SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Quality Assurance Project Plan for Criteria Pollutant Monitoring Program

QAPP001

Revision 2.0

April 2020

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QAPP REVISION HISTORY

Revision Number	Date	Responsible Party	Description of Changes
0	11/2012	Jason Low, Ph.D., QA Manager	Initial South Coast AQMD QAPP for Criteria Pollutant Monitoring
1.0	05/2016	Andrea Polidori, Ph.D., QA Manager	QAPP revision to address revised federal guidance and QA Handbook (U.S. EPA 2013 *QA Handbook for Air Pollution Measurement Systems, Volume II*) and U.S. EPA comments on the 2012 QAPP
2.0	04/2020	Kevin Durkee, QA Manager	Comprehensive QAPP revision to address revised federal guidance and QA Handbook (U.S. EPA 2017 *QA Handbook for Air Pollution Measurement Systems, Volume II*) and U.S. EPA comments on the 2016 QAPP revision, (ref. U.S. EPA Region 9 conditional approval letter dated 2/14/2017); Updated content and formatting to incorporate the U.S. EPA 2018 *Guide to Writing Quality Assurance Project Plans for Ambient Air Monitoring Networks*. Addressed U.S. EPA Region 9 comments on December 2019 draft version.

0. INTRODUCTION

The South Coast Air Quality Management District (South Coast AQMD) is the regional air pollution control agency with jurisdiction over the South Coast Air Basin (Basin), including all of Orange County and the non-desert portions of Los Angeles, Riverside, and San Bernardino counties, and portions of the Riverside County desert areas in the Mojave Desert Air Basin (MDAB) and the Salton Sea Air Basin (SSAB), including the Coachella Valley. South Coast AQMD is responsible for controlling emissions primarily from stationary and area sources of air pollution. South Coast AQMD develops and adopts Air Quality Management Plans (AQMPs) that delineates the regional strategy for bringing the region into compliance with the National Ambient Air Quality Standards (NAAQS), as well as the progress toward meeting California Ambient Air Quality Standards (CAAQS). To assess progress toward the AQMP goals and to provide current air quality information to the public, South Coast AQMD conducts air quality measurements and laboratory analyses, including the criteria[1] air pollutant monitoring program. The criteria pollutant monitoring program has shown the magnitude and spatial distribution of these ambient air contaminants across the region as influenced by the source emissions, complex terrain and meteorology.

South Coast AQMD is designated by U.S. EPA as a Primary Quality Assurance Organization (PQAO), along with California Air Resources Board (CARB), San Diego County Air Pollution Control District (SDCAPCD), Bay Area Air Quality Management District (BAAQMD), and other federal and Tribal PQAOs operating in the State of California. Two Tribal PQAOs, the Morongo Band of Mission Indians and the Pechanga Band of Luiseño Indians, and the National Park Services (NPS) are recognized PQAOs that operate monitoring networks within the historical borders of the South Coast Air Basin. CARB also conducts monitoring within the South Coast AQMD jurisdiction, at times. Together, South Coast AQMD and the tribal, State and federal PQAOs constitute a cooperative effort to monitor air quality in the Basin.

As of this writing, South Coast AQMD operates 38 permanent criteria pollutant air monitoring stations and four single-pollutant source impact Lead (Pb) air monitoring sites in the Basin and a portion of the SSAB in the Coachella Valley. Some of the more recent permanent sites were added as part of the near-road monitoring network, with locations at: (1) Interstate Highway 5 (I-5), near Vernon Street in Orange County; (2) I-10, near Etiwanda Avenue, east of I-15 in San Bernardino County; (3) I-710, located near Long Beach Blvd. in Los Angeles County; and (4) California Highway Route 60 (CA-60), located west of Vineyard Avenue in San Bernardino County near the Riverside County border. A permanent ambient monitoring station in Mecca in the Coachella Valley monitors PM10 in the southeastern portion of the Coachella Valley and natural hydrogen sulfide (H2S) emissions from the Salton Sea. The most recent source impact Pb sites were added in January 2010, to meet U.S. EPA regulation. The South Coast AQMD criteria air pollutant monitoring network continually evolves, as stations are closed (e.g., due to loss of lease, suitability, safety, or changing needs) and new locations are instituted. The South Coast AQMD monitoring

[1] Criteria air pollutants are those associated with NAAQS, including: Ozone (O3), Carbon Monoxide (CO), Nitrogen Dioxide (NO2), Sulfur Dioxide (SO2), Respirable Particulate Matter (PM10), Fine Particulate Matter (PM2.5) and lead (Pb).

network is described in further detail in the South Coast AQMD *Annual Air Quality Monitoring Network Plan* (South Coast AQMD, 2019), which is the most current snapshot of the air monitoring network as of this writing, updated each year.

Through this monitoring, South Coast AQMD is better able to implement effective criteria pollutant control measures targeting those constituents most harmful to public health quality of life. The network also provides critical information for the South Coast AQMD daily air quality forecast program, the air quality alert system for public notification of air pollution events, including public access to real-time air quality data. The goals of this program are consistent with South Coast AQMD's mission and belief that all people who live or work under its jurisdiction have a right to breathe clean air.

South Coast AQMD management policy requires that sufficient quality assurance activities be conducted to demonstrate that all data collected by and on behalf of South Coast AQMD are scientifically and legally valid for the purposes to which they are intended. The purpose of this Criteria Pollutant Monitoring Quality Assurance Project Plan (QAPP) is to document management policy and those activities and procedures necessary for accomplishing specified program objectives for the criteria air pollutant monitoring program. This QAPP incorporates and follows the General Quality Assurance Policies for Environmental Measurements, identified in Section 2.3 of the South Coast AQMD Quality Management Plan (QMP) for Environmental Measurement Programs (South Coast AQMD, 2016), so that the quality of all data reported from this program shall meet agency, State, and U.S. EPA program requirements where appropriate. Environmental measurement activities performed by staff within South Coast AQMD or performed on behalf of South Coast AQMD by independent contractors or consultants will comply with the following general quality assurance (QA) policies:

a) The objectives of each environmental measurement program/project shall be clearly delineated during the planning stages of the program/project. These objectives shall be consistent with the mission, policies, and priorities of the South Coast AQMD.

b) Acceptable limits of data uncertainty shall be identified during the planning stages of each environmental measurement program/project so that the appropriate procedures and resources may be incorporated into the design of the program/project.

c) QA and quality control (QC) activities shall be integrated into all environmental measurement programs/projects in a cost-effective manner while attaining stated quality objectives.

d) A QAPP describing how each project/program will achieve the stated objectives and required level of data reliability, shall be developed for each environmental measurement program/project. Each QAPP is reviewed and approved by the manager(s) of the program/project, the Quality Assurance Manager (QA Manager-STA/M&A), the Assistant Deputy Executive Officer for Science & Technology Advancement (ADEO-STA/M&A), and the Deputy Executive Officer for Science & Technology Advancement (DEO-STA).

e) Sample collection, sample chain-of-custody (COC), sample analysis, training and data management activities shall be evaluated routinely by supervisory personnel and QA Branch

staff to identify and correct deficiencies and to enhance the credibility of each environmental measurement program/project.

f) Measures shall be instituted within each environmental measurement program/project to ensure that the quality of the environmental data collected is accurately and permanently documented. These measures include data validation audits, performance audits, systems audits, corrective action requests (CARs), and quality reports to management, and others.

This QAPP was prepared using the U.S. EPA Quality Assurance (QA) regulations and guidance described in EPA-QA/R-5, *EPA Requirements for Quality Assurance Project Plans* (U.S. EPA, 2001) and the accompanying document EPA-QA/G-5, *Guidance for Quality Assurance Project Plans* (U.S. EPA, 2002), along with the recent *Guide to Writing Quality Assurance Project Plans for Ambient Air Monitoring Networks* (U.S. EPA, 2018a). All pertinent elements of the regulations and guidance are addressed in this QAPP, including the following sections: (1) Project Management; (2) Data Generation and Acquisition; (3) Assessment and Oversight; and (4) Data Validation and Usability. In addition, specific details on meeting the regulatory monitoring program requirements are included in the South Coast AQMD Standard Operating Procedure (SOP) documents that support the criteria air pollutant monitoring program.

SOP documents are considered to be a part of this QAPP and play a significant role in supporting the South Coast AQMD criteria air monitoring program. Specific details as to how the South Coast AQMD monitoring program is implemented, including how the regulatory monitoring requirements are met, can be found in the relevant SOPs and Operation Assistance Guides (OAGs) that support the criteria air pollutant monitoring program, as listed in Appendix E. These SOPs are to be reviewed annually and revised at least every five years. The revised SOPs are also to be periodically submitted to U.S. EPA Region 9 for review along with QAPP revisions and as requested for prior to Technical Systems Audits (TSAs).

A glossary of terms used in this document is provided in Appendix A. Appendix B lists pertinent references. Appendix C lists additional South Coast AQMD documents related to the QAPP. Appendix D shows South Coast AQMD STA organizational charts. Appendix E lists the South Coast AQMD SOPs relevant to this QAPP. Appendix F shows an example of the South Coast AQMD/STA training forms. Appendix G reproduces the March 2017 U.S. EPA *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Monitoring Program, Appendix D, Measurement Quality Objectives and Validation Templates* (U.S. EPA, 2017b), the current version as of this writing.

1. PROJECT MANAGEMENT

This Quality Assurance Project Plan (QAPP) for the South Coast Air Quality Management District (South Coast AQMD) Criteria Pollutant Monitoring Program is a comprehensive document that describes in detail the necessary quality assurance (QA), quality control (QC), and all other technical activities that are implemented to ensure that the work performed satisfies the stated performance criteria. The requirements set forth have been developed to be consistent with the South Coast AQMD's Quality Management Plan (QMP) for Environmental Measurement Programs and comply with agency quality assurance policies. This QAPP conforms to the requirements of the United States Environmental Protection Agency (U.S. EPA) Order 5360.1 and the applicable sections of 40 CFR Parts 30, 31, and 35, as well as any specific grant agreements, as applicable.

Following the U.S. EPA *Guide to Writing QAPPs for Ambient Air Monitoring Networks* (U.S. EPA, 2018), Section 1 of this QAPP includes the following project management elements:

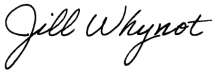
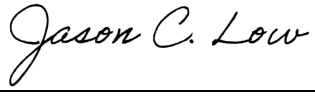
1.1 Title and Approval Sheet
1.2 Table of Contents and List of Acronyms and Abbreviations
1.3 Distribution List
1.4 Project/Task Organization
1.5 Problem Definition and Background
1.6 Project/Task Description
1.7 Quality Objectives and Criteria for Measurement Data
1.8 Training/Certification
1.9 Documentation and Records

1.1 Title and Approval Sheet

Document Title: South Coast Air Quality Management District Quality Assurance Project Plan for Criteria Air Pollutant Monitoring, Revision 2.0

Organization: South Coast Air Quality Management District, Monitoring and Analysis Division

The attached Quality Assurance Project Plan (QAPP) is hereby recommended for approval and commits the South Coast Air Quality Management District, Monitoring and Analysis Division to follow the elements described within.

APPROVALS		
Name & Position	**Signature**	**Date**
South Coast Air Quality Management District		
Executive Office		
Wayne Nastri Executive Officer		5/6/2020
Jill Whynot Chief Operating Officer		5/6/2020
Science & Technology Advancement		
Matt Miyasato, Ph.D. Deputy Executive Officer, Science & Technology Advancement		5/5/2020
Jason Low, Ph.D. Assistant Deputy Executive Officer, Science & Technology Advancement		05/05/2020
Rene Bermudez Atmospheric Measurements Manager, Monitoring Network Branch		5/5/2020
Aaron Katzenstein, Ph.D. Senior Enforcement Manager, Laboratory Services Branch		5/5/2020
Kevin Durkee Quality Assurance Manager, Quality Assurance Branch		5/4/2020
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Audrey L. Johnson Manager, Quality Assurance Office	Audrey L Johnson Digitally signed by Audrey L Johnson Date: 2020.07.07 11:26:07 -07'00'	

1.2 Contents

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS	
AAQC or AAQ Chemist	Assistant Air Quality Chemist
ADEO	Assistant Deputy Executive Officer
AQC or AQ Chemist	Air Quality Chemist
AQIS	Air Quality Instrument Specialist
AQMP	Air Quality Management Plan
AQS	Air Quality System
AQ Spec	Air Quality Specialist
AM Branch	Former Atmospheric Measurements Branch – now Monitoring Network Branch (see MN Branch)
AMT or AMT Branch	Advanced Monitoring Technologies Branch
AMTIC	U.S. EPA Ambient Monitoring Technology Information Center
ARM	Approved Regional Method
BAAQMD	Bay Area Air Quality Management District
Basin	South Coast Air Basin
BAM	Beta Attenuation Monitor
CAA	Clean Air Act
CAR	Corrective Action Request
CARB	California Air Resources Board
CBSA	Core Based Statistical Area
CFR	Code of Federal Regulations
CO	Carbon Monoxide
COC	Chain of Custody
CSN	Chemical Speciation Network
CV	Coefficient of Variation
DEO	Deputy Executive Officer
DMS	Data Management System
DOC	Demonstration of Capability
DQI	Data Quality Indicator
DQO	Data Quality Objective
ESC	Environmental Systems Corporation
EO	Executive Officer
FEM	Federal Equivalent Method
FRM	Federal Reference Method
GLP	Good Laboratory Practices
H2S	Hydrogen Sulfide (CA State Standard Pollutant)
IM	South Coast AQMD/Administrative Office/Information Management
IP	Internet Protocol
LDL	Lower Detectable Limits

LIST OF ACRONYMS AND ABBREVIATIONS	
LIMS	Laboratory Information Management System
LPM	Liters Per Minute
LS or LS Branch	Laboratory Services Branch
M&A	Monitoring & Analysis Division
MDAB	Mojave Desert Air Basin
MDL	Minimum Detection Limit
MN or MN Branch	Monitoring Network Branch (former AM Branch)
MQO	Measurement Quality Objective
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standard
NAMS	National Air Monitoring Station
NAP	Non-Attainment Plan
NATTS	National Air Toxic Trend Site
NCore	National Core – multi-pollutant network for particles, pollutant gases and meteorology
NEI	National Emissions Inventory
NIST	National Institute of Standards and Technology
NO	Nitric Oxide
NO2	Nitrogen Dioxide
NOx	Nitrogen Oxides
NPAP	National Performance Audit Program
NPEP	National Performance Evaluation Program
O3	Ozone
OAG	Operation Assistance Guide
PAMS	Photochemical Assessment Monitoring Stations
PAQC or PAQ Chemist	Principal Air Quality Chemist
PAQIS	Principal Air Quality Instrument Specialist
Pb	Lead
PE	Performance Evaluation
PEP	Performance Evaluation Program
PGVP	Protocol Gas Verification Program
PM10	Particulate Matter (aerodynamic diameter less than or equal to 10 microns)
PM2.5	Particulate Matter (aerodynamic diameter less than or equal to 2.5 microns)
PQAO	Primary Quality Assurance Organization
PRA or PRDAS	South Coast AQMD/Planning, Rule Development, and Area Sources Office
PWEI	Population Weighted Emissions Index
QA	Quality Assurance

LIST OF ACRONYMS AND ABBREVIATIONS	
QA Branch	Quality Assurance Branch
QAA	Quality Assurance Alert
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RFP	Request for Proposal
RFQ	Request for Quotation
SAQ Chemist	Senior Air Quality Chemist
SDCAPCD	San Diego County Air Pollution Control District
SIP	State Implementation Plan
SoCAB (also see Basin)	South Coast Air Basin
South Coast AQMD	South Coast Air Quality Management District
SLAMS	State and Local Air Monitoring Stations
SO2	Sulfur Dioxide
SO_4^{2-}	Sulfates (CA State Standard Pollutant, from FRM PM10)
SOP	Standard Operating Procedure
SOx	Sulfur Oxides
SPM	Special Purpose Monitors
SRM	Standard Reference Material
SSAB	Salton Sea Air Basin
STA	South Coast AQMD/Science & Technology Advancement Office
STE Branch	Source Test Engineering Branch
STP	Standard Temperature and Pressure
TAA	Technical Assistance Audit
TEOM	Tapered Element Oscillating Microbalance
TRM	Traceable Reference Material
TSA	Technical Systems Audit
TSP	Total Suspended Particulate
U.S. EPA	United States Environmental Protection Agency

QAPP Structure Cross-Walk

The table below provides a comparison to the structure utilized in this QAPP (four main numbered sections with associated sub-sections) to the structure of the U.S. EPA *Guide to Writing Quality Assurance Project Plans for Ambient Air Monitoring Networks* (U.S. EPA, 2018a) and the associated U.S. EPA *Air Monitoring QAPP Review Checklist* (U.S. EPA, 2018b), which utilize 24 sequentially numbered sections.

QAPP Structure Cross-Walk to U.S. EPA QAPP Guide and Checklist

Project Management (Group 1 or A)				Data Generation and Acquisition (Group 2 or B)				Assessment and Oversight (Group 3 or C)			
Section #			Section Title	Section #			Section Title	Section #			Section Title
1	1.1	A1	Title and Approval Sheet	10	2.1	B1	Network Description	20	3.1	C1	Assessment and Response Actions
2	1.2	A2	Table of Contents	11	2.2	B2	Sampling Methods	21	3.2	C2	Reports to Management
3	1.3	A3	Distribution List	12	2.3	B3	Sample Handling and Custody	Data Validation and Usability (Group 4 or D)			
4	1.4	A4	Project/Task Organization	13	2.4	B4	Analytical Methods				
5	1.5	A5	Problem Definition and Background	14	2.5	B5	Quality Control	22	4.1	D1	Data Review, Verification, and Validation
6	1.6	A6	Project/Task Description	15	2.6	B6	Instrument/Equipment Testing, Inspection, and Maintenance	23	4.2	D2	Verification and Validation Methods
7	1.7	A7	Quality Objectives and Criteria	16	2.7	B7	Instrument/Equipment Calibration and Frequency	24	4.3	D3	Reconciliation with User Requirements
8	1.8	A8	Training	17	2.8	B8	Inspection/Acceptance of Supplies and Consumables				
9	1.9	A9	Documentation and Records	18	2.9	B9	Non-Direct Measurements				
				19	2.1	B10	Data Management				

1.3 Distribution List

To ensure that South Coast AQMD quality assurance information, policies and procedures are appropriately distributed and inherent in all applicable data collection and analysis processes for the criteria pollutant air quality monitoring program, this QAPP is distributed as follows:

- All individuals listed in Section 1.1: Title and Approval Sheet;
- The CARB QA Manager; and
- South Coast AQMD Monitoring & Analysis Division (M&A) supervisory and line staff and contractors directly involved in any aspect of this criteria air pollutant monitoring program.

Hardcopies of this QAPP will be provided to criteria pollutant monitoring program staff through the QA Branch, with a signature sheet to document receipt. Division-wide distribution is also performed via the M&A on-line documentation resources for centralized access. Current M&A staff will be notified by email with links to the PDF of this document on the M&A Shared Drive and the South Coast AQMD internal intranet website at:
http://airnet2.aqmd.gov/sta/mad/qa/SitePages/Home.aspx.

Training of staff members new to the Criteria Pollutant Monitoring Program will include QAPP contents and location of centralized documents. Periodic refresher training of all experienced staff will also summarize this content and document locations.

The official, controlled version of this QAPP is located as a hard copy in the QA central records repository maintained by the South Coast AQMD Quality Assurance Branch and electronically as a protected Microsoft Word® document on the South Coast AQMD STA/M&A network shared drive.

1.4 Project/Task Organization

The South Coast AQMD organizational structure and the general description of the administrative, management, and staff responsibilities are outlined in the approved South Coast AQMD *Quality Management Plan for Environmental Measurement Programs* (QMP), Appendix C (South Coast AQMD, 2016), and the most current South Coast AQMD M&A organization charts can be found in Appendix D of this document. The criteria pollutant monitoring program is primarily conducted by M&A under the Office of Science & Technology Advancement (STA) within South Coast AQMD. The five branches of M&A are Monitoring Network (MN), Advanced Monitoring Technologies (AMT)[2], Laboratory Services (LS), Source Test Engineering (STE)[3], and Quality Assurance (QA). The roles and responsibilities of these branches are outlined in the South Coast

[2] The Advanced Monitoring Technologies Branch was recently created (2018) and includes atmospheric measurements for non-criteria air pollutant monitoring programs and special studies.

[3] The Laboratory Services and Source Testing Branch was recently (January 2019) split into two separate branches: Laboratory Services Branch and Source Test Engineering Branch. The recent changes will be included in the next update of the QMP.

AQMD QMP (South Coast AQMD, 2016), Section 3.

Table 1-1 shows the general QA responsibilities and upward lines of communication for all staff involved in the Criteria Pollutant Monitoring Program. The QA Branch maintains independence from and oversight of the monitoring and analysis programs, working with all levels of staff and management to promote data quality. Detailed descriptions of specific quality control responsibilities for various positions are identified in the related Standard Operating Procedures (SOPs). Table 1-2 shows primary responsibilities for criteria pollutant monitoring tasks.

Table 1-1
South Coast AQMD Position Responsibilities

Position	Responsibilities	Upward Lines of Communication
Deputy Executive Officer (DEO) – STA	Accountable for the successful accomplishment of project objectives	Executive Officer, Executive Council, and Governing Board
Assistant Deputy Executive Officer (ADEO) – STA/M&A	Accountable for the successful accomplishment of project objectives	DEO – STA, Executive Officer, Executive Council, and Governing Board
Assistant Deputy Executive Officer (ADEO) – IM	Accountable for computer, software, hardware and communications support	Executive Officer, Executive Council, and Governing Board
Senior Enforcement Manager (Laboratory Manager) Laboratory Services Branch (LS)	Responsible for laboratory oversight, including preparation of sampling media and analysis of samples submitted to laboratory, timely data reporting consistent with data quality requirements and program objectives, laboratory documentation, training and safety. Serves as the M&A records custodian, with oversight of data retention and public records requests.	ADEO – STA/M&A
Atmospheric Measurements Manager Monitoring Network Branch (MN)	Responsible for establishment, operation and maintenance of air monitoring stations	ADEO – STA/M&A
Quality Assurance Manager Quality Assurance (QA) Branch	Responsible for reviewing, developing, documenting, and overseeing implementation of QA/QC practices and procedures, implementation of performance and technical systems evaluations and coordinating evaluations with U.S. EPA and CARB; Annually certifies data submitted to U.S. EPA.	ADEO – STA/M&A
Principal Air Quality Chemist – Aerosol Analysis	Responsible for laboratory operations of the Aerosol Analysis group including PM2.5 and PM10 Mass and TSP Lead; data validation and AQS submittals; maintenance of SOPs and QAPPs.	LS Manager
Senior Air Quality Chemist	Responsible for supporting Aerosol Analysis Group operations and Level 2 and/or 3 data validation, submittal of data into AQS; COC and Sample Custodians; point of contact for relevant Senior AQIS; also QA oversight of laboratory functions and safety (QA Branch)	Principal AQ Chemist for LS/ Aerosol Analysis Group; or QA Manager for QA Branch
Assistant Air Quality Chemist and Air Quality Chemist	Responsible for following SOPs and GLP in the analysis of samples; Level 0 and/or Level 1 data validation;	Principal AQ Chemist – LS/Aerosol Analysis

Position	Responsibilities	Upward Lines of Communication
Laboratory Technician	Responsible for following SOPs and GLP for the preparation of samples or sampling media; Level 0 and/or Level 1 data validation	Principal AQ Chemist – LS/Aerosol Analysis
Principal Air Quality Instrument Specialist	Responsible for station operations and deployment and oversight of Data Management/Validation Group and/or coordinating repair and calibrations	Atmospheric Measurements Manager –MN Branch
Senior Air Quality Instrument Specialist	Responsible for supporting operations, 3rd level data validation, repair and calibration, and/or QA audit function; submittal of continuous data to AQS	Principal Air Quality Instrument Specialist for MN Branch; QA Manager for QA Branch
Assistant Air Quality Instrument Specialist and Air Quality Instrument Specialist I and II	Responsible for following SOPs and GLP in the collection of samples from the field sites, Level 1 (Operations Group AQIS I) & Level 2 (Data Validation Group AQIS I) continuous data validation, maintaining the station site and instruments, repair and calibration, and/or QA audits	Principal Air Quality Instrument Specialist for MN Branch; or QA Manager for QA Branch
Staff Specialist	Responsible for evaluating, implementing and maintaining STA/M&A servers, software and databases in coordination with IM staff	QA Manager – STA/M&A/QA Branch

Table 1-2
South Coast AQMD Key Task Responsibilities

Task	Responsible Staff
Who has the authority to stop work? For example, if there is a personnel/equipment safety issue in the field due to an approaching storm, who could order a site to power down? Similarly, if an assessment shows severe data quality issues, who could issue an order to halt data collection until corrective actions have been implemented?	Any STA/M&A/MN, LS, AMT, or QA Branch staff may temporarily stop work or operations for immediate safety concern in the field or laboratory, with upward follow-up through chain-of-command and documentation, as appropriate to the situation; Orders to halt data collection for severe data quality issues pending corrective action can be made by STA/M&A ADEO or QA Branch Manager, in coordination with MN/LS senior staff and management with QA Branch oversight and Corrective Action Request (CAR) and work order follow-up
Who has the authority to direct work to resume after a stoppage?	MN Branch Senior AQIS, Principal AQIS, Senior AQ Chemist, or Principal AQ Chemist with upward clearance through chain-of-command appropriate to the situation for work stopped for safety concern; M&A ADEO or QA Manager with corrective action confirmation for stoppage due to severe data quality issues
Who has authority to install additional monitors within the network, or to order monitors to be discontinued or replaced?	EO, STA/DEO, or STA/M&A ADEO approval, typically based on recommendation of MN, AMT, QA or LS Managers, as appropriate
Who is primarily responsible for developing the Annual Network Plan (ANP) and the 5-year Network Assessment?	MN Branch Principal AQIS; approved by MN Branch Manager
Who serves as a liaison to the U.S. EPA Regional Office and is the primary point of contact (POC)?	Liaison: QA, MN, or LS Branch Managers, Principal AQIS or Principal AQ Chemist; Criteria Air Pollutant primary POC: STA/M&A ADEO
Who is the "tie breaker" (i.e., final decision maker) when a disagreement exists? This is especially important with regards to data validation activities.	QA Manager or STA/M&A – ADEO
Who verifies data?	MN Branch Station Operators, Repair Group, Data Management Group, LS Branch; QA Oversight
Who validates data?	Continuous Data: MN Branch/Operations AQIS I (Level 1 Validation) and MN Branch/Data Validation Group (Level 2 & 3 Validation); Lab Data: LS Branch Aerosol Analysis Group AQ Chemist (Level 1) and Senior AQ Chemist and/or Principal AQ Chemist (Levels 2 & 3); QA Branch Review
Who certifies data?	Certification prepared by QA Branch; Certification letter to U.S. EPA signed by STA/M&A ADEO with QA Manager recommendation
Who is ultimately responsible for the quality of the project's data? (This may or may not be the same person who performs data certification activities and generates the requisite reports.)	QA Manager (and all related staff)
Who is responsible for writing the agency's QMP?	QA Branch
Who is responsible for writing the agency's QAPP/SOPs? Who is responsible for revising and maintaining them? (These may or may not be the same individuals.)	QAPPs: Written & revised by relevant M&A Branch staff and Principal AQIS or Principal AQ Chemist and Manager with QA Branch assistance, oversight & approval; approval through STA/DEO; SOPs/OAGs: written & revised by staff familiar with the task, instrument, method, process, etc. and approved by relevant Branch Principals and Managers and QA Manager;

Task	Responsible Staff
	Current approved QAPP/SOP/OAG documents are maintained by QA Branch
Who is responsible for ensuring QAPP/SOP revisions are communicated and distributed to all parties in the distribution list?	Appropriate Branch Managers and Principal and Senior staff
Who is the AQS Administrator for the program? Similarly, who is responsible for AQS data entry/submittal? (These may or may not be the same individuals.)	AQS Administrator: QA Branch Senior AQIS, backup MN Branch Data Validation Senior AQIS; Continuous Data AQS Data Entry: MN Branch-Data Validation Group; Lab Data AQS Data Entry: LS Branch – Aerosol Analysis Group Senior AQ Chemist
Who manages other database systems? (e.g., DMS, AirVision, LIMS, EQuIS)	Staff of relevant Branch (MN or LS) Senior/Principal staff for each project with support of QA Branch Staff Specialist and IM
Who manages the agency's air monitoring documents and records?	STA/M&A relevant Branch (MN, LS or QA) Senior staff maintains records, documents and logbooks, with QA oversight; QMP, QAPP, SOP, OAG final documents maintained by QA Branch; The M&A Division Records Custodian oversees data retention and public record requests. Under the Records Retention Policy, the Records Retention Coordinator (i.e., Records Custodian) is the LS Branch Manager, responsible for overseeing implementation of the South Coast AQMD Policy for the M&A Division. The Branch Managers and work group Principal AQISs, Principal Chemists, and the QA Manager, along with their staff, support the management of the agency's criteria pollutant program documents and records for their work groups.
Who tracks inventory and orders supplies/consumables, when needed? (These may or may not be the same individuals.)	MN or LS, Branch Administrative staff, Principal and Senior AQIS/AQ Chemist with Branch Manager oversight and order approval; For QA supplies/consumables: Administrative staff, Senior AQIS, Senior AQ Chemist or Staff Specialist with QA Manager oversight and approval
Who operates, calibrates, and performs required quality control (QC) checks on analyzers/samplers?	Sampler Operation: MN Branch Operations Group; Sampler Calibration: MN Branch Support Group with supporting efforts by Operations Group field staff; Sampler QC Checks: as above; Lab Analyzer Operation, Calibration & QC Checks: LS Branch Aerosol Analysis Group QA oversight
Who performs preventive maintenance? Instrument repairs?	Field & support instrument preventative maintenance: MN Branch Operations and/or Support Group staff; Instrument Repairs: MN Branch Support Group; Laboratory instrument preventative maintenance or repairs: contractor or assigned staff for LS Branch; QA Branch Oversight
Who certifies/verifies standards (if performed in-house)?	Primarily by LS Branch or MN Branch Support Group; also, some by QA Branch or contract lab, if needed; Some standards are certified by EPA R9, CARB, or outside vendors.
Who tracks the certification of standards to ensure that all used within the network are National Institute of Standards and Technology (NIST) traceable and accurate?	MN Branch Support Group & Operations Senior staff, LS Branch and QA Branch staff

Task	Responsible Staff
Who collects physical samples, such as particulate matter (PM) and lead?	MN Branch Operations Group
Who conducts performance audits? Systems audits? 40 CFR Part 58, Appendix E siting evaluations?	In-house: QA Branch; External: CARB MLD QA Branch; U.S. EPA/U.S.EPA contractors
Who performs data quality assessments (DQAs)?	QA Branch with support from MN & LS Branch Data Management & Validation staff
Who performs audits of data quality (ADQs)?	External: ADQs occur during U.S. EPA Technical Systems Audits (TSAs) Internal: QA Branch conducts weekly, monthly and periodic (quarterly) ADQ audits of data quality; also, annual data quality checks as PM annual data is complete and in preparation for Data Certification
Who judges the success of corrective actions, once implemented, to ensure they are appropriate and effective?	QA Branch Manager approval based upon based upon evidence provided by MN, AMT, or LS Branch Senior, Principal or Manager and QA staff recommendation; The most severe issues and corrective actions will also be reviewed and approved by the M&A ADEO.
Who oversees training for the ambient air monitoring program?	MN and LS Branch Managers and Principals with QA Branch for QA training, oversight and support
Who performs gravimetric analyses of PM filters (e.g., an individual within the monitoring program, an inter-departmental laboratory, or a contractor laboratory)?	LS Branch Aerosol Analysis Group
Who performs analyses of lead and/or air toxics samples (e.g., an inter-departmental laboratory, a contract laboratory hired by the agency, or an EPA national contract laboratory)?	TSP-Pb analyses for the Criteria Pollutant Program are analyzed by the LS Branch Aerosol Analysis Group
If operated in-house, who is the laboratory analyst?	LS Branch, Aerosol Analysis Group, technicians and chemists
Is there a lab supervisor? If not, who oversees the work of the laboratory analyst?	LS Branch Aerosol Analysis Group Senior AQ Chemists supervises criteria pollutant work with overall supervision by the Aerosol Analysis Group Principal AQ Chemist
Who is (are) the COC custodian(s)?	The COC custodians are the Sr. AQ Chemists of the Aerosol Analysis Group that are responsible for each portion of the program under supervision of the Principal AQ Chemist.
Who is (are) the sample custodian(s)?	The laboratory sample custodians are the Sr. AQ Chemists of the Aerosol Analysis Group that responsible for each portion of the program under supervision of the Principal AQ Chemist.
Who serves as a liaison to the laboratory, especially if laboratory activities are outsourced?	MN Branch Manager and Operations Group Principal and Senior AQIS and Data Management Group Senior AQIS; QA Branch Manager, QA Branch Senior AQ Chemist and Senior AQIS; LS Branch Principal AQ Chemist and Senior AQ Chemists.
Is there a back-up laboratory in place? If so, identify the laboratory and explain the potential responsibilities (i.e., which analyses, etc.)	Yes. Primarily for PM Analyses – SDCAPCD Laboratory Also, CARB MLD and BAAQMD laboratories, if needed.
If utilizing a contractor(s), who within the agency is responsible for contractor oversight and assessment of deliverables?	Contractors are not generally used for criteria pollutant monitoring program, but if used, they are assigned to supervisory staff to oversee and assess work and deliverables, with contract invoice approvals by immediate supervisor, Branch Manager, and M&A ADEO

Criteria air pollutant monitoring is a federal requirement created in support of the Clean Air Act under which U.S. EPA is required to set National Ambient Air Quality Standards (NAAQS). U.S. EPA delegates the measurement of criteria pollutants to state, local, and tribal agencies. South Coast AQMD is designated by U.S. EPA as a Primary Quality Assurance Organization (PQAO), along with CARB, SDCAPCD, BAAQMD, and other federal and Tribal PQAOs operating in the State of California. Two Tribal PQAOs, the Morongo Band of Mission Indians and the Pechanga Band of Luiseño Indians, and the National Park Services (NPS) are recognized PQAOs that operate criteria pollutant monitoring networks within the borders of the South Coast AQMD jurisdiction. In addition, tribes that are not currently designated as PQAOs monitor criteria pollutants within the South Coast jurisdiction, including the Torres Martinez Desert Cahuilla Indians, the Cabazon Band of Mission Indians, the Twenty-Nine Palms Band of Mission Indians. The Imperial Irrigation District (IID) operates non-FRM/FEM monitors near the Salton Sea, primarily for PM10. CARB may also conduct criteria pollutant monitoring within the South Coast AQMD jurisdiction, at times. Together, South Coast AQMD and the tribal, State and federal PQAOs constitute a cooperative effort to monitor air quality in the South Coast jurisdiction.

The relationship and roles between the U.S. EPA, California Air Resources Board (CARB), and South Coast AQMD with respect to criteria air pollutant monitoring and assessment is presented in Table 1-3. The relationship of these agencies with respect to the air monitoring process responsibilities is graphically displayed in Figure 1-1.

Table 1-3
Agency Roles and Responsibilities

Agency	Responsibilities
U.S. EPA	1. Develops National Ambient Air Quality Standards (NAAQS) including national data collection methodologies 2. Ensure that NAAQS standards are met, or attained in cooperation with state, Tribal, and local governments through national standards and strategies to control pollutant emissions from automobiles, factories, and other sources 3. Identifies a minimum set of quality control samples from which to evaluate data quality 4. Assess data quality from the various states, local agencies and tribal agencies and require corrective action, when appropriate 5. Provide a national data repository for recording documentation and data collected in support of the Clean Air Act 6. Program funding support through U.S. EPA grants
CARB	1. Performs data collection as specified under federal guidance documents or developed to comply with federal monitoring requirements, except where delegated to local air quality agencies 2. Develops and implements a quality assurance program that will meet data quality requirements, except where delegated to local air quality agencies 3. Assess data quality from CARB, local agencies and tribal agencies monitoring networks, and take corrective action and/or require corrective action, when appropriate 4. Coordinate statewide training for the CARB PQAO and other California PQAOs
South Coast AQMD	1. Responsible for performing data collection, analysis, and review as specified under federal and/or state regulation and guidance, as well as implementing a quality assurance program that will meet data quality requirements *2.* Assess data quality and take corrective action when appropriate

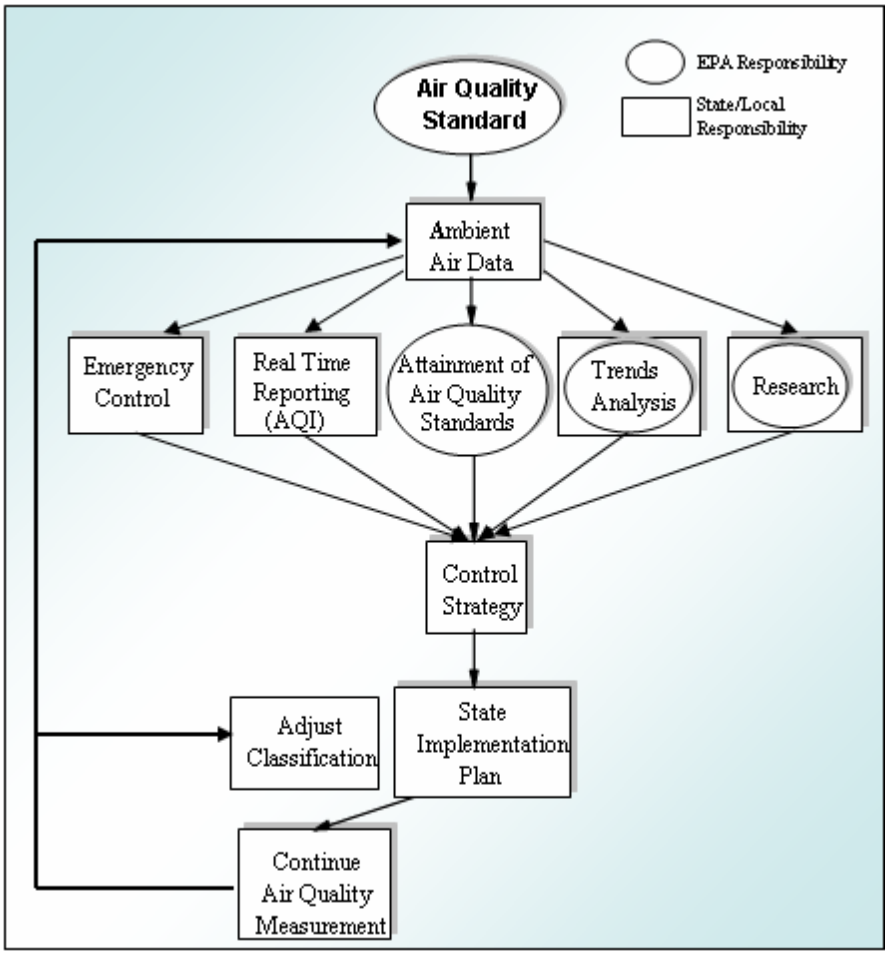


Figure 1-1
Ambient Air Quality Monitoring Data Process
Responsibilities for Criteria Air Pollutant Monitoring and Control between U.S. EPA and the State and Local Agencies

South Coast AQMD operates within the jurisdiction of U.S. EPA Region 9 and collaborates with U.S. EPA and CARB, as needed to ensure South Coast AQMD's ambient air monitoring program meets or exceeds regulatory requirements. As part of its responsibility for assessing the suitability of South Coast AQMD criteria pollutant data, U.S. EPA Region 9 reviews and approves the annual network plans, QMPs, and QAPPs, tracks progress of data submission, and finalizes the certification of data in the U.S. EPA Air Quality System (AQS). U.S. EPA and their contract laboratories also conduct performance audits, technical systems audits (TSAs), and other related evaluations, as described further in Section 3.1. CARB conducts performance evaluations and other audits and organizes periodic PQAO training for the agencies in the PQAOs in the State of California.

