evaluate the status of the air pollutants in the atmosphere as compared to clean air standards and historical information.

Analysis (chemical) – This is the determination of the qualitative and/or quantitative composition of a substance.

Assessment — The evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation, management systems review, peer review, inspection, or surveillance.

Audit — A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Bias — The systematic or persistent distortion of a measurement process that causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Blank — A sample subjected to the usual analytical or measurement process to establish a zero baseline or background value. Sometimes used to adjust or correct routine analytical results. A sample that is intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

Calibration — Comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies.

Certification — The process of testing and evaluation against specifications designed to document, verify, and recognize the competence of a person, organization, or other entity to perform a function or service, usually for a specified time.

Chain of Custody (COC) — An unbroken trail of accountability that ensures the physical security of samples, data, and records.

Collocated Samples — Two or more portions collected at the same point in time and space so as to be considered identical. These samples are also known as field replicates and should be identified as such. Typically, samples collected at the same time but using two completely separate collection systems. 40 CFR Part 58 Appendix A defines collocated sampling.

Comparability — A measure of the confidence with which one data set or method can be compared to another.

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

Conformance — An affirmative indication or judgment that a product or service satisfies the relevant specification, contract, or regulation.

Contractor — any organization or individual that contracts to furnish services or items or perform work; a supplier in a contractual situation.

Corrective Action — Any measures taken to rectify conditions adverse to quality and, where possible, to prevent recurrence.

Corrective Action Report (CAR) — A report issued by the South Coast AQMD Quality Assurance Branch to document and notify appropriate personnel of an issue or finding that may potentially impact data quality, completeness, storage, or reporting, along with the resolution. CARs can address to measurements, analyses, procedures, maintenance, documentation, training, safety, or other QA oversight components. The resolution of a CAR should document measures taken to rectify conditions adverse to quality and, where possible, to prevent recurrence. Similar to the South Coast AQMD CAR, the California Air Resources Board (CARB) QA group issues Air Quality Data Actions (AQDAs).

Criteria Pollutant — The seven pollutants (ground level ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, PM10 respirable particulate matter, PM2.5 fine particulate matter, and Pb-lead) regulated by the Clean Air Act, i.e., those pollutants associated with National Ambient Air Quality Standards (NAAQS).

Data Quality — A measure of the degree of acceptability or utility of data for a particular purpose.

Data Quality Assessment (DQA) — A scientific and statistical evaluation of a data set to determine if data obtained from environmental operations are of the adequate type, quality, and quantity to support their intended use.

Data Quality Indicators (DQIs) — The quantitative statistics and qualitative descriptors used to interpret and assess the degree of acceptability or utility of data to the user. The principal DQIs are bias, precision, accuracy (bias is preferred), comparability, completeness, representativeness, and sensitivity. In aggregate, DQIs provide an assessment that measurement systems are maintained within prescribed limits, ensuring the resulting data are of quality acceptable for the intended use.

Data Quality Objectives (DQOs) — The qualitative and quantitative statements derived from the DQO Process that clarify technical and quality objectives of a study or program, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Data Quality Objective Process — A systematic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use. DQOs are the qualitative and quantitative outputs from the DQO Process.

Data Reduction — The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collating them into a more useful form. Data reduction is irreversible and generally results in a reduced data set and an associated loss of detail (unless the initial raw data is also archived).

Data Usability — The process of ensuring or determining whether the quality of the data produced meets the intended use of the data.

Data Validation — An analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set.

Data Verification — The process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual specifications.

Design — The specifications, drawings, design criteria, and performance specifications. Also, the result of deliberate planning, analysis, mathematical manipulations, and design processes.

Detection Limit — The lowest concentration or amount of target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. A measure of the capability of an analytical method to distinguish samples that do not contain a specific analyte from samples that contain low concentrations of the analyte; the lowest concentration or amount

of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. DLs are analyte- and matrix-specific and may be laboratory-dependent.