The South Coast AQMD laboratory has contingency measures planned for additional or backup laboratory services for the Criteria Pollutant Monitoring Program PM2.5, PM10 and/or TSP-Pb

analyses, if needed. This is typically to be accomplished by utilizing facilities, staff and/or equipment at other California PQAO laboratories, including CARB, SDCAPCD, or BAAQMD through cooperative agreements. In addition, contract agreements with commercial laboratories could also be considered, if necessary. Situations that would warrant utilizing a backup laboratory include issues with the South Coast AQMD laboratory that would prevent the timely preparation or analysis of filters. Examples include prolonged inaccessibility of lab facilities due to power failure, construction, or natural disaster, or for any situation that is expected to cause a prolonged inability to maintain required cleanliness, temperature and/or humidity control in the weigh room.

South Coast AQMD employees are responsible for operations, support, laboratory analyses and QA oversight for the Criteria Pollutant Monitoring Program and contractors are not typically used. Contractors have been used for extended technical support and development of software packages such as DMS or LIMS and infrequently for staffing support, such as temporary laboratory technicians while filling permanent positions. Contractors and subcontractors are used for air monitoring station preparations or improvements. Technical support contracting to cover program tasks remains a backstop possibility, if needed.

South Coast AQMD has an established Procurement Policy and Procedure (see link in Appendix C) that covers the process of contracting for consulting and professional services. This document includes:

- Contracting Methods – determination and use of sole-source contract and competitive bid contract awards, based on assessment of project objectives, future needs, existing staff capabilities, scope of work, contractor qualifications, special circumstances, and resources needed, along with an estimate of project costs;
- Bidding Procedures –preparation of a request for proposals (RFP), approvals needed to release an RFP, advertising of RFPs, the acceptance and rejection of bids, proposal evaluation, including requirements for contracts funded with federal funds;
- Contract Approval Process – requester or lead knowledgeable staff (contract manager), supervisor, branch manager, ADEO, DEO, Procurement Manager and District Counsel review and approval with contract execution by the Executive Officer or the Governing Board Chair after Board approval process through a Board Letter.

South Coast AQMD contractors are carefully selected and a detailed work statement is included in the contract and signed by both parties. Contractor qualifications are verified by requiring detailed descriptions of the contractor's management structure and resources, resumes of key staff, and summaries of related work with references that are contacted prior to contract award. The contracts are managed and monitored for contract performance with a clear expectation of the work to be performed, defined evaluation measures of work acceptance criteria with milestones and interim deliverables, oversight of efforts, review of progress reports, progress review meetings, review of contractor invoices and timely corrective actions to meet the objectives, schedule and budget. The Procurement Training Guide/Contracts (South Coast AQMD, 2015 – see Appendix C) provides detailed guidelines on the implementation of the Procurement Policy and Procedure.

Contractors or subcontractors providing work specific to the Criteria Pollutant Monitoring Program are required to review and follow this QAPP and the SOPs or OAGs related to the contracted effort or the QA Branch can review and approve the contractor's SOPs for the work. Qualifications and training, including QA training, are verified or conducted prior to work and a project manager is assigned to oversee the contract effort and verify the work progress and, if necessary, initiate corrective action through the South Coast AQMD process for contract breach, as well as through the QA Branch corrective action process that documents issues, the resolution, and steps to help prevent future recurrence. If a contractor or subcontractor is found to be in breach of contract requirements, a *stop-work order* can be issued to halt further work and additional costs until the performance problem is corrected. Alternatively, a *notice to cure* can be issued that notifies the contractor about a contract breach and provides a fixed amount of time to cure the breach. South Coast AQMD contracts can be terminated for *breach* for failure to comply with the contract terms and conditions or for *convenience*, when the contract is not in breach but a change in policy direction or other circumstances warrant discontinuation.

1.5 Problem Definition and Background

This QAPP revision addresses the South Coast AQMD long-term, ongoing criteria air pollutant monitoring program. It will be reviewed annually and updated every five years, at minimum. Records will be retained with the original document with the name and signature of the person or persons completing the review, even if no revisions to the document are made.

The environmental problem that is to be addressed in this QAPP is primarily the assessment of air quality in the Basin and the Riverside County portion of the Salton Sea Air Basin (SSAB), which primarily comprises the Coachella Valley. Monitoring, as well as further analyses and modeling, of criteria pollutants that are not in attainment of the National Ambient Air Quality Standards (NAAQS) is critical for State Implementation Plan (SIP) submittals for control strategies and demonstrating progress toward the NAAQS attainment, as well as for public notification of air pollution events, air quality forecasting and meeting other federal requirements. The Basin is currently a non-attainment area for O3 and PM2.5, while the Coachella Valley is a non-attainment area for O3 and PM10. Furthermore, the Basin is a maintenance area for lead (Pb) and PM10, having attained those standards relatively recently. Ongoing monitoring of other criteria pollutants that have been in attainment of the NAAQS for a longer time, such as CO, NO2 and SO2, is also important as emission sources change and the population continues to grow. Measurement of meteorology and some other pollutants (e.g., NOx, NO, VOCs, and speciated PM2.5), are also critical to this effort.

The program described in this QAPP is the evolution of a long-standing air monitoring program in the South Coast Air Basin, beginning with early measurements in the City of Los Angeles in the 1940s. Between the years 1900 and 1970, the emission of air pollutants increased significantly. In 1970, Congress passed the Clean Air Act (CAA) which required the states to assess their attainment to the NAAQS for air pollutants. CARB transferred air monitoring responsibilities to local air pollution control agencies where there were existing programs, and for which South Coast AQMD became the agency responsible for monitoring the air for the Basin and Coachella Valley.

The CAA and its amendments provide the framework for all pertinent organizations to protect air quality. The CAA requires U.S. EPA to revise or update federal air quality standards based on review of the latest scientific information on known and potential human health effects associated with concentrations of criteria pollutants typically found in the ambient air (40 CFR Part 50). In fulfilling these obligations, U.S. EPA periodically reviews the air quality criteria and NAAQS for criteria pollutants and epidemiological range of serious health effects.

Urban emissions along with complex terrain bounded by tall mountains and frequent meteorological conditions that favor trapping of primary air pollutants and the formation of secondary air pollutants (especially ozone and PM) have led to the region's history of having some of the poorest air quality in the country. The potential for significant population exposure is high, with over 16 Million people that live in the Basin. Criteria air pollutant issues in Southern California are not constrained within city and county boundaries, and generally need to be addressed at the regional level. Recognizing the regional nature of the problem, the air pollution control districts (APCDs) from Los Angeles, Orange, Riverside and San Bernardino Counties merged to form the South Coast AQMD in 1977.

As the regional air quality agency for Orange County and portions of Los Angeles, Riverside, and San Bernardino Counties, including the Coachella Valley, South Coast AQMD is responsible for stationary sources with some limited mobile source and consumer product authority. South Coast AQMD also has the primary responsibility for the development and adoption of the Air Quality Management Plan (AQMP) which outlines the South Coast AQMD maintenance and control strategies with the goal of reaching compliance with the NAAQS. The South Coast AQMD criteria air pollutant monitoring network has evolved over the years to meet the regulatory and planning requirements, while also informing the public of the quality of the air to which they are exposed.

Federal regulations prescribe the minimum number of monitors for each pollutant, the type of monitors, the methodology for locating the monitors, the quality assurance needed for the monitors, and the schedule for reporting data to U.S. EPA. Ambient air monitoring data historically have been and will continue to be the primary basis for any decisions regarding the attainment or non-attainment of the NAAQS in the South Coast AQMD jurisdiction. Besides the criteria air monitoring program, with near-road monitoring, South Coast AQMD conducts other monitoring programs, including the National Air Toxics Trends Stations (NATTS), Photochemical Air Monitoring Stations (PAMS), National Core (NCore), and the Chemical Speciation Network (CNS), as well as state and local programs that assess toxic and carcinogenic air contaminants in communities and across the region. The following summarizes the criteria air pollutants and standards and the current air quality and NAAQS attainment status of the Basin and the Coachella Valley.

1.5.1 National and State Ambient Air Quality Standards

Current federal regulation defines the criteria pollutants as particulate matter (PM10 and PM2.5), sulfur dioxide (SO2), carbon monoxide (CO), nitrogen dioxide (NO2), ozone (O3), and lead (Pb). Ambient air quality standards for the criteria pollutants have been set by both the State of California and the federal government. The State has also set standards for PM10 sulfates (SO_4^{2-}), H2S, and visibility reducing particles. The threshold levels of the federal NAAQS and

State CAAQS standards for each of these pollutants and their effects on health are summarized in Table 1-4.

Table 1-4
National and State Ambient Air Quality Standards and Pollutant Key Health and Welfare Effects

AIR POLLUTANT	FEDERAL STANDARD (NAAQS)	CA STATE STANDARD (CAAQS)	KEY HEALTH & WELFARE EFFECTS[#]
	Concentration, Averaging Time, Year of NAAQS Review	Concentration, Averaging Time	
Ozone (O3)	**0.070 ppm, 8-Hour (2015)** 0.075 ppm, 8-Hour (2008) 0.08 ppm, 8-Hour (1997) 0.12 ppm, 1-Hour (1979)	**0.070 ppm, 8-Hour** **0.09 ppm, 1-Hour**	(a) Pulmonary function decrements and localized lung injury in humans and animals; (b) Risk to public health implied by alterations in pulmonary morphology and host defense in animals; (c) Increased mortality risk; (d) Increased respiratory related hospital admissions and emergency room visits; I Vegetation damage; (f) Property damage
Fine Particulate Matter (PM2.5)	**35 µg/m³, 24-Hour (2006)** **12.0 µg/m³, Annual (2012)** 15.0 µg/m³, Annual (1997)	**12 µg/m³, Annual**	(a) Exacerbation of symptoms in sensitive patients with respiratory or cardiovascular disease; (b) Decline in pulmonary function or growth in children; (c) Increased risk of premature death; (d) Increased risk of lung cancer; I increased asthma-related hospital admissions; (f) increased school absences and lost work days; (g) possible link to reproductive effects; (h) visibility reduction
Respirable Particulate Matter (PM10)	**150 µg/m³, 24-Hour (1997)**	**50 µg/m³, 24-Hour** **20 µg/m³, Annual**	
Carbon Monoxide (CO)	**35 ppm, 1-Hour (1971)** **9 ppm, 8-Hour (1971)**	**20 ppm, 1-Hour** **9.0 ppm, 8-Hour**	(a) Aggravation of angina pectoris and other aspects of coronary heart disease; (b) Decreased exercise tolerance in persons with peripheral vascular disease and lung disease; (c) Possible impairment of central nervous system functions; (d) Possible increased risk to fetuses
Nitrogen Dioxide (NO2)	**100 ppb, 1-Hour (2010)** **0.053 ppm, Annual (1971)**	**0.18 ppm, 1-Hour** **0.030 ppm, Annual**	(a) Potential to aggravate chronic respiratory disease and respiratory symptoms in children with asthma; (b) Increased airway responsiveness in asthmatics; (c) Contribution to atmospheric discoloration
Sulfur Dioxide (SO2)	**75 ppb, 1-Hour (2010)**	**0.25 ppm, 1-Hour** **0.04 ppm, 24-Hour**	Respiratory symptoms (bronchoconstriction, possible wheezing or shortness of breath) during exercise or physical activity in persons with asthma
Lead (Pb)	**0.15 µg/m³, rolling 3-month average (2008)**	**1.5 µg/m³, 30-day average**	(a) Learning disabilities; (b) Impairment of blood formation and nerve conduction; (c) cardiovascular effects, including coronary heart disease and hypertension
Sulfates-PM10 (SO_4^{2-})	**N/A**	**25 µg/m³, 24-Hour**	(a) Decrease in lung function; (b) Aggravation of asthmatic symptoms; (c) Vegetation damage; (d) Degradation of visibility; I Property damage
Hydrogen Sulfide (H2S)	**N/A**	**0.03 ppm, 1-hour**	Exposure to lower ambient concentrations above the standard may result in objectionable odor and may be accompanied by symptoms such as headaches, nausea, dizziness, nasal irritation, cough, and shortness of breath

ppm – parts per million by volume; ppb – parts per billion by volume (0.01 ppm = 10 ppb)
Standards in bold are the current, most stringent standards; there may be continuing obligations for former standards
State standards are "not-to-exceed" values based on State designation value calculations
Federal standards follow the 3-year design value form of the NAAQS

[#] List of health and welfare effects is not comprehensive; detailed health effects information can be found in the 2016 AQMP, Appendix I: Health Effects or in the U.S. EPA NAAQS documentation at http://www.epa.gov/ttn/naaqs/

1.5.2 NAAQS Attainment Status

The current status of NAAQS attainment[4] for criteria pollutants is presented in Table 1-5 for the Basin and in Table 1-6 for the Riverside County portion of the SSAB (Coachella Valley). It should be noted that a single exceedance of the concentration level of a federal standard does not necessarily mean that the NAAQS was violated or that it would cause a nonattainment determination for that standard. The form of the standard must also be considered. For example, for 24-hour PM2.5, the form of the standard is the annual 98th percentile value of all the 24-hour PM2.5 daily sample concentrations at each station. For 8-hour ozone, the form of the standard is the annual fourth highest measured 8-hour average daily maximum concentration at each station. For NAAQS attainment/nonattainment decisions, the most recent three years of data are considered (one year for CO and 24-hour SO2), along with the form of the standard, to calculate a *design value* for each station. The overall design value for an air basin or other defined region is the highest design value of all the stations in that area. Table 1-7 shows the NAAQS, along with the design value form of each federal standard.

[4] Further NAAQS attainment information can be found on the U.S. EPA website at: https://www.epa.gov/green-book.

Table 1-5
National Ambient Air Quality Standards (NAAQS) Attainment Status – South Coast Air Basin

Criteria Pollutant	Averaging Time	Designation[a]	Attainment Date[b]
Ozone (O3)	(1979) 1-Hour (0.12 ppm)[c]	Nonattainment ("extreme")	2/26/2023 (revised deadline)
	(2015) 8-Hour (0.070 ppm)[d]	Nonattainment ("extreme")	8/3/2038
	(2008) 8-Hour (0.075 ppm)[d]	Nonattainment ("extreme")	7/20/2032
	(1997) 8-Hour (0.08 ppm)[d]	Nonattainment ("extreme")	6/15/2024
PM2.5[e]	**(2006) 24-Hour (35 µg/m^3)**	Nonattainment ("serious")	12/31/2019
	(2012) Annual (12.0 µg/m^3)	Nonattainment ("moderate")	12/31/2021
	(1997) Annual (15.0 µg/m^3)	Attainment (final determination pending)	4/5/2015 (attained 2013)
PM10[f]	**(1987) 24-hour (150 µg/m^3)**	Attainment (Maintenance)	7/26/2013 (attained)
Lead (Pb)[g]	**(2008) 3-Months Rolling (0.15 µg/m^3)**	Nonattainment (Partial) (Attainment determination to be requested)	12/31/2015
CO	**(1971) 1-Hour (35 ppm)**	Attainment (Maintenance)	6/11/2007 (attained)
	(1971) 8-Hour (9 ppm)	Attainment (Maintenance)	6/11/2007 (attained)
NO2[h]	**(2010) 1-Hour (100 ppb)**	Unclassifiable/Attainment	N/A (attained)
	(1971) Annual (0.053 ppm)	Attainment (Maintenance)	9/22/1998 (attained)
SO2[i]	**(2010) 1-Hour (75 ppb)**	Attainment/Unclassifiable	N/A (attained)
	(1971) 24-Hour (0.14 ppm) (1971) Annual (0.03 ppm)	Attainment/Unclassifiable	3/19/1979 (attained)

a) U.S. EPA often only declares Nonattainment areas; everywhere else is listed as Unclassifiable/Attainment or Unclassifiable

b) A design value below the NAAQS for data through the full year or smog season prior to the attainment date is typically required for an attainment demonstration

c) The 1979 1-hour ozone NAAQS (0.12 ppm) was revoked, effective 6/15/05; however, the Basin has not attained this standard and therefore has some continuing obligations with respect to the revoked standard; original attainment date was 11/15/2010; the revised attainment date is 2/6/23

d) The 2008 8-hour ozone NAAQS (0.075 ppm) was revised to 0.070 ppm, effective 12/28/15, and the "extreme" nonattainment determination was effective 8/3/18; the 1997 8-hour ozone NAAQS (0.08 ppm) was revoked in the 2008 ozone NAAQS implementation rule, effective 4/6/15; there are continuing obligations under the revoked 1997 and revised 2008 ozone NAAQS until they are attained

e) The attainment deadline for the 2006 24-hour PM2.5 NAAQS was 12/31/15 for the former "moderate" classification; U.S.EPA approved reclassification to "serious," effective 2/12/16 with an attainment deadline of 12/31/2019; the 2012 (proposal year) annual PM2.5 NAAQS was revised on 1/15/13, effective 3/18/13, from 15 to 12 µg/m^3; new annual designations were final 1/15/15, effective 4/15/15; on July 25, 2016 U.S. EPA finalized a determination that the Basin attained the 1997 annual (15.0 µg/m^3) and 24-hour PM2.5 (65 µg/m^3) NAAQS, effective August 24, 2016

f) The annual PM10 NAAQS was revoked, effective 12/18/06; the 24-hour PM10 NAAQS deadline was 12/31/2006; the Basin's Attainment Re-designation Request and PM10 Maintenance Plan was approved by U.S. EPA on 6/26/13, effective 7/26/13

g) Partial Nonattainment designation – Los Angeles County portion of the Basin only for near-source monitors; expect to remain in attainment based on current monitoring data; attainment re-designation request pending

h) New 1-hour NO2 NAAQS became effective 8/2/10, with attainment designations 1/20/12; annual NO2 NAAQS retained

i) The 1971 annual and 24-hour SO2 NAAQS were revoked, effective 8/23/10; however, these 1971 standards will remain in effect until one year after U.S. EPA promulgated area designations for the 2010 SO2 1-hour NAAQS, which became effective on 4/9/18; Basin in attainment due to ongoing clean data

Table 1-6
National Ambient Air Quality Standards (NAAQS) Attainment Status
Coachella Valley Portion of the Salton Sea Air Basin

Criteria Pollutant	Averaging Time	Designation[a]	Attainment Date[b]
Ozone (O3)	(1979) 1-Hour (0.12 ppm)[c]	Attainment	11/15/2007 (attained 12/31/2013)
	(2015) 8-Hour (0.070 ppm)[d]	Nonattainment (Severe-15)	8/3/2033
	(2008) 8-Hour (0.075 ppm)[d]	Nonattainment (Severe-15)	7/20/2027
	(1997) 8-Hour (0.08 ppm)[d]	Nonattainment (Severe-15)	6/15/2019
PM2.5[e]	**(2006) 24-Hour (35 µg/m^3)**	Unclassifiable/Attainment	N/A (attained)
	(2012) Annual (12.0 µg/m^3)	Unclassifiable/Attainment	N/A (attained)
	(1997) Annual (15.0 µg/m^3)	Unclassifiable/Attainment	N/A (attained)
PM10[f]	**(1987) 24-hour (150 µg/m^3)**	Nonattainment ("serious")	12/31/2006
Lead (Pb)	**(2008) 3-Months Rolling (0.15 µg/m^3)**	Unclassifiable/Attainment	Unclassifiable/ Attainment
CO	**(1971) 1-Hour (35 ppm)**	Unclassifiable/Attainment	N/A (attained)
	(1971) 8-Hour (9 ppm)	Unclassifiable/Attainment	N/A (attained)
NO2[g]	**(2010) 1-Hour (100 ppb)**	Unclassifiable/Attainment	N/A (attained)
	(1971) Annual (0.053 ppm)	Unclassifiable/Attainment	N/A (attained)
SO2[h]	**(2010) 1-Hour (75 ppb)**	Unclassifiable/Attainment	N/A
	(1971) 24-Hour (0.14 ppm) (1971) Annual (0.03 ppm)	Unclassifiable/Attainment	N/A

a) U.S. EPA often only declares Nonattainment areas; everywhere else is listed as Unclassifiable/Attainment or Unclassifiable
b) A design value below the NAAQS for data through the full year or smog season prior to the attainment date is typically required for an attainment demonstration
c) The 1979 1-hour ozone NAAQS (0.12 ppm) was revoked, effective 6/15/05; the Southeast Desert Modified Air Quality Management Area, including the Coachella Valley, had not timely attained this standard by the 11/15/07 "severe-17" deadline, based on 2005-2007 data; on 8/25/14, U.S. EPA proposed a clean data finding based on 2011–2013 data and a determination of attainment for the former 1-hour ozone NAAQS for the Southeast Desert nonattainment area; this rule was finalized by U.S. EPA on 4/15/15, effective 5/15/15, that included preliminary 2014 data
d) The 2008 8-hour ozone NAAQS (0.075 ppm) was revised to 0.070 ppm, effective 12/28/15, and the "severe-15" nonattainment determination was effective 8/3/18; the 1997 8-hour ozone NAAQS (0.08 ppm) was revoked in the 2008 ozone NAAQS implementation rule, effective 4/6/15; there are continuing obligations under the 1997 and 2008 ozone NAAQS until they are attained; reclassification of the 1997 8-hour ozone NAAQS from Severe-15 to Extreme is currently in process
e) The annual PM2.5 standard was revised on 1/15/13, effective 3/18/13, from 15 to 12 µg/m^3
f) The annual PM10 standard was revoked, effective 12/18/06; the 24-hour PM10 NAAQS attainment deadline was 12/31/2006; the Coachella Valley Attainment Re-designation Request and PM10 Maintenance Plan was postponed by U.S. EPA pending additional monitoring and analysis in the southeastern Coachella Valley
g) New 1-hour NO2 NAAQS became effective 8/2/10; attainment designations 1/20/12; annual NO2 NAAQS retained
h) The 1971 annual and 24-hour SO2 NAAQS were revoked, effective 8/23/10; however, these 1971 standards will remain in effect until one year after U.S. EPA promulgated area designations for the 2010 SO2 1-hour NAAQS, which became effective on 4/9/18

TABLE 1-7
National Ambient Air Quality Standards (NAAQS) and Design Value Requirements

Pollutant	Averaging Time**	NAAQS Level	Design Value Form of NAAQS*
Ozone (O3)	1-Hour (1979) [revoked 2005]	0.12 ppm	Not to be exceeded more than once per year averaged over 3 years
	8-Hour (2015)	**0.070 ppm**	**Annual fourth highest 8-hour average concentration, averaged over 3 years**
	8-Hour (2008) [revised 2015]	0.075 ppm	
	8-Hour (1997) [revoked 2015]	0.08 ppm	
Fine Particulate Matter (PM2.5)	**24-Hour (2006)**	**35 µg/m^3**	**3-year average of the annual 98th percentile of daily 24-hour concentration**
	Annual (2012)	**12.0 µg/m^3**	**Annual average concentration, averaged over 3 years** *(annual averages based on average of 4 quarters)*
	Annual (1997) [revised 2012]	15.0 µg/m^3	
Respirable Particulate Matter (PM10)	**24-Hour (1987)**	**150 µg/m^3**	**Not to be exceeded more than once per year averaged over 3 years**
	Annual (1987) [revoked 2006]	50 µg/m^3	Annual average concentration, averaged over 3 years
Carbon Monoxide (CO)	**1-Hour (1971)**	**35 ppm**	**Not to be exceeded more than once a year**
	8-Hour (1971)	**9 ppm**	
Nitrogen Dioxide (NO2)	**1-Hour (2010)**	**100 ppb**	**3-year avg. of the annual 98th percentile of the daily maximum 1-hour average concentrations (rounded)**
	Annual (1971)	**0.053 ppm**	**Annual avg. concentration, averaged over 3 years**
Sulfur Dioxide (SO2)	**1-Hour (2010)**	**75 ppb**	**99th percentile of 1-hour daily maximum concentrations, averaged over 3 years**
	24-Hour (1971)#	0.14 ppm	Not to be exceeded more than once per year
	Annual (1971)#	0.03 ppm	Annual arithmetic average
Lead (Pb)	**3-Month Rolling Average (2008)##**	**0.15 µg/m^3**	**Highest rolling 3-month average of the 3 years**

Bold text denotes the current and most stringent NAAQS

* The NAAQS is attained when the design value (form of concentration listed) is equal to or less than the level of the NAAQS; for pollutants with the design values based on "exceedances" (1-hour ozone, 24-hour PM10, CO, and 24-hour SO2), the NAAQS is attained when the concentration associated with the design value is less than or equal to the standard level:

- For 1-hour ozone and 24-hour PM10, the NAAQS is attained when the fourth highest daily concentrations of the 3-year period is less than or equal to the standard level
- For CO and 24-hour SO2, the standard is attained when the second highest daily concentration of the most recent year is equal to or less than the standard level

** Year of U.S. EPA NAAQS update review shown in parenthesis and revoked or revised status in brackets; for revoked or revised NAAQS, areas may have continuing obligations until that standard is attained: for 1-hour ozone, the Basin has continuing obligations under the former 1979 standard; for 8-hour ozone, the NAAQS was lowered from 0.08 ppm to 0.075 ppm to 0.070 ppm, but the previous 8-hour ozone NAAQS and most related implementation rules remain in place until that standard is attained

\# Annual and 24-hour SO2 NAAQS will be revoked 4/9/2019, one year from final attainment designations for the (2010) 1-hour SO2 NAAQS effective 4/9/2018

\## 3-month rolling averages of the first year (of the three-year period) include November and December monthly averages of the prior year; the 3-month average is based on the average of "monthly" averages

The Basin and the Coachella Valley are both nonattainment areas for the current and former 8-hour ozone NAAQS. The Basin also remains a nonattainment area for the 1979 1-hour ozone NAAQS, while the Coachella Valley is in attainment of that former standard. For 2018, the Basin and Coachella Valley each exceeded the level of the 2015 8-hour ozone NAAQS on 141 and 73 days, respectively. Despite substantial improvement in air quality over the past few decades, some air monitoring stations in the Basin still exceed the NAAQS for ozone more frequently than any other areas in the United States. In 2018, stations in the Basin accounted for five of the ten highest 8-hour ozone concentrations measured in the nation and five of the ten highest number of days exceeding the 2015 8-hour ozone NAAQS.[5]

The Basin and Coachella Valley continue to be in attainment of the NAAQS for SO2, CO, and NO2. In 2017, the level of the 1-hour NO2 NAAQS was exceed at a near-road monitor (I-710) on one day, but the 98th percentile form of the design value has not been violated. U.S. EPA designated the Los Angeles County portion of the Basin (excluding the San Clemente and Santa Catalina Islands and the Antelope Valley) as nonattainment for the revised (2008) federal Pb standard (0.15 µg/m^3, rolling 3-month average). This designation was based on two source-specific monitors in Vernon and in the City of Industry exceeding the 2008 standard over the 2007-2009 period. For the three-year design value periods starting with 2012–2014 through 2016-2018, no stations in Los Angeles County showed violations of the federal lead standard. The Maximum 3-month rolling average in 2018 was 0.02 µg/m^3 (at the highest source-specific monitor). A request to U.S. EPA to re-designate Los Angeles County to attainment of the lead NAAQS is pending. The remainder of the Basin outside the Los Angeles County nonattainment area, as well as the Coachella Valley, remain in attainment of the 2008 lead standard, including both ambient monitors and source-oriented monitors.

PM2.5 levels in the Basin have improved significantly since those measurement began in 1999. Starting in 2013 and through 2018, there are no FRM PM2.5 stations violating the former 1997 annual PM2.5 NAAQS (15.0 µg/m^3) for the 3-year design value period with the filter-based federal reference method (FRM).[6] On July 25, 2016 U.S. EPA finalized a determination that the Basin attained the 1997 annual (15.0 µg/m^3) and 24-hour PM2.5 (65 µg/m^3) NAAQS, effective August 24, 2016. Of the 17 FRM PM2.5 ambient stations in the Basin and the Coachella Valley for the 2016–2018 period, five stations had design values over the current 2012 annual PM2.5 NAAQS (12.0 µg/m^3), including: Mira Loma (Basin maximum at 13.9 µg/m^3), Rubidoux, Central Los Angeles, Pico Rivera, and Compton. The current annual PM2.5 NAAQS is also exceeded for the 2016-2018 design value for the two PM2.5 near-road sites (I710 and CA-60). The Coachella Valley is in attainment of both the annual and 24-hour PM2.5 NAAQS.

[5] Source: 2018 air quality data summarized from U.S. EPA Air Data website pre-generated data files, *Table of Annual Summary Data* for 2018, by monitor. [https://aqs.epa.gov/aqsweb/airdata/annual_conc_by_monitor_2018.zip].

[6] South Coast AQMD also employs continuous monitors at several stations in the Basin to provide real-time data for the public and to support daily air quality forecasting. U.S. EPA grants annual waivers to South Coast AQMD from using these continuous monitors for regulatory/attainment determination purposes, since they do not meet the precision and bias requirements to be considered as federal equivalent method (FEM) measurements.

In 2018, all but four of the 17 ambient stations in the Basin with FRM PM2.5 monitors and both near-road stations had one or more PM2.5 daily average concentrations exceeding the level of the federal 24-hour PM2.5 NAAQS (35.0 µg/m^3), with a total of 11 days over that standard in the Basin. However, in the 2016–2018 period, only two stations (in Metropolitan Riverside County at Mira Loma and Compton), had design values over the 24-hour PM2.5 NAAQS.[7] While it was previously anticipated that the Basin 24-hour PM2.5 NAAQS would be attained by 2015, this did not occur, based on the data for 2013 through 2015. The higher number of days exceeding the 24-hour NAAQS, over what was expected based on the current control strategy, is largely attributed to the recent severe drought conditions in California, along with significant impact to PM2.5 concentrations from wildfires in 2017, including the very large Thomas Fire.

The Basin has remained in attainment of the PM10 24-hour NAAQS for several years, with occasional exceptional events due to high winds. In 2018, the Basin exceeded the level of the PM10 NAAQS at two stations (Upland and Mira Loma). This was associated with a high-wind natural event that also did not contribute to a violation of the 3-year form of the PM10 NAAQS, which allows for no more than an average of one exceedance per year over a three-year period. All three Coachella Valley air monitoring stations show exceedances of the PM10 NAAQS in recent years. However, the monitoring data also shows that the exceedances are all related to high-wind natural events and that the Coachella Valley can meet the PM10 NAAQS, pending South Coast AQMD documentation submittal and subsequent U.S. EPA concurrence of days flagged under the Exceptional Events Rule.

Figure 1-2 shows typical recent Basin and Coachella Valley 3-year design values (2016-2018) for ozone and PM2.5, as a percentage of the corresponding current and former federal standards. The 24-hour PM10 NAAQS is also exceeded in the Coachella Valley due to high-wind natural events. Figure 1-3 shows the 1995-2018 trends of the South Coast Air Basin maximum design values for ozone and PM2.5, the only pollutants that still violate the NAAQS in the Basin. While these pollutants have shown significant improvement over the years, recent years have shown some increase for these pollutants in the Basin.

[7] The 24-hour PM2.5 design value is based on the annual 98th percentile concentration for each station averaged over the 3-year period; for stations that monitor every day, this is typically the eighth highest concentration.

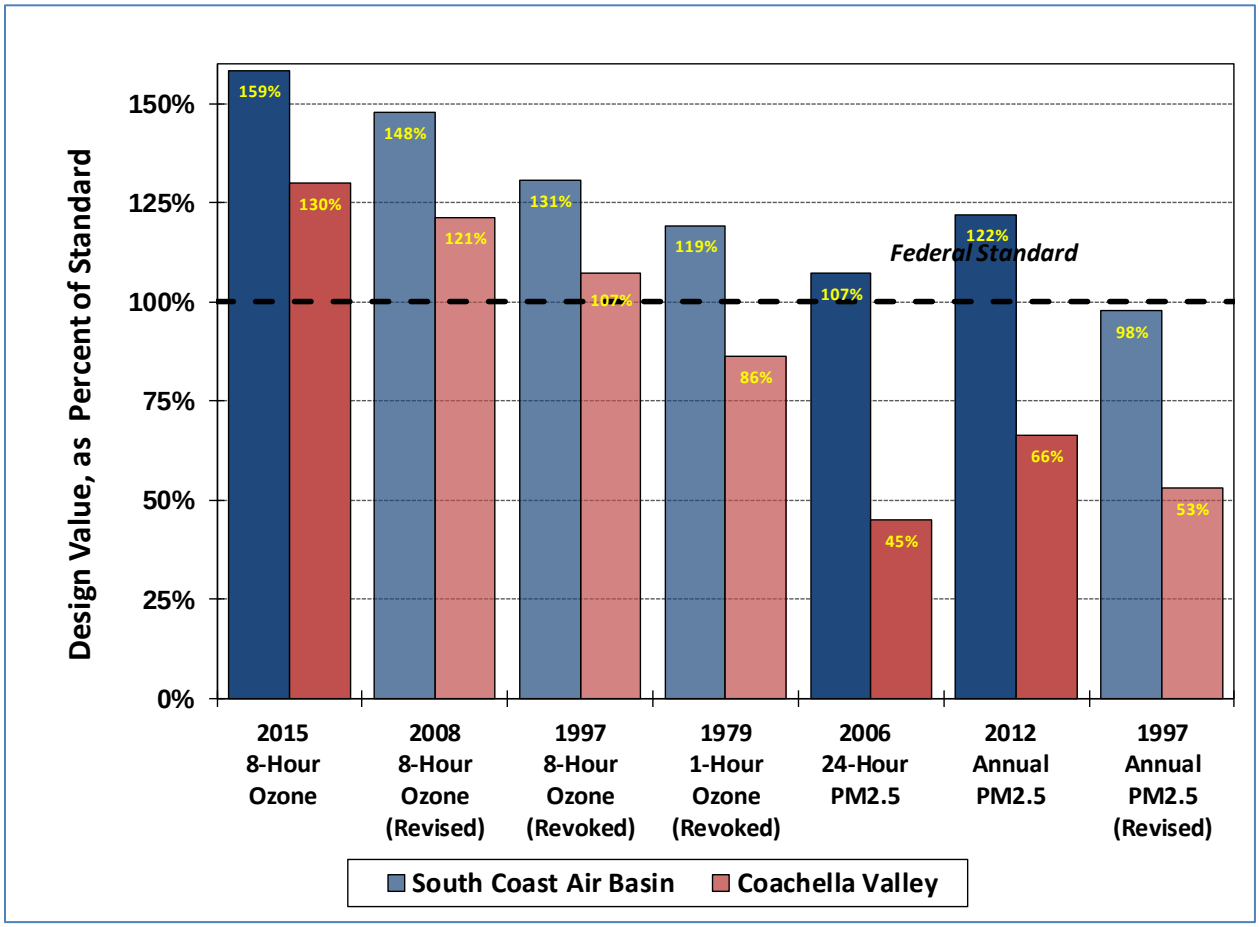


Figure 1-2
South Coast Air Basin and Coachella Valley 3-Year Ozone and PM2.5 Design Values
(Percentage of current and former federal standards, by criteria pollutant based on 2016-2018 period)

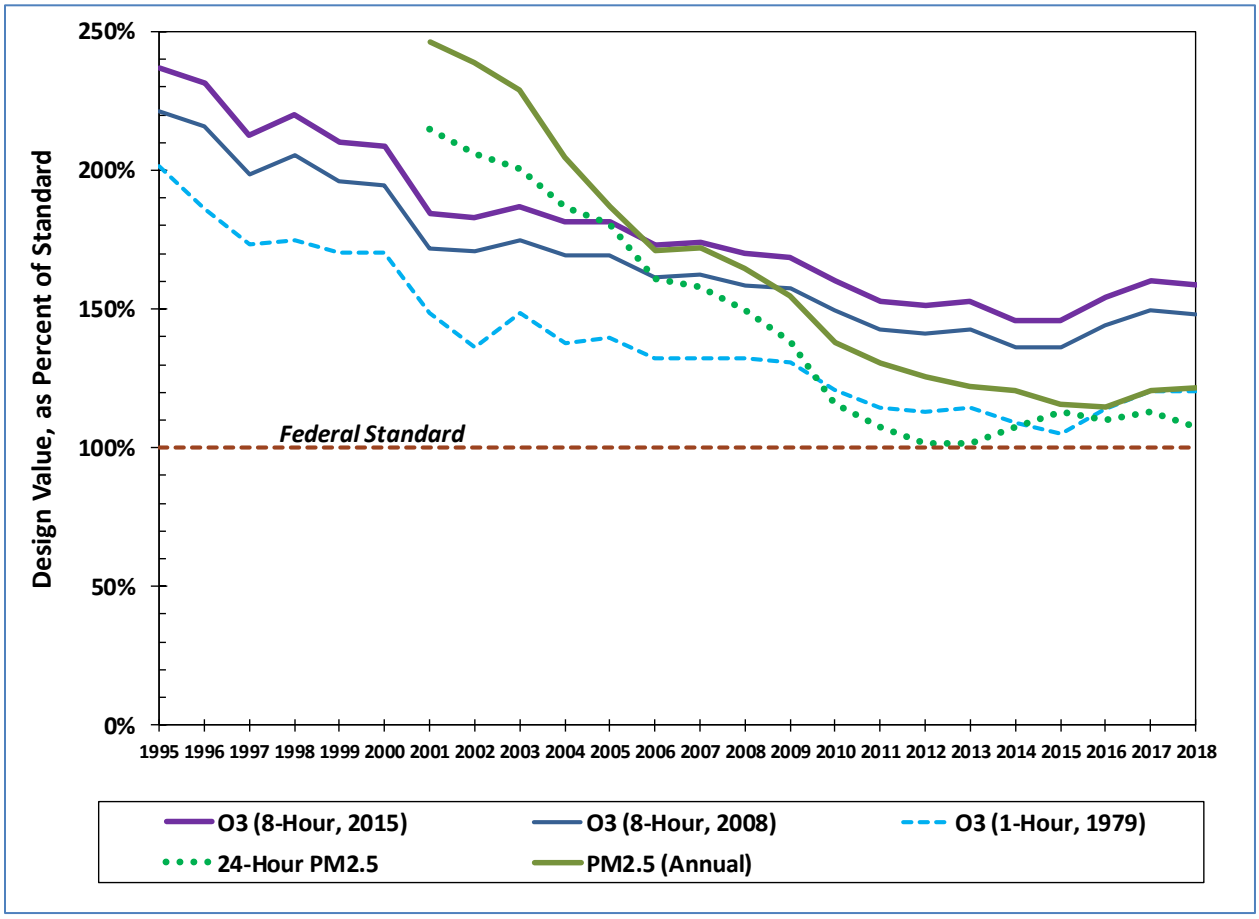


Figure 1-3
Trends of South Coast Air Basin Maximum 3-Year Design Values for Ozone and PM2.5
[(2015 8-hour, 2008 8-hour, and 1979 1-hour NAAQS) and PM2.5 (24-hour and Annual), 1995-2017, *as Percentages of the Respective NAAQS]*

1.6 Project/Task Description

Criteria air pollutant monitoring is a key component for assessing compliance with the NAAQS and CAAQS, assessing air quality with statistical metrics, evaluating the effectiveness of emission reductions and controls, and providing information considered in the South Coast AQMD AQMP/State Implementation Plan (SIP) development. The regulatory standards for criteria pollutant monitoring principles, methods and requirements are promulgated in the Federal Register, including: 40 CFR 50 – National Primary and Secondary Ambient Air Quality Standards; 40 CFR 53 – Ambient Air Monitoring Reference and Equivalent Methods; and 40 CFR 58 – Ambient Air Quality Surveillance.

In accordance with U.S. EPA requirements, as detailed in the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Monitoring Program, (U.S. EPA, 2017a), the South Coast AQMD ambient air monitoring network is designed to collect data to meet three basic objectives:

1. Provide air pollution data to the general public in a timely manner;
2. Support compliance with air quality standards and emission reduction strategy development; and
3. Support air pollution research.

This QAPP details the work that is required to collect, document and report the ambient monitoring data for this project, the existing South Coast AQMD criteria pollutant monitoring program with an established network and procedures that has evolved since the 1970s. Work activities pertinent to this project include: field monitoring and sample collection, support and audit activities; laboratory analysis activities, data review, validation, verification and assessments, and products/reports that are generated.

Field activities for the criteria pollutant monitoring program include efforts by the MN Branch, including the Operations and Support Groups, and the QA Branch for QA oversight of the work and resulting data. The field activities include:

- Siting, installation, and acceptance testing of new monitors or stations;
- Routine station and instrument operations, maintenance and sample collection;
- QC checks;
- Data review and initial validation;
- Calibrations, troubleshooting and repair of equipment;
- Maintenance of documentation for sample chain-of-custody (COC) and station/instrument logbooks; and
- QA assessment and oversight activities.

South Coast AQMD maintains its own laboratory in support of the criteria monitoring program. The QA Branch, including the QA Manager and a dedicated Senior Chemist, provides QA oversight of the laboratory work and resulting data. Laboratory activities that support this project include:

- Preparation and tare weighing of filters prior to field sampling;
- Post-sampling analyses of filters and blanks;
- Preparation and maintenance of documentation for COC;
- Data validation, reporting and submittal;
- Laboratory performance evaluations and audits; and
- QA assessment and oversight.

South Coast AQMD employees are responsible for operations, support, laboratory analyses and QA oversight for the Criteria Pollutant Monitoring Program and contractors are not typically used. However, technical support contracting to cover program tasks remains a backstop possibility, if needed. As discussed in Section 1.4, Quality Assurance oversight applies to contractual work and the resulting data. Contractors are carefully selected through the South Coast AQMD contract process, including evaluation of qualifications, experience, training and verified references. Contractors or subcontractors providing work specific to the Criteria Pollutant Monitoring Program are required to review and follow this QAPP and the SOPs or OAGs related to the contracted effort. Alternatively, the QA Branch can review and approve the contractor's SOPs for the work. QA system issues with contractor procedures or data products are addressed by the QA Branch through the Corrective Action process, that documents the issue and its resolution, along with recommendations to help prevent future recurrence. Contract non-compliance or breach is addressed through the South Coast AQMD contract corrective action process and may involve a stop work order or a notice to cure, as well as possible contract termination.

The measurement data that will be collected and reported during this project include ambient data from both continuous monitoring instruments and laboratory analyses of samples, QA/QC data, and site metadata.

Assessments for the South Coast AQMD criteria pollutant monitoring program include the following, with responsibilities within the MN, LS, and QA Branches:

- Annual Network Plans;
- 5-Year Network Assessments;
- Technical Systems Audits (TSAs);
- Internal and CARB Systems Audits;
- Performance Audits (both internal and external);

- Data Quality Assessments (DQAs); and
- Annual Data Certification.

Tables of QA/QC, laboratory and field station operation and repair critical documents and records that will be maintained for the criteria pollutant monitoring program are included in Section 1.9, Documentation and Records, including the QAPP, SOPs, QA assessment reports, training files, corrective action report, laboratory, station and instrument logbooks, calibration records, user's manuals, QC records, and COC forms.

The list and description of monitoring purposes for the criteria air pollutant monitoring program include the following and individual monitor purposes can be found in the Annual Network Plan (ANP), *South Coast AQMD Annual Air Quality Monitoring Network Plan* (South Coast AQMD, 2019):

- **Background Level** monitoring is used to determine general background levels of air pollutants as they enter the Basin.
- **High Concentration** monitoring is conducted at sites to determine the highest concentration of an air pollutant in an area within the monitoring network. A monitoring network may have multiple high concentration sites (i.e., due to varying meteorology year to year).
- **Pollutant Transport** is the movement of pollutant between air basins or areas within an air basin. Transport monitoring is used to assess and mitigate upwind areas when transported pollutant affects neighboring downwind areas. Also, transport monitoring is used to determine the extent of regional pollutant transport among populated areas and to rural areas.
- **Population Exposure** monitoring is conducted to represent the air pollutant concentrations to which a populated area is exposed.
- **Representative Concentration** monitoring is conducted to represent the air quality concentrations for a pollutant expected to be similar throughout a geographical area. These sites do not necessarily indicate the highest concentrations in the area for a particular pollutant.
- **Source Impact** monitoring is used to determine the impact of significant sources or source categories of air quality emissions on ambient air quality. The air pollutant sources may be stationary or mobile.
- **Trend Analysis** monitoring is useful for comparing and analyzing air pollution concentrations over time. Usually, trend analyses can be used to assess the progress in improving air quality for an area over a period of many years.
- **Site Comparison** monitoring is used to assess the effect on measured pollutant levels of moving a monitoring location a short distance (usually less than two miles). Some monitoring stations become no longer usable due to development, change of lease terms,

or eviction. In these cases, attempts are made to conduct concurrent monitoring at the old and new site for a period of at least one year in order to compare pollutant concentrations.

- **Welfare-Related Impact** monitoring is used to assess the effect of air pollutants on public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.
- **Quality Assurance** monitoring is used to assess the quality of other measurements such as collocation sampling or performance audits.
- **Real-Time Data Reporting/Modeling** is used to provide air monitoring data for general public access air pollution on a near-real-time basis. Some examples include: South Coast AQMD's current air pollution advisories and hourly air quality data access[8], the U.S. EPA's AIRNOW system,[9] and the CARB Air Quality and Meteorological Information System (AQMIS).[10] South Coast AQMD also uses air monitoring data to provide accurate and timely air quality forecast guidance to residents of the Basin.

1.6.1 South Coast AQMD Criteria Pollutant Air Monitoring Network

Each year, South Coast AQMD MN Branch submits an Annual Air Monitoring Network Plan (more recent as of this writing is South Coast AQMD, 2019) to U.S. EPA Region 9 for review and approval of the configuration and planned changes, including State and Local Air Monitoring Stations (SLAMS), Photochemical Assessment Monitoring Stations (PAMS), PM2.5 Speciation, National Air Toxic Trend Site (NATTS), and NCORE monitors. Public notice of network modifications occurs as part of the annual network plan process. Furthermore, the South Coast AQMD Five Year Network Assessment (South Coast AQMD, 2015) considers more detailed metrics to evaluate the value and adequacy of the monitoring program and station siting, considering the modernizing of data and measurement quality objectives, new technologies, and the geographic areas that should have increased or decreased network coverage. This frequent effort and review ensure that the monitoring requirements for these federal programs are being met. Figure 1-4 shows the location of the spatial distribution of the South Coast AQMD air monitoring stations.

[8] South Coast AQMD website, Current Air Quality Data and Forecasts: (http://www.aqmd.gov/home/air-quality/air-quality-data-studies. Also available through South Coast AQMD cell phone apps and Interactive Voice Response (IVR) automated telephone messaging system (1-800-CUT-SMOG).

[9] U.S. EPA AirNow website: https://www.airnow.gov/

[10] CARB website, Air Quality and Meteorological Information System (AQMIS): https://www.arb.ca.gov/aqmis2/aqmis2.php

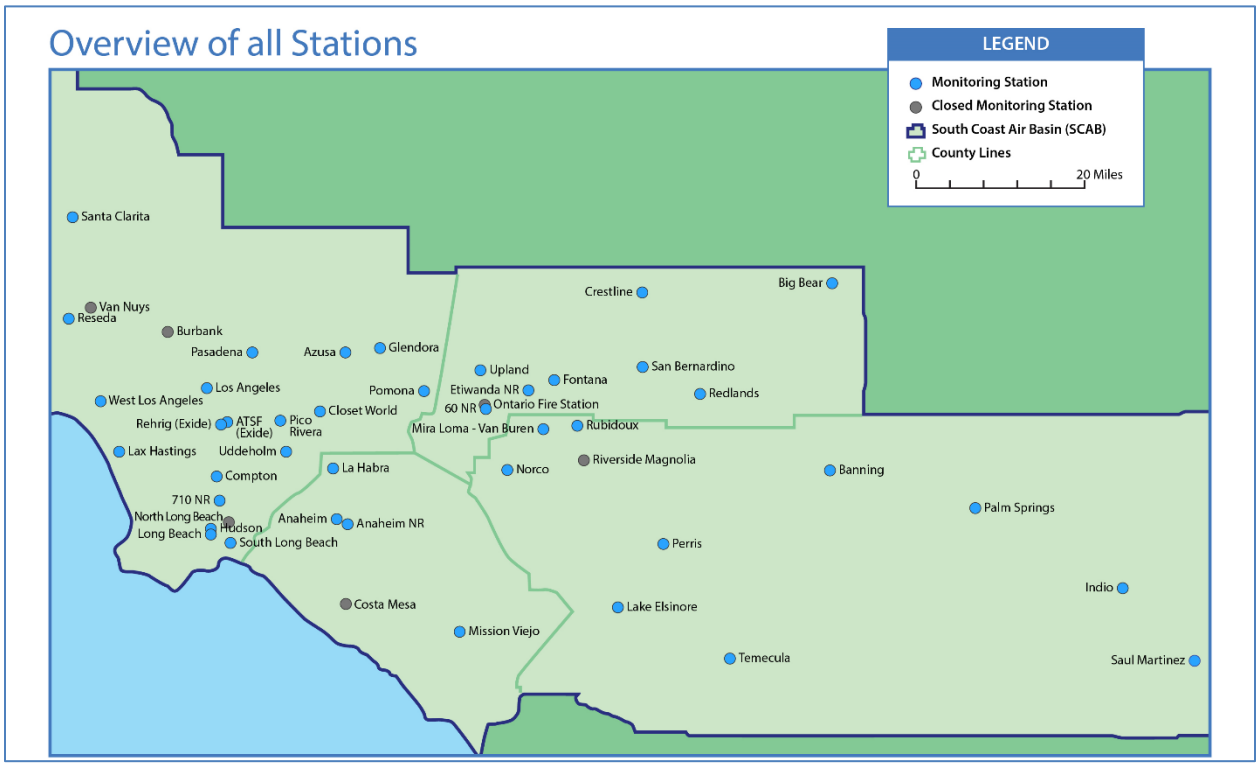


Figure 1-4
South Coast AQMD Air Monitoring Stations

[Note stations closed (grey dots): N. Long Beach in 2013 (FRM PM2.5 still operating), Burbank and Ontario Fire Station in 2014, Riverside-Magnolia in 2015, Van Nuys Airport lead (Pb) monitor, and Costa Mesa station closed in 2018; Salton Sea Air Basin includes: Palm Springs, Indio, and Mecca-Saul Martinez stations, in Riverside County's Coachella Valley; all other stations are in the South Coast Air Basin; I-710 (labeled 710 NR), CA-60 (60 NR), I-5 (Anaheim NR), and I-10 (Etiwanda NR) are near-road stations]

The South Coast AQMD network meets or exceeds the minimum monitoring requirements for all criteria pollutants. Table 1-8 lists the stations in the South Coast AQMD criteria air monitoring network and the pollutants measured. Table 1-9 provides additional detail as to the measurement methods employed at each station. The U.S. EPA requirements for the minimum number of monitors by Metropolitan Statistical Area (MSA) are shown in Table 1-10, along with the current number of South Coast AQMD monitors. The minimum number of monitors for each pollutant is based on MSA populations as described in *40 CFR Part 58 Appendix D*. The number of South Coast AQMD monitors meets, and in most cases exceeds, the required minimum, but the actual number of monitors can vary year by year as is updated through the South Coast AQMD annual network plan. The minimum number of monitors required is also assessed in the five-year network assessment that is conducted by South Coast AQMD and submitted to U.S. EPA Region 9. Note that there may be other considerations besides the MSA populations that influence the need for criteria monitoring locations, including real-time data reporting, forecasting, modeling, or SIP requirements, such as maintenance plans. These considerations are especially important in the large urban area and population of the South Coast AQMD jurisdiction, with air pollution strongly influenced by complex emissions, terrain, and meteorological conditions.

TABLE 1-8
South Coast AQMD Air Monitoring Network Stations and Pollutants Measured (2019)

	Location	AQS No.	Pollutants Monitored	Start Date
1	Anaheim	060590007	CO, NO2, O3, PM10, PM2.5	08/2001
2	Anaheim I-5 Near Road	060590008	CO, NO2	01/2014
3	ATSF (Exide)	060371406	Pb	01/1999
4	Azusa	060370002	CO, NO2, O3, PM10, PM2.5	01/1957
5	Banning Airport	060650012	NO2, O3, PM10, PM2.5	04/1997
6	Big Bear	060718001	PM2.5	02/1999
7	Closet World (Quemetco)	060371404	Pb	10/2008
8	Compton	060371302	CO, NO2, O3, PM2.5, Pb	01/2004
9	Central San Bernardino Mountains	060710005	O3, PM10, PM2.5	10/1973
10	Fontana	060712002	CO, NO2, SO2, O3, PM10, PM2.5	08/1981
11	Glendora	060370016	CO, NO2, O3, PM10, PM2.5	08/1980
12	Indio	060652002	O3, PM10, PM2.5	01/1983
13	La Habra	060595001	CO, NO2, O3	08/1960
14	Lake Elsinore	060659001	CO, NO2, O3, PM10, PM2.5	06/1987
15	LAX Hastings	060375005	CO, NO2, O3, PM10, Pb	04/2004
16	Long Beach (Hudson)	060374006	CO, NO2, SO2, O3, PM10	01/2010
17	Long Beach I-710 Near Road	060374008	NO2, PM2.5	01/2015
18	Long Beach (North)	060374002	PM2.5	10/1962
19	Long Beach (South)	060374004	PM10, PM2.5, Pb	06/2003
20	Los Angeles (Main St.)	060371103	CO, NO2, SO2, O3, PM10, PM2.5, Pb	09/1979
21	Mecca (Saul Martinez)	060652005	PM10	01/2011
22	Mira Loma (Van Buren)	060658005	CO, NO2, O3, PM10, PM2.5	11/2005
23	Mission Viejo	060592022	CO, O3, PM10, PM2.5	06/1999
24	Norco	060650003	PM10	12/1980
25	Ontario CA-60 Near Road	060710027	NO2, PM2.5	01/2015
26	Ontario Etiwanda I-10 Near Road	060710026	CO, NO2	06/2014
27	Palm Springs	060655001	CO, NO2, O3, PM10, PM2.5	04/1971
28	Pasadena	060372005	CO, NO2, O3, PM2.5	04/1982
29	Perris	060656001	O3, PM10	05/1973
30	Pico Rivera	060371602	CO, NO2, O3, PM10, PM2.5, Pb	09/2005
31	Pomona	060371701	CO, NO2, O3	06/1965
32	Redlands	060714003	O3, PM10	09/1986
33	Rehrig (Exide)	060371405	Pb	11/2007
34	Reseda	060371201	CO, NO2, O3, PM2.5	03/1965
35	Rubidoux	060658001	CO, NO2, SO2, O3, PM10, PM2.5, Pb	09/1972
36	San Bernardino	060719004	CO, NO2, O3, PM10, PM2.5, Pb	05/1986
37	Santa Clarita	060376012	CO, NO2, O3, PM10, PM2.5	05/2001
38	Temecula	060650016	O3, PM2.5	06/2010
39	Uddelholm (Trojan Battery)	060371403	Pb	11/1992
40	Upland	060711004	CO, NO2, O3, PM10, PM2.5	03/1973
41	West Los Angeles	060370113	CO, NO2, O3	05/1984

Table 1-9
South Coast AQMD Criteria Pollutant Air Monitoring and Methods (2019)

#	AIRS Site ID	Station	O3	CO	SO2	NO2	PM2.5 FRM	PM10 FRM	PM2.5 Continuous	PM10 Continuous	TSP-Pb	Met Station
1	060590007	Anaheim	X	X		X	Daily-2025i-c	X	FEM BAM M1	BAM M1		X
2	060590008	Anaheim I-5 Near Road		NR		NR						X
3	060371406	*ATSF (Exide)									X (Source)	
4	060370002	Azusa	X	X		X	3Day-2000i	X				X
5	060650012	Banning Airport	X			X		X	BAM M1			X
6	060718001	*Big Bear					6Day-2000i					
7	060371504	*Closet World (Quemetco)									X (Source)	
8	060371302	Compton	X	X		X	3Day-RAAS				X-c	X
9	060710005	Central San Bernardino Mtns	X					X	BAM M1			X
10	060712002	Fontana	X	X	X	X	3Day-2000i	X				X
11	060370016	Glendora	X	X		X			BAM M1	BAM M1		X
12	060652002	Indio	X				3Day-RAAS	3Day-c	FEM BAM SPM	TEOM		X
13	060595001	La Habra	X	X		X						X
14	060659001	Lake Elsinore	X	X		X			BAM M1	TEOM		X
15	060375005	LAX-Hastings	X	X	X	X		X			X	X
16	060374006	Long Beach (Hudson)	X	X	X	X		X				X
17	060374008	Long Beach I-710 Near Road				NR	Daily-2025i		FEM Thermo			X
18	060374002	Long Beach (North)					Daily-2025i					
19	060374004	*Long Beach (South)					Daily	X	FEM BAM M1		X	X
20	060371103	Los Angeles Main Street	X	X	X	X	Daily-2025i-c	X	FEM BAM M1	BAM M1	X-c	X
21	060652005	Mecca (Saul Martinez)						X		TEOM		
22	060658005	Mira Loma (Van Buren)	X	X		X	Daily-2025i-c	X-c	FEM BAM M1	BAM M1		X
23	060592022	Mission Viejo	X	X			3Day-RAAS	X	FEM Thermo			X
24	060650003	*Norco						X				
25	060710027	Ontario CA-60 Near Road				NR	Daily-2025i		FEM Thermo			
26	060710026	Ontario Etiwanda I-10 Near Road		NR		NR						
27	060655001	Palm Springs	X	X		X	3Day-RAAS	X		TEOM		X
28	060372005	Pasadena	X	X		X	3Day-RAAS					X
29	060656001	Perris	X					X				X
30	060371602	Pico Rivera	X	X		X	3Day-2000i				X	X
31	060371701	Pomona	X	X		X						X
32	060714003	Redlands	X					X				X
33	060371405	*Rehrig (Exide)									X (Source)	
34	060371201	Reseda	X	X		X	3Day-RAAS		BAM M1			X
35	060658001	Rubidoux	X	X	X	X	Daily-2025i-c	3Day-c	FEM BAM M1	BAM M1	X	X
36	060719004	San Bernardino	X	X		X	3Day-RAAS	X		TEOM	X	X
37	060376012	Santa Clarita	X	X		X		X	BAM M1			X
38	060650016	Temecula	X						BAM M1			X
39	060371403	*Uddelholm (Trojan Battery)									X (Source)	
40	060711004	Upland	X	X		X			BAM M1	BAM M1		X
41	060370113	West Los Angeles	X	X		X						X
		TOTAL Sites	**28**	**24**	**5**	**26**	**19**	**20**	**16**	**11**	**11**	**31**
							(3 collocated)	(3 collocated)	(8 FEM-waiver, 9 Non-FEM)	(5 BAM, 6 TEOM)	(4 Source, 7 Ambient)	
		U.S. EPA Method Codes	047, 087	054, 106, 158, 593	560	074, 099, 157	143, 145, 155	054, 063	170, 183	079, 122	110	

* = No site manifold; -c = Collocated sampling; NR = Near Road Station; Source = Source Oriented Lead Monitoring
Daily = Daily sampling; 3Day = Every third day sampling; 6Day = Every 6th day sampling
FRM = Federal Reference Method; FEM = Federal Equivalent Method; SPM = Special Purpose Monitor
2000i = Thermo Fisher Scientific Partisol Model 2000i Air Sampler
2025i = Thermo Fisher Scientific Partisol Model 2025i Sequential Air Sampler
RAAS = Andersen Reference Ambient Air Sampler
M1 = Met One Model BAM-1020 Continuous Particle Monitor
Thermo = Thermo Scientific Model 5014i Beta Continuous Ambient Particulate Monitor
TEOM = Tapered Element Oscillating Microbalance Continuous Ambient Particulate Monitor

Table 1-10
Minimum Monitoring Requirements and Active Monitors
by Metropolitan Statistical Area (MSA)

Pollutant	Los Angeles & Orange County MSA		Riverside & San Bernardino MSA	
	Monitors Required	**Monitors Active**	**Monitors Required**	**Monitors Active**
O3	4	15	3	13
PM2.5	3	10 [1]	3	9 [1]
PM10	2-4 (med. concentration)	8	6-10 (med. concentration)	11
NO2	2	14 [2]	2	8 [2]
SO2	1	4	1	1
CO	0	15 [3]	0	7 [3]
Pb	0	4 [4]	0	1 [4]

1. PM2.5 FRM monitors; requirement for 2 continuous FEM PM2.5 monitors in each MSA is also met
2. NO2 area-wide monitors; requirement for 2 near-road NO2 monitors in each MSA is also met
3. NO2 area-wide monitors; requirement for 1 near-road CO monitor in each MSA is also met
4. Pb area-wide, non-source, non-NCore monitors; requirement for 1 NCore Pb monitor in each MSA is met but may be discontinued upon approval of waiver per 79 FR 54395, September 11, 2014; there is no longer a requirement for source oriented Pb monitoring in the Basin

A brief description of the South Coast AQMD criteria air pollutant monitoring network, as of this writing (a snapshot for 2018), is listed below for each pollutant.

1.6.1.1 Ozone (O3)

South Coast AQMD currently operates 28 stations where O3 measurements are made as part of the Air Monitoring Network, including 2 locations in the Coachella Valley. As shown in Figure 1-5, O3 sites are spread throughout the Basin and the Coachella Valley. The highest O3 concentrations are typically measured in the inland areas of the Basin and in the western portion of the Coachella Valley, but exceedances of the current 8-hour O3 NAAQS occur at most of the South Coast AQMD air monitoring stations each year.

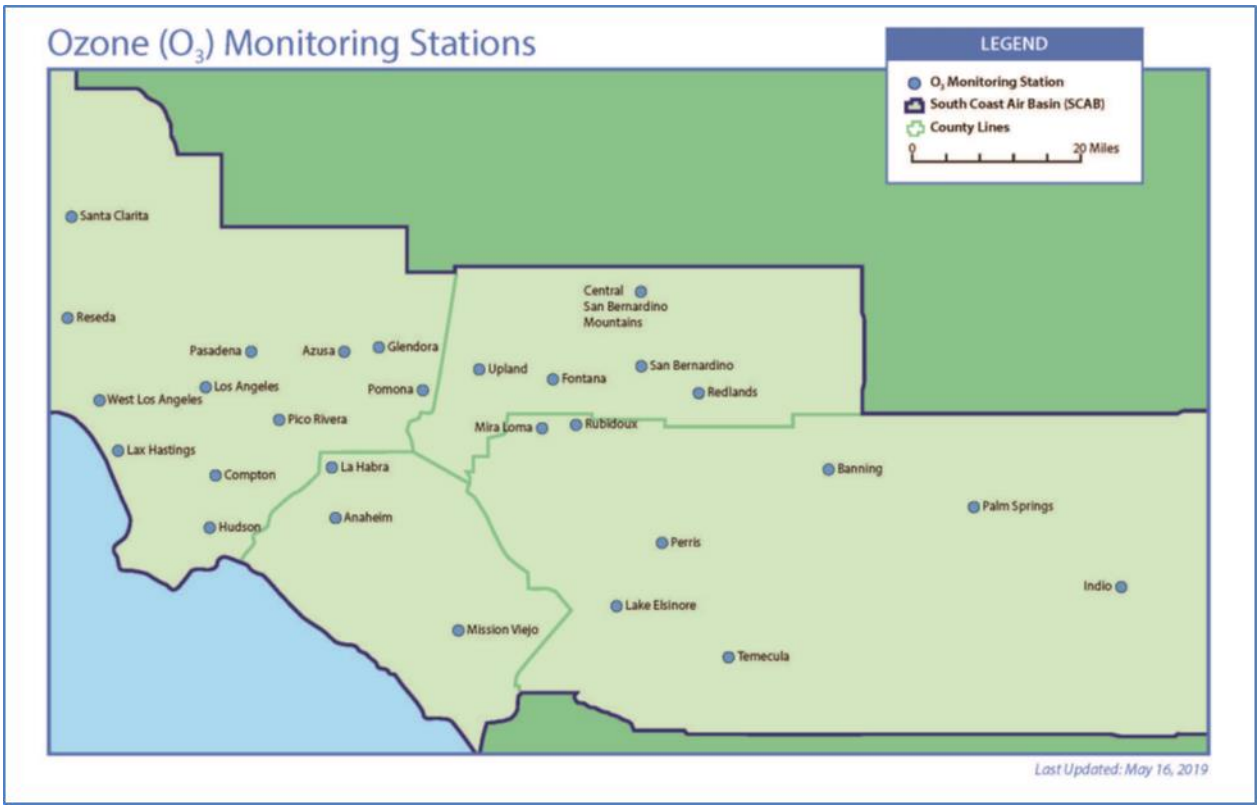


Figure 1-5
South Coast AQMD O3 Air Monitoring Locations
(Note that the Costa Mesa air monitoring station was recently closed)

1.6.1.2 Particulate Matter (PM10)

South Coast AQMD currently measures PM10 concentrations at 23 stations, either continuously or with manual filter sampling, including three locations in the Coachella Valley. Twenty stations employ manual high-volume, filter-based FRM PM10 samplers with size-selective inlets. The 24-hour (midnight to midnight) samples are run on the federally required minimum 6-day sampling schedule, except that the Riverside-Rubidoux, Mira Loma (frequency increased in 2015), and Indio (Coachella Valley) stations sample on a 3-day schedule for additional temporal resolution at these historic peak PM10 locations.

Eleven stations currently employ continuous PM10 monitors, utilizing primarily BAM and TEOM instruments that report hourly concentrations. Eight of these are collocated with FRM samplers, while the remaining three are not sited along with FRM monitors. Unlike PM2.5 FEM measurements, there is no waiver process for PM10 FEM instruments, and those measurements are part of NAAQS attainment determination. At locations where both FRM samplers and FEM PM10 continuous analyzers are deployed together, the data is generally combined for attainment purposes, with the FRM data being the primary data source, as available. Figure 1-6 shows the routine ambient PM10 monitoring sites in the South Coast AQMD jurisdiction.

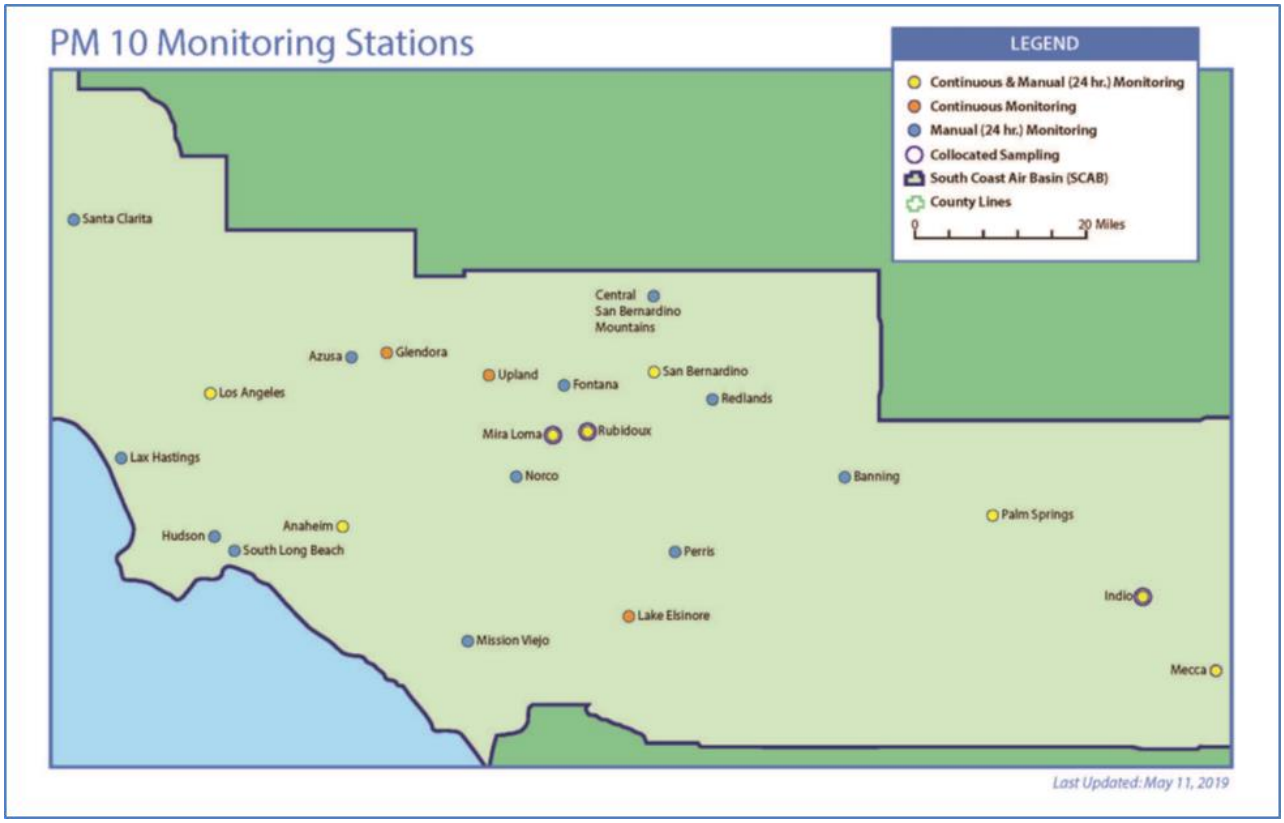


Figure 1-6
South Coast AQMD PM10 Air Monitoring Locations

The continuous PM10 monitors provide public information in near-real time covering much of the South Coast AQMD jurisdiction, with additional measurements clustered in the higher concentration areas, including the Coachella Valley desert area where high-wind natural events still cause exceedances of the 24-hour PM10 NAAQS. In downwind areas of the Basin, high-wind events can occasionally cause NAAQS exceedances, but a large fraction of the particulate matter forms from secondary processes, in the atmosphere.

Quality Control for Manual PM10 requires 15 percent of the primary monitors be collocated. Fifty percent of the collocated quality control monitors should be deployed at sites with daily concentrations estimated to be within plus or minus 20 percent of the applicable NAAQS and the remainder at the PQAOs discretion. If an organization has no sites with daily concentrations within plus or minus 20 percent of the NAAQS, 50 percent of the collocated quality control monitors should be deployed at those sites with the daily mean concentrations among the highest for all sites in the network and the remainder at the PQAOs discretion. The Indio, Mira Loma and Rubidoux sites meet this requirement and are designated PM10 collocated.

1.6.1.3 PM10 Sulfate (PM10-SO_4^{2-})

South Coast AQMD also analyzes the manual PM10 FRM filters at select stations for sulfate (SO_4^{2-}) to demonstrate the long-standing and continuing attainment of the PM10-SO_4^{2-} CAAQS. There is no corresponding federal standard for sulfate.

1.6.1.4 Particulate Matter (PM2.5)

Routine PM2.5 concentrations are currently monitored at 26 locations, either continuously or by discrete filter sampling, throughout the South Coast AQMD jurisdiction. This includes two stations in the Coachella Valley (Palm Springs and Indio), two near-road sites (I-710 and CA-60 Near Road), and two NCore stations (Los Angeles-Main Street and Riverside-Rubidoux). Filter-based FRM PM2.5 sampling is employed at 19 of these stations and eight of the FRM measurement stations sample daily to improve FRM temporal coverage beyond the minimally required 1-in-3-day sampling schedule, including the two near-road sites and the two NCore sites. Sixteen stations, including two near-road sites, employ continuous PM2.5 monitors (primarily Met One 1020 and Thermo 5014i BAM instruments and testing of Teledyne T640), including seven FEM monitors that are collocated with FRM measurements and seven non-FEM monitors. Many FEM PM2.5 monitors in the Basin do not meet the U.S. EPA criteria to be used for NAAQS comparison[11] and South Coast AQMD has been granted annual waivers by U.S. EPA precluding their use in NAAQS attainment consideration. The continuous PM2.5 data is used for forecasting, real-time data display, air quality alerts, and for evaluating hour-by-hour variations. Figure 1-7 shows the routine PM2.5 monitoring sites in the South Coast AQMD jurisdiction.

[11] The continuous PM2.5 monitors deployed by South Coast AQMD are FEM-designated Beta Attenuation Monitor (BAM) instruments, but in use they do not meet the correlation and bias requirements set by U.S. EPA for equivalency to FRM filter measurements. The U.S. EPA waiver from NAAQS compliance for the continuous samplers is re-evaluated annually as part of the South Coast AQMD Annual Air Quality Monitoring Network Plan with a PM2.5 Continuous Monitor Comparability Assessment.

[http://www.aqmd.gov/home/air-quality/clean-air-plans/monitoring-network-plan].