Document — Written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results.

Document Control — The policies and procedures used by an organization to ensure that its documents and their revisions are proposed, reviewed, approved for release, inventoried, distributed, archived, stored, and retrieved in accordance with the organization's specifications.

Environmental Conditions — The description of a physical medium (for example, air, water, soil, sediment) or a biological system expressed in terms of its physical, chemical, radiological, or biological characteristics.

Environmental Data — Measurements or information that describe environmental processes, location, or conditions; ecological or health effects and consequences; or the performance of environmental technology. For U.S. EPA, environmental data include information collected directly from measurements, produced from models, or compiled from other sources such as data bases or the literature.

Environmental Data Operation — Work performed to obtain, use, or report information pertaining to environmental processes and conditions.

Environmental Monitoring — The process of measuring or collecting environmental data.

Environmental Process — A manufactured or natural process that produces discharge to, or that impacts, the ambient environment.

Environmental Programs — Work or activities involving the environment, including but not limited to: characterization of environmental processes and conditions; environmental monitoring; environmental research and development; the design, construction, and operation of environmental technologies; and laboratory operations on environmental samples.

Environmental Technology — An all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be used to remove pollutants or contaminants from, or to prevent them from entering, the environment. Examples include wet scrubbers (air), soil washing (soil), granulated activated carbon unit (water), and filtration (air, water). Usually, this term applies to hardware-based systems; however, it can also apply to methods or techniques used for pollution prevention, pollutant reduction, or containment of contamination to prevent further movement of the contaminants, such as capping, solidification or vitrification, and biological treatment.

Field Blank — A clean analyte-free sample which is carried to the sampling site and then exposed to sampling conditions, returned to the laboratory, and treated as an environmental sample. This

blank is used to provide information about contaminants that may be introduced during sample collection, storage, and transport and it provides information about contaminants that may be introduced during sample collection, storage, and transport.

Financial Assistance — The process by which funds are provided by one organization (usually governmental) to another organization for the purpose of performing work or furnishing services or items. Financial assistance mechanisms include grants, cooperative agreements, and governmental interagency agreements.

Graded Approach — The process of applying managerial controls to an item or work according to the intended use of the results and the degree of confidence needed in the quality of the results.

Guidance — A suggested practice that is not mandatory, intended as an aid or example in complying with a standard or specification.

Holding Time — The period of time a sample may be stored before analysis. While exceeding the holding time does not necessarily negate the veracity of analytical results, it causes the qualifying or "flagging" of any data not meeting all of the specified acceptance criteria.

Independent Assessment — An assessment performed by a qualified individual, group, or organization that is not a part of the organization directly performing and accountable for the work being assessed.

Inspection — The examination or measurement of an item or activity to verify conformance to specifications.

Management System — A structured, non-technical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Matrix Spike Sample — A sample prepared by adding a known amount of the target analyte to a specified amount of a matrix. Spiked samples are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Measurement Quality Objectives (MQOs) — The individual performance or acceptance goals for the individual Data Quality Indicators, such as precision or bias.

Measurement Uncertainty — A term used to describe deviations from a true concentration or estimate that are related to the measurement process and not to spatial or temporal population attributes of the air being measured.

Metadata — Information that describes the data and the quality criteria associated with their generation.

Method — A body of procedures and techniques for performing an activity (for example, sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Method Blank — A blank prepared to represent the sample matrix as closely as possible and analyzed exactly like the calibration standards, samples, and quality control (QC) samples. Results of method blanks provide an estimate of the within-batch variability of the blank response and an indication of bias introduced by the analytical procedure.

National Ambient Air Quality Standards (NAAQS) — Primary and secondary federal air quality standards for Criteria Pollutants, established by the Clean Air Act with periodic review and revision. ***Primary standards*** set limits to protect public health, including the health of "sensitive" populations such as those with heart or lung disease, children, and older adults. ***Secondary standards*** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

Outlier — An extreme observation that is shown to have a low probability of belonging to a specified data population.