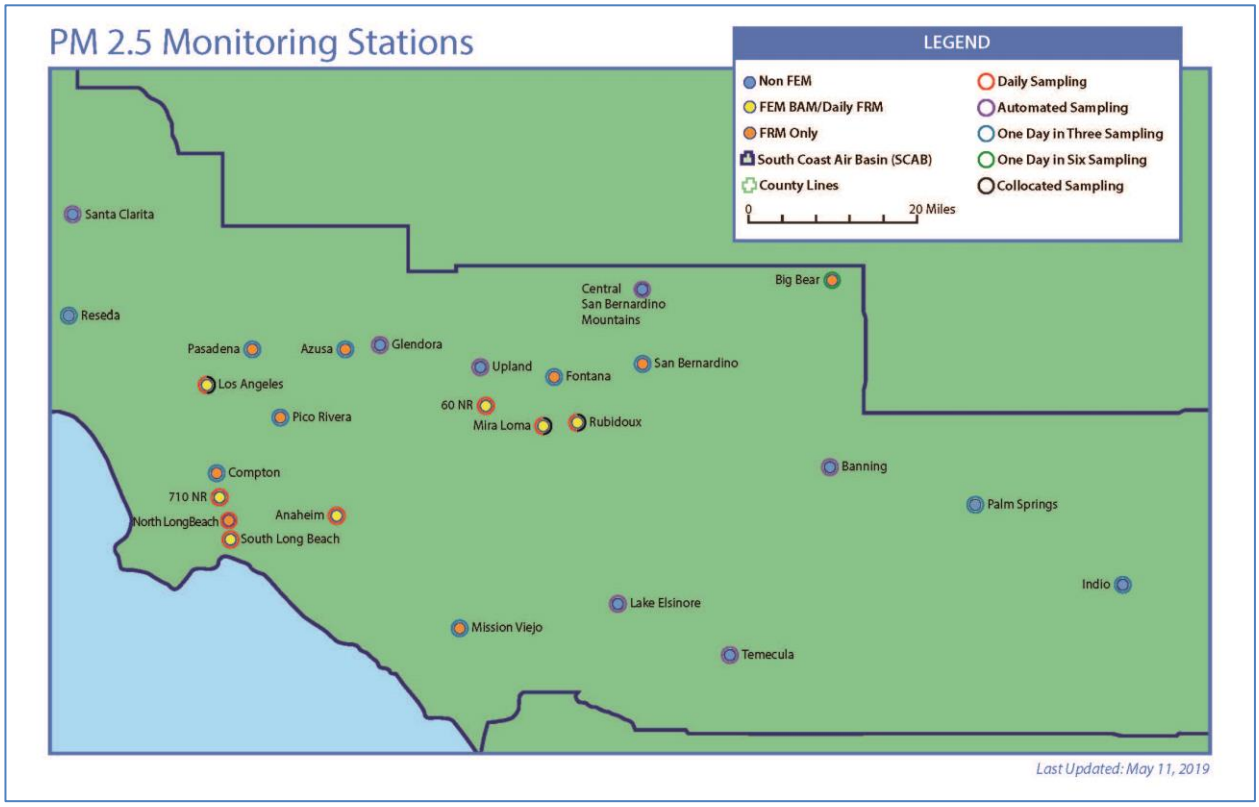


Figure 1-7
South Coast AQMD PM2.5 Air Monitoring Locations
(Note that while the station at N. Long Beach was closed in 2013, FRM PM2.5 monitoring was allowed to continue; some continuous monitors are not certified as FEM monitors, shown as Non-FEM; Palm Springs and Indio stations are FRM samplers only and are in the Salton Sea Air Basin – Coachella Valley; the Route 710 and Route 60 Near Road PM2.5 monitoring started on January 1, 2015; Continuous FEM PM2.5 monitoring was added at Mission Viejo in 2019)

The manual FRM PM2.5 sampling method continues to be used for NAAQS comparison purposes in the Basin, but it requires significant laboratory analysis efforts. South Coast AQMD is conducting comparison studies of newer FEM technologies to determine their ability to meet the criteria to be compared against the NAAQS. Until such time when the assessment indicates that the FEM monitors are within the acceptance criteria at particular locations, South Coast AQMD will notify U.S. EPA on an annual basis through the Annual Air Monitoring Network Plan with the PM2.5 Continuous Monitor Comparability Assessment and Request for Waiver when the FEM monitors are not meeting acceptance criteria and recommend that these data continue to not be compared to the NAAQS.

The federal minimum monitoring requirements for PM2.5 are being met and/or exceeded by the South Coast AQMD PM2.5 monitoring network. Several stations in the Basin exceed the levels of either the 24-hour PM2.5 NAAQS and/or the annual average PM2.5 NAAQS each year, while the Coachella Valley remains in attainment of both forms of the PM2.5 NAAQS. Collocated FRM PM2.5 sites include Anaheim, Central Los Angeles, and Mira Loma (Van

Buren), Pasadena, and Rubidoux. Of the collocated sites, three are located at sites with annual mean particulate concentrations among the highest 25 percent of the annual mean concentrations for all sites in the network as required in *40 CFR Part 58 Appendix A 3.3.1*.

Manual PM2.5 monitors are sited as neighborhood scale, representing community wide air quality, with multiple sites listed as population exposure. Because the Basin is non-attainment for PM2.5, most of the sites are in areas that experience poor air quality, therefore multiple sites are listed as population exposure and high concentration. All sites in the Network using FRM samplers are suitable for comparison against the annual PM2.5 NAAQS.

1.6.1.5 PM Coarse (PM10-2.5)

PM10-2.5 (PM Coarse) was previously required at NCore sites until the revision to 40 CFR Part 58 in 2016 (81 FR 17247, published 3/28/2016, effective 4/27/2016)[12], to match the 2013 PM NAAQS final rule. PM Coarse is derived from the continuous BAM PM10 and PM2.5 particulate monitors. South Coast AQMD continues to measure this optional parameter utilizing the continuous BAM monitors at the Los Angeles (Main) and Rubidoux air monitoring sites.

1.6.1.6 Nitrogen Dioxide (NO2)

The current South Coast AQMD NO2 network consists of 26 sites, including four near-road stations and one ambient station in the Coachella Valley. These sites are mostly located in areas of highest NO2 concentration. The spatial distribution of NO2 monitors is shown in Figure 1-8. The near-road sites are located adjacent to some of the most heavily traveled roadways identified in the Basin. Site selection took into consideration satisfying siting criteria, site logistics (e.g., gaining access to property and safety), and population exposure for those who live, work, play, go to school, or commute within the near-roadway environment. Additionally, the Regional Administrator identified 40 NO2 sites (RA 40 sites) nationwide with a primary focus on siting these monitors in locations to protect susceptible and vulnerable populations. The Regional Administrator in collaboration with South Coast AQMD identified the Los Angeles (Main), Compton, and San Bernardino sites from the existing area-wide monitoring network to meet this requirement (58.10[a][5]). NO2 data from 1992 through 2018 shows that the Basin, including the near-road monitors, and the Coachella Valley have remained in attainment of the NO2 NAAQS, as well as the state NO2 CAAQS.

[12] https://www.gpo.gov/fdsys/pkg/FR-2016-03-28/pdf/2016-06226.pdf

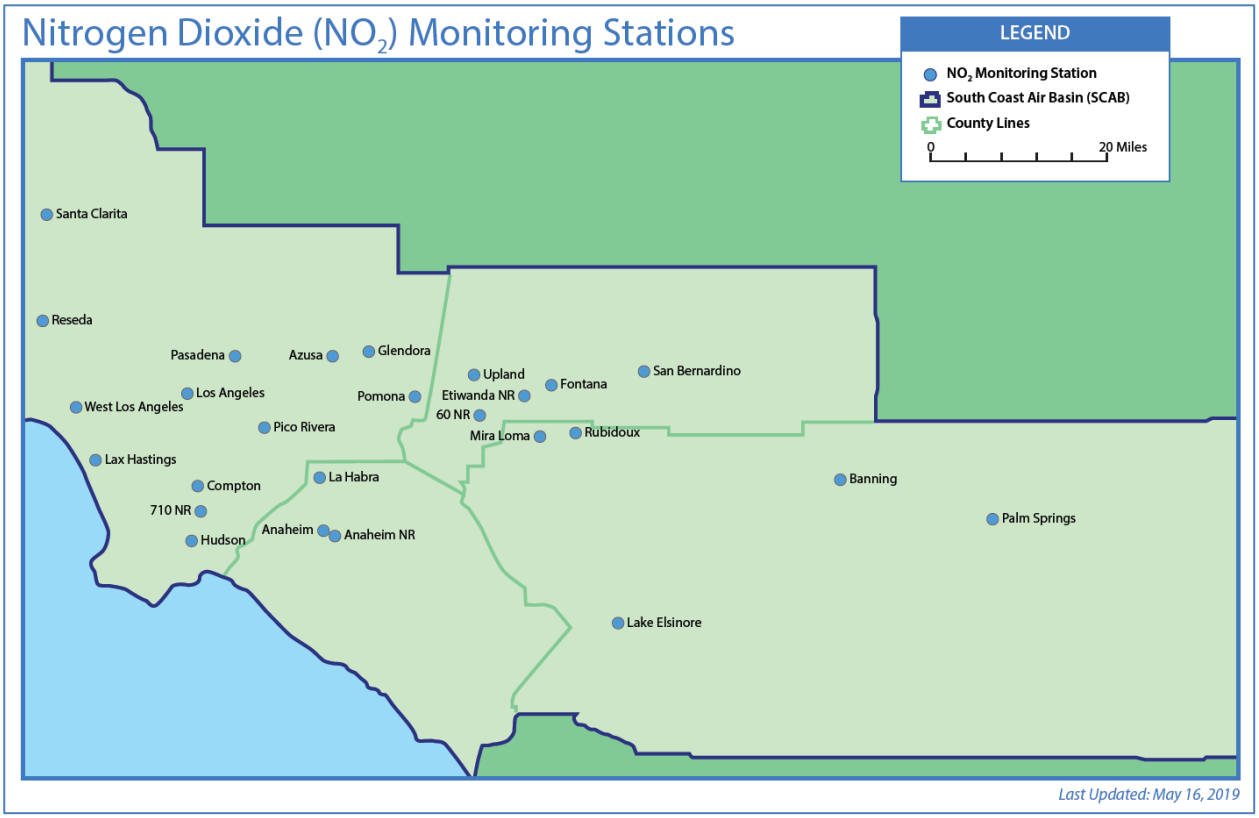


Figure 1-8
South Coast AQMD NO2 Air Monitoring Locations
[Note that NO2 near-road stations on the I-710 (labelled 710NR), CA-60 (60NR), I-5 (Anaheim NR), and I-10 (Etiwanda NR) are mapped]

1.6.1.7 Carbon Monoxide (CO)

Currently, South Coast AQMD measures CO at 24 locations, including one station in the Coachella Valley and two year-road monitors, as shown in Figure 1-9. CO emissions, primarily from motor vehicles, show a pattern consistent with major freeway arteries. The highest concentrations of CO continued to be recorded in the areas of Los Angeles County, where vehicular traffic is most dense, with the highest concentrations of CO recorded in the areas of Los Angeles County. All areas of the Basin have continued to remain below the CO NAAQS (35 ppm 1-hour and 9 ppm 8-hour) since 2003 and the Coachella Valley also has also remained in attainment of the NAAQS. The Basin and the Coachella Valley are also well below the State CO CAAQS (20 ppm 1-hour and 9.0 ppm 8-hour). The near-road sites also remain in attainment of the NAAQS and CAAQS.

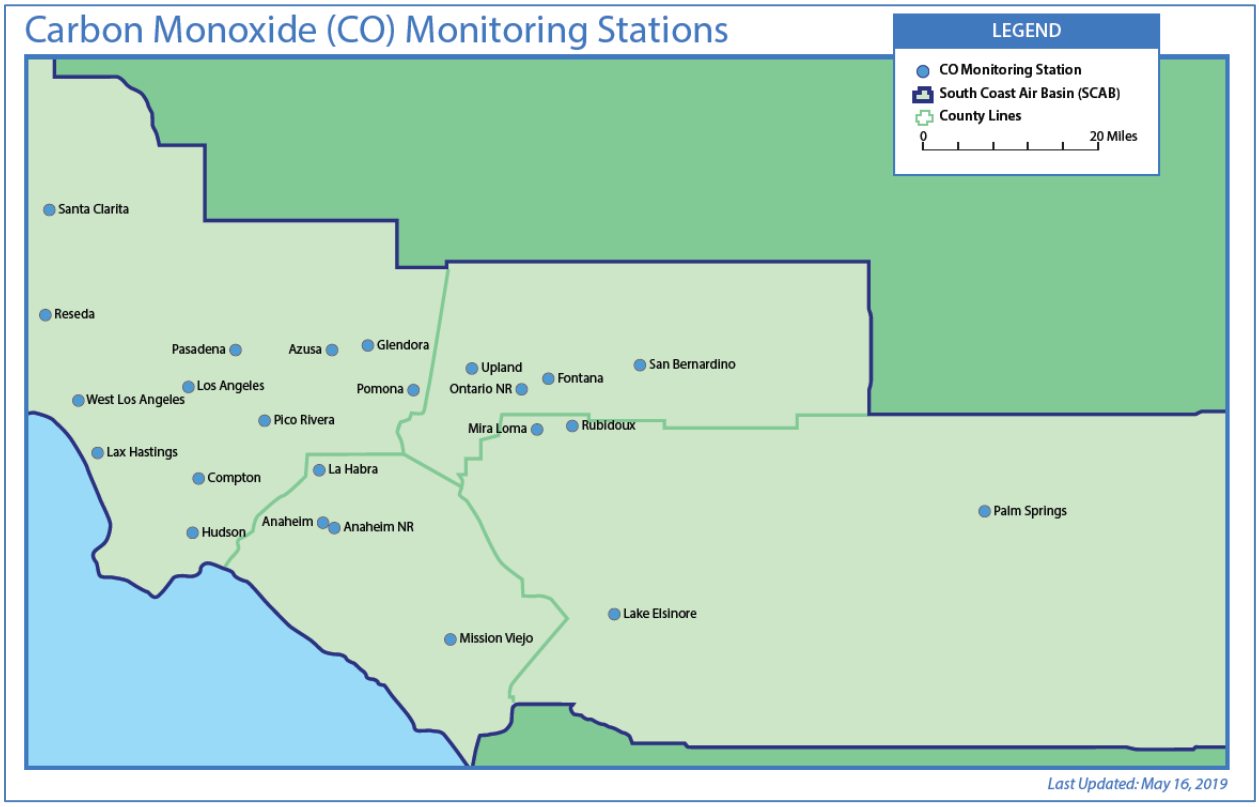


Figure 1-9
South Coast AQMD CO Air Monitoring Locations
[Note that the Costa Mesa ambient station was closed in 2017; near-road CO stations on the I-10 (labelled Ontario NR) and the I-5 (Anaheim NR) are mapped]

1.6.1.8 Sulfur Dioxide (SO2)

SO2 monitors are currently located at five sites, as shown in Figure 1-10. With the establishment of the 1-hour SO2 NAAQS (75 ppb) in 2010, the network design requirements included new minimum requirements be determined by the Population Weighted Emissions Index (PWEI). Based on this analysis, as described in the South Coast AQMD Annual Air Monitoring Network Plan, a minimum of one SO2 monitor is required for each Core Based Statistical Area (CBSA) in the Basin, so South Coast AQMD exceeds the minimum requirement for SO2 monitors. Most SO2 emissions come from transportation sources, such as marine vessels. The monitors are clustered mostly in the areas where these sources are located. No exceedances of federal or State standards for SO2 occurred in any recent year, at any of the six ambient monitoring locations in the Basin. SO2 has not been measured in the Coachella Valley in recent years. Historical measurements and source emission profiles show that expected SO2 concentrations in the Coachella Valley is well below State and federal standards.

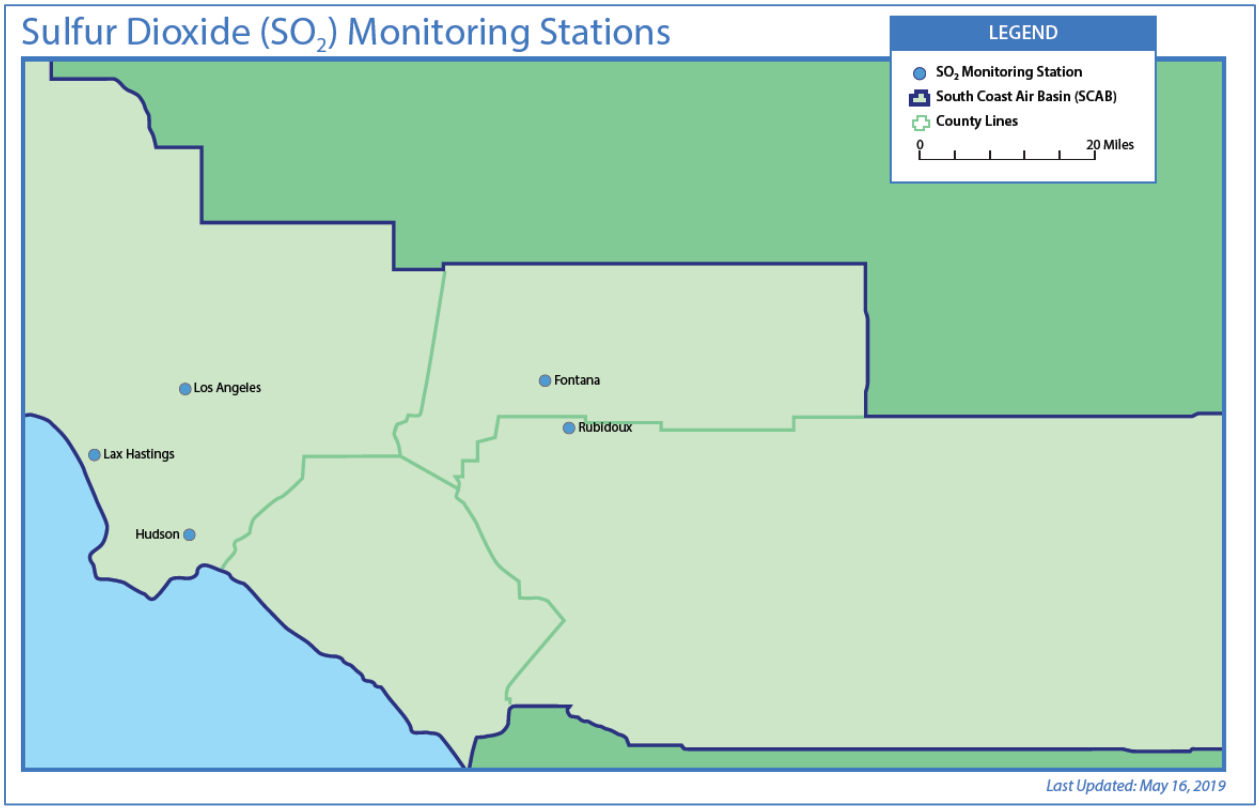


Figure 1-10
South Coast AQMD SO2 Air Monitoring Locations

1.6.1.9 Particulate Lead (Pb)

Lead (Pb), as analyzed from Total Suspended Particulate (TSP) samples, are collected using manual FRM monitors at 11 stations in the Basin, including four source-oriented sites[13], two NCore stations, and five ambient locations, as shown in Figure 1-11. Based on the review of the NAAQS for Pb, U.S. EPA established the current standard of 0.15 µg/m3 for a rolling 3-month average, effective October 15, 2008. There have been no violations of the Pb standards at the District's regular population-based ambient air monitoring stations since 1982, primarily as a result of removal of lead from gasoline. However, monitoring at two locations immediately adjacent to stationary sources of Pb (battery recycling facilities) recorded exceedances of the revised Pb NAAQS in Los Angeles County over the 2007-2009 time period. Since these data were used for designations under the revised standard that also included new

[13] U.S. EPA regulations require local agencies conduct ambient air Pb monitoring near Pb sources which are expected to or have been shown to contribute to a maximum Pb concentration in ambient air in excess of the NAAQS, taking into account the logistics and potential for population exposure. At a minimum, there must be one source-oriented SLAMS site located to measure the maximum Pb concentration in ambient air resulting from each non-airport Pb source which emits 0.50 or more tons per year and from each airport which emits 1.0 or more tons per year based the most recent National Emission Inventory (NEI). The most recent NEI data (https://www.epa.gov/air-emissions-inventories/national-emissions-inventory) shows no Basin non-airport Pb sources which emits 0.50 or more tons per year or any airports exceed the 1.0 tpy threshold requiring a monitoring plan.

requirements for near-source monitoring, a nonattainment designation was finalized for the Los Angeles County portion of the Basin when the current standard was implemented. While the near-source Pb measurements in Los Angeles County had violated the current NAAQS, there have been no further violations of the federal standard in the Basin beginning with the 2012-2014 design value period. South Coast AQMD has continued to operate source-oriented Pb sites surrounding the Exide (Vernon; facility now closed), Quemetco (Industry), and Trojan Battery facilities. South Coast AQMD meets the U.S. EPA Pb collocation requirements, as is described further in the South Coast AQMD Annual Air Monitoring Network Plan.

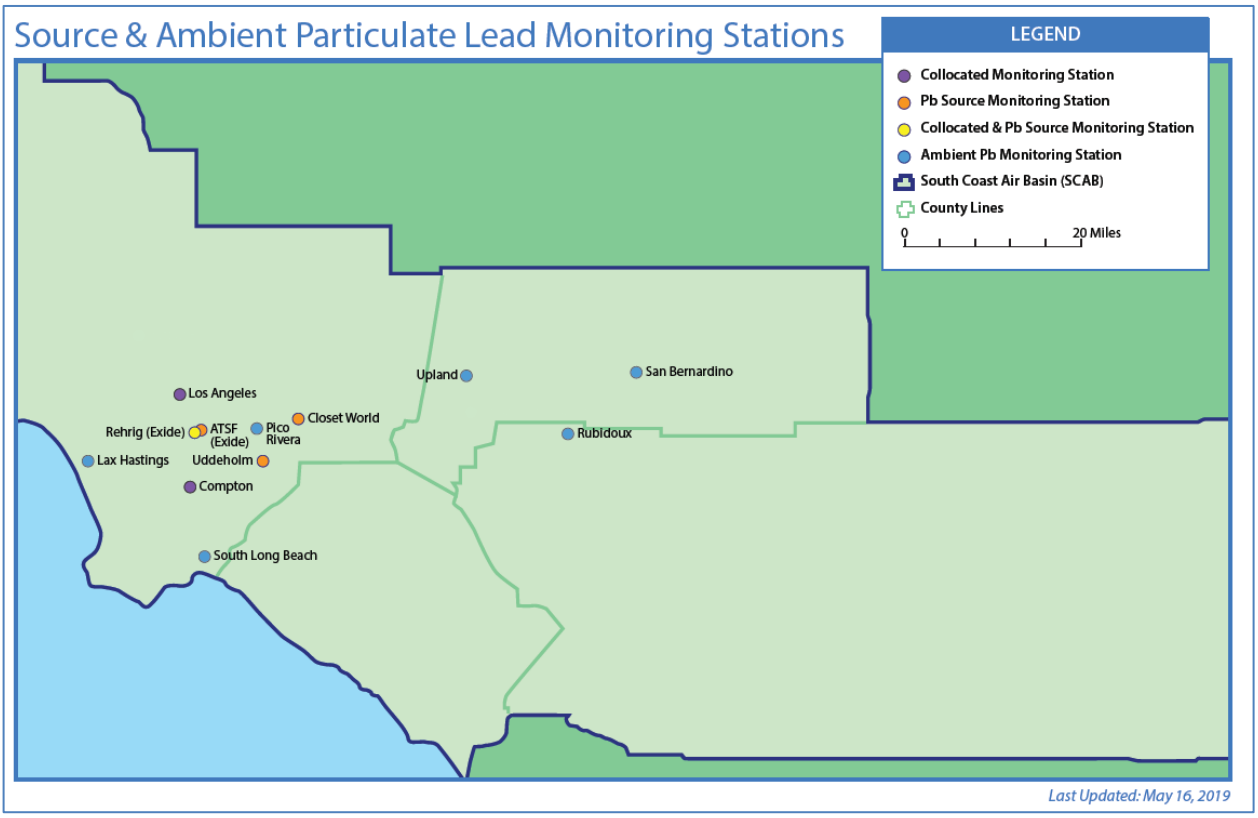


Figure 1-11
South Coast AQMD TSP-Pb Air Monitoring Locations

U.S. EPA regulation requires local agencies conduct ambient air Pb monitoring near Pb sources which are expected to or have been shown to contribute to a maximum Pb concentration in ambient air in excess of the NAAQS, taking into account the logistics and potential for population exposure. At a minimum, there must be one source-oriented SLAMS site located to measure the maximum Pb concentration in ambient air resulting from each non-airport Pb source which emits 0.50 or more tons per year (tpy) and from each airport which emits 1.0 or more tpy based the most recent National Emission Inventory (NEI). The most recent NEI data (https://www.epa.gov/air-emissions-inventories/national-emissions-inventory) shows no, non-

airport Pb sources which emits 0.50 or more tpy or any airports exceed the 1.0 tpy threshold requiring a monitoring plan. Although no source Pb monitoring is required based on NEI estimates, South Coast AQMD elected to continue operating source-oriented Pb sites near the closed Exide facility and the operating Quemetco and Trojan Battery facilities.

In 2016, U.S. EPA finalized a revision to the ambient air monitoring network design criteria, eliminating the requirement to monitor Pb at non-source oriented NCore sites (81 FR 17247, published 3/28/2016, effective 4/27/2016).[14] Currently the Los Angeles and Rubidoux NCore stations still monitor Pb, but future action may be taken to remove these monitors, in consultation with U.S. EPA.

1.7 Quality Objectives and Criteria for Measurement Data

1.7.1 Data Quality Objectives (DQOs)

Data quality objectives (DQOs) and acceptability criteria define factors critical for producing data of a known and acceptable quality for its intended use. The DQO process is a strategic planning approach used to prepare for a data collection activity in order to achieve data of adequate quality to support decision-making. The DQO process helps to ensure that the type, quantity, and quality of environmental monitoring data will be sufficient for the data's intended use, while simultaneously ensuring that resources are not wasted collecting unnecessary, redundant, or overly precise data. The formal DQO process consists of seven steps that allow an experimental design to be developed to meet specific decision criteria specified by stakeholders in the decision, as described in U.S. EPA QA/G-4, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (U.S. EPA, 2006a), and in Section 3 of the *Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. II, Ambient Air Quality Monitoring Program* (U.S. EPA, 2017a).

The DQO Process:

- establishes a common language to be shared by decision makers, technical personnel, and statisticians in their discussion of program objectives and data quality;
- provides a mechanism to pare down a multitude of objectives into major critical questions;
- facilitates the development of clear statements of program objectives and constraints that will optimize data collection plans; and
- provides a logical structure within which an iterative process of guidance, design, and feedback may be accomplished efficiently.

The seven steps of the DQO process are:

[14] Federal Register, Vol. 81, No. 59, March 28, 2016. [https://www.gpo.gov/fdsys/pkg/FR-2016-03-28/pdf/2016-06226.pdf]

1. **State the Problem** – define the problem that necessitates the study or monitoring; identify the planning team, examine the budget and the schedule;
2. **Identify the Goal** – state how environmental data will be used in meeting objectives and solving the problem, identify study questions, define alternative outcomes;
3. **Identify Information Inputs** – identify data and information needed to answer study questions;
4. **Define Boundaries** – specify the target population and characteristics of interest, define spatial and temporal limits, scale of inference;
5. **Develop the Analytical Approach** – define the parameter of interest, specify the type of inference, and develop the logic for drawing conclusions from findings;
6. **Specify Performance or Acceptance Criteria**
    - *Decision making (hypothesis testing)* – specify probability limits for false rejection and false acceptance decision errors;
    - *Estimation approaches* – develop performance criteria for new data being collected or acceptable criteria for existing data being considered for use;
7. **Develop the Plan for Obtaining Data** – select the resource-effective sampling and analysis plan that meets the performance criteria.

For the criteria air pollutants, a priority objective is to ensure that decision makers can make comparisons to the NAAQS within a specified degree of certainty. With the data quality needed for NAAQS evaluation, South Coast AQMD can sufficiently support both timely data reporting and research goals. For the collection of criteria pollutant data by South Coast AQMD for regulatory decision-making purposes, the quantitative DQOs can be found in *40 CFR Part 58, Appendix A, Section 2.3*. These regulatory criteria establish the allowable measurement uncertainty and decision rate error in the collected data sets.

1.7.1.1 State Problem

Criteria pollutants can impact human health and the environment. U.S. EPA established the NAAQS as the levels that ensure adequate protection. The South Coast AQMD attainment status of the gaseous NAAQS is determined for the criteria pollutants by comparing monitoring results for the design value form of the applicable NAAQS, as specified in *40 CFR Part 50* and shown previously in Section 1.5, Table 1-7. U.S. EPA uses a formal process to designate South Coast AQMD as attainment, nonattainment, or unclassifiable for the criteria pollutants, which includes reviewing the recommendations made by South Coast AQMD, the State of California, and the monitoring data. The attainment determination may impact activities related to the regulation of the particular pollutant and related emissions sources.

Criteria pollutant data also used for trend analyses, to assess the effects of national, state, and local emission control programs and to assess population-weighted exposure to levels above the NAAQS. This data is used to inform and evaluate air quality modeling, both for source permitting and regional planning purposes, including the development of the AQMP and

associated control strategies. In addition to the federal program needs, criterial pollutant data are used to track progress with respect to the CAAQS.

1.7.1.2 Identify Goal

The primary goal of the South Coast AQMD criteria air pollutant monitoring program is to provide a basis for decision makers to make comparisons to the NAAQS within a specified degree of certainty. Monitoring is performed to provide data of sufficient quantity and quality to determine the NAAQS attainment/nonattainment status and progress, particularly for the criteria pollutants for which South Coast AQMD is not in attainment in the Basin (1-hour and 8-hour O3 and annual and 24-hour average PM2.5) and in the Coachella Valley (1-hour and 8-hour O3 and 24-hour average PM10 (shown in Section 1.5, Tables 1-5 and 1-6 for the Basin and the Coachella Valley, respectively). Other decisions include informational uses and the timely declaration and dissemination of public air pollution data and health advisories, alerts, warnings, or emergency conditions, as well triggering the implementing of air pollution abatement actions. Criteria pollutant data also supports air pollution research and, in some cases, this data may also inform compliance enforcement actions.

1.7.1.3 Identify Information Inputs

Information inputs required for the decisions specific to the NAAQS include:

- Annual Monitoring Network Plan that demonstrates the monitoring network meets the requirements of 40 CFR Part 58;
- Three years of one-hour average of continuous gaseous pollutant (O3, NO2, CO, SO2) monitoring data;
- Three-year average of the 4th highest daily maximum 8-hour average O3 value for each O3 monitoring site;
- Fourth highest daily maximum 1-hour O3 in a 3-year period for each O3 monitoring site;
- Annual average NO2 value for a 3-year period for each NO2 monitoring site;
- Annual 98th percentile daily maximum NO2 value averaged over three years for each monitoring site;
- Annual 2nd highest daily maximum 1-hour and 8-hour CO levels for each monitoring site;
- Annual 99th percentile daily maximum 1-hour SO2 value averaged over three years for each monitoring site;
- Three years of annual arithmetic mean (average of 4 quarterly averages) PM2.5 values for each PM2.5 monitoring site;
- The 3-year average of annual 98th percentile 24-hour average PM2.5 mass concentration values recorded at each eligible monitoring site;
- Fourth highest daily 24-hour PM10 in a 3-year period for each PM10 monitoring site;

- Rolling 3-month average Pb values.

Non-NAAQS related inputs that affect the design and function of the network include:

- Point-source or regional air pollutant modeling requirements and objectives;
- Air pollutant distribution and temporal changes;
- Air pollution history and trends;
- Annual and real-time reporting of air quality data to the public;
- Meteorology;
- Topography;
- Budget and staffing;
- Maintenance Plan and State Implementation Plan (SIP) requirements;
- South Coast AQMD rule requirements (including, but not limited to Rules 403, 403.1, 444, 445, 701);
- Timely and reasonable real-time data reporting;
- Community feedback.

1.7.1.4 Define Boundaries

The geographic study boundary is defined as the area under the jurisdiction of South Coast AQMD, including the South Coast Air Basin and the Riverside County portion of the Salton Sea Air Basin (primarily the Coachella Valley). The South Coast AQMD jurisdictional boundary encompasses large portions of two MSAs as defined by the U.S. Office of Management and Budget and the U.S. Census Bureau. The Los Angeles-Long Beach-Anaheim CA MSA (Code 31080) had an estimated population[15] of 13,291,486 and the Riverside-San Bernardino-Ontario MSA\CBSA (Code 40140) has an estimated population of 4,622,361 based on the 2018 U.S. Census estimates. The South Coast AQMD air monitoring network, along with its representativeness is further discussed in the South Coast AQMD Annual Air Monitoring Network Plan (South Coast AQMD, 2019 – or latest version).

The temporal boundaries for criteria pollutant NAAQS decisions, as listed above in Section *1.7.1.3 Identify Information Inputs*, include the need for a minimum of three years of adequately complete data meeting the NAAQS at representative stations for an attainment decision and, typically, a minimum of 10 years of data meeting the NAAQS to demonstrate maintenance of an attainment decision. South Coast AQMD air pollution issues are considered to be year-round, including for ozone, requiring measurements all year. Real-time reporting of air quality to the public generally requires continuous, hourly data with adequate spatial to

[15] Source: https://factfinder.census.gov/faces/nav/jsf/pages/download_center.xhtml

calculate representative Air Quality Index values, using the U.S. EPA approved methodology as included in NAAQS rulemakings or in U.S. EPA guidance.

1.7.1.5 Develop the Analytical Approach

NAAQS Related Decisions

Non-attainment is determined if the information input for a specific pollutant exceeds the acceptable level in the NAAQS (Table 1-7). If the monitoring data for the gaseous NAAQS show that South Coast AQMD is non-attainment for a specific NAAQS, then U.S. EPA will designate the South Coast AQMD, or a portion thereof, as non-attainment for that NAAQS. If the South Coast AQMD is designated as non-attainment for one of the NAAQS, then the South Coast AQMD is required to prepare and submit a course of action in a Non-Attainment Plan (NAP) or AQMP submitted to the U.S. EPA, constituting a portion of the SIP that demonstrates how the South Coast AQMD will attain the specified NAAQS by the required attainment date.

Attainment status is determined if the information input for a specific pollutant is less than or equal to the acceptable level in the NAAQS (Table 1-7). If the South Coast AQMD is designated as attainment for one of the NAAQS, then the South Coast AQMD is likely to be required to prepare and submit a maintenance plan or specify in the AQMP submitted to the U.S. EPA that demonstrates how the South Coast AQMD will remain in attainment with the specified NAAQS.

NAAQS related decisions require a determination that the criteria air monitoring data meet regulatory requirements and are scientifically valid for the intended purposes. South Coast AQMD follows federal requirements and guidelines to ensure this quality data, including meeting minimum data completeness, network density and collocation requirements, sufficient quality control checks and performance audits, an adequate multi-level data validation and certification process to assert that the data are scientifically valid. The *U.S. EPA QA Handbook, Volume II, Appendix D* (U.S. EPA, 2017b) summarizes three levels of criteria for sampling: Critical Criteria, Operational Criteria, and Systematic Criteria. Critical criteria are those for which observations that do not meet each and every criterion should be invalidated unless there are documented compelling reasons and justification for not doing so. Examples of critical criteria include using monitors that meet FRM/FEM/ARM designation requirements, filter holding times and sampling and weighing parameters, and one-point QC check and zero/span check thresholds for gaseous monitoring.

Operational criteria are those that are important for maintaining and evaluation the quality of the data collection system. Violation of an operational criterion or number of criteria may be cause for invalidation. The decision maker should consider other quality control information that may or may not indicate the data are acceptable. The sample or group of samples for which one or more of the operational criteria are not met are suspect unless other quality control information demonstrates otherwise and is documented. The reason for not meeting the criteria must be investigated, mitigated or justified. Examples of operational criteria include requirements for shelter temperature ranges, performance evaluations and federal audits (NPAP), verification and calibration, zero air checks, standard certification, collocated

sampling, monitor maintenance, filter and lab QC checks (e.g., blanks, re-weighing, and lab environmental checks, verifications and calibrations)

Systematic criteria are those that are important for the correct interpretation of the data, but that do not usually impact the validity of a sample or group of samples. Violation of a minimum of 75 percent completeness per calendar quarter is an indicator of whether there is sufficient data for NAAQS determination, in most cases. For O3 NAAQS determinations, data completeness must meet a 90 percent systematic criteria for the valid daily maximum 8-hour averages during the ozone season, with a minimum of 75 percent completeness in any one year. If there is not sufficient data to determine attainment status of South Coast AQMD for a specified NAAQS, then the U.S. EPA may designate the South Coast AQMD as unclassifiable for the specified NAAQS, and the South Coast AQMD could be required to collect more data. Poor data completeness would trigger an action for determining the cause of the low completion and addressing any findings to improve completion percentages.

Determining whether data meets regulatory requirements, for scientific and legal validity, relevance, accuracy, precision, completeness and comparability is a critical activity governing the ability to make NAAQS-related decisions. This is accomplished through the process of data review, validation and ultimate certification as described further in Section 3.

Non-NAAQS Related Decisions

Non-NAAQS related actionable results may include:

- Alerting the public when levels of pollutants impact regional air quality
  - Air pollution emergency contingency actions (Rule 701)
    - Health Advisory, Stage 1, 2 or 3 (South Coast AQMD Rule 701, Air Pollution Emergency Contingency Actions)
  - Advisories (based on imminent or occurring conditions):
    - Smoke Advisories
    - Windblown dust advisories
      - South Coast Air Basin
      - Coachella Valley (associated with Rule 403.1 high wind and windblown dust forecasts)
    - Windblown Ash Advisories
  - Air Alerts: Public air pollution alerts based upon measured real-time AQI thresholds over 100 (Unhealthy for Sensitive Groups, or above)
- Air Quality Forecasts (forecasts rely on current and historical air monitoring data)
  - Criteria pollutant concentration and AQI forecasts
  - Residential wood burning restrictions (Rule 445 Check Before You Burn program)
  - Open burning restrictions (agricultural and prescribed burning – Rule 444)
  - Coachella Valley high wind and windblown dust forecasts (Rule 403.1)
- Public outreach mechanisms (forecasts, advisories, and current air quality conditions):

  - South Coast AQMD web maps and on-line data
  - U.S. EPA AirNow web maps and data
  - CARB web maps and data
  - Cellular phone applications
  - Email, social media and FAX-based forecasts and alerts (South Coast AQMD AirAlerts/U.S. EPA EnviroFlash, twitter, etc.)
  - Interactive Voice Response (IVR) automated telephone system
  - Media outreach
  - School flag program
- Identifying potential sources of pollutants
  - Source apportionment
  - Emissions inventory reconciliation
  - Inform rule development
  - Inform Compliance & Enforcement activities

As with NAAQS-related decisions, determining whether data meets programmatic requirements, for scientific and legal validity, relevance, accuracy, precision, completeness and comparability is a critical activity governing the ability to make decisions based upon the data for its intended use. This is accomplished through the process of data review, validation and, as appropriate, certification as described further in Section 3.