Parameter — A quantity, usually unknown, such as a mean or a standard deviation characterizing a population. Commonly misused for “variable,” “characteristic,” or “property.”

Participant — When used in the context of environmental programs, an organization, group, or individual that takes part in the planning and design process and provides special knowledge or skills to enable the planning and design process to meet its objective.

Particulate Matter (PM) —Any material, except uncombined water, which exists in a finely divided form as a liquid or solid aerosol at standard conditions. **PM10** means the particulate matter with an aerodynamic diameter smaller than or equal to 10 microns as measured by applicable state and federal reference test methods. **PM2.5** means the particulate matter with an aerodynamic diameter smaller than or equal to 2.5 microns as measured by applicable state and federal reference test methods.

Performance Criteria — Address the adequacy of information that is to be collected for the project. These criteria often apply to new data collected for a specific use (“primary” data).

Performance Evaluation — A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

Precision — A measure of mutual agreement among repeated individual measurements of the same property, usually under prescribed similar conditions; expressed generally in terms of the Standard Deviation. Other metrics, such as Relative Percent Difference, are typically used when there are too few data points to determine a valid standard deviation.

Procedure — A specified way to perform an activity.

Primary Quality Assurance Organization (PQAO) — A monitoring organization or a group of monitoring organizations that share a number of common quality assurance factors, such as: (1) operation by a common team of field operators according to a common set of procedures; (2) use of a common QAPP or standard operating procedures; (3) common calibration facilities and standards; (4) oversight by a common quality assurance organization; and (5) support by a common management, laboratory or headquarters.

Process — A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Proficiency Test — A type of assessment in which a sample, the composition of which is unknown to the analyst, is provided to test whether the analyst/laboratory can produce analytical results within the specified acceptance criteria.

Quality — The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

Quality Assurance (QA) — An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer or user.

Quality Assurance Alert (QAA) — An South Coast AQMD report generated from staff to inform the QA Branch of an issue that affects or potentially affects data quality or safety. The QA Branch may issue a Corrective Action Report (CAR) as a result to document the finding and its resolution. The California Air Resource Board's Corrective Action Notification is similar to the South Coast AQMD QAA on the State level.

Quality Assurance Manager — The individual designated as the principal manager within the organization having management oversight and responsibilities for planning, documenting, coordinating, and assessing the effectiveness of the quality system for the organization.

Quality Assurance Project Plan (QAPP) — A formal document describing in comprehensive detail the necessary quality assurance procedures, quality control activities, and other technical activities that need to be implemented to ensure that the results of the work performed will satisfy the stated performance or acceptance criteria. The QAPP components are divided into four groups of elements: (A) Project Management; (B) Data Generation and Acquisition; (C) Assessment and Oversight; and (D) Data Validation and Usability. QAPP requirements and preparation guidance can be found in EPA QA/R-5 (U.S. EPA, 2001, in Appendix B, References) and QA/G-5 (U.S. EPA, 2002 and U.S. EPA, 2018).

Quality Control (QC) — The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the specifications established by the customer or user; operational techniques and activities that are used to fulfill requirements for quality. The system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring the results are of acceptable quality.

Quality Control Sample — An uncontaminated sample matrix spiked with known amounts of analytes from a source independent of the calibration standards. Generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality Management — That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, documentation, and assessment) pertaining to the quality system.

Quality Management Plan — A document that describes the quality system in terms of the organization's structure, the functional responsibilities of management and staff, the lines of authority, and the interfaces for those planning, implementing, and assessing all activities conducted.

Quality System — A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out quality assurance procedures and quality control activities.

Readiness Review — A systematic, documented review of the readiness for the start-up or continued use of a facility, process, or activity. Readiness reviews are typically conducted before proceeding beyond project milestones and before initiation of a major phase of work.

Record — A completed document that provides objective evidence of an item or process. Records may include photographs, drawings, magnetic tape, and other data recording media.

Recovery — The act of determining whether or not the methodology measures all of the analyte contained in a sample.

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

Self-Assessment — The assessment of work conducted by individuals, groups, or organizations directly responsible for overseeing and/or performing the work.

Sensitivity — The capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest.

Specification — A document stating requirements and which refers to or includes drawings or other relevant documents. Specifications should indicate the means and the criteria for determining conformance.

Spike — A substance that is added to an environmental sample to increase the concentration of the target analyte by known amount; used to assess measurement accuracy (spike recovery). Spike duplicates are used to assess measurement precision.

Split Samples — Two or more representative portions taken from one sample in the field or in the laboratory and analyzed by different analysts or laboratories. Split samples are quality control samples that are used to assess analytical variability and comparability.

Standard Operating Procedure (SOP) — A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps to be followed. It is officially approved as the method for performing certain routine or repetitive tasks.

Supplier — An individual or organization furnishing items or services or performing work according to a procurement document or financial assistance agreement. This is an all-inclusive term used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, or consultant.

Surveillance (quality) — Continual or frequent monitoring and verification of the status of an entity and the analysis of records to ensure that specifications are being fulfilled.

Technical Assessment – The evaluation process used to measure the performance or effectiveness of a technical system and its elements with respect to documented specifications and objectives. Such assessments may include qualitative and quantitative evaluations. A technical assessment may either be performed by those immediately responsible for overseeing and/or performing the work (i.e., a technical self-assessment) or by someone other than the group performing the work (i.e., a technical independent assessment).

Technical Assistance Audit (TAA) – A thorough, systematic, on-site, qualitative audit of facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a system which also includes training and discussion that will allow staff to perform activity meeting programmatic requirements.

Technical Systems Audit (TSA) — A thorough, systematic, on-site qualitative audit of facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a system.

Uncertainty — A parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand.

Validation — An analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set. Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

Verification — The process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual specifications. Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. In design and development, verification concerns the process of examining a result of a given activity to determine conformance to the stated requirements for that activity.

APPENDIX B
REFERENCES

40 CFR 58. Code of Federal Regulations, U.S. EPA, *Ambient Air Quality Surveillance.* [https://www.ecfr.gov/cgi-bin/retrieveECFR?n=40y6.0.1.1.6]

South Coast AQMD (2016). *South Coast Air Quality Management District Quality Management Plan*, Version 2.0, Diamond Bar, CA.

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South Coast AQMD (2019). *South Coast Air Quality Management District Annual Air Quality Monitoring Network Plan*. Diamond Bar, CA. [http://www.aqmd.gov/home/air-quality/clean-air-plans/monitoring-network-plan]

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U.S. EPA (2017). *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Monitoring Program*, Report No. EPA-454/B-17-001, U.S. EPA, Washington, DC. [https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/Final%20Handbook%20Document%201_17.pdf]

U.S. EPA (2018). *Guide to Writing Quality Assurance Project Plans for Ambient Air Monitoring Networks*, Report No. EPA-454/B-18-006, U.S. EPA, Research Triangle Park, NC. [https://www3.epa.gov/ttn/amtic/files/ambient/qaqc/Air%20Monitoring%20QAPP%20Guide%20-%20FINAL.pdf]

APPENDIX C
SOUTH COAST AQMD INTERNAL DOCUMENTS

South Coast AQMD Administrative Policies & Procedures #28: *Safety and Health Guidelines Policy. [Provided by Human Resources to all new South Coast AQMD staff; copies provided upon request]*

South Coast AQMD *Annual Air Quality Monitoring Network Plan* (July 1, 2019)
[http://www.aqmd.gov/home/air-quality/clean-air-plans/monitoring-network-plan]