1.7.1.6 Specify Performance or Acceptance Criteria

For NAAQS comparison purposes and South Coast AQMD planning purposes that use criteria air pollutant data (i.e., SIP modeling, trends analysis, etc.), South Coast AQMD uses the following acceptable limits for measurement uncertainty, as specified in the QA Handbook Volume II, Appendix D (U.S. EPA, 2017b):

- **O3:** an upper 90 percent confidence limit for the coefficient of variation (CV) of less than 7.1 percent for precision and an upper 95 percent confidence limit of less than ±7.1 percent for bias (using 1-point QC checks).
- **CO and SO2:** an upper 90 percent confidence limit for the CV of less than 10.1 percent for precision and an upper 95 percent confidence limit of less than ±10.1 percent for bias (using 1-point QC checks).
- **NO2:** an upper 90 percent confidence limit for the CV of less than 15.1 percent for precision and an upper 95 percent confidence limit of less than ± 15.1 percent for bias (using 1-point QC checks).
- **Manual PM2.5:** CV less than 10.1 percent for precision for values ≥ 3.0 $\mu g/m^3$ (based on collocation) and less than ±10.1 percent for values ≥ 3.0 $\mu g/m^3$ for bias (based on Performance Evaluation Program, PEP, audits).

- **Continuous PM2.5:** CV of less than 10.1 percent for values ≥ 3.0 μg/m^3 (based on collocation) for precision and an upper 95 percent confidence limit of less than ±10.1 percent for values ≥ 3.0 μg/m^3 (based on PEP audits) for bias.
- **Manual PM10 (Hi-Vol):** CV of less than 10.1 percent for values ≥ 15 μg/m^3 for precision.
- **TSP-Pb:** as an upper 90 percent confidence limit for the CV of less than 20.1 percent for values ≥ 0.02 μg/m^3 for precision and an upper 95 percent confidence limit for the bias of less than ±15.1 percent for values ≥ 0.02 μg/m^3 for bias (based on PEP audits).

For non-NAAQS objectives that are on shorter timescales for reporting such as forecasting and alerts, the tolerances are based upon balancing data reporting time frames and control checks that are capable of being done in that time frame. Therefore, the uncertainty is defined by a subset of quality control checks presented in Section 2.2 that can be conducted in real time. There are many automatic quality control checks as well as threshold concentrations that alert MN and QA Branch staff to check the instrumentation to ensure proper operation. These thresholds are based on station location and parameter. Additional measures include comparing to historical air data for season and location and if data look unusual from historical comparisons and current expectations, to investigate the data further. In addition to the checks for normal range of data, automated screening may include checks for sticking values, rate of change, and other tests for proper instrument operation, including automated QC checks, and instrument codes and alarms, leading to flagging of the data for further assessment.

1.7.1.7 Develop the Plan for Obtaining Data

The primary design objectives of the South Coast AQMD criteria pollutant monitoring network is to meet the three basic U.S. EPA air monitoring objectives as found in *40 CFR Part 58 Appendix D, Network Design Criteria for Ambient Air Quality Monitoring*:[16]

- Support compliance with ambient air quality standards and emissions strategy development. Data from FRM, FEM, and ARM monitors for NAAQS pollutants will be used for comparing an area's air pollution levels against the NAAQS. Data from monitors of various types can be used in the development of attainment and maintenance plans. Data will be used to evaluate the regional air quality models used in developing emission strategies, and to track trends in air pollution abatement control measures' impact on improving air quality. In monitoring locations near major air pollution sources, source-oriented monitoring data can provide insight into how well industrial sources are controlling their pollutant emissions.
- Provide air pollution data to the general public in a timely manner. Data can be presented to the public through air quality maps, newspapers, internet sites, smartphone application, and as part of forecasts and public advisories.

[16] 40 CFR Part 58, Appendix D. [https://www.ecfr.gov/cgi-bin/retrieveECFR?n=40y6.0.1.1.6#ap40.6.58_161.ahttps://www.law.cornell.edu/cfr/text/40/appendix-D_to_part_58]

- Support for air pollution research studies. Air pollution data network can be used to supplement data collected by researchers working on health effects assessments and atmospheric processes, or for monitoring methods development work.

In order to support the air quality management work indicated in the basic air monitoring objectives, a network must be designed with a variety of types of monitoring sites. These sites must be capable of informing managers about many things including the peak air pollution levels, typical levels in populated areas, air pollution transported into and outside of a city or region, and air pollution levels near specific sources. Criteria pollutant air monitoring networks generally fall into one or more of the following site types:

1. Sites located to determine the highest concentrations expected to occur in the area covered by the network.
2. Sites located to measure typical concentrations in areas of high population density.
3. Sites located to determine the impact of significant sources or source categories on air quality.
4. Sites located to determine general background concentration levels.
5. Sites located to determine the extent of regional pollutant transport among populated areas; and in support of secondary standards.
6. Sites located to measure air pollution impacts on visibility, vegetation damage, or other welfare-based impacts.

Network design also considers impending decisions which may be based upon the data with higher priority measurements receiving quality control that meets or exceeds the federal requirements, such as design value sites for pollutants that have an ambient concentration near the NAAQS, such as PM2.5 in the Basin. South Coast AQMD optimizes quality control and quality assurance criteria as outlined in the *Quality Assurance Handbook Volume II, Appendix D* (U.S. EPA, 2017b) and is detailed further in Chapters 2 through 5. Planning for the criteria pollutant network design is addressed and shared with U.S. EPA Region 9 through the 5-Year Network Assessment and changes that occur are included in each Annual Network Plan (ANP).

South Coast AQMD establishes local DQOs based upon the federal data quality requirements if the objective is intended that the data be comparable to the NAAQS. This may mean that other objectives, including those with less stringent requirements, may still meet the requirements for the NAAQS where applicable. This ensures that decision makers could make comparisons to the NAAQS within the required certainty of the measurements if intended. Design considerations such as pollutant attainment status, projected pollutant attainment designation, proximity of the ambient concentrations to the NAAQS, instrument reliability, and special studies objectives may affect the level of data quality practices above the requirements for criteria pollutant measurements.

Other air monitoring objectives not related to the criteria pollutants require different DQOs and are beyond the scope of this document. However, other South Coast AQMD QAPPs may address those other DQOs, especially if related to other federal programs such as PM2.5 Speciation, NATTS, PAMS, and NCORE. If the objectives do not match any of the federal programs, then it may be addressed in the Special Monitoring Projects QAPP.

1.7.2 Data Quality Indicators (DQIs)

Data quality indicators (DQIs) describe the general framework for ensuring that network data are of known and documented quality and available in a timely manner to meet the DQOs. They are quantitative (i.e., calculated statistics) and qualitative characteristics associated with quality of the collected data. These indicators include precision, accuracy/bias, completeness, representativeness, sensitivity, comparability, and other related criteria. This section contains detailed descriptions for criteria pollutant DQIs including applicable formulae for determination of DQIs. U.S. EPA provides assessments of data quality for the criteria pollutants aggregated by site and PQAO. The DQIs are calculated in reports from the U.S. EPA Air Quality System (AQS) database, including AMP600, AMP255, AMP430, AMP450, and others. South Coast AQMD reviews DQI data statistics each quarter for data validation and QA oversight assessments, as well as annually as part of the validation and QA certification processes. Table 1-11 shows the data quality indicators calculated for each measured criteria air pollutant.

Table 1-11
Data Quality Indicators Calculated for Criteria Air Pollutants

Pollutant	Gaseous Assessments (Precision or Bias)	One-Point Flow Rate Bias Estimate	PM2.5 Bias	Semi-Annual Flow Rate Audits	Precision Estimate from Collocated Samples	Lead Bias	Data Completeness
O3	Precision Estimate/ Bias Estimate						Percent Complete
SO2	Precision Estimate/ Bias Estimate						Percent Complete
NO2	Precision Estimate/ Bias Estimate						Percent Complete
CO	Precision Estimate/ Bias Estimate						Percent Complete
PM2.5		One-Point Flow Rate	Bias Estimate, including PEP	Semi-Annual Flow Rate	Precision Estimate		Percent Complete
PM10		One-Point Flow Rate		Semi-Annual Flow Rate	Precision Estimate		Percent Complete
Lead				Semi-Annual Flow Rate		Precision Estimate/ Bias Estimate	Percent Complete

1.7.2.1 Precision and Accuracy/Bias

Precision is a quantitative measure of how reproduceable the data are. Accuracy/bias is a quantitative measure of how well the measurements reflect what is actually in the sample. The following subsections, describe the calculation of statistics used to assess precision and bias, as adapted from *40 CFR Part 58 Appendix A (Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards), Section 4* and further details can be found in the *U.S. EPA Guideline on the Meaning and the Use of Precision and Bias Data Required by 40 CFR Part 58 Appendix A* (U.S. EPA, 2007c).

1.7.2.1.1 Statistics for Assessment of QC Checks for Gaseous Pollutants

Precision and bias estimates are based on 1-point QC checks for SO2, NO2, O3 and CO. The bias estimates are validated using the annual performance evaluations (audits). Precision is defined as a measure of mutual agreement among individual measurements of the same property usually under prescribed similar conditions, expressed generally in terms

of the standard deviation. Precision checks are performed by challenging an analyzer with a known concentration of gas from an on-site gas dilution calibrator or transfer standard or by challenging other equipment with a standard or reference material.

Percent Difference

Many of the measurement quality checks start with a comparison of an audit concentration or value (flow rate) to the concentration/value measured by the monitor and use percent difference as the comparison statistic as described in Equation 1. For each single point check, calculate the percent difference, d_i, as follows:

Equation 1

$$d_i = \frac{meas - audit}{audit} \cdot 100$$

where *meas* is the concentration indicated by the PQAO's instrument and *audit* is the audit concentration of the standard used in the QC check being measured.

For the purposes of this QAPP and the measurement of criteria air pollutants, the analyzer or other equipment must respond within the criteria listed in the U.S. EPA Quality Assurance Handbook, Volume II, Appendix D – Validation Tables and shown Section 2 of this QAPP. South Coast AQMD performs zero and precision checks daily and span checks weekly on the continuous gaseous instruments. The South Coast AQMD Laboratory also performs analytic instrument precision checks per batch for discrete sample analyses.

The precision percent differences for the performance evaluations, calculated using Equation 1, can be compared to the probability intervals for the respective site or at the primary quality assurance organization level. Ninety-five percent of the individual percent differences (all audit concentration levels) for the performance evaluations should be captured within the probability intervals for the primary quality assurance organization.

Precision Estimate

The precision estimate is used to assess the one-point quality control (QC) checks for SO2, NO2, O3, or CO described in Section 3.1.1 of Appendix A to 40 CFR Part 58. The precision estimator is the coefficient of variation upper bound and is calculated using Equation 2:

Equation 2

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

where *n* is the number of single point checks being aggregated; $X^{20.1,n-1}$ is the 10th percentile of a chi-squared distribution with n-1 degrees of freedom.

Bias Estimate

The bias estimate is calculated using the one-point QC checks for SO2, NO2, O3, or CO described in Section 3.1.1 of Appendix A to 40 CFR Part 58. The bias estimator is an upper bound on the mean absolute value of the percent differences as described in Equation 3:

Equation 3

$$|bias| = AB + t_{0.95,n-1} \cdot \frac{AS}{\sqrt{n}}$$

Equation 4

$$AB = \frac{1}{n} \cdot \sum_{i=1}^{n} |d_i|$$

where *n* is the number of single point checks being aggregated; $t^{0.95,n-1}$ is the 95th quantile of a t-distribution with n-1 degrees of freedom; the quantity *AB* is the mean of the absolute values of the d_i's and is calculated using Equation 4:

and the quantity *AS* is the standard deviation of the absolute value of the *d*i ′ s and is calculated using Equation 5:

Equation 5

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

Assigning a Sign (positive/negative) to the Bias Estimate

Since the bias statistic as calculated in Equation 3 uses absolute values, it does not have a tendency (negative or positive bias) associated with it. A sign will be designated by rank ordering the percent differences of the QC check samples from a given site for a particular assessment interval.

Calculating the 25th and 75th Percentiles of the Percent Differences for Each Site

The absolute bias upper bound should be flagged as positive if both percentiles are positive and negative if both percentiles are negative. The absolute bias upper bound would not be flagged if the 25th and 75th percentiles are of different signs.

1.7.2.1.2 Statistics for Assessment of PM10, PM2.5, and Pb

Collocated Quality Control Sampler Precision Estimate for PM10, PM2.5, and Pb

Precision is estimated via duplicate measurements from collocated samplers. South Coast AQMD generally follows the U.S. EPA recommendation that the precision be aggregated at the PQAO level quarterly, annually, and at the 3-year level. The data pair would only be considered valid if both concentrations are greater than or equal to the minimum values specified in section 4(c) of 40 CFR Part 58, Appendix A, which states:

> *At low concentrations, agreement between the measurements of collocated quality control samplers, expressed as relative percent difference or percent difference, may be relatively poor. For this reason, collocated measurement pairs are selected for use in the precision and bias calculations only when both measurements are equal to or above the following limits:*

- Pb: 0.002 µg/m^3 (Methods approved after 3/04/2010, with exception of manual equivalent method EQLA-0813-803).
- Pb: 0.02 µg/m^3 (Methods approved before 3/04/2010, and manual equivalent method EQLA-0813-803).
- PM10 (Hi-Vol): 15 µg/m^3
- PM10 (Lo-Vol): 3.0 µg/m^3
- PM2.5: 3 µg/m^3

For each collocated data pair, calculate the relative percent difference, d_i, using Equation 6, as follows:

Equation 6

$$d_i = \frac{X_i - Y_i}{(X_i + Y_i)/2} \cdot 100$$

where X_i is the concentration from the primary sampler and Y_i is the concentration value from the audit sampler. The coefficient of variation upper bound is calculated using Equation 7:

Equation 7

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

where *n* is the number of valid data pairs being aggregated, and $X^{20.1,n-1}$ is the 10th percentile of a chi-squared distribution with n-1 degrees of freedom. The factor of 2 in the denominator adjusts for the fact that each d_i is calculated from two values with error.

One-Point Flow Rate Verification Bias Estimate for PM10, PM2.5, and Pb

For each one-point flow rate verification, calculate the percent difference in volume using Equation 1 (Section 1.7.2.1.1) where *meas* is the value indicated by the sampler's volume measurement and *audit* is the actual volume indicated by the auditing flow meter. The absolute volume bias upper bound is then calculated using Equation 3 (Section 1.7.2.1.3), where *n* is the number of flow rate audits being aggregated; $t^{0.95,n-1}$ is the 95th quantile of a t-distribution with n-1 degrees of freedom, the quantity *AB* is the mean of the absolute values of the d_i's and is calculated using Equation 4, and the quantity *AS* in Equation 3 is the standard deviation of the absolute values if the d_i's and is calculated using Equation 5.

Semi-Annual Flow Rate Audit Bias Estimate forPM10, PM2.5 and Pb

Use the same procedure described in Section 1.7.2.2.2 for the evaluation of flow rate audits.

Performance Evaluation Programs Bias Estimate for Pb

The Pb bias estimate is calculated using the paired routine and the PEP monitor as described in Section 3.4.7 of 40 CFR Part 58 Appendix A, as an independent assessment to estimate total system bias. Use the same Bias Estimate calculation procedures as described previously in Section 1.7.2.1.3 for the calculations to evaluate bias between the primary Pb monitor and the NPEP audit performance evaluation monitor.

Performance Evaluation Programs Bias Estimate for PM2.5

The bias estimate is calculated using the PEP audits using the Bias Estimate calculation described in Section 1.7.2.1.3. The bias estimator is based on the mean percent differences (Equation 1). The mean percent difference, D, is calculated by Equation 8 below.

Equation 8

$$D = \frac{1}{n_j} \cdot \sum_{i=1}^{n_j} d_i$$

where n_j is the number of pairs and d_1, d_2, ...d_{nj} are the biases for each pair to be averaged.

Pb Audit Bias Estimate

The bias estimate is calculated using the Pb analysis audit data described in Section 3.4.6 of 40 CFR Part 58 Appendix A. Each calendar quarter, the Pb reference or equivalent method analytical procedure is audited using filters containing known quantities of Pb in specified ranges. Use the same bias estimate procedure as described above in Section 1.7.2.1.3.

1.7.2.2 Completeness

Completeness, as defined for South Coast AQMD under this program, is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected for scheduled sampling. The minimum valid data recovery objective for the Criteria Pollutant Monitoring Program is greater than or equal to 75%. Typical good performance is 90%. The calculation of percent completeness is based on the number of valid measurements as compared to the number of possible measurements, as shown in Equation 9.

Equation 9

$$C = \frac{V}{P} * 100\%$$

where:

C = % completeness;
V = valid measurements; and
P = scheduled samples.

1.7.2.3 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. Temperature control of samples transported to the lab is an example of ensuring the representativeness of those samples. Spatial scales of representativeness are described in terms of the physical dimensions of the air parcel nearest to a monitoring site throughout which actual pollutant concentrations are reasonably similar, as follows (*40 CFR Part 58, Appendix D*):

1. ***Microscale*** — Defines the concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters;
2. ***Middle scale*** — Defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometer;

3. ***Neighborhood scale*** — Defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range. The neighborhood and urban scales listed below have the potential to overlap in applications that concern secondarily formed or homogeneously distributed air pollutants;
4. ***Urban scale*** — Defines concentrations within an area of city-like dimensions, on the order of 4 to 50 kilometers. Within a city, the geographic placement of sources may result in there being no single site that can be said to represent air quality on an urban scale;
5. ***Regional scale*** — Defines usually a rural area of reasonably homogeneous geography without large sources, and extends from tens to hundreds of kilometers;
6. ***National and global scales*** — These measurement scales represent concentrations characterizing the nation and the globe as a whole.

The general relationship between the various site types that can be used to support the basic criteria pollutant monitoring objectives and the scales of representativeness are presented in Table 1-12.

Table 1-12
General Relationship between Site Types and Scales of Representativeness

Site Type	Appropriate Siting Scales
1. Highest concentration	Micro, middle, neighborhood (*sometimes* urban or regional for secondarily formed pollutants).
2. Population oriented	Neighborhood, urban.
3. Source impact	Micro, middle, neighborhood.
4. General/background & regional transport	Urban, regional.
5. Welfare-related impacts	Urban, regional.

Historical data and modeling studies are used to establish the representativeness of monitoring for criteria pollutants based upon an expectation that measurements will be similar throughout a geographical area. Many stations in the air monitoring network do not necessarily indicate the highest concentrations in the area for a particular pollutant. Due to the secondary formation processes involved in the ozone and PM air quality in Southern California, a variety of siting scales apply to the various measurements within the South Coast AQMD air monitoring network.

To achieve the criteria pollutant data representativeness data quality objective, siting assessments are conducted periodically. The first representativeness assessment was performed in 1980 when South Coast AQMD along with CARB, conducted an extensive

review of the air monitoring sites in the Basin. NAMS or SLAMS designations, monitoring objectives, and spatial scales of representativeness were assigned to the criteria pollutants monitored by site. South Coast AQMD, U.S. EPA Region 9 and CARB staff continue to periodically evaluate all sites with respect to compliance with applicable siting criteria, representativeness of collected data, and related requirements in the five-year network assessment. In addition, South Coast AQMD conducts an annual evaluation including the continued representativeness of data collected by the air monitoring network, and reports evaluation results to U.S. EPA through the ANP (South Coast AQMD, 2019).[17]

1.7.2.4 Comparability

Comparability is a qualitative measure of the confidence with which one data set or method can be compared to another. It addresses how similar the data should be compared to data from other studies or from similar locations of the same study or even the same sampling location at different times of the year. Siting, equipment specifications, adopted monitoring protocols, and validation and reporting procedures are consistent at criteria pollutant monitoring sites throughout the network and follow U.S. EPA national siting guidelines and requirements. South Coast AQMD ANP and the 5-year Network Assessment evaluate appropriateness of station siting with regard to monitoring needs and data comparability. Also, annual review of documentation and training confirms requirements are being followed and that program updates are incorporated. Some other examples of criteria pollutant program components that ensure comparability include: certification of and traceability to the same standards; audit programs with independent QA staff; consistent training, documentation and data reporting requirements; and program-focused work groups within the same reporting chain. Ensuring comparability requires that data be reported in standard units. Continuous monitoring data are reviewed by the MN Branch data validation staff supervisors before uploading to AQS and then reviewed by the QA Branch before being certified. Discrete filter sampling data is reviewed by the LS Branch Aerosol Analysis Senior AQ Chemist or Principal before uploading to AQS, then reviewed by QA Branch before certification.

1.7.2.5 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. The field and laboratory instruments and methods for criteria pollutant measurements and laboratory analyses are chosen for their capability to measure or analyze the range of concentrations typically found in the South Coast Air Basin and Coachella Valley, which can range be from very clean to highly polluted in this diverse region with its weather and geographical influences along with emissions from a large population. Instruments must be sensitive enough and have available operating ranges suitable for the site in order to accurately quantify concentrations for parameters of concern at or below the regulatory standards, including the determination of the pollutant levels and when exceedances of the NAAQS have occurred. The sensitivity also plays a role accurately determining monitoring requirements at other thresholds, such as when PM sample frequency requirements increase for stations close to the NAAQS. Similarly, the

[17] South Coast AQMD 2019 Air Quality Monitoring Annual Network Plan Website (ANP, current version): http://www.aqmd.gov/home/air-quality/clean-air-plans/monitoring-network-plan

test levels chosen for gaseous QC checks, calibrations, and audits for each pollutant are chosen to reflect the sensitivity of the instrument, considering the method detection limit, and the range observed in the measured data.

Selection of appropriate laboratory methods and analysis must be capable of the sensitivity to provide quality data at concentrations below standards and other action limits. This includes the determination of the minimum concentration measured by a method, the method detection limit (MDL), or by a laboratory, the quantition limit (QL). The MDL is the minimum concentration that can be detected above background or baseline/signal noise by a specific instrument and for a given analytical method. It is not recognized as an accurate value for the reporting of data. The QL is the minimum concentration that can be identified and quantified above the DL within some specified limits of precision and accuracy/bias during routine analytical operating conditions. It is matrix and media-specific and it is also recommended that the QL is supported by the analysis of a standard of equivalent concentration in the calibration curve (typically, the lowest calibration standard). Note that the actual "real time" sample Reporting Limit or RL is the QL adjusted for any necessary sample dilutions, sample volume deviations, and/or extract/digestate volume deviations from the standard procedures. If a parameter is detected at a concentration less than the QL but equal to or greater than the MDL, it should be qualified as an estimated value. Laboratory QC samples, such as laboratory control samples and laboratory blanks ensure accurate qualifying of data at QL and the concentrations of these samples are typically at or near the QL, which is typically defined by the lowest point of a calibration range. For lab instruments and methods, MDLs are evaluated periodically, per the laboratory SOPs.

Monitoring organizations can use Federal MDLs as listed in AQS, which is currently how South Coast AQMD establishes MDLs. A table of South Coast AQMD's currently used criteria gaseous pollutant monitors and MDLs is included in Section 2.6.3. Alternate MDLs can be used if developed and reported to AQS by the agency. The MDLs are used to help identify the low calibration and audit levels. They also can provide information for identifying the appropriate concentration for 1-point QC checks and the second annual Performance Evaluation (PE) audit level (99^{th} percentile). The options are defined as follows:

- **Federal MDL** – For any FRM/FEM method the Federal MDL is reported to AQS when the method is approved.
- **Alternative MDL** – This is an MDL created by the monitoring organization if they have performed MDL testing on their monitors. This alternate MDL must be reported to AQS if it is used.

1.7.3 Measurement Quality Objectives (MQOs)

Measurement quality objectives (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. For the U.S. EPA Criteria Pollutant Monitoring program measurement objectives, including NAAQS decisions, these were developed and organized in the

form of validation templates for each pollutant listed in the *Quality Assurance Handbook for Air Pollution Measurement Systems Vol. II, Ambient Air Quality Monitoring Program* (U.S. EPA, 2017a), Appendix D – *Measurement Quality Objectives and Validation Templates* (U.S. EPA, 2017b). The validation templates are reproduced in Appendix G of this QAPP. South Coast AQMD measurements are expected to meet or exceed these requirements and guidelines. The South Coast AQMD does not deviate from the validation template tables that are current as of the writing of this QAPP.

South Coast AQMD conducts activities to verify that the criteria are satisfied and performs corrective action(s) if the acceptance criteria are not met. If activities are conducted at the QC level that are outside the criteria for field operations, work orders are issued from the operations group to the support group for instrumentation issues or to the Information Management Division for telemetry or software issues. Work orders and other documented activity are reviewed by the Data Validation group who perform data flagging and/or invalidation as appropriate. When issues are found that have significant consequences to the data quality or completeness, they are documented and followed through the corrective action process, utilizing Corrective Action Requests (CARs) with subsequent follow-up, as further described in Section 11.5 of the South Coast AQMD QMP (South Coast AQMD, 2016) and in Section 3.1 of this QAPP.

The measurement performance criteria and QA/QC process for NAAQS decisions are sufficient, or more than sufficient, for non-NAAQS data uses and decisions, such as preparing data and trend summaries, assessing CAAQS attainment, and rule development or compliance evaluations. For short-term data needs and decisions, such as for real-time data reporting, forecasts, advisories and alerts, and for short-term data summary information reports, South Coast AQMD monitors and evaluates the criteria pollutant data routinely. To ensure that data quality remains sufficiently high for the real-time and short-term data needs and decisions, South Coast AQMD utilizing automatic alerts from the daily one-point QC checks (using the U.S. EPA Validation Template criteria), along with automated data screening (i.e., Level 0 Data Validation) and evaluation of input from staff that routinely works with the data, (e.g., STA field operations, repair, data validation, laboratory, and QA, as well as the PRA Meteorology and Air Quality Assessment group).

1.8 Training/Certification

South Coast AQMD general training practices are documented in the South Coast AQMD QMP (South Coast AQMD, 2016). South Coast AQMD implements appropriate training of all staff involved in the Criteria Pollutant Monitoring Program, including laboratory personnel, field operations and support personnel, QA personnel, temporary and contract personnel, and supervisory and management personnel. This ensures that staff has sufficient knowledge to perform assigned duties under the criteria pollutant monitoring program, including the ability to satisfy program and agency QA requirements. Mandatory quality assurance training is conducted within the first year of being hired or a major position change and every 2-3 years thereafter. A basic overview course has been developed. The formalized QA training is given by the QA Branch and additional detail is provided, when needed, in each specific Branch or work group. QA training is tracked by the QA Branch in a spreadsheet in addition to the training records kept by

each Branch.

South Coast AQMD staff conducting work in the Criteria Pollutant Monitoring Program must satisfy class specifications for each position performing a function related to the program. 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 the Criteria Pollutant Monitoring Program are required to meet the minimum requirements of the classification specification typically assigned to these tasks.

South Coast AQMD staff are required to be trained for the tasks to which they are assigned. Newly hired or assigned staff to the Criteria Pollutant Monitoring Program are required to be trained with the basic measurement or analytical techniques relevant to the tasks that they perform. A staff member experienced in the method serves as a mentor to the trainee. Typically, a trainee is assigned study of the relevant portions of instrument manuals, SOPs, QAPPs, and other available documentation. The mentor trains the trainee on operation methodology and practices, including the performance of good work techniques with an emphasis on avoiding contamination of equipment, supplies and samples. The mentor instructs and queries the understanding of the trainee on the basic requirements of their assigned tasks, instrument operation, the contents of the SOP(s), and other relevant documents before commencing "hands-on" training (i.e., on-the-job training). The mentor trains the trainee on the task(s) to be performed and whom to contact for assistance, typically working from the relevant SOP(s) and a check sheet of tasks and training goals that is attached to or included on the training record form.

After training is complete, the mentor observes the trainee perform the assigned tasks including checking performance of operations and analytical tasks such as calibration, quality control, data treatment, system maintenance, and record keeping. Once satisfied the trainee has mastered the assigned tasks (i.e., can successfully and independently perform the monitoring activities), the mentor completes a Training Record Form (see Appendix F for an example) 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 filed in the employee's training file, with summary information included in a Branch training spreadsheet. On an annual basis, or more frequently, the QA Branch will review training records for completeness of covered topics and the inclusion of relevant staff.

Once the Training Record Form is filed, the trainee is deemed qualified to perform the assigned tasks independently. Even then, the trainee works under the direction of the mentor and supervisor until the mentor is satisfied the staff is ready to work independently. Ongoing performance is monitored by the work group Senior and/or Principal level staff through review of forms and analytical data from samples, as well as the results of both internal and external audits. Project staff are encouraged to attend courses, such as 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 for recovery (or bias), accuracy, and precision before being deemed ready to perform analysis independently. This in part fulfills requirements for laboratory demonstration of capability (DOC) as described in South Coast AQMD SOP00136.

Data reviewers are trained and mentored as per above in the operational properties and expectations of monitoring instrumentation, data acquisition systems, QA, and calibration and maintenance procedures. The ability to review data for quality and completeness for submission to AQS is critical for staff involved in the review and validation of data. The data reviewers are trained on the data collection, analysis, review, visualization, validation, and reporting software tools and techniques utilized for data management, validation and AQS data submission. Current related software used by South Coast AQMD includes Agilaire Air Vision®, Sonoma Technology Data Management System® (DMS), Promium Element® Laboratory Information Management System (LIMS), and other commercial and in-house developed software.

QA Branch staff routinely participate in staff meetings for the other STA Branches to discuss and ensure that the project participants stay current on QA and monitoring-related competencies, information and resolution of QA issues.

In addition to the hands-on training specific to job duties by mentors and supervisors, the MN and LS Branches hold routine training sessions in conjunction with regular work group meetings that typically occur monthly, quarterly, and as needed to address issues that occur under this program. Specific courses may also be arranged and attended by staff onsite, online, or at other locations, such as training at professional meetings, instrument vendor training, workshops or conferences, including the National Ambient Air Monitoring Conference (https://www.epa.gov/amtic/national-ambient-air-monitoring-conference), CARB's PQAO Training (https://ww2.arb.ca.gov/air-monitoring-training-modules), U.S. EPA AQS system training (https://www.epa.gov/aqs/aqs-training), or training courses offered through the U.S. EPA Air Pollution Training Institute (APTI; https://www.epa.gov/advance/webinars-and-training).

All new or newly assigned South Coast AQMD field 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.

1.9 Documentation and Records

South Coast AQMD LS, MN and QA Branch documents and records may consist of entries in logbooks (station, sampler, and instrument), COCs, instrument/sampler outputs (written, printed.

and/or electronic), and reports. This information is stored electronically on the local drives, shared network drives, and Structured Query Language (SQL) servers and/or hard copy logbooks, COCs and other forms, such as maintenance or downtime sheets or corrective action forms. Table 1-13 lists South Coast AQMD QA/QC documentation and record-keeping requirements. Tables 1-14 and 1-15 list general Laboratory and Monitoring documentation and record-keeping requirements, respectively. Both electronic and paper records shall be stored in a logical order for ease of access.

Retention of documents and records, including emails and records involved in litigation, are governed by the South Coast AQMD Records Retention Policy and Schedule (https://www.aqmd.gov/docs/default-source/Career/administrative-code.pdf?sfvrsn=16; beginning page 17), with specified retention schedules for STA/M&A functions, including: Monitoring & Source Test Engineering, Laboratory Services, Quality Control Testing, Quality Assurance Program and Microscopy. The policy provides requirements and guidelines for managing the life cycle of all South Coast AQMD records and information. The retention times related to the criteria pollutant monitoring program are generally long in order to ensure that related data is processed, analyzed, validated and certified with all supporting data available and that regulatory analyses and decisions have sufficient supporting information available for addressing questions.

As stated in the QA Handbook, Vol. II (U.S. EPA, 2017a), retention requirements for records are codified in 2 CFR 200.333 for federal air monitoring programs and grants. In general, all information considered as documentation and records should be retained for 3 years from the date the grantee submits its final expenditure report, unless otherwise noted in the funding agreement. However, if any litigation, claim, negotiation, audit, or other action involving the records has been started before the expiration of the 3-year period, the records must be retained until all litigation, claim, or audit findings involving the records have been resolved and final action taken. Title 2 Part 1500.6(a) further states that, in the U.S. EPA, some programs require longer retention requirements for records by statute. Therefore, where there is a difference between the retention requirements for records defined in 2 CFR 200.333 and the applicable statute, the non-federal entity will follow the retention requirements for records in the statute (see 2 CFR 1500.6(b)). For clarification purposes, the retention of samples produced as a result of required monitoring may differ depending on the program and/or purpose collected. For retention of samples for a specific program, please refer to the appropriate reference in CFR for the individual program. All original documents and records be kept for the statute of limitation. If documents and records are desired to be kept for some time after the statute of limitations has expired, scanning this material into an electronic form may be a viable option.

The current South Coast AQMD records retention policy has general retention schedules (i.e., for correspondence and interoffice memoranda) less than the 3 years required for federal programs. This is anticipated to be addressed in an upcoming revision of the policy. Pending that change, such documents shall be retained for 3 years from the date South Coast AQMD submits its final expenditure report for the criteria pollutant monitoring program to U.S. EPA, unless otherwise noted in the funding agreement.

Within each South Coast AQMD department or business unit, appropriate staff are delegated as Records Retention Coordinator (i.e., records custodian), with the overall responsibility of implementing the records retention policy within the scope of their responsibility, including but not limited to:

- Ensuring full and complete implementation of the Records Retention Schedule.
- Coordinating one or more Records Purge Days each year.
- Evaluating the effectiveness of the retention schedules and proposing revisions to the Records Retention Schedule relating to the records within the scope of their responsibility.
- Working with the General Counsel's Office to periodically update the Records Retention Schedule.
- Ceasing the disposal of relevant records or information promptly upon notification by SCAQMD attorneys of a disposal suspension for litigation or other reasons.

For M&A, the Records Retention Coordinator duties are assigned to the LS Branch Manager. The other M&A Branch Managers and Principal AQISs, Principal Chemists, or Program Supervisors of each work group, and relevant staff support the management of the documents and records related to the Criteria Pollutant Monitoring Program. Per the South Coast AQMD Records Retention Policy, every person in each South Coast AQMD department is directly responsible for the proper management of records, documents, files, data and other information pertaining to South Coast AQMD's official business.

Knowledgeable staff typically prepare records or documents for public record requests, which are governed by the California Public Records Act (State Code Section 6250). M&A management also reviews and approves public record responses, including the Records Retention Coordinator. Guidelines and procedures for obtaining public records from the South Coast AQMD can be found on the South Coast AQMD website (http://www.aqmd.gov/nav/online-services/public-records).

For continuous measurements, the South Coast AQMD uses the Agilaire LLC AirVision® software as the primary telemetry system to poll the ESC data loggers in the field. The data from AirVision feeds into the Sonoma Technology, Inc. Data Management System® (DMS) for processing of continuous data streams, including the following:

- Real-time data processing for public access via the South Coast AQMD, CARB and U.S. EPA AirNow websites;
- Air quality forecasting;
- Incorporation of QC checks (e.g., automated 1-point checks);
- Ongoing data verification;
- Data validation and flagging;
- Preliminary data analyses;

- Data submittal to AQS.

Discrete samples consist of both LS and MN Branch documentation and data records. The Laboratory utilizes Promium Element® Laboratory Information Management System (LIMS) as the primary data management software for a diverse range of functions, such as scheduling for sample collection, COC creation, pre-sample collection (if applicable), COC archive post-sample collection (if applicable), field data entry/import, sample tracking, analytical data import, result calculations, data review, data flagging, data reporting, and data storage. Information and data entered in Element LIMS are stored in a SQL database located on the Laboratory SQL server, accessible through the Element LIMS interface or by SQL programming language. Changes made in Element LIMS are tracked using a built-in audit trail function.

In addition to Element LIMS, the Laboratory uses a combination of proprietary and customized software for sample analysis, data acquisition, and data management. Instrument specific analytical applications are typically installed on each corresponding instrument PC and provides instrument control during the analytical process. Post-analysis, analytical data are transferred into Element LIMS with built-in or customized import tools. Native electronic files generated from analytical software are stored on local PCs and may be transferred to the shared network drive, if applicable. Additionally, hard copies and/or PDF instrument data are produced for review. These files are stored in assigned locations in the Laboratory or shared network drive, as appropriate. Handwritten instrument and analytical information are stored in Laboratory notebooks located at each station or archived in the designated area of the lab storage/stock room.

Sampling information from Monitoring are recorded on sample logs, COC sheets (envelops for PM_{10} & TSP only), sampler printouts, and digital sampler outputs. COCs and sampler printouts are submitted to the Laboratory along with the corresponding samples. COCs are typically scanned and stored electronically in Element® LIMS and/or kept in designated Laboratory stations (hard copies). Electronic sampler data are placed in a shared drive within the shared network by the field staff, as applicable. In the Laboratory, the information and data on the COCs, electronic data files (if applicable), and samples are compared and reviewed for inconsistencies and/or errors. The sampler data are then transferred to Element® LIMS by Laboratory staff. Depending on the type of sample, sampler data transfer to Element® LIMS is accomplished by manual entry or utilizing an import function via Element® LIMS, either prior to sample analysis or imported together with analytical data.