South Coast AQMD *Chemical Hygiene Plan*, Version 1.5, October 2015
[Available on SCQMD Laboratory shared drive; copies provided upon request]

South Coast AQMD *Emergency Contact Information for Air Monitoring Stations*, March 2018
[Available on South Coast AQMD AirNet internal website; copies provided upon request]

South Coast AQMD *Guidelines for Implementing the California Public Records Act* (adopted by the South Coast AQMD Governing Board July 5, 2013)
[http://www.aqmd.gov/docs/default-source/default-document-library/Guidelines/pra-guidelines.pdf?sfvrsn=2]

South Coast AQMD *Injury and Illness Prevention Program*, South Coast AQMD Administrative & Human Resources, Risk Management Division, Revised November 2010
[Available on South Coast AQMD AirNet internal website; copies provided upon request]

South Coast AQMD *Laboratory Safety Manual*, Version 2.5, October 2015 (revision pending)
[Available on South Coast AQMD AirNet internal website; copies provided upon request]

South Coast AQMD *Monitoring Station Safety Manual*, Version 2.1.2, January 2019
[Available on South Coast AQMD AirNet internal website; copies provided upon request]

South Coast AQMD *Procurement Policy and Procedure*, (revision adopted by the South Coast AQMD Governing Board May 3, 2019)
[http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2019/2019-may3-009.pdf?sfvrsn=2]

South Coast AQMD *Procurement Training Guide/Contracts,* August 2015 update
[Available on South Coast AQMD AirNet internal website; copies provided upon request]

South Coast AQMD Procurement Memorandum, *Check list for RFPs/RFQs,* May 10, 2013
[Available on South Coast AQMD AirNet internal website; copies provided upon request]

APPENDIX C

U.S. EPA Data Qualifier Codes (2018)

Qualifier Code	Qualifier Description	Qualifier Type Code
1C	A 1-Point QC check exceeds acceptance criteria but there is compelling evidence that the analyzer data is valid.	NULL
AA	Sample Pressure out of Limits.	NULL
AB	Technician Unavailable.	NULL
AC	Construction/Repairs in Area.	NULL
AD	Shelter Storm Damage.	NULL
AE	Shelter Temperature Outside Limits.	NULL
AF	Scheduled but not Collected.	NULL
AG	Sample Time out of Limits.	NULL
AH	Sample Flow Rate or CV out of Limits.	NULL
AI	Insufficient Data (cannot calculate).	NULL
AJ	Filter Damage.	NULL
AK	Filter Leak.	NULL
AL	Voided by Operator.	NULL
AM	Miscellaneous Void.	NULL
AN	Machine Malfunction.	NULL
AO	Bad Weather.	NULL
AP	Vandalism.	NULL
AQ	Collection Error.	NULL
AR	Lab Error.	NULL
AS	Poor Quality Assurance Results.	NULL
AT	Calibration.	NULL
AU	Monitoring Waived.	NULL
AV	Power Failure.	NULL
AW	Wildlife Damage.	NULL
AX	Precision Check.	NULL
AY	Q C Control Points (zero/span).	NULL
AZ	Q C Audit.	NULL
BA	Maintenance/Routine Repairs.	NULL
BB	Unable to Reach Site.	NULL
BC	Multi-point Calibration.	NULL
BD	Auto Calibration.	NULL
BE	Building/Site Repair.	NULL
BF	Precision/Zero/Span.	NULL
BG	Missing ozone data not likely to exceed level of standard.	NULL
BH	Interference/co-elution/misidentification.	NULL