For example, gravimetric PM2.5 measurements are collected using a customized software interface connected directly to a custom-built SQL database located on the Laboratory SQL server. PM2.5 mass data are accessible using the weight acquisition application or by SQL programming language. As part of the data processing procedure, electronic PM2.5 FRM sampler field data and gravimetric Laboratory data are combined and exported to csv files using customized Access software. The data in the csv files are then imported into Element® LIMS for final calculations and review. Similarly, PM10 weights are obtained and stored in a customized application and database (Access). PM10 field sampler data are then manually entered, then combined with Laboratory data, and exported to csv files. Final calculations and review are performed after the data from the

csv files are imported into Element® LIMS. PM2.5 and PM10 weights are also manually recorded in logbooks stored at designated stations in the Laboratory. All mass measurement data are imported into Element® LIMS for final calculations.

Electronic files on servers, including the files associated with the above software and internal shared drives, are backed up by Information Management (IM) with daily incremental backups and monthly full backups with offsite storage. South Coast AQMD no longer uses paper or paperless strip chart recorders (e.g., Dickson® paper or Chessell® digital paperless chart recorders, as used in the past). Certification reports for standards are scanned and stored electronically to the M&A shared drive.

The development and usage of electronic records is planned to increase for South Coast AQMD air monitoring and analysis programs. This will likely include electronic logbooks, forms, COC, and other documentation and records. The development of electronic records and reports will incorporate the related concepts outlined in Appendix J – Guidance on the Use of Electronic Logbooks of the U.S. EPA QA Handbook, Volume II (U.S. EPA, 2017), including: security and administration, identification of personal entering or editing information, time stamping of entries, and recording/archival of original entries when changes are made. As such, the electronic COC is designed to meet relevant National Archives and Records Administration (NARA)[18] to collect, organize, and categorize information and to facilitate the preservation, retrieval, use, and disposition of records. For use with federal programs, electronic logbook systems and other electronic records that may be used in the future, will need to meet both South Coast AQMD and U.S. EPA policies that include: integrity; metadata/identity; backup; organization/delegations; accessibility; retrievability; migration; auditability; disability compliance; electronic signatures; information security; data entry, revision and locking capabilities; and version control. Further information on the current effort to develop electronic COCs can be found in Section 2.3.1. The QA Branch Staff Specialist works with the relevant M&A branches and IM to plan and implement electronic record and data systems, including oversight on the application of the U.S. EPA guidance and NARA requirements.

The South Coast AQMD security procedures for electronic documents, records, and data systems include controls to insure that:

- The system has adequate levels of security and administration to ensure data cannot be tampered with and has adequate levels of backup (i.e., frequency and multiple storage locations).
- The system access and usage are restricted to authorized personnel with further restriction on the ability to edit information. The system will allow accessibility as appropriate to personnel such as site operators, lab personnel, QA staff, independent auditors, management, and system administrators with defined levels of access or permission each group or individual may have.

[18] National Archives and Records Administration (NARA) regulations at 36 CFR Part 1236, Electronic Records Management, including Subparts B and C.

- Personnel entering, editing, or revising information are uniquely identified and have been given authority to enter/edit. Edit or revision authority may be restricted to senior or supervisory staff in most cases. E-signatures or automated electronic automation are used to identify who made changes.
- Every entry/edit (entry session) is date/time stamped and the entry person identified.
- Original entries are recorded and archived. Initial entries are not erased when revisions (edits to previous entries in a different entry session) are made. This ensures an audit trail is available for all entries.
- Once data from an entry session has been generated and transmitted, it must be immediately secured as an official record. It must also comply with U.S. EPA and federal requirements for safeguarding information resources and confidential business information, if applicable.
- Information about the program developers as well as the users should be stored. There should be a log of developer rights and developer changes to the programs. Version control of software is used to track updates and keep personnel aware of the current version that is in use.

Corrections in electronic data systems used for this program, including AQS, DMS, AirVision, LIMS and EQuIS, are tracked in the software to retain the original information and to document the change, including the data and who made the edit. Edits to other electronic other electronic records are not permitted without appropriate senior staff/supervisory approval. Such changes are documented in writing, either in the electronic file or by a notification memo or email that is saved by the impacted group or groups, including data validation staff. When documentation beyond the immediate work group is needed a Quality Assurance Alert (QAA) may be sent by the work group to the QA Branch.

For handwritten documentation and records, including station and instrument logbooks and paper forms, such as maintenance sheets and monthly downtime logs, best practices are to be followed by any South Coast AQMD staff, other agency staff, or contractor visiting the site. This is described in the South Coast AQMD SOP for General Air Monitoring Station Operations (SOP00116) and on stickers attached to the inside cover of logbooks. At minimum, the following guidelines are followed:

- Station and instrument logbooks are bound scientific books with pre-numbered pages and an assigned tracking number, as well as appropriate station or instrument information;
- Logbook pages are not to be removed;
- Logbooks are kept in a safe place in the stations where they are easily found;
- The name of the staff doing the work is entered the logbook (minimum first initial and last name), along with the date the work was done (month, day and year) and the purpose of the visit and/or work;

- Indelible ink must be used (i.e., standard blue or black ball point pens, no markers);
- Entries are to be clear, concise and legible with no blank space between entries;
- If the entry is continued onto a following page, write "continued" at the bottom of the earlier page, make sure that page has the name and date included, then include the name and date on the continued page;
- Incorrect entries are corrected with a single-line strikethrough (no erasures, correction fluid or torn-out pages) so that the entry is still legible, along with initials, date, the correction, and a brief reason for the correction where clarification is warranted (i.e., if the reason for the change will not be obvious during future review by staff or auditors).

Handwritten forms, such as maintenance sheets, are stored for at least three years. Completed station logbooks are stored onsite for a period of one year, then returned to South Coast AQMD headquarters to be archived by the MN Branch Operations Group. Instrument logbooks serve as a permanent record of the acceptance testing, installation, relocation, repairs, calibrations and performance audits for that instrument. As such, the instrument logbook always remains with the instrument , wherever it is located, and are archived by the MN Branch Operations Group when a new logbook is started, or the instrument is permanently removed from service. Laboratory logbooks, COCs, and maintenance sheets are retained for 5 years in accordance to EPA requirements which are reflected in the *South Coast AQMD's Record Retention Policy*. (referenced in Appendix C).

Quality Assurance Alerts (QAAs) forms are used by staff to inform the QA Branch of potential issues or changes that could impact the data or safety. Corrective Action Requests (CARs) are issued by the QA Branch for findings that could impact data quality or safety in order to:

- Inform impacted personnel;
- Open discussion for determining a resolution and a reasonable deadline;
- Track progress of resolving the finding to achieve deadline;
- Document the problem, its resolution and steps to keep the issue from recurring.

Corrective action (QAA and CAR) documentation are stored by the QA Branch as hard copy in QA paper files and electronically on a STA server shared drive that is write-protected and regularly backed up. Corrective action reports from outside agencies (e.g., CARB, U.S. EPA) or contractors and all audit reports, both internal and external, are stored electronically by the QA Branch on the STA server shared drive. These are retained long-term to facilitate the analysis of previous findings and corrective action resolutions for similar or repeated issues and as examples to assist staff in preparing for new assessments.

Table 1-13
QA/QC Documentation and Records

Document Name	Brief Description	Format	Storage Location
Training Files	Records substantiating the training and proficiency of staff relevant to this program	Hard copy and electronic	MN Branch: File cabinet in MN records storage area; LS Branch: Training Binder at Laboratory Front Desk; PDF copies: M&A shared network drive; Educational records and CVs are maintained by HR to protect employee confidentiality. Original records of training programs offered through the South Coast AQMD, such as SDS training and HAZWOPER training, are maintained by HR
QAPP	Master version of each QAPP and pending revisions, with a master list of QAPPs maintained by QA Branch; Prior versions are accessible in archives; QAPPs are reviewed annually and updated every 5 years, or sooner	Hard copy and electronic Master versions are read-only with electronic backup	QA Branch records storage area and M&A online resources and shared network drive, including long-term storage of current and prior versions. (M&A staff is notified of document updates and access via email)
SOPs and OAGs	Current version of all SOPs with a master list of SOPs and OAGs maintained by QA Branch; Prior versions are accessible in archives; SOP/OAGs are reviewed annually and updated every 5 years, or sooner	Hard copy and electronic Master versions are read-only with electronic backup	QA Branch records storage area and M&A online resources and shared network drive, including long-term storage of current and prior versions (PDF and MS Word documents.
Performance Evaluations and Audits	Results of internal and external assessments	Hard copy and electronic	QA Branch records storage area and M&A shared network drive, including long-term storage of current and prior versions; MN Branch: Principal AQIS of Operations; LS Branch: Laboratory Report Binder and shared network drive
Corrective Action Documentation	Findings or identified QA problems and their resolution	Hard copy and electronic	Copy to affected Branch Manager and Principal; QA Program Office, QA Branch storage area and M&A shared network drive, including long-term storage of past actions.

Table 1-14
Laboratory Documentation and Records

Document Name	Brief Description	Format	Location
Laboratory Notebooks	Includes the following types of notebooks and bound data sheets: - analysts' notebooks; - instrument maintenance logs; - reagent preparation logs; - materials acceptance tests	Hard copy	Next to each instrument on Laboratory bench; long-term storage in Lab storage/stock room; Critical supporting data for analyses are archived in LS Branch LIMS database
Calibration Certificates and Records	Includes certificates of NIST traceability and similar records	Hard copy	Next to each instrument on Laboratory bench, including long-term storage; Removal as per the South Coast AQMD Record Retention Policy
Control Charts	QC information displayed in sequence to help diagnose problems with analytical instruments; usually includes acceptance limits that are periodically recomputed	Hard copy or electronic spreadsheet	Hardcopies: Next to each instrument on Laboratory Bench, including long-term storage; Electronic: instrument control PCs, including long-term storage; Removal per the South Coast AQMD Record Retention Policy
Chain of Custody (COC) records	Trail of accountability that ensures the physical security of samples, data, and records	Hard copy or electronic (PDF)	With samples until analysis complete, then stored in laboratory file storage area, including long-term storage; Removal per the South Coast AQMD Record Retention Policy
Instrument User's Manual and/or Manufacturer's Instructions	Information for setting up, using, and troubleshooting instrumentation	Hard copy and/or electronic (PDF)	Hardcopies: Next to Instrument on Laboratory Bench; Electronic: Instrument control PC hard drive; Kept for life of instrument
SOPs	Current copies of SOPs relevant to the analyses performed in a particular laboratory	Hard copy and electronic (PDF)	Next to instrument on Laboratory bench and M&A online resources and shared network drive; long-term storage in QA Branch protected file storage
QAPP	A current copy of this QAPP. The Principal Chemist must ensure that each analyst has access to a current copy of the QAPP	Hard copy and electronic (PDF)	QA Branch hardcopy and electronic file storage including past versions and long-term storage and M&A online resources and shared network drive
Analytical Results Database	Results for each chemical analysis with identifying information	Native instrument files, spreadsheets, Access, SQL Server	Analysis computer/lab shared drive; SQL Server; including long-term storage
Analytical QC Database	Includes all QC information for each weighing session including standard weights, duplicates, field blanks, and laboratory blanks	Native instrument files, Access, SQL Server	Analyst computer/lab shared drive; SQL Server
Data Review Software	Includes in-house programs and commercially available software that is used to visualize data spatially and graphically as well as to identify problematic data points	Electronic (Excel, Access, Element LIMS)	Shared network drives with write-protected copies and on analyst/instrument computers

Table 1-15
Station Documentation and Records

Document Name	Brief Description	Format	Location
Station Logbooks	Logs station activity	Hard copy	Station; when completed, stored at station for 1 year then archived in the MN Branch storage area per retention policy
Instrument Logbooks	Logs specific instrument/sampler activity including maintenance, calibrations, repairs, etc.	Hard copy	With instrument, then stored at least 5 years in MN Branch storage area
Instrument User's Manual and/or Manufacturer's Instructions	Information for setting up, using, and troubleshooting the continuous gaseous monitors	Hard copy/electronic	Station/shared network drive; copies stored in MN Branch storage areas for long-term storage
SOPs	Relevant SOPs available onsite	Hard copy/electronic	Station/shared network drive; long-term storage with prior version in QA Branch electronic archive
Calibration Certificates and Records	Includes NIST traceability certification for gases, other chemicals and instrumentation used for calibration	Hard copy/ electronic	Station/shared network drive; long-term storage in the MN Branch file storage area
QC Records	Results of instrument blanks, calibrations, standard recoveries, and replicate precision	Computer files and hard copy	Maintenance Sheets/Calibration Sheets/Database stored in MN Branch file storage area, including long-term storage per retention policy
Raw Data Records	Results of instrument analyses (including supporting data that is not uploaded to the database)	spreadsheets; hard copy; DMS, custom database	Database/Server, including long-term storage per retention policy; hard copies in MN Branch file storage area
Annual Network Plan & 5-Year Network Assessment	Assesses and documents the air monitoring network along with recent or proposed changes and waiver requests	Hard copy/electronic	MN Branch files and shared network drive, including long-term storage of previous versions
Station Lease Agreements	Legal agreements for site use	Hard copy or electronic copy maintained by MN Branch; Hard copy original maintained by Finance Division	MN Branch files and shared network drive; MN Manager & Secretary Official signed documents: Finance/Procurement files and long-term storage per retention policy

SECTION 2. DATA GENERATION AND ACQUISITION

This section includes the following data generation and acquisition elements:

2.1 Network Description (Sampling Process Design)

The South Coast AQMD criteria pollutant air monitoring network is well established and documented. It is designed primarily to generate regulatory data for purpose of assessing NAAQS compliance and, therefore, to meet the network design criteria as outlined in 40 CFR Part 58. This includes meeting requirements for station selection, operation and QA/QC, including the following:

- **Operating Schedule Requirements** (40 CFR Part 58.12);
- **Quality Assurance Requirements** (40 CFR Part 58, Appendix A), including quality control checks, audits, and collocation;
- **Network Design Criteria** (40 CFR Part 58, Appendix D), including monitoring objectives and spatial scales, minimum monitoring requirements for pollutants based on Metropolitan Statistical Area (MSA) population and design value, and sampling seasons;
- **Probe and Monitoring Path Siting Criteria** (40 CFR Part 58, Appendix E), including horizontal and vertical placement, spacing from sources, obstructions, trees, and roadways, interferences, monitoring path length, probe material and sample residence time, and waiver provisions.

The South Coast AQMD network and an assessment of how it meets the above requirements is documented in the agency's *Annual Air Quality Monitoring Network Plan*[19] (most recent as of this writing is South Coast AQMD, 2019). This annual network plan (ANP) document contains maps, population counts, tables with site IDs, sites types (e.g., maximum concentration, background, transport, etc.), and the types of monitoring stations or program designations that are included

[19] South Coast AQMD Air Quality Monitoring Annual Network Plan Website (ANP, current version): http://www.aqmd.gov/home/air-quality/clean-air-plans/monitoring-network-plan

throughout the South Coast AQMD network (e.g., SLAMS, SPMS, NCore, PAMS, NATTS, etc.). Some of this information has been included in Chapter 1 of this QAPP, as well. Any variances from 40 CFR Part 58 requirements are documented in the Annual Network Plan and waivers are sought from U.S. EPA Region 9. Appendix B, of the ANP contains details of each South Coast AQMD air monitoring site with AQS identification numbers, including the pollutants measured and the specific monitors/samplers employed.

South Coast AQMD currently samples criteria pollutant air quality at 41 fixed air monitoring stations, meeting both NAAQS-related and non-NAAQS objectives (see Section 1.7). Table 2-1 identifies the current (2018) South Coast AQMD criteria air pollutant monitoring station locations along with AQS site identification numbers, criteria pollutants monitored and the start date of each station. Table 2-2 shows the discrete filter-based sampling locations for PM2.5, PM10 and TSP-Pb, collocation monitor locations, and the sampling frequency, following the U.S. EPA sampling schedule.[20]

The discrete sample methods for the criteria pollutant filter samples (FRM PM10, PM2.5 and Pb) require preparation of filters in the laboratory, deployment and collection of filters at the air monitoring stations by an Air Quality Instrument Specialist (AQIS), and then post-collection analysis in the laboratory. The data for the discrete samples is validated by laboratory staff laboratory servers and then submitted to the U.S. EPA Air Quality System (AQS) database. At most South Coast AQMD air monitoring stations, the ambient air is also analyzed with continuous instruments in near-real time for (gaseous criteria pollutants and FEM PM10 and PM2.5). The data is transmitted via telemetry to servers located at South Coast AQMD where it is validated and then submitted to AQS. Figure 2-1 shows the overall operations process for the criteria pollutant monitoring program.

The Operations Group within the MN Branch has the primary responsibility for maintaining instrumentation that is at the air monitoring stations, checking and recording data from continuous instruments, collecting discrete samples and delivering them to the appropriate destination for analysis. The Support Group within the MN Branch is responsible for providing calibration for all samplers and air monitoring instrumentation in the South Coast AQMD air monitoring network. The Support Group maintains schedules for following up on completed repairs and providing timely calibrations. The Data Management Group within the MN Branch is responsible conducting the 2nd and 3rd level data review of the continuous pollutant measurements (O3, CO, NOx, SO2, and continuous PM) and submission of the data to AQS.

The Aerosol Analysis Group within the LS Branch conducts the pre- and post-sampling mass analysis for the FRM PM10 and PM2.5 and TSP-Pb discrete filter samples and blanks and they are responsible for the 2nd and 3rd level data review and submission of that data to AQS.

The QA Branch conducts or oversees contracted station/instrument performance and system evaluations of the continuous and discrete monitoring and laboratory analyses, conducted to meet or exceed the assessment requirements of 40 CFR Part 58. QA Branch coordinates with CARB

[20] U.S. EPA Sampling Schedule Calendar: https://www3.epa.gov/ttn/amtic/calendar.html

and U.S. EPA on the implementation of state and federal performance and technical system evaluations. Prior to May 1st of the following year, the QA Branch conducts the certification process of the data that has been submitted to AQS.

Table 2-1
South Coast AQMD Criteria Pollutant Network Stations and Pollutants Measured (2019)

	Location	AQS No.	Pollutants Monitored	Start Date
1	Anaheim	060590007	CO, NO2, O3, PM10, PM2.5	08/2001
2	Anaheim I-5 Near Road	060590008	CO, NO2	01/2014
3	ATSF (Exide)	060371406	Pb	01/1999
4	Azusa	060370002	CO, NO2, O3, PM10, PM2.5	01/1957
5	Banning Airport	060650012	NO2, O3, PM10, PM2.5	04/1997
6	Big Bear	060718001	PM2.5	02/1999
7	Closet World (Quemetco)	060371404	Pb	10/2008
8	Compton	060371302	CO, NO2, O3, PM2.5, Pb	01/2004
9	Central San Bernardino Mountains	060710005	O3, PM10, PM2.5	10/1973
10	Fontana	060712002	CO, NO2, SO2, O3, PM10, PM2.5, Pb	08/1981
11	Glendora	060370016	CO, NO2, O3, PM2.5, PM10	08/1980
12	Indio	060652002	O3, PM10, PM2.5	01/1983
13	La Habra	060595001	CO, NO2, O3	08/1960
14	Lake Elsinore	060659001	CO, NO2, O3, PM2.5, PM10	06/1987
15	LAX Hastings	060375005	CO, NO2, O3, PM10, Pb	04/2004
16	Long Beach (Hudson)	060374006	CO, NO2, SO2, O3, PM10	01/2010
17	Long Beach I-710 Near Road	060374008	NO2, PM2.5	01/2015
18	Long Beach (North)	060374002	PM2.5	10/1962
19	Long Beach (South)	060374004	PM10, PM2.5, Pb	06/2003
20	Los Angeles (Main St.)	060371103	CO, NO2, SO2, O3, PM10, PM2.5, Pb	09/1979
21	Mecca (Saul Martinez)	060652005	PM10	01/2011
22	Mira Loma (Van Buren)	060658005	CO, NO2, O3, PM10, PM2.5	11/2005
23	Mission Viejo	060592022	CO, O3, PM10, PM2.5	06/1999
24	Norco	060650003	PM10	12/1980
25	Ontario CA-60 Near Road	060710027	NO2, PM2.5	01/2015
26	Ontario Etiwanda I-10 Near Road	060710026	CO, NO2	06/2014
27	Palm Springs	060655001	CO, NO2, O3, PM10, PM2.5	04/1971
28	Pasadena	060372005	CO, NO2, O3, PM2.5	04/1982
29	Perris	060656001	O3, PM10	05/1973
30	Pico Rivera	060371602	CO, NO2, O3, PM10, PM2.5, Pb	09/2005
31	Pomona	060371701	CO, NO2, O3	06/1965
32	Redlands	060714003	O3, PM10	09/1986
33	Rehrig (Exide)	060371405	Pb	11/2007
34	Reseda	060371201	CO, NO2, O3, PM2.5	03/1965
35	Rubidoux	060658001	CO, NO2, SO2, O3, PM10, PM2.5, Pb	09/1972
36	San Bernardino	060719004	CO, NO2, O3, PM10, PM2.5, Pb	05/1986
37	Santa Clarita	060376012	CO, NO2, O3, PM10, PM2.5	05/2001
38	Temecula	060650016	O3, PM2.5	06/2010
39	Uddelholm (Trojan Battery)	060371403	Pb	11/1992
40	Upland	060711004	CO, NO2, O3, PM10, PM2.5	03/1973
41	West Los Angeles	060370113	CO, NO2, O3	05/1984

Table 2-2
Filter Sampling Frequency for South Coast AQMD FRM PM2.5, PM10 and TSP-Pb (2019)

(Daily = Daily sampling; 1/3 = Every 3rd day sampling; 1/6 = Every 6th day sampling; following U.S. EPA sampling schedule)

	Location	AQS No.	PM2.5 FRM	PM10 FRM	TSP-Pb
1	Anaheim	060590007	Daily	1/6	
2	ATSF (Exide)	060371406			1/6 (Source)
3	Azusa	060370002	1/3	1/6	
4	Banning Airport	060650012		1/6	
5	Big Bear	060718001	1/6		
6	Closet World (Quemetco)	060371404			1/6 (Source)
7	Compton	060371302	Daily		1/6 (Collocated1/6)
8	Central San Bernardino Mountains (Crestline – Lake Gregory)	060710005		1/6	
9	Fontana	060712002	1/3	1/6	
10	Indio	060652002	1/3	1/3 (Collocated 1/6)	
11	LAX Hastings	060375005		1/6	1/6
12	Long Beach (Hudson)	060374006		1/6	
13	Long Beach I-710 Near Road	060374008	Daily		
14	Long Beach (North)	060374002	Daily		
15	Long Beach (South)	060374004	Daily	1/6	1/6
16	Los Angeles (Main St.)	060371103	Daily (Collocated 1/6)	1/6	1/6 (Collocated 1/6)
17	Mecca (Saul Martinez Elementary)	060652005		1/6	
18	Mira Loma (Van Buren)	060658005	Daily (Collocated 1/6)	1/3 (Collocated 1/6)	
19	Mission Viejo	060592022	1/3	1/6	
20	Norco	060650003		1/6	
21	Ontario CA-60 Near Road	060710027	Daily		
22	Palm Springs	060655001	1/3	1/6	
23	Pasadena	060372005	1/3 (Collocated 1/6)		
24	Perris	060656001		1/6	
25	Pico Rivera	060371602	1/3 (Collocated 1/6)		1/6
26	Redlands	060714003		1/6	
27	Rehrig (Exide)	060371405			Daily (Source; Collocated 1/6)
28	Reseda	060371201	1/3		
29	Rubidoux	060658001	Daily (Collocated 1/6)	1/3 (Collocated 1/6)	1/6
30	San Bernardino	060719004	1/3	1/6	1/6
31	Santa Clarita	060376012		1/6	
32	Uddelholm (Trojan Battery)	060371403			1/6 (Source)

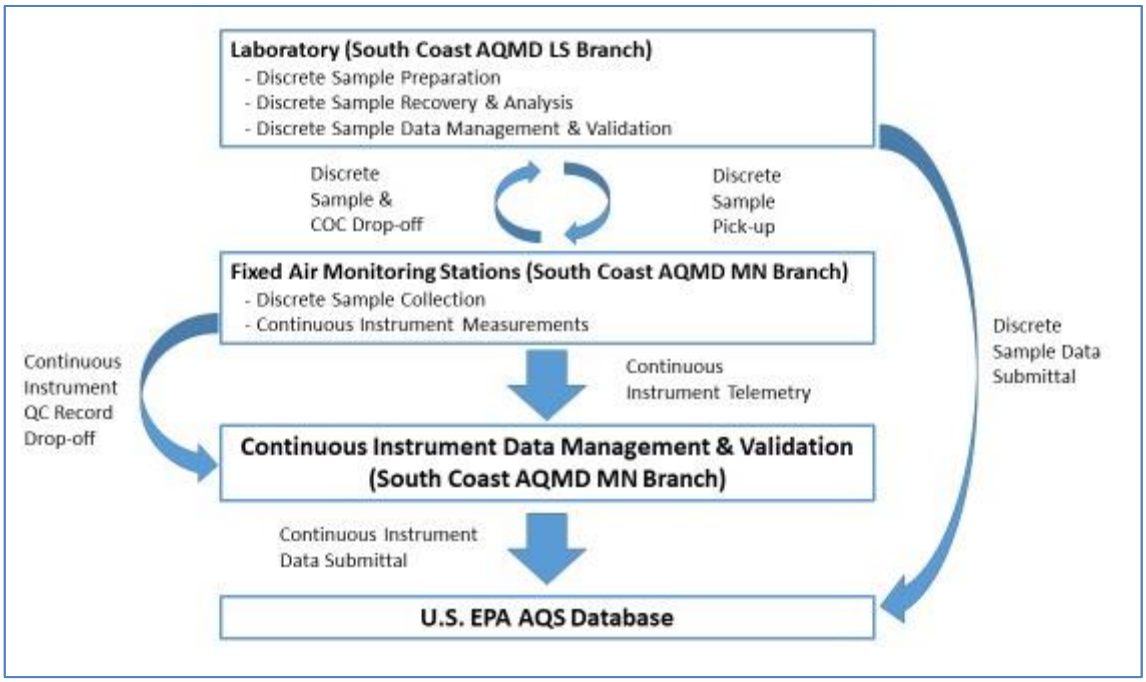


Figure 2-1
Flow Diagram of South Coast AQMD Criteria Pollutant Monitoring Program

2.2 Criteria Pollutant Sampling Methods

For the ambient air monitoring network, the criteria pollutant sampling methods are established in the Appendices to 40 CFR Part 50. Guidelines can also be found in the QA Handbook, Volume II, especially in Section 7, including: monitor placement, environmental controls, sampling probes and manifolds, and FRM/FEM designations. Since the South Coast AQMD criteria pollutant monitoring network primarily focuses on NAAQS regulatory comparability, the field analyzers and samplers meet federal reference or equivalent methods (FRM or FEM), indicating that they have been tested and found to be acceptable for this purpose. Current U.S. EPA approved air monitoring methods for criteria methods are listed in the U.S EPA *List of Designated Reference and Equivalent Methods* (U.S. EPA, 2018c).[21] For intermittent, discrete sampling (e.g., PM10, PM2.5 or TSP-Pb), physical samples are collected. For continuous sampling, physical samples are not collected. Instead, the "samples" are analyzed in-situ, within the analyzer itself. Table 2-3 lists the continuous and discrete monitors currently in use by South Coast AQMD for the criteria pollutant monitoring program, including the make, model, sampling methodology, South Coast AQMD SOP reference, AQS method code, and U.S. EPA FRM/FEM reference number. For further information, Appendix B, of the ANP (South Coast AQMD, 2019) contains details of each South Coast AQMD air monitoring site, including the measured pollutants and details on the monitors or samplers employed.

[21] U.S. EPA Ambient Monitoring Technology Information Center (AMTIC) website for Air Monitoring Methods – Criteria Pollutants: https://www.epa.gov/amtic/air-monitoring-methods-criteria-pollutants

Table 2-3
South Coast AQMD Criteria Pollutant Instruments and Methods

Pollutant	Instrument & Model	Sampling Method	South Coast AQMD SOP Reference	AQS Method Code	FRM/FEM Designation Method
Ozone					
	Thermo 49i	UV Photometric	SOP00109/SOP00149	047	EQOA-0880-047
	Teledyne 400E	UV Photometric	SOP00058/SOP00068	087	EQOA-0992-087
Carbon Monoxide					
	Horiba APMA-360	NDIR Analysis	SOP00051A/SOP00054	106	RFCA-0895-106
	Horiba APMA-370	NDIR Analysis	SOP00051/SOP00054	158	RFCA-0506-158
	Teledyne 300EU	NDIR Analysis	SOP00132	593	RFCA-1093-093
	Thermo 48i	NDIR Analysis	SOP00139/SOP00188	054	RFCA-0981-054
Nitrogen Oxides					
	Teledyne 200E	Chemiluminescence	SOP00055/SOP00166	099	RFNA-1194-099
	Thermo 42i	Chemiluminescence	SOP00075/SOP00056	074	RFNA-1289-074
	Horiba APNA-370	Chemiluminescence	SOP00148/SOP00167	157	RFNA-0506-157
Sulfur Dioxide					
	Thermo 43i-TLE	Pulsed Fluorescent	SOP00126	560	EQSA-0486-560
Particulate Matter PM2.5					
	Thermo Partisol 2025i	VSCC FRM Sequential Air Sampler	SOP00151	145	EQPM-0202-145
	Thermo Partisol 2000i	VSCC FRM Single shot Air Sampler	SOP00151	143	EQPM-0202-143
	Thermo/Andersen RASS 300	VSCC FRM Sequential Air Sampler	SOP00061	155	EQPM_0804-155
	Thermo BAM 5014i	VSCC Continuous FEM Beta Attenuation Mass Monitor	SOP00129	183	EQPM-0609-183
	Met One BAM 1020	VSCC Continuous FEM Beta Attenuation Mass Monitor	SOP00072	170	EQPM-0308-170
Particulate Matter PM10					
	Andersen GMW 1200/HI-Q	High Volume Size Selective Inlet Air Sampler	SOP00081	063	RFPS-1287-063
	Tisch Environmental TE-6070	High Volume Size Selective Inlet Air Sampler	SOP00164	141	RFSP-0202-141
	Thermo/R&P TEOM	Tapered Element Micro Balance	S0P00062	079	EQPM-1090-079
	Met One BAM 1020	Beta Attenuation Monitor	SOP00072	122	EQPM-0798-122
TSP Lead					
	Tisch TE-HVPLUS-BL	Total Suspended Particulate Matter	SOP00078	110	Manual Reference High-Volume Method: 40 CFR Part 50, App B
	High Q 5300 AFC	Total Suspended Particulate Matter	SOP00082		

The SOPs listed in Table 2-3 show how the sample collection procedures and methods, based on the 40 CFR Part 50 requirements, are implemented. They list equipment needed; identify support facilities; identify individuals responsible for corrective actions; describe the process for preparation and decontamination of sampling equipment; describe selection and preparation of sample containers and sample volumes; describe preservation methods, present maximum holding times, and provide guidance in safely performing monitoring and analysis activities. All criteria pollutant monitoring program SOPs are listed in Appendix E. The master log of SOPs, version control, and review history are maintained by the QA Branch.

The South Coast AQMD FEM and FRM instruments operate in accordance with U.S. EPA FRM/FEM designation specifications. SOPs and training emphasize that modifications to the methods are not to be done. Furthermore, as part of the South Coast AQMD assessment program audits, the QA Branch monitors and reviews instrument logbook entries by field staff to assess if any unapproved changes to the method or major deviation from the SOPs have taking place. The instrument SOPs address routine maintenance, including information on possible monitor interferences and how they will be addressed (e.g., dust build-up).

At each air monitoring station, the sampling probe and intake sampling lines for all criteria gaseous pollutants are FEP or PFA Teflon®. The probe is sheltered in an aluminum housing with a rain hat and connected to a T-Type (horizontal) borosilicate glass manifold mounted inside the station shelter that is connected to a vacuum pump to ensure that the 20 seconds sample residence time requirements are met per QA Handbook Vol. II, Appendix D – *Measurement Quality Objectives and Validation Template* (U.S. EPA, 2017b). CARB also requires ≤ 10 seconds residence time from manifold to instrument, in some cases. Ambient air enters from a single inlet, passes through the manifold, and is then distributed through outlet ports to individual analyzers. The manifold and lines are on a regular cleaning schedule, at least every six months or more frequently in heavy polluted areas or after impacts from a fire or dust storm in the area. The manifold, lines and other components are inspected regularly and replaced as needed. Leak tests are performed after the manifold is significantly modified or disassembled for cleaning. The sample residence time is verified on that same 6-month schedule, exceeding the systematic requirement to verify annually.

The majority of the South Coast AQMD criteria pollutant air monitoring stations shelters are modified shipping containers with separated office and instrument space, except for four sites that are housed in existing building structures. The container used meet the climate control requirements for proper operation of the instrument for the range for which they were designated, as well as the U.S. EPA Quality Assurance Handbook, Volume II Appendix D (U.S. EPA, 2017b) acceptance criteria and the instrument manufacturer recommendations. The South Coast AQMD shelters are located in secured areas with access only through locked gates.

2.2.1 Continuous Monitoring

South Coast AQMD continuous monitoring of gaseous criteria pollutants (O_3, CO, NO_2, and SO_2) employs Federal Reference Methods (FRMs). The continuous particulate matter ($PM_{2.5}$ and PM_{10}) monitoring employs Federal Equivalent Methods (FEMs) at stations designated as SLAMS. A few South Coast AQMD continuous PM non-FEM or FEM monitors designated special purpose monitors (SPM) in AQS are used to provide real-time data for special studies,

instrument evaluation purposes, or public information and forecasting, including wildland fire smoke or windblown dust monitoring.

2.2.1.1 Standard Operating Procedures for Continuous Monitoring

Table 2-4 identifies the procedures and methods for operating, maintaining and calibrating instruments and support equipment used to conduct continuous criteria pollutant measurements, including those listed in Table 2-3. The SOP for General Air Monitoring Station Operations (SOP00116) and individual specific SOPs provide detailed guides for duties expected for a field operator and presents the QC needed to satisfy program requirements as listed in the *QA Handbook for Ambient Air Quality Measurement Systems, Volume II,* Section 10 (2017a). The SOP for Data Management of Continuous Instruments (SOP00124) serves as a guide for staff in the Data Validation group. The remaining SOPs are instrument specific technical guidance. The SOPs identify and list equipment, scheduled activities, and QC criteria, as well as provide corrective action guidance.

Table 2-4
SOPs for Continuous Criteria Pollutant and Meteorological Monitoring

SOP#	SOP Title
SOP00051	Operations of Horiba Ambient CO Monitor APMA-370
SOP00051A	Operations of Horiba Ambient CO Monitor APMA-360
SOP00054	Horiba CO Analyzer Calibrations (Series APMA-360 or APMA-370)
SOP00055	Operations of API/Teledyne 200E NO/NOx/NO2
SOP00056	Thermo 42i NO/NOx Instrument Calibrations
SOP00058	Operations of API/Teledyne 400E Ozone Analyzer
SOP00060	Installation and Calibration for the Met One BAM 1020 PM2.5 and PM10 Monitor
SOP00061	Andersen RAAS PM2.5 Sequential Sampler Model 300
SOP00062	Rupprecht & Patashnick TEOM Series 1400a PM10 Monitor
SOP00064	Environics 9100 Calibrator
SOP00068	API/Teledyne 400E Ozone Instrument Calibration
SOP00070	Operation of Meteorological Systems (including sensors for winds, temperature, pressure, relative humidity, solar radiation, and total UV radiation)
SOP00072	Operations of Met One BAM 1020 PM2.5 FEM, PM2.5 Non-FEM, and PM10
SOP00075	Operations of Thermo 42i NO/NOx/NO2 Analyzer
SOP00078	Operating and Calibrating the Tisch High Vol+ TSP Sampler Controller
SOP00081	Hi-Q SSI PM10 Sampler Operations & Calibration
SOP00082	Hi-Q TSP Sampler Operations & Calibration
SOP00083	Data Management of Continuous Instruments
SOP00109	Operations of Thermo 49i Ozone Analyzer
SOP00115	Calibration of TEOM Series 1400a/1400ab Ambient PM10 Monitor
SOP00116	General AMS Station Operations
SOP00117	Gas Calibrations System Station Operations (Teledyne API Mode 701H and T700, and Environics 100 and 9100)
SOP00118	Data Collection System Station Operations
SOP00122	Teledyne T700/T700U Dynamic Dilution Calibrator Setup and Calibration
SOP00126	Thermo-Scientific 43i TLS SO2 Trace Level Analyzer Operations and Calibration
SOP00129	Thermo Model 5014i Beta Continuous Particulate Monitor
SOP00132	Teledyne-Scientific 300EU CO Trace Level Analyzer (NCore) Operations and Calibration

SOP#	SOP Title
SOP00139	Thermo 48i Trace Level – Enhanced CO Analyzer
SOP00140	Installation of ESC Series 8832 Data System Controller
SOP00148	Horiba APNA-370 NOx/NO Analyzer
SOP00149	Thermo 49i Ozone Instrument Calibration
SOP00151	Partisol FRM PM2.5 Samplers Model 2000i and 2025i
SOP00156	General Air Monitoring Station Calibrations
SOP00159	Agilaire Digital Site Platform Setup & Installation (Series 8872)
SOP00164	Operating and Calibrating the Tisch PM10 + Sampler Controller
SOP00165	Thermo Model 5014i Beta Continuous Particulate Monitor Calibration
SOP00166	Teledyne/API 200E NO/NOx Instrument Calibrations
SOP00167	Horiba APNA 370 NOx Calibrations

2.2.2 Discrete Sample Monitoring

FRM criteria pollutant monitoring for PM10, PM2.5, and TSP-Pb requires discrete sampling methods. These methods describe the preparation of sampling media, transport of the media to stations, collection of media after sampling, and return of media to the laboratory for recovery and analysis. Table 2-5 summarizes elements for each type of measurement. Field Operations staff (typically AQIS-I or Assistant AQIS) picks up prepared filters and chain of custody forms from a pre-designated place in the South Coast AQMD laboratory, collects the samples at the assigned field stations according to the sampling schedule, and returns the samples to a designation location in the South Coast AQMD laboratory.