Qualifier Code	Qualifier Description	Qualifier Type Code
BI	Lost or damaged in transit.	NULL
BJ	Operator Error.	NULL
BK	Site computer/data logger down.	NULL
BL	QA Audit.	NULL
BM	Accuracy check.	NULL
BN	Sample Value Exceeds Media Limit.	NULL
BR	Sample Value Below Acceptable Range.	NULL
CS	Laboratory Calibration Standard.	NULL
DA	Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Shifts).	NULL
DL	Detection Limit Analyses.	NULL
EC	Exceeds Critical Criteria.	NULL
FI	Filter Inspection Flag.	NULL
MB	Method Blank (Analytical).	NULL
MC	Module End Cap Missing.	NULL
QV	Quality Control Multi-point Verification.	NULL
SA	Storm Approaching.	NULL
SC	Sampler Contamination.	NULL
ST	Calibration Verification Standard.	NULL
SV	Sample Volume out of limits.	NULL
TC	Component Check & Retention Time Standard.	NULL
TS	Holding Time Or Transport Temperature Is Out Of Specs.	NULL
XX	Experimental Data.	NULL
1	Deviation from a CFR/Critical Criteria Requirement.	QA
1V	Data reviewed and validated.	QA
2	Operational Deviation.	QA
3	Field Issue.	QA
4	Lab Issue.	QA
5	Outlier.	QA
6	QAPP Issue.	QA
7	Below Lowest Calibration Level.	QA
9	Negative value detected - zero reported.	QA
CB	Values have been Blank Corrected.	QA
CC	Clean Canister Residue.	QA
CL	Surrogate Recoveries Outside Control Limits.	QA
DI	Sample was diluted for analysis.	QA
DN	DNPH peak less than NATTS TAD requirement, reported value should be considered an estimate.	QA
EH	Estimated; Exceeds Upper Range.	QA

Qualifier Code	Qualifier Description	Qualifier Type Code
FB	Field Blank Value Above Acceptable Limit.	QA
FX	Filter Integrity Issue.	QA
HT	Sample pick-up hold time exceeded.	QA
LB	Lab blank value above acceptable limit.	QA
LJ	Identification Of Analyte Is Acceptable; Reported Value Is An Estimate.	QA
LK	Analyte Identified; Reported Value May Be Biased High.	QA
LL	Analyte Identified; Reported Value May Be Biased Low.	QA
MD	Value less than MDL.	QA
MS	Value reported is 1/2 MDL substituted.	QA
MX	Matrix Effect.	QA
ND	No Value Detected, Zero Reported.	QA
NS	Influenced by nearby source.	QA
QP	Pressure Sensor Questionable.	QA
QT	Temperature Sensor Questionable.	QA
QX	Does not meet QC criteria.	QA
SQ	Values Between SQL and MDL.	QA
SS	Value substituted from secondary monitor.	QA
SX	Does Not Meet Siting Criteria.	QA
TB	Trip Blank Value Above Acceptable Limit.	QA
TT	Transport Temperature is Out of Specs.	QA
V	Validated Value.	QA
VB	Value below normal; no reason to invalidate.	QA
W	Flow Rate Average out of Spec.	QA
X	Filter Temperature Difference or Average out of Spec.	QA
Y	Elapsed Sample Time out of Spec.	QA
IA	African Dust.	INFORM
IB	Asian Dust.	INFORM
IC	Chem. Spills & Indust. Accidents.	INFORM
ID	Cleanup After a Major Disaster.	INFORM
IE	Demolition.	INFORM
IF	Fire - Canadian.	INFORM
IG	Fire - Mexico/Central America.	INFORM
IH	Fireworks.	INFORM
II	High Pollen Count.	INFORM
IJ	High Winds.	INFORM
IK	Infrequent Large Gatherings.	INFORM
IL	Other.	INFORM
IM	Prescribed Fire.	INFORM

Qualifier Code	Qualifier Description	Qualifier Type Code
IN	Seismic Activity.	INFORM
IO	Stratospheric Ozone Intrusion.	INFORM
IP	Structural Fire.	INFORM
IQ	Terrorist Act.	INFORM
IR	Unique Traffic Disruption.	INFORM
IS	Volcanic Eruptions.	INFORM
IT	Wildfire-U. S.	INFORM
J	Construction.	INFORM