Table 2-5
Summary of Criteria Pollutant Discrete Sampling Methodologies

PM10	
Sampling Media	Quartz Fiber Filters (Received from U.S. EPA Region 9)
Media Preparation	Light inspection, conditioning, taring
Media Storage	Envelopes
Type of Sample	Air sample selectively sized cut to PM10 or smaller, integrated over 24-hr period
Sample Delivery	Downstream pump and flow controller; SSI head
Sample Line	N/A
Sample Manifold	N/A
Sample Flow Rate	40 CFM
Sampler Make & Model	Hi-Q HVP-4300AFC, Tisch Environmental HIGH VOL+
Sample Storage	Envelopes
Sample Recovery	24 Hour conditioning
Sample Analysis	Analytical Balance
PM2.5	
Sampling Media	Filters, 46.2 mm, Teflon (Received from U.S. EPA Region 9)
Media Preparation	Light inspection, conditioning, taring
Media Storage	Petrislides / Filter cassettes
Type of Sample	Air sample through cyclone cut to PM2.5 or smaller, integrated over 24-hr period
Sample Delivery	Downstream pump and flow controller, cyclone head
Sample Line	N/A
Sample Manifold	N/A
Sample Flow Rate	16.67 LPM
Sampler Make & Model	Anderson RAAS / Thermo Partisol 2000i & 2025i
Sample Storage	Petrislides / Filter cassettes
Sample Recovery	24 Hour Conditioning
Sample Analysis	Analytical Balance
TSP-Pb (Hi Vol)	
Sampling Media	Filters, 8”x10” quartz fiber filter (Received from U.S. EPA Region 9)
Media Preparation	Light inspection
Media Storage	Envelopes
Type of Sample	Whole Air sample, integrated over 24-hr period
Sample Delivery	Downstream pump and flow controller (Hi Q mass flow control)
Sample Line	N/A
Sample Manifold	N/A
Sample Flow Rate	42 CFM
Sampler Make-Model	Tisch Hi Vol+ / Hi-Q HVP-4300AFC
Sample Storage	Envelopes
Sample Analysis	ICP-MS

2.2.2.1 Standard Operating Procedures for Discrete Sample Collection

Table 2-6 lists the SOPs for the collection of PM10, PM2.5, and TSP-Pb samples in support of the South Coast AQMD Criteria Pollutant Monitoring Program.

Table 2-6
SOPs for Discrete Sample Collection

SOP #	SOP Title
SOP00061	Andersen Reference Ambient Air Sampler (RAAS) PM2.5 Sequential Sampler Model 300-2.5
SOP00078	Operating and Calibrating the Tisch HIGH VOL+ TSP Sampler Controller (V6 firmware)
SOP00081	HI-Q SSI PM-10 Sampler Operations & Calibration
SOP00104	Weigh Room Operations and Weighing of PM2.5 Samples
SOP00112	The Gravimetric Determination of PM10 Mass
SOP00113	Selection, Preparation & Extraction of Quartz Filters for Metals Analysis
SOP00121	Data Processing and Validation (Laboratory)
SOP00151	Partisol FRM PM2.5 Samplers, Model 2000i and 2025i

2.3 Sample Handling and Custody

This section summarizes the South Coast AQMD sample handling and custody procedures for physical samples collected for particulates and lead, per OAG QA0044, Visual Inspection and Acceptance of Filters and SOP00104 PM2.5 Laboratory. Sample handling and custody for criteria pollutants are also addressed in 40 CFR and in Section 8 of the QA Handbook, Vol. II. Chain-of-custody (COC) is a method of identifying each sample and documenting who has had possession of (i.e., who handled it) it throughout its life cycle, in order to demonstrate the sample's integrity. Samples are generally hand-delivered from the field stations by the station operators (MN Branch AQIS or Assistant AQIS) to the laboratory at South Coast AQMD headquarters in Diamond Bar. The person who has custody of the samples must be able to testify that no tampering occurred. At every custody change, the samples are checked to ensure that their integrity is intact and checked against the COC form to ensure that all samples listed are included. Security must be continuous. As such, if they are stored in a freezer or other storage, it must be locked or in a secure, locked locations such as an air monitoring shelter or the laboratory. If the samples are put in a vehicle, the vehicle is locked. After delivery to the laboratory, the samples must be kept in a secured place with restricted access.

For the South Coast AQMD criteria pollutant discrete filter samples, the filters are pre-conditioned and inspected by the gravimetric lab analyst in the South Coast AQMD Laboratory (typically an AQ Laboratory Technician), who prepares the sample media (i.e., clean Teflon® or other filter

media, as appropriate) and the associated COC forms. After pre-conditioning, filters are pre-weighed, placed in cassette filter rings, where needed, with filter number matching packaging and prepared for transport to the field. The filters are distributed to the station operators (typically an AQIS I or Assistant AQIS) from the laboratory in a designated location, packaged in small batches by station (typically a one-week supply), along with a printout showing the station (see Figure 2-2, for example), number of sample filters and field blanks included, filter numbers included, and a "sample by" stale date, after which the filter cannot be used (accounting for 30 days from pre-sample weigh to post-sample weigh for PM2.5, 180 days for PM10 and TSP filters).

When preparing a sampler for a run, the site operator chooses a filter and enters the filter number on the COC form with the appropriate supporting information. When the filter is loaded into the sampler, the field operator will document the date, time, station, sampler ID number, and name of person loading the sampler, confirming filter number on the COC form with that of the filter. The site operator collects the actual time-integrated sample on the prepared media, then recovers the exposed sample from the sampler and prepares it for transport. After the time-integrated sampling, the site operator checks or completes relevant portions of the COC form, including: date, time and name of personnel removing the sample from the sampler. PM2.5 samples must be removed from the sampler within 177 hours (just over 7 days) from the end of the sampling event. Sample removal for PM10 Hi Vol and TSP-Pb Hi Vol samples is 'as soon as possible.' On the every 6th day schedule, this would need to be less than 144 hours on a non-sequential sampler.

If a given sample is invalidated in the field (e.g., due to damage or mishandling) prior to the scheduled run, a new filter from the package that is intended for a later run can be used and the station operator will obtain a replacement filter and COC form from the South Coast AQMD Laboratory. If a given sample was not collected, a make-up sample is run if feasible. The make-up must be run after the date that it is intended to make up and prior to the next scheduled sample run, with a new filter and COC form.

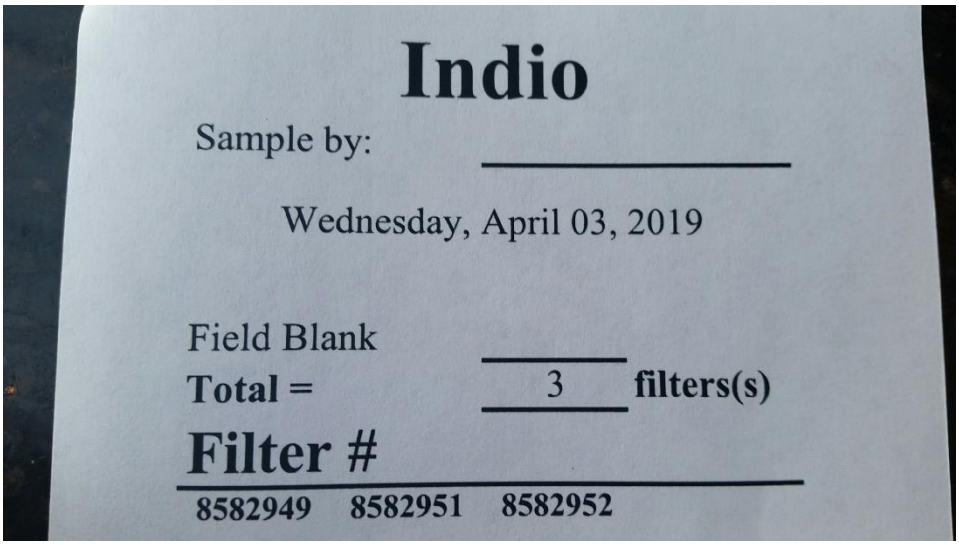


Figure 2-2
Example of Station FRM Filter Packing Summary Form

If the exposed filter is not being delivered to the laboratory right away, the filter is placed in a refrigerator for storage until delivery. Field personnel will document date and time when the filter is placed in refrigerator. PM2.5 samples must be protected from temperatures above 25°C to maximize analytical holding time, so they are chilled during transport. Filter storage temperatures are recorded, typically with temperature sensor and a Hobo® data logger (or similar) during storage and during transit to the lab.

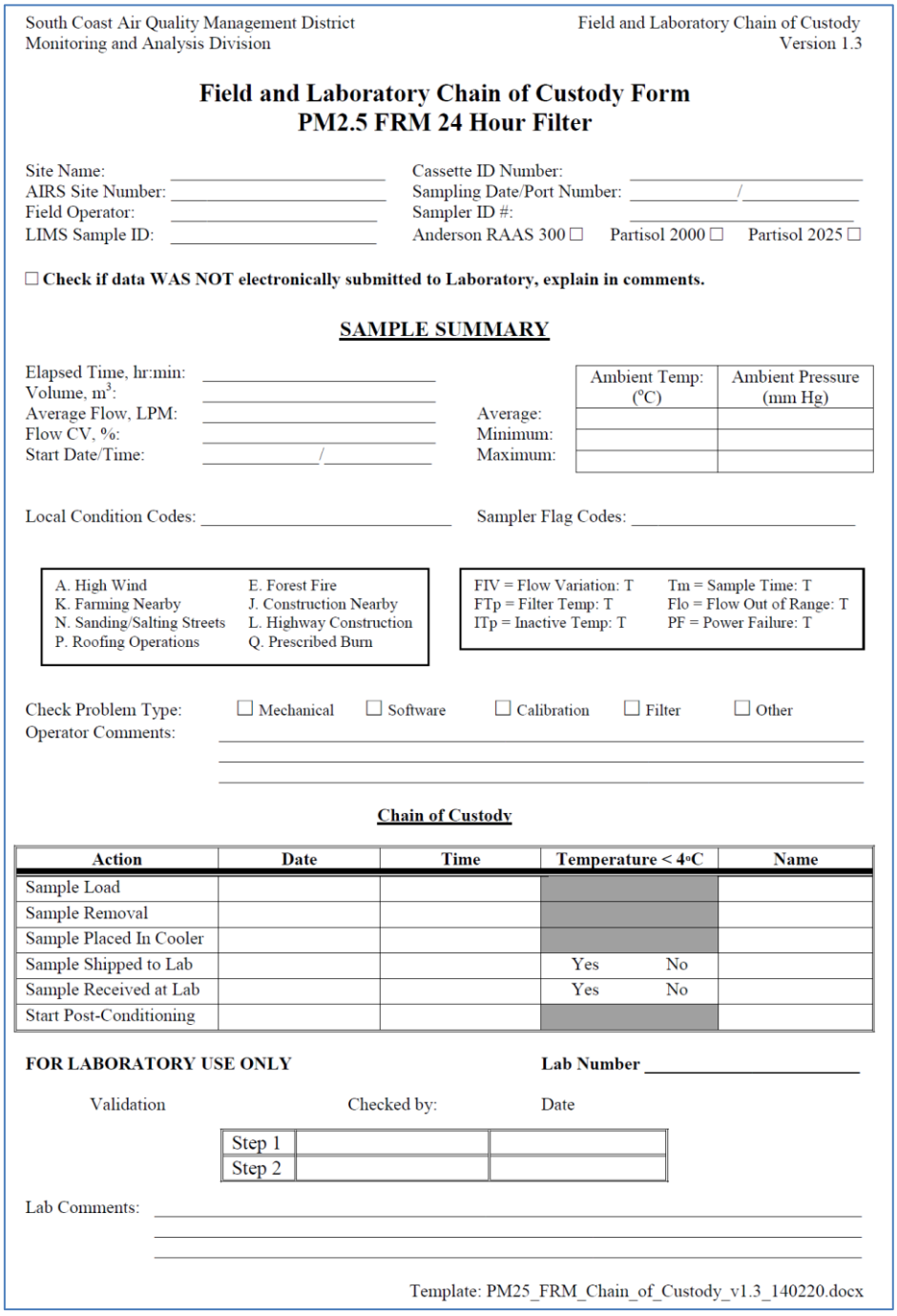
When the filter is returned to the laboratory, the date, time, and personnel returning the filter are documented. When the filter arrives at the designated location in the laboratory, the date, time, and person receiving the filter are documented. Filters are processed into the laboratory, with storage temperature information from the data logger downloaded and stored to the Laboratory server. Filters will be signed in and deposited in the lab freezer into laboratory custody until removed by the LS Branch Aerosol Analysis Group AQ Laboratory Technician for conditioning and analysis. The AQ Laboratory Technicians or temporary (student) technicians for the Aerosol Analysis Group sign for receipt of the sample and COC form into laboratory custody for conditioning & analysis.

The COC record is signed and dated by the individual in possession of the sample and retained with the sample. The completed COC forms are reviewed by the LS Branch AQ Laboratory Technician during the analysis and they are stored in a Laboratory storage room for no less than five years, per *South Coast AQMD Record Retention Policy*. After analysis, PM10 and TSP filters are stored in the PM filter storeroom. PM2.5 filters are refrigerated for one year after analysis, then transferred to the PM filter storeroom. The sampled filters are archived in the lab for a period of no less than five years. Examples of the COC forms for PM2.5, PM10 and TSP-Pb are shown in Figures 2-3, 2-4 and 2-5, respectively. Information typically documented on the COC forms includes:

- Sampling location;
- Sampler ID number;
- Sample filter identification number (e.g., LIMS sample ID number);
- Individual responsible for sample collection;
- Sample start date and time;
- Sample elapsed time;
- Sampler flow/volume information;
- Relevant field comments (e.g., fire in area, nearby construction, weather conditions, etc.) and, notification when necessary, of invalid sample and the reason (e.g., torn or mishandled filter, sampler power failure, etc.).

In the South Coast AQMD laboratory for the criteria pollutant program, both the Sample Custodians and the COC Custodians are the Sr. AQ Chemists, under the supervision of the

Principal AQ Chemist for the Aerosol Analysis Group. They are the responsible staff that one would go to in order to locate a particular filter sample or COC for PM2.5, PM10 and TSP-Pb, including if analyzed and in the storage/archive.



South Coast Air Quality Management District
Monitoring and Analysis Division

Field and Laboratory Chain of Custody
Version 1.3

Field and Laboratory Chain of Custody Form
PM2.5 FRM 24 Hour Filter

Site Name: _____ Cassette ID Number: _____
AIRS Site Number: _____ Sampling Date/Port Number: _____/_____
Field Operator: _____ Sampler ID #: _____
LIMS Sample ID: _____ Anderson RAAS 300 ☐ Partisol 2000 ☐ Partisol 2025 ☐

☐ **Check if data WAS NOT electronically submitted to Laboratory, explain in comments.**

SAMPLE SUMMARY

Elapsed Time, hr:min: _____
Volume, m^3: _____
Average Flow, LPM: _____
Flow CV, %: _____
Start Date/Time: _____/_____

	Ambient Temp: (°C)	Ambient Pressure (mm Hg)
Average:		
Minimum:		
Maximum:		

Local Condition Codes: _____ Sampler Flag Codes: _____

A. High Wind	E. Forest Fire
K. Farming Nearby	J. Construction Nearby
N. Sanding/Salting Streets	L. Highway Construction
P. Roofing Operations	Q. Prescribed Burn

FIV = Flow Variation: T	Tm = Sample Time: T
FTp = Filter Temp: T	Flo = Flow Out of Range: T
ITp = Inactive Temp: T	PF = Power Failure: T

Check Problem Type: ☐ Mechanical ☐ Software ☐ Calibration ☐ Filter ☐ Other
Operator Comments: _____

Chain of Custody

Action	Date	Time	Temperature < 4°C		Name
Sample Load					
Sample Removal					
Sample Placed In Cooler					
Sample Shipped to Lab			Yes	No	
Sample Received at Lab			Yes	No	
Start Post-Conditioning					

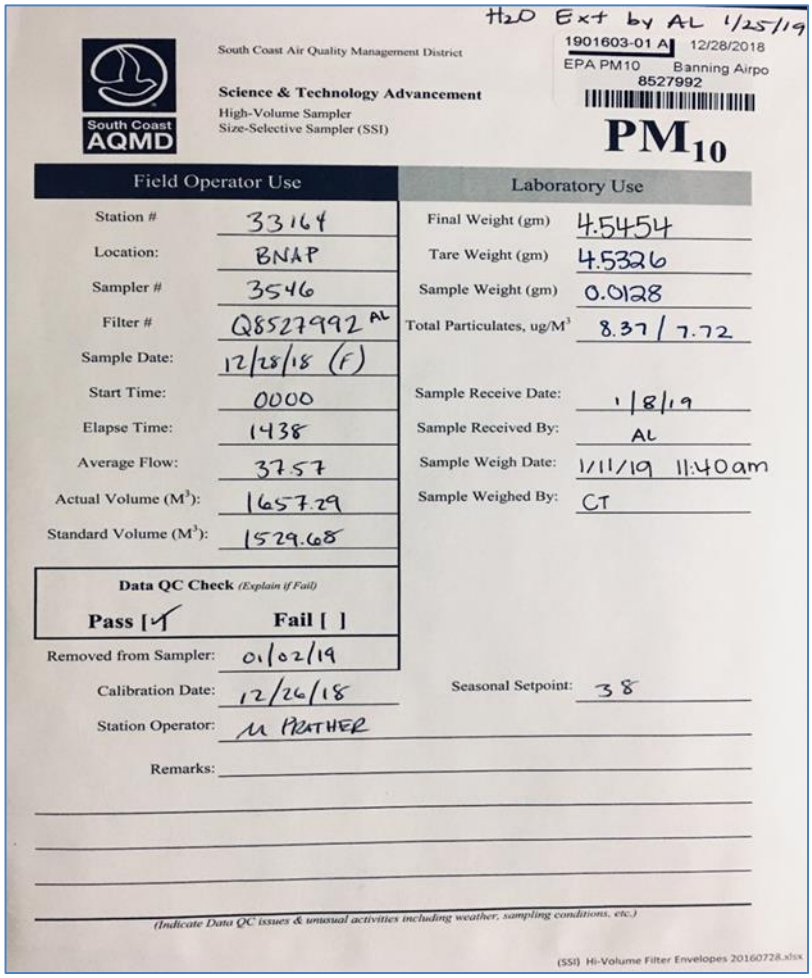
FOR LABORATORY USE ONLY **Lab Number** _____

Validation	Checked by:	Date
Step 1		
Step 2		

Lab Comments: _____

Template: PM25_FRM_Chain_of_Custody_v1.3_140220.docx

Figure 2-3
Example of PM2.5 FRM Sample Chain-of-Custody Form



H2O Ext by AL 1/25/19

South Coast Air Quality Management District

Science & Technology Advancement

High-Volume Sampler
Size-Selective Sampler (SSI)

1901603-01 A 12/28/2018
EPA PM10 Banning Airpo
8527992

PM_{10}

Field Operator Use		Laboratory Use	
Station #	33164	Final Weight (gm)	4.5454
Location:	BNAP	Tare Weight (gm)	4.5326
Sampler #	3546	Sample Weight (gm)	0.0128
Filter #	Q8527992 AL	Total Particulates, ug/M³	8.37 / 7.72
Sample Date:	12/28/18 (F)		
Start Time:	0000	Sample Receive Date:	1/8/19
Elapse Time:	1438	Sample Received By:	AL
Average Flow:	37.57	Sample Weigh Date:	1/11/19 11:40am
Actual Volume (M³):	1657.29	Sample Weighed By:	CT
Standard Volume (M³):	1529.68		

Data QC Check *(Explain if Fail)*

Pass [✓] **Fail [ ]**

Removed from Sampler: 01/02/19

Calibration Date: 12/26/18 Seasonal Setpoint: 38

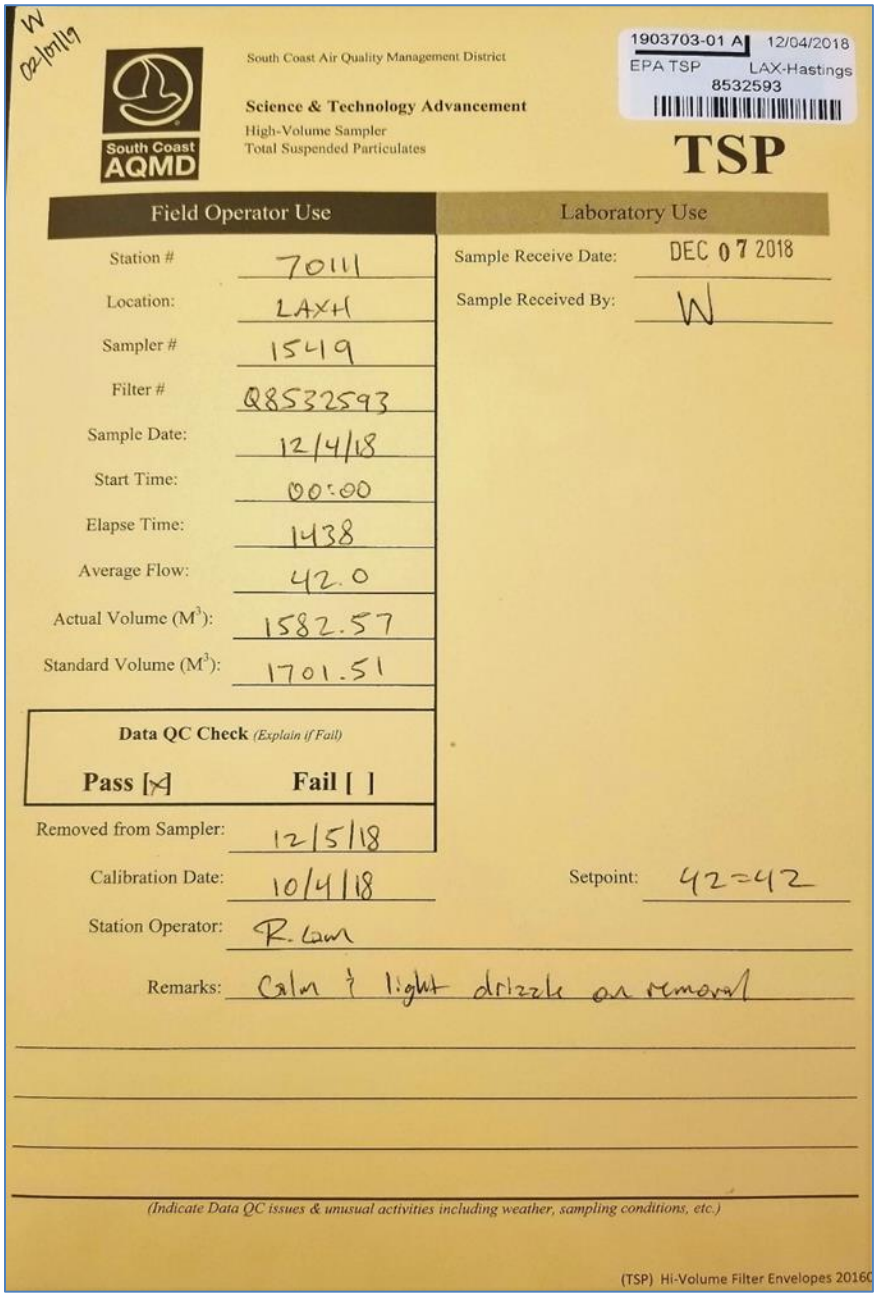
Station Operator: M PRATHER

Remarks:

(Indicate Data QC issues & unusual activities including weather, sampling conditions, etc.)

(SSI) Hi-Volume Filter Envelopes 20160728.xlsx

Figure 2-4
Example of PM10 FRM Sample Chain-of-Custody Form



W
02/07/19

South Coast Air Quality Management District

Science & Technology Advancement

High-Volume Sampler
Total Suspended Particulates

1903703-01 A 12/04/2018
EPA TSP LAX-Hastings
8532593

TSP

Field Operator Use		Laboratory Use	
Station #	70111	Sample Receive Date:	DEC 07 2018
Location:	LAX-1	Sample Received By:	W
Sampler #	1519		
Filter #	Q8532593		
Sample Date:	12/4/18		
Start Time:	00:00		
Elapse Time:	1438		
Average Flow:	42.0		
Actual Volume (M^3):	1582.57		
Standard Volume (M^3):	1701.51		

Data QC Check *(Explain if Fail)*

Pass [X] **Fail [ ]**

Removed from Sampler: 12/5/18

Calibration Date: 10/4/18 Setpoint: 42=42

Station Operator: R. Lam

Remarks: Calm & light drizzle on removal

(Indicate Data QC issues & unusual activities including weather, sampling conditions, etc.)

(TSP) Hi-Volume Filter Envelopes 2016

Figure 2-5
Example of TSP Sample Chain-of-Custody Form

2.3.1 Electronic Chain-of-Custody

At the time of writing this QAPP, South Coast AQMD COC records are hardcopy. However, electronic COC is being developed and tested with the EarthSoft Inc. EQuIS™ environmental data management system. Paper COCs will be maintained until all testing and staff training is complete, until such time that the relevant LS, MN and QA branch Senior and Principal staff and manager agree that the electronic system is ready for full production. The development of the EQuIS COC system incorporates the related concepts outlined in Appendix J – Guidance on the Use of Electronic Logbooks of the U.S. EPA QA Handbook, Volume II (U.S. EPA, 2017), including: security and administration, identification of personal entering or editing information, time stamping of entries, and recording/archival of original entries when changes are made. As such, the electronic COC is designed to meet relevant National Archives and Records Administration (NARA)[22] to collect, organize, and categorize information and to facilitate the preservation, retrieval, use, and disposition of records. For use with federal programs, the EQuIS COC, as well as any electronic logbook system that may be used in the future, will need to meet both South Coast AQMD and U.S. EPA policies that include the following.

- **Integrity** – The system must ensure the integrity of the records it manages and be able to:
  - Minimize the risk of unauthorized alteration or erasure of the records.
  - Allow only authorized personnel access to the records in the system.
  - Allow only authorized personnel to perform administrative functions such as creating or deleting directories, altering the parameters of metadata fields, and assigning access rights.
  - Ensure system security through the use of rigorous passwords and authenticating factors (challenge questions).
  - Ensure that locational information of entry session is recorded.
- **Metadata/Identity** – Identify each record sufficiently to enable authorized personnel to retrieve, protect, and carry out the disposition of the records in the system. Appropriate identifying information may include:
  - Organization of origin
  - site ID
  - date
  - code for type of logbook file or form
  - key words for retrieval – i.e., site common name , logbook form name, etc.
  - addressee (if any)
  - author- person completing the form (entry session) and unique identifier(s) of that person
  - Record of review/approval of data, if required
  - authorized disposition (coded or otherwise)
  - security classification (if applicable).

[22] National Archives and Records Administration (NARA) regulations at 36 CFR Part 1236 Electronic Records Management including Subparts B and C.

- **Backup** – The system must allow for records to be backed up to protect against information loss and be able to:
    - Be backed up on a regular basis (e.g., nightly) to safeguard against the loss of information due to equipment malfunctions or human error.
    - Provide for recovery of the records that have been copied during the backup.
    - Allow duplicate copies of records to be maintained in storage areas separate from the location of the records that have been copied.
- **Organization/Delegations** – The system should be documented in a manner that identifies roles and responsibilities for:
    - System development and maintenance
    - System administration and access authority
    - Logbook entry at designated sites and laboratory facilities
    - Logbook review auditing personnel
    - Password codes and protection from unauthorized users.
- **Accessibility** – The system should document the process of providing access to various monitoring organization personnel such as site operators, lab personnel, QA staff, independent auditors, management and system administrators, as well as detail the "levels" of access or permissions (read/write authority) each group might have.
- **Retrievability** – The system must retrieve records and be able to:
    - Permit easy retrieval in a timely fashion
    - Ensure that records are accessible by individuals who have a business need for information in the records
    - Provide a method for all authorized users of the system to retrieve desired documents
    - Permit retrieval of both individual records and groupings of related records.
- **Migration** – The system must allow records to be migrated and be able to:
    - Retain the records in a universal or similar format for their required retention period and until their authorized disposition date.
    - Ensure that information is not lost because of changing technology or deterioration.
    - Allow for the conversion of storage media to provide compatibility with current hardware and software.
    - Maintain a link between records and their metadata through conversion or migration.
    - Ensure that the authorized disposition of the records can be implemented after conversion.
- **Auditability** – The system should be developed and documented in a manner that it can be tested (hardware and software) and reviewed by information technology experts and QA auditing personnel both internal and external to the monitoring agency.
- **American with Disability Act (ADA) Compliance** – The e-logbook system should meet ADA standards.

- **e-Signatures/Legal Signatures** – E-signatures are accepted practice and must be considered for use as part of the submission process and the legal defensibility of e-logbook information. The system may be based on the set-up of secure password systems. The system should identify the individuals that are authorized to perform activities that generate information.
- **Information Security/Locking** – Once data from an entry session has been generated and transmitted, it must be immediately secured as an official record. It must also comply with U.S. EPA and federal requirements for safeguarding information resources and confidential business information, if applicable. Information about the program developers as well as the users should be stored. There should be a log of developer rights and developer changes to the programs.
- **Data entry/data revision/correction** – An entry session may be recalled and revised. However, those capable of revising the entry should be limited and be identified in the software system (i.e. originator, manager). In addition, the revision cannot overwrite the original information which must be maintained in the record.
- **Version Control** – The system may change and be revised over time. Version control of software must be maintained. Each program or file should have a version number so that updates can be tracked over time. Agency personnel must be aware of the version that is current and in use at all times, especially if the software is not located on a central IM system. A process of keeping users aware about versions in use must be developed. As software (e.g., MS Office) continues to be updated, there are often compatibility issues. Monitoring organizations need to be vigilant about this if a system/program/file is developed in a constantly changing environment.

2.4 Analytical Methods

This section of the QAPP is primarily about laboratory work for PM2.5, PM10 and lead analyses of discrete samples. These analyses are primarily done in the South Coast AQMD Laboratory. South Coast AQMD has arrangements with laboratories at other agencies (i.e., SDCAPCD, BAAQMD, or CARB) or contract laboratories where analyses can be completed if extended down time occurs with the South Coast AQMD Laboratory equipment or weight room.

For the gaseous pollutant analyzers, the in-situ monitoring methods are self-contained within the monitor in the field and no additional laboratory analyses is required. The theories of operations for the gaseous monitors can be found in the instrument user manuals, which are referenced in the relevant SOPs.

The following equipment is used for criteria pollutant analyses of discrete samples.

- Sartorius MC5® microbalance for PM2.5;
- Sartorius A22S analytical balance for PM10; and

- Perkin Elmer ELAN® DRC II Inductively Coupled Plasma Mass Spectrometer (ICP-MS) for TSP-Pb.

2.4.1 Discrete Sample Preparation

2.4.1.1 Standard Operating Procedures for Discrete Sample Preparation

Table 2-7 identifies the SOPs for handling criteria pollutant monitoring program filters prepared in the South Coast AQMD laboratory.

Table 2-7
SOPs for Discrete Sample Preparation

SOP #	SOP Title
SOP00104	Weigh Room Operations and Weighing of PM2.5 Samples
SOP00112	The Gravimetric Determination of PM10 Mass
SOP00113	Selection, Preparation & Extraction of Quartz Filters for Metals Analysis
OAG QA0044	Selection, Visual Inspection and Acceptance of Filters

2.4.2 Discrete Sample Recovery and Analysis

The South Coast AQMD uses a Promium Element® LIMS Data System to track laboratory prepared samples, samples taken into the field, and samples returned and/or awaiting analysis. This is documented in Operation Assistance Guide (OAG) QA0022, PM10 and TSP Sample Login/Quality Control and Generation of Work Order Bar Codes and SOP00104 (Weigh Room Operations and Weighing of PM2.5 Samples). Filters from each sample set are distributed to one or more analysts for analysis (e.g. PM10, PM2.5, and TSP-Pb).

2.4.2.1 Standard Operating Procedures for Discrete Sample Recovery and Analysis

Table 2-8 identifies the methods used for the analysis of South Coast AQMD Criteria Pollutant Monitoring Program discrete method samples.

Table 2-8
SOPs for Discrete Sample Recovery and Analysis

SOP #	SOP Title
SOP00096	Determination of Metals in Ambient Particulate Matter by Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
SOP00104	Weigh Room Operations and Weighing of PM2.5 Samples
SOP00112	The Gravimetric Determination of PM10 Mass
SOP000113	Selection, Preparation & Extraction of Quartz Filters for Metals Analysis
OAG QA0022	PM10 and TSP Sample Login/Quality Control and Generation of Work Order Bar Codes
OAG QA0057	Perkin Elmer Inductively Coupled Plasma-Mass Spectrometer (PE ICP-MS) Instrument Operation & Maintenance

2.5 Quality Control

This section describes quality control for both continuous monitoring and discrete sampling, including requirements, procedures, sampling frequency, and associated acceptance criteria. As discussed previously in Section 1.7.3, the measurement quality objectives (MQOs) are the acceptance or performance criteria 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. Technical QC elements are found in 40 CFR Part 58, Appendix A for regulatory monitors and guidance can be found in Sections 10 and 12 of the QA Handbook, Volume II and in the OAQPS technical memoranda that is found on the AMTIC website.

For the U.S. EPA criteria pollutant monitoring program, the measurement objectives, including NAAQS decisions, were developed and organized in the form of the U.S. EPA *Measurement Quality Objectives and Validation Templates* for each criteria pollutant, listed in Appendix D of the *Quality Assurance Handbook for Air Pollution Measurement Systems Vol. II, Ambient Air Quality Monitoring Program* (U.S. EPA, 2017a). South Coast AQMD criteria pollutant measurements and analyses are expected to meet or exceed these requirements and guidelines. U.S. EPA may make periodic revisions, to the Validation Templates, with notice provided to the monitoring agencies. These revisions are to be considered for the South Coast AQMD criteria monitoring program within a reasonable assessment and implementation period. As of the writing of this QAPP, the current version of the U.S. EPA QA Handbook, Volume II, Appendix D – *Measurement Quality Objectives and Validation Templates* is Revision No. 1, dated March 2017, as available on the AMTIC website[23]. This document is also reproduced in Appendix G of this QAPP.

[23] U.S. EPA QA Handbook Volume II, Appendix D – *Measurement Quality Objectives and Validation Templates, Revision No. 1, March 2017,* AMTIC website (available separately from full QA Handbook Volume II document):

Should monitoring or analysis issues arise that are not adequately addressed by routine field and laboratory quality control or the South Coast AQMD work order process for calibration or repair, or if there is a potential for significant data loss, a Quality Assurance Alert (QAA) is prepared by the affected group and sent to the QA Branch to be further discussed, tracked, resolved and documented. The QA Branch may issue a Corrective Action Request (CAR) to ensure that the issue is resolved and to prevent future reoccurrence.

40 CFR Part 58, Appendix A identifies a number of quality control samples that must be implemented for criteria pollutants that are used in comparison to the NAAQS. In addition, the quality control requirements found in the reference methods and the measurement principles described in 40 CFR Part 50 must be implemented unless there is a technical memo from U.S. EPA that provides an alternative procedure or check. Any special purpose monitors that use FRMs or FEMs will also be required to follow these requirements unless granted a waiver by the Regional Administrator (or delegate).

Due to successes over the years in reducing pollution, ambient air monitoring concentrations have decrease in the South Coast Air Basin, especially for CO, NO2 and O3. Some monitoring is now being accomplished with trace-level gas monitors, currently for the NCore sites (Rubidoux and Central Los Angeles CO, NOy and SO2), which includes the criteria pollutant monitoring for CO and SO2 at these sites, although there are still non-trace-level CO monitors at these two stations, as well. All the SO2 monitors in the South Coast AQMD network are trace level instruments. The ambient air QA regulations have kept up with this trend by lowering concentration levels for one-point QC checks and performance evaluation audit levels and suggesting that the audit levels chosen reflect ambient concentrations measured by the analyzer being evaluated. The intent of the regulatory language is to perform and report quality control data at concentrations more reflective of the routine concentrations.

A control chart is a graph used to study how a repetitive process changes over time. They are an important tool to visualize repeated problems with instruments or procedures and to quickly identify data anomalies and outliers without waiting to run an AQS standard report. Control charts can be especially helpful with timely evaluation of repeated issues or declining trends in an instrument's QC checks (e.g., zero and span drifts), as well as calibration (e.g., standard error and correlation coefficients), collocation, and audit results. U.S. EPA strongly recommends that this tool be used to monitor the zero/span and 1-point QC drift performance of each analyzer to assist the monitoring organization in determining when a calibration is needed. At this time, a few control charts have been developed by staff, using MS Access or Excel, for evaluation of QA/QC results for data validation and assessment purposes. South Coast AQMD will work toward introducing the use of more control charts in the workflow to visually represent and statistically monitor drift. The South Coast AQMD DMS system allows charting of many parameters in the data base. It also allows the flagging of out-of-control results from the plots. The Agilaire/ESC

[https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/APP_D%20validation%20template%20version%2003_2017_for%20AMTIC%20Rev_1.pdf]

Model 8872 data loggers and the AirVision system also allow visualization capabilities, both remotely and at the field stations.

2.5.1 Quality Control for Continuous Monitoring

This section identifies Criteria Pollutant Monitoring Program QC procedures, sampling frequency, and analytic procedures, as well as associated acceptance criteria. Current guidance indicates the following for each of the QC checks for gaseous pollutants (per U.S. EPA QA Handbook, Vol. II, Section 10.4):

Operating Range – This term should be used for the ranges that are promulgated in the approved federal reference method (FRM) or federal equivalent method (FEM) designation. Some instruments have been designated for more than one operating range and one range may need to be selected for operating the instrument. This range needs to be acknowledged when determining calibration concentrations, but only to the extent that one would not operate within one operating range and calibrate with points higher than the selected operating range.

Calibration Scale – The term should be used to indicate the concentration range that the instrument is calibrated over. U.S. EPA feels that the monitoring organization should have more flexibility in deciding their calibration scale and, although it needs to be within the selected operating range, it does not necessarily need to be performed at concentration levels not normally measured by the monitor. It is suggested that monitoring organizations select a calibration scale that provides more calibration points at the lower concentrations to establish a better test of linearity at the routine concentration ranges. The calibration scale minimally should cover the "controlling" NAAQS standard especially if the monitor is used for regulatory purpose (comparison to the NAAQS). Some NAAQS have more than one level (e.g., CO has a 9 ppm 8-hour level and a 35 ppm 1-hour level). The controlling standard is the level that a monitor is more likely to approach. See guidance on selecting appropriate concentration ranges for gaseous QC samples below for more details.

Zero Point – the bi-weekly zero point is a well-defined and a straightforward procedure for using zero air generators or standards to measure a zero point. Some air monitoring analyzers are capable of periodically carrying out automatic zero and span calibrations and making their own zero and span self-adjustments to predetermined readings. U.S. EPA discourages the use of either adjustment but considers automatic zero adjustments reasonable when: 1) the automatic zero standards pass through the sample inlet and sample conditioning system, 2) the zero point/adjustment is performed daily, and applied to the following 24-hour period, 3) the zero reading is within the 24-hour acceptance criterion, and 4) both the adjusted and unadjusted zero response readings can be obtained from the data recording device. Zero adjustments cannot be used to correct data prior to zero test.

Span Point – the bi-weekly span points have been traditionally set at 80-90% of the operating range. The span check concentration should be selected that is more beneficial to the quality control of the routine data at the site and U.S. EPA suggests: (1) the selection of an appropriate calibration scale (as described above); and (2) selecting a span that at a minimum is above 120%

of the highest NAAQS (for sites used for designation purposes) and above 99% of the routine data over a 3-year period and within the calibration scale.

One-Point QC – The bi-weekly one-point QC check is required to be reported within the range of 0.005- 0.080 ppm for O3, SO2 and NO2 and 0.5- 5 ppm for CO (per Section 3.1 of Appendix A, 40 CFR Part 58, revised 2016). The QC check gas concentration selected within the prescribed range should be related to the monitoring objectives for the monitor. If monitoring at an NCore site or for trace level monitoring, the QC check concentration should be selected to represent the mean or median concentrations at the site. If the mean or median concentrations at trace gas sites are below the MDL of the instrument the agency can select the lowest concentration in the prescribed range that can be practically achieved. If the mean or median concentrations at trace gas sites are above the prescribed range the agency can select the highest concentration in the prescribed range. An additional QC check point is encouraged for those organizations that may have occasional high values or would like to confirm the monitor's linearity at the higher end of the operational range or around NAAQS concentrations. If monitoring for NAAQS decisions, the QC concentration can be selected at a higher concentration within the prescribed range but should also consider precision points around mean or median monitor concentrations. Due to the audit levels being expanded to allow for lower concentration audits to support NCore and trace-level work, a May 5, 2016, Technical Memo[24] was posted on AMTIC in which U.S. EPA suggests the use of "dual" acceptance criteria for one-point QC checks that are performed at lower concentration ranges. The data can be evaluated in the AQS AMP256 Report under "One Point Quality Control". The 2016 memo lists the acceptance criteria for the one-point QC checks, as follows:

- O3: < ±1.5 ppb difference or < ±7.1 percent difference, whichever is greater (from 5-21.5 ppb, 1.5 is greater than 7.1%);
- SO2: < ±1.5 ppb difference or < ±10.1 percent difference (from 5-15 ppb, 1.5 is greater than 10.1%);
- NO2: < ±1.5 ppb difference or ±15.1 percent difference (from 5-10 ppb, 1.5 is greater than 15.1%);
- CO: Note that since the low end of CO one-point QC checks is 0.500 ppm, the absolute difference acceptance criteria that was developed for the annual PE (±0.03 ppm for concentrations < 0.200 ppm) will not be in effect.

The one-point QC check is made by challenging the analyzer with a QC check gas of known concentration between within the range given above. The ranges allow for appropriate check gas selection for SLAMS sites that may be sampling for different objectives, i.e., trace gas monitoring vs. comparison to National Ambient Air Quality Standards (NAAQS). The QC check gas concentrations selected are related to the routine concentrations normally measured at sites within

[24] *Technical Note – Guidance on Statistics for Use of 1-Point QC Checks at Lower Concentrations as described in 40 CFR Part 58 Appendix A Section 3.1.1,* U.S. EPA, Research Triangle Park, NC, May 5, 2016. [https://www3.epa.gov/ttn/amtic/files/policy/Tech_Memo_%20for_%201-pt_QC.pdf]

the South Coast AQMD air monitoring network in order to appropriately reflect the precision and bias at these routine concentration ranges. To check the precision and bias of SLAMS analyzers operating at ranges either above or below the levels identified, check gases of appropriate concentrations are used as approved by the appropriate U.S. EPA Regional Administrator or their designee. The standards from which check concentrations are obtained meet the specifications of Section 2.6 of 40 CFR Part 58, Appendix A. SOP00117, *Gas Calibration System Station Operations*, further describes the QC check process.

Based on the requirements and guidelines, South Coast AQMD is running daily one-point QC precision checks and weekly span checks using certified gases at the delivery gas concentrations shown in Table 2-9.

Table 2-9
Gas Concentrations for 1-Point Precision and Span Checks

Gas	PC Concentration	Span Concentration
Ozone	60 ±5 ppb	200 ±10 ppb
NO2	60 ±5 ppb	200 ±10 ppb
NO/NOx	100 ppb ±5%	400 ppb ±5%
CO	2.0 ppm ±5%	8.0 ppm ± 5%
CO – trace level	0.5 ppm ±5%	2.0 ppm ± 5%
SO2	9.0 ppb ±5%	36 ppb ± 5%

The delivery gas concentrations are selected within the prescribed range from 40 CFR Part 48 Appendix A and were chosen related to the monitoring objectives of the South Coast AQMD monitors. These values are based on the ambient data and the NAAQS levels. In the case of SO2, the values were set to the lowest possible using an 8 ppm SO2 bottle.

South Coast AQMD Automated precision and zero checks are performed daily, seven days per week, using the acceptance criteria and internal warning limits shown in Table 2-10 and 2-11, respectively. Automated span checks are performed weekly on the continuous gaseous instruments, using the acceptance criteria and internal warning levels shown in Table 2-12.

Table 2-10
Acceptance Criteria for Gaseous Criteria Pollutant Daily One-Point QC Checks (Precision)

Pollutant	Warning Limit (percent difference)	Acceptance Criteria
O3	5%	**< ±7.1%** (percent difference) or < ±1.5 ppb difference, whichever is greater
NO2 (incl. NCore trace-level)	10%	**< ±15.1%** (percent difference) or < ±1.5 ppb difference, whichever is greater
NO	10%	**< ±15.1%** (percent difference) or < ±1.5 ppb difference, whichever is greater
NOx	10%	**< ±15.1%** (percent difference) or < ±1.5 ppb difference, whichever is greater
NOy (NCore – not Criteria pollutant)	10%	**< ±15.1%** (percent difference) or < ±1.5 ppb difference, whichever is greater
CO (incl. NCore trace-level)	7%	**< ±10.1%** (percent difference)
SO2	7%	**< ±10.1%** (percent difference) or < ±1.5 ppb difference, whichever is greater
H2S (not Criteria pollutant)	10%	**< ±15.1%** (percent difference) or < ±1.5 ppb difference, whichever is greater

Table 2-11
Acceptance Criteria for Gaseous Criteria Pollutant Daily Zero Checks

Pollutant	Acceptance Criteria
O3	**< ±3.1 ppb (24 hr)** < ±5.1 ppb (>24 hr-14 day)
NO2 (incl. NCore trace-level)	**< ±3.1 ppb (24 hr)** < ±5.1 ppb (>24 hr-14 day)
NO	**< ±3.1 ppb (24 hr)** < ±5.1 ppb (>24 hr-14 day)
NOx	**< ±3.1 ppb (24 hr)** < ±5.1 ppb (>24 hr-14 day)
NOy (NCore – not Criteria Pollutant)	**< ±2.1 ppb (24 hr)** < ±5.1 ppb (>24 hr-14 day)
CO	**< ±0.41 ppm (24 hr)** < ±0.61 ppm (>24 hr-14 day**)**
CO (NCore trace-level)	**< ±50.1 ppb (24 hr)**
SO2	**< ±3.1 ppb (24 hr)** < ±5.1 ppb (>24 hr-14 day)
H2S (not Criteria pollutant)	**< ±3.1 ppb (24 hr)** < ±5.1 ppb (>24 hr-14 day)

Table 2-12
Acceptance Criteria for Gaseous Criteria Pollutant Weekly Span Checks

Pollutant	Warning Limit (percent difference)	Acceptance Criteria (percent difference)
O3	5%	**< ±7.1%**
NO2 (incl. NCore trace-level)	10%	**< ±10.1%**
NO	10%	**< ±15.1%**
NOx	10%	**< ±15.1%**
NOy (NCore – not Criteria Pollutant)	7%	**< ±15.1%**
CO (incl. NCore trace-level)	7%	**< ±10.1%**
SO2	7%	**< ±10.1%**
H2S (not Criteria pollutant)	10%	**< ±15.1%**

The South Coast AQMD MN Branch station operators, generally an AQIS I or Assistant AQIS, perform initial field checks and reviews the daily automated one-point QC checks as part of the Level 1 data validation. These QC checks are provided to most MN Branch Operations and Support staff and to the QA Branch every morning though the automated "DMS Moring Report" email. MN Branch/Operations Group Principal AQIS and Senior AQIS staff and QA Branch staff review the daily precision and zero checks and weekly span checks to monitor instrument performance and to quickly address and issues. A monthly summary report is also produced that is reviewed by MN and QA Branch staff.

Most quality control activities take place internally, meaning the South Coast AQMD is responsible for collecting the data and also develops and implements the quality control activities, evaluates the data, and takes corrective action when necessary. The internal activities can be used to take immediate action if data appear to be out of acceptance. Routine quality control checks, including flow, pressure and temperature verifications, are performed on continuous PM monitors, as shown in Table 2-13 with acceptance criteria. The acceptance criteria in these tables are consistent with the QA Handbook, Volume II, Appendix D – Validation Templates (U.S. EPA, March 2017 revision). The QC checks and their use in data validation are described further in SOP00117, *Gas Calibration System Station Operations*, and SOP00083, *Data Management and Validation for Continuous Instruments*.

Table 2-13
Quality Control Activities and Acceptance Criteria for Continuous PM10 and PM2.5

Activity	Frequency	Responsible Staff/Section	Acceptance Criteria	Corrective Action
PM10 Continuous Sampler, (STP Conditions)				
Average Flow Rate ***(Critical Criteria)***	Every 24 hours of operation	MN/Operations AQIS	Average within < ±5.1% of design (16.67 LPM)	Investigate/Invalidate
One-Point Flow Rate Verification ***(Critical Criteria)***	Every 30 days, each separated by 14 days	MN/Operations AQIS	< ±7.1% of transfer standard	Investigate/Invalidate
Inlet/Downtube Cleaning	Every 90 days and 4 times a calendar year	MN/Operations AQIS	Cleaned	Investigate/Correct
PM2.5 Continuous Sampler, (Local Conditions)				
Average Flow Rate ***(Critical Criteria)***	Every 24 hours of operation	MN/Operations AQIS	Average within 5% of 16.67 LPM at local conditions	Investigate/ Invalidate
Variability in Flow Rate ***(Critical Criteria)***	Every 24 hours of operation	MN/Operations AQIS	CV ≤ 2%	Investigate/Invalidate
One-Point Flow Rate Verification ***(Critical Criteria)***	Every 30 days, each separated by 14 days	MN/Operations AQIS	< ±4.1% of transfer standard < ±5.1% of flow rate design value	Investigate/Invalidate
Leak Check	Every 30 days	MN/Operations AQIS	< 1.0 LPM for BAM (Not Thermo BAM) ±0.15 LPM for TEOM	Investigate/Correct
One-Point Temperature Verification	Every 30 days	MN/Operations AQIS	< ±2.1°C	Investigate/Correct

Since the gaseous criteria pollutant measurements are sensitive to temperature, interior shelter temperature is monitored at the South Coast AQMD stations and kept within specified tolerances. Shelter temperature is recorded, and the data is automatically flagged if the hourly average temperature is outside the criteria range of 20.0-30.0oC, or to the most restrictive operable range of the instruments in the shelter based on instrument manufacturers specifications. At shelter temperatures approaching the extremes of this range, MN Branch Operations and Repair Group staff are warned by automated email alerts. The daily shelter temperature control, based on the hourly values, should have a standard deviation of < 2.1°C over 24 hours. The shelter temperature device is checked twice per calendar year (every 182 days) to be < ±2.1°C of the standard. PM2.5 FEM continuous monitors also have requirements for shelter temperature, with the temperature range as specified in the manufacturer's operational manual and the same daily shelter temperature control and temperature device check requirements as for gaseous criteria pollutants.

If checks reveal measurements do not satisfy criteria, the AQIS station operator records the observations on the maintenance sheets and/or downtime logs and informs his or her Senior AQIS

to assess needed action(s) and to generate an AM Work Order (SOP00116). With consensus that action is necessary, the Senior AQIS issues an e-mail to the MN Branch AM Work Orders Distribution List. In this e-mail, the problem is described, and a request is made to have the issue addressed by the Support Group. Once the work order has been created utilizing the Work Order Data Base, the Support Group Senior will assign the work order to the appropriate AQIS. The technician will perform necessary diagnostics and initiate appropriate action. The work order is tracked until the responsible Support Group AQIS reports the problem has been addressed and corrected. The details of the work performed are then entered in the Work Order Data Base. At that point, the AQIS who reported the problem is required to submit an email to their Senior AQIS stating whether the problem has been corrected. Once the Senior AQIS is satisfied with the outcome, they will then send an email giving the approval to close the work order. The work order is then archived upon completion. Status of work orders are distributed weekly by the Office Assistant in the Operations Group. Suspect data is flagged or recommended for invalidation by the AQIS as part of the Level 1 data validation.

Calibrations

Air monitoring instrumentation requires calibration work at regular intervals. Automated analyzers (except ozone) are calibrated by comparing the instrument's response when sampling a cylinder gas standard mixture to the cylinder's known concentration level. The analyzer is then adjusted to produce the correct response. Ozone analyzers are calibrated by on-site generation of ozone whose concentration is determined by a separate analyzer which has its calibration traceable to U.S. EPA. The site's analyzer is then adjusted to produce the same measured concentration as the traceable analyzer. Manual samplers are calibrated by comparing their volumetric flow rate at one or more flow rates to the flow measured by a flow rate transfer standard. Calibrations are performed when an instrument is first installed and at semi-annual intervals thereafter. Calibrations are also performed after instrument repairs or when the review of QC checks and monitored data indicates a drift in response to quality control check standards. Station operators preform this review as part of the Level 1 data validation.

South Coast AQMD air monitoring station calibrations are described in SOP00156, which follows 40 CFR Part 58 Appendix A and the QA Handbook, Vol. II, Appendix D, Validation Templates. More specific details are included in the individual instrument calibration SOPs. These typically reference the instrument manufacturer recommendations and manual regarding calibration frequency, if not addressed in U.S. EPA requirements or guidance. AM Support is responsible for performing calibrations of all samplers and air monitors within these recommended calibration intervals. Table 2-14 presents the criteria pollutant monitoring program sampler and instrumentation calibration schedule including acceptance criteria for acceptable calibration and associated activity such as zero air generation cleanliness. The frequencies for activities stated in the table are the minimum required. Additional calibration activity occurs after repairs, when controls, checks or audits indicate potential issues, and for increased data confidence at stations with a high decisional data value, such as after high multi-day ozone episodes occur.

Table 2-14
Calibration Schedule for Continuous Monitoring

Instrument or Equipment	Calibration Item	Frequency	Acceptance Criteria
Zero Air Generator Systems	**Zero air cleanliness verification**	Every 365 days and once per calendar year	**Concentrations below LDL** 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 Systems	**Flow controller**	Every 365 days and once per calendar year or after failure of one-point QC check or performance evaluation	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; 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**	All points < ±2.1% or < ±0.03 ppm difference of best-fit straight line, 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 Dynamic 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 pre-calibration 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, each within < ± 10.1% of target

Instrument or Equipment	Calibration Item	Frequency	Acceptance Criteria
PM2.5 Continuous Sampler	**Leak Check** ***(Critical Criteria)***	If failure of operational leak test or every 365 days and once a calendar year	Method Specific. See operator's manual.
	Design Flow Rate Adjustment ***(Critical Criteria)***	After multi-point calibration or verification	< ±2.1% of design flow rate
	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
	<u>Monitor Maintenance</u> 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.		

The MN Branch Support Group maintains an electronic spreadsheet recording the latest calibration date for each instrument within the South Coast AQMD air monitoring network. Page two of the spreadsheet calculates "days since last calibration". This spreadsheet toggles the background of items approaching a scheduled calibration or requiring calibration in orange. This spreadsheet toggles the background of items exceeding the scheduled calibration time window to red. Calibration personnel are responsible for monitoring assigned stations and keeping instruments within recommended calibration intervals.

Additional calibration activity beyond scheduled calibrations can be initiated by issuance of a work order. Typically, a work order asking for instrument calibration is filed whenever instrument drift is beyond control limits, and when an instrument either fails an audit or data approaches an audit acceptance limit. A request for a calibration work order will generally be initiated by the Station Operator, Senior AQIS, Principal AQIS, or in response to a QA Branch Corrective Action Request (CAR). Once created, it is assigned to the appropriate calibration technician. These work orders are tracked using the AM Work Order Data Base from issuance through completion and is closed

by the responsible Senior AQIS. The work order is then archived upon completion. Status of work orders are followed up weekly by the Office Assistant in the Operations Group.

Concentration Ranges for Gaseous Calibrations

SOP00156, *Air Monitoring Station Calibrations*, is the general SOP regarding calibrations of field monitors and samplers. Additional information can be found in the calibration SOPs for individual instruments. For the gaseous criteria samplers the calibration range, scale and points are included in SOP00156 and reproduced below in Table 2-15, including the rationale justifying the five calibration points chosen. To choose the calibration points, staff generally followed the example from the U.S. EPA QA Handbook, Vol. II, Section 10.4, *Selecting Appropriate Concentration Ranges for Gaseous QC Samp*les. This approach allows for flexibility for the sites and concentrations measured within the South Coast AQMD monitoring network. Ambient air monitoring data from numerous stations from the most recent 5-year period, including averages and maximum concentrations, the MDLs, 1-point QC checks, and NAAQS levels were assessed for each pollutant to choose appropriate calibration levels using approach that is consistent across the network. This data was also used to assess the annual Performance Evaluation audit levels.

Table 2-15
South Coast AQMD Calibration Scales for Gaseous Criteria Pollutants with Calibration Points and Rationale

Pollutant	Model	Range	Calibration Scale	Calibration Point #	Calibration Level +/- 10%	Rationale
CO	Horiba APMA-360, APMA-370 Thermo 48i	20 ppm	10 ppm	1	8 ppm	80% calibration scale, span value, near 8-Hour NAAQS
				2	6 ppm	Network 3-Year maximum value
				3	4 ppm	3-year maximum value at other sites
				4	2 ppm	1-Point PC
				5	1 ppm	Near MDL, near mean ambient concentration
Ozone	Teledyne T400 & 400E Thermo 49i	500 ppb	250 ppb	1	200 ppb	80% calibration scale and span value
				2	150 ppb	Network 3-year maximum reading
				3	100 ppb	Maximum readings at multiple site
				4	60 ppb	1-point PC check, near 8-Hour NAQQS
				5	20 ppb	Near MDL
NO2	Teledyne T200 Thermo 42i	1000 ppb	500 ppb	1	200 ppb NO2	Span Check (400 ppb NO, 200 PPB O3)
				2	100 ppb NO2	Network 3-year maximum value, 1-Hour NAQQS
				3	60 ppb NO2	1-point PC, Annual Avg. NAQQS
				4	30 ppb NO2	3-year ambient data mean
				5	20 ppb NO2	Near MDL
SO2	Thermo 43i-TLE	100 ppb	100 ppb	1	80 ppb	Near 1-Hour NAQQS level
				2	60 ppb	Linearity check
				3	40 ppb	Span Check point
				4	20 ppb	Network 3-year maximum value
				5	5 ppb	Near MDL, 3-year ambient data, 1-point PC levels

Stability of Gaseous Calibration & Audit Points

When challenging an analyzer with test atmospheres, such as during a routine biweekly one-point QC check or an annual performance audit, the operator/auditor pays close attention to the stability of the analyzer and the associated gas delivery system. There are several factors that can influence the stability of a reading, including the analyzer's response time. At a minimum, the operator allows the challenge gas to saturate the delivery system, then wait at least for the analyzer's lag and rise time (see 40 CFR §53.23) for each targeted concentration level. These two parameters, however, are not meant as a measure of when an instrument is stable enough to take a reading, but rather serve as a mark of the time the instrument takes to respond to a change in the test concentration. The longer the operator waits to take a reading, the better the results. At a minimum, U.S. EPA recommends that an operator wait 5 additional minutes after the analyzer has begun to measure consistent, instantaneous concentrations that show minimal variability and no discernible slope.

Some analyzers display diagnostics that alert the operator as to their stability, which typically represents the standard deviation of the concentrations collected by the analyzer (generally using second data readings held internally within the analyzer). For these analyzers with a stability indicator, the manufacturer will define in the user manual what value indicates that the analyzer has reached stability. If the operator utilizes the analyzer's stability readout as an indicator for when it is a safe time to take a concentration reading, it is recommended to wait an additional five minutes to ensure a static system before taking the reading.

The calibrator uses the electronic display, to view the minute data collected by the datalogger (or analyzer) in conjunction with any QA/QC procedure. While conducting the QA/QC check, the operator views the analyzer response to each concentration level during the test procedure, polling and graphing the minute data. The graphical display of the minute data is an excellent tool to assist the operator in determining the stability of each concentration level and can be accomplished in near-real time, using in the South Coast AQMD DMS or AirVision systems, as well as some instrument displays. U.S. EPA suggests the collection of 5 data points, at a minimum, is needed to produce a chart that will show clear "walkable stair steps" at each calibration or audit level (i.e., a 5-minute period with 5 1-minute data averages, at minimum).

South Coast AQMD has incorporated the U.S. EPA stability guidance for calibrations and audits. Individual points are evaluated for and must display stability at each check point. At the time a reading is taken the instrument trace is evaluated for stability and should not be rising or falling and must not be varying any more than ±1 ppb (±1 ppm for CO) over a five-minute period.

Concentration Ranges for Gaseous Audits

A performance evaluation (PE) audit must be conducted on each primary ozone, CO, NO2 and SO2 monitor once a year, per Appendix A to 40 CFR Part 58. This can be accomplished by evaluating 25 percent of the primary monitors each quarter. The evaluation should be conducted by a trained experienced technician other than the routine site operator. The evaluation is made by challenging the monitor with audit gas standards of known concentration from at least three audit levels. For point analyzers, the evaluation is carried out by allowing the monitor to analyze the audit gas test atmosphere in its normal sampling mode such that the test atmosphere passes through all filters, scrubbers, conditioners, and other sample inlet components used during normal ambient sampling and as much of the ambient air inlet system as is practicable. Additional information on the QA Branch PE audit program can be found in Section 3.1 of this QAPP. SOP00135, *Field Station Criteria Pollutant Ambient Air Instrument Performance Evaluation*, describes the gaseous PE procedures.

Appendix A of 40 CFR Part 58 defines the audit levels and concentration range by gaseous pollutant, as shown in Table 2-16. One point must be within two to three times the method detection limit of the instruments within the PQAOs network, the second point will be less than or equal to the 99th percentile of the data at the site or the network of sites in the PQAO or the next highest audit concentration level. The third point can be around the primary NAAQS or the highest 3-year concentration at the site or the network of sites in the PQAO. An additional 4th level is encouraged for those agencies that would like to confirm the monitors' linearity at the higher end

of the operational range. Both the evaluation concentrations of the audit gases and the corresponding measured concentration indicated or produced by the monitor being tested are reported to AQS. The percent differences between these concentrations are used to assess the quality of the monitoring data.

Table 2-16
Gaseous Audit Levels and Concentration Ranges (40 CFR Part 58, Appendix A)

Audit Level (L)	Concentration Range, ppm			
	O3	SO2	NO2	CO
1	0.004-0.0059	0.0003-0.0029	0.0003-0.0029	0.020-0.059
2	0.006-0.019	0.0030-0.0049	0.0030-0.0049	0.060-0.199
3	0.020-0.039	0.0050-0.0079	0.0050-0.0079	0.200-0.899
4	0.040-0.069	0.0080-0.0199	0.0080-0.0199	0.900-2.999
5	0.070-0.089	0.0200-0.0499	0.0200-0.0499	3.000-7.999
6	0.090-0.119	0.0500-0.0999	0.0500-0.0999	8.000-15.999
7	0.120-0.139	0.1000-0.1499	0.1000-0.2999	16.000-30.999
8	0.140-0.169	0.1500-0.2599	0.3000-0.4999	31.000-39.999
9	0.170-0.189	0.2600-0.7999	0.5000-0.7999	40.000-49.999
10	0.190-0.259	0.8000-1.000	0.8000-1.000	50.000-60.00

The standards from which audit gas test concentrations are obtained must meet the specifications of Section 2.6.1 of Appendix A to 40 CFR Part 58, as outlined in the following subsection. The gas standards and equipment used for the performance evaluation must not be the same as the standards and equipment used for one-point QC, calibrations, span evaluations, or NPAP. Audit test gases are generated by dilution of U.S. EPA protocol gas standards using a Multi-Gas Phase Titration Dilution System and Zero Air Generator. The concentration range for the certified U.S. EPA Protocol Gases used for the South Coast AQMD through-the-probe (TTP) audits are shown in Table 2-17.

Table 2-17
Concentration Ranges of U.S. EPA Protocol Gases for South Coast AQMD Through-the-Probe (TTP) Performance Evaluation Audits

Gas Cylinder	Concentration	Regulator Type
High CO	8-10 ppm	590 Brass
Low CO	1.5-2.5 ppm	590 Brass
Super Blend	8-13 ppm SO2, 20-40 ppm NO, 1000-1300 ppm CO	660 SS
Ultra-Pure Air	THC (as CH4) < 0.01 ppmv, CO < 0.01 ppmv, NOx < 0.001 ppmv, SO2 < 0.001 ppmv, NO < 0.1 ppmv, O2: 18-21%	660 SS

The concentration ranges and stability for South Coast AQMD annual gaseous PE audits are addressed in South Coast AQMD SOP00135, *Field Station Criteria Pollutant Ambient Air Instrument Performance Evaluation*. The stability discussion in the prior section applies to the PE audits as well as calibrations. The equipment used by the QA Branch for gaseous TTP PE audits, as of this writing, is shown in Table 2-18. The audit range, scale and targeted concentration levels are shown in Table 2-19, including the rationale justifying the four audit points chosen. Table 2-20 show the acceptance criteria used by South Coast AQMD for passing or failing a gaseous PE, from the QA Handbook, Vol. II, Appendix D, Validation Templates, along with the warning level at which the MN Branch is notified about potential developing instrument concerns for follow-up.

Table 2-18
QA Branch Equipment for Annual TTP Performance Evaluation Audits (2019)

Instrument	Make	Model
CO	Horiba	APMA-370
O3	Thermo Scientific	49i
Dilution System	Teledyne	T700U
Zero Air	Teledyne API	701H
Laptop Computer	Toshiba (or newer)	TECRA A11-S3521
4-port borosilicate glass manifold	Ace Glass	7488-34
Needle Valves	Parker (VALIN)	4Z-V4LN_SS

Table 2-19
South Coast AQMD Performance Evaluation Scales for Gaseous Criteria Pollutants with Audit Points and Rationale

Pollutant	Model	Range	Audit Point #	Air Flow (lpm)	Gas Flow	Target Concentration	Audit Level	Rationale
					(1250 ppm, 25 ppm NO/NOx)			
CO	Horiba APMA-360, APMA-370 Teledyne EU300 Thermo 48i	0-20 ppm (0-5 ppm for trace-level)	1	12	85 ccm	9.0 ppm	L6 (8.0-15.9 ppm)	80% of full scale, Span value, NAAQS 8-hour
			2	12	42.5 ccm	4.0 ppm	L5 (3.0-7.99 ppm)	Network 3-year maximum value
			3	12	12 ccm	1.5 ppm	L4 (0.9-2.99 ppm)	2-3 times MDL, 1-Point PC check
			4	12	6 ccm	0.5 ppm	L3 (0.2-0.899 ppm)	3-year mean ambient data & MDL (0.5 ppm)
Ozone	Teledyne T400, T400E Thermo 49i	0-500 ppb	1	12	0	150 ppb	L8 (140-169 ppb)	80% calibration scale and span value, network 3-year max value
			2	12	0	110 ppb	L6 (90-119 ppb)	3-year maximum reading at multiple sites & linearity check point.
			3	12	0	60 ppb	L4 (40-69 ppb)	Ozone NAAQS 8-hour (70 ppb), 1-point PC check, Ozone annual mean value (60 ppb)
			4	12	0	12 ppb	L2 (6-19 ppb)	Near 2-3 times MDL (5 ppb)
NO2	Teledyne T200 T500, T200E (Trace-level) Thermo 42i	0-1000 ppb (0-500 ppb trace-level)	1	12	85 ccm (175 ppb NO/NOx)	110 ppb	L7 (100-299.9 ppb)	Network 3-year max value, near 1-hour NAAQS (100 ppb)
			2	12	50 ccm (103 ppb NO/NOx)	60 ppb	L6 (50-99.9 ppb)	Primary and secondary NAQQS (53 ppb Annual Mean), 1-point PC check
			3	12	25 ccm (52 ppb NO/NOx)	30 ppb	L5 (20-49.9 ppb)	3-year ambient data mean (30 ppb)
			4	12	12 ccm (25 ppb NO/NOx)	12 ppb	L4 (8-19.9 ppb)	2-3 times MDL (2.7 & 5 ppb)
					9.0 ppm SO2 & 1250 ppm CO			
SO2	Thermo 43i-TLE (trace-level)	100 ppb	1	12	84	65	L6 (50-99 ppb)	1-hour NAQQS
			2	12	42	35	L5 (20-49.9 ppb)	Span check value
			3	12	20	12	L4 (8-19.9 ppb)	Network 3-year max value
			4	12	5	5	L3 (5-7.9 ppb)	Near MDL, 3-year ambient data, and 1-point PC level

Table 2-20
South Coast AQMD Gaseous TTP Gaseous Performance Evaluation Acceptance Criteria and Warning Levels

Variable	Acceptance Criteria	Failure	Warning Level (percent difference)
O3	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1 & 2 < ± 1.5 ppb difference or < ±15.1%	≥ ±15.1% ≥ ±1.5 ppb	±10-15%
NO2 (incl. NCore trace-level)	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1 & 2 < ± 1.5 ppb difference or < ±15.1%	≥ ±15.1% ≥ ±1.5 ppb	±10-15%
NO2 Converter Efficiency (incl. NCore trace-level)	Between 96% and 104.1%	< 96% or > 104%	Between 94% & 96% or 102% & 104%
CO (incl. NCore trace-level)	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1 & 2 < ±0.031 ppm difference or < ±15.1%	≥ ±15.1% ≥ ±0.031 ppm	±10-15%
SO2 (incl. trace-level)	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1 & 2 < ±1.5 ppb difference or < ±15.1%	≥ ±15.1% ≥ ±1.5 ppb	±10-15%

Equipment and Gas Certification

Equipment certification is also maintained by the MN Branch Support Group. Table 2-21 shows the equipment and the schedule for certifications. If acceptance criteria are not met after multiple attempts, then the device is inspected and repaired or exchanged with an instrument in inventory, if necessary. If there is a reason that sample data potentially would be affected, a Quality Assurance Alert (QAA) is generated to the QA Branch.

Both gaseous and flow-rate audit standards must meet the requirements outlined in Section 2.6 of 40 CFR Part 58, Appendix A. Accurate gaseous criteria pollutant measurements are dependent on the accuracy of calibration gases used. Gaseous pollutant concentration standards (permeation devices or cylinders of compressed gas) used to obtain test concentrations for CO, SOS, NO, and NO2 must be certified as traceable to either a National Institute of Standards and Technology (NIST) Traceable Reference Material (NTRM) or a NIST-certified Gas Manufacturer's Internal Standard (GMIS). Test concentrations for O3 must be obtained in accordance with the ultraviolet photometric calibration procedure specified in Appendix D to 40 CFR Part 50 and by means of a certified NIST-traceable O3 transfer standard. Flow rate measurements must be made by a flow measuring instrument that is NIST-traceable to an authoritative volume or other applicable standard. South Coast AQMD flow rate transfer standards are NIST traceable.

Table 2-21
Equipment Certification Schedule

Certification	Frequency	Acceptance Criteria
Ozone Transfer Standard – <u>Level 3 and Greater</u>:		
Qualification	Upon receipt of transfer standard	< ±4.1% or < ±4 ppb (whichever is greater)
Certification	After qualification and upon receipt/ adjustment/ repair	RSD of six slopes ≤ 3.7%; Std. Dev. of 6 intercepts ≤ 1.5
Recertification to a Higher Level Standard	Beginning and end of O3 season or every 182 days and twice per calendar year, whichever is less	New slope within ±0.05 of previous and RSD of six slopes ≤ 3.7% Std. Dev. Of 6 intercepts ≤ 1.5
Ozone Transfer Standard – <u>Level 2</u>:		
Certification/Recertification to a Level 1 Standard Reference Photometer	Every 365 days and once per calendar year (all)	Single point difference < ±3.1%
Level 2 and Greater Transfer Standard Precision		Standard Deviation < 0.005 ppm or 3.0%, whichever is greater
Recertification via a Transfer Standard		Regression slopes = 1.00 ± 0.003 and two intercepts are 0 ± 3 ppb
Field Thermometer	Every 365 days and once a calendar year	±0.1ºC resolution, ±0.5ºC accuracy
Field Barometer	Every 365 days and once a calendar year	±1 mm Hg resolution, ±5 mm Hg accuracy
Clock/Timer Verification	PM2.5: Every 30 days PM10 Hi-Vol: 4/year PM10 Cont.: every 180 days and twice a calendar year Pb Hi-Vol: Every 90 days and 4 times a calendar year	PM2.5: 1 min/month PM10: 15 min/day Pb: ±2 min/24-hour
Flow Rate Transfer Standard	Every 365 days and once a calendar year	< ±2.1% NIST traceable standard (For Pb Hi-Vol: Resolution 0.02 m^3/min ±2% reproducibility)
Gas Dilution System	Every 365 days and once per calendar year or after failure of one-point QC check or performance evaluation	Accuracy < ±2.1%

U.S. EPA has established a traceability protocol for the assay and certification of compressed gas calibration standards used for federal monitoring programs including the Criteria Pollutant Monitoring program (Protocol 1 gases). Specifically, Parts 50, 58, 60, and 75 of the monitoring regulations require that gaseous pollutant concentration standards used for calibration and audit of ambient air quality analyzers and continuous emission monitors be traceable to either a National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) or a NIST Traceable Reference Material (TRM). U.S. EPA requires that all Protocol 1 gases used in support of federal programs be from suppliers that participate in the U.S. EPA Protocol Gas Verification Program (PGVP) and demonstrate a minimum competency in the quality of Protocol 1 Gases. The South Coast AQMD only accepts Protocol 1 gases meeting criteria in EPA-600/R-12/531 (U.S.EPA, 2012a). Table 2-22 presents the Protocol 1 gas certification frequency and acceptance criteria as per the same U.S. EPA document.

Table 2-22
U.S. EPA Protocol 1 Gaseous Criteria Pollutant Maximum Certification Periods for Calibration Standards in Passivated Aluminum Cylinders

Gaseous Criteria Pollutant	Mixture	Certification Frequency	Acceptance Criteria[b]
CO	Nitrogen or air	1 ppm to 15% 8 years	±2.0 percent uncertainty
NO2	Nitric oxide in oxygen-free nitrogen	0.5 to 20 ppm 3 years	±2.0 percent total uncertainty
	Nitrous oxide in air[a]	20 ppm to 1% 8 years	±2.0 percent uncertainty
	Oxides of nitrogen in air	10 ppm to 1% 6 years	±2.0 percent uncertainty
SO2	Sulfur dioxide in air	1 to 50 ppm 4 years	±2.0 percent uncertainty
	Sulfur dioxide in air	50 ppm to 1% 8 years	±2.0 percent uncertainty

a. NIST defines its total NOx standards as containing nitrogen dioxide plus contaminant nitric acid.
b. Acceptance criteria as stated in EPA-600/R-12/531 (U.S. EPA, 2012a) is defined in the U.S. EPA Acid Rain Program (40 CFR Part 75) which states that a Protocol Gas must have a specialty gas producer certified uncertainty (95% confidence interval) that must not be greater than 2.0 percent of the certified concentration (tag value) of the gas mixture. Each Protocol gas also must have an estimated concentration for candidate standard with a value ≤±1 percent of the concentration of the reference standard used when certifying the standard.

Collocation of Continuous PM

Collocation of primary monitors is required for FEM continuous PM2.5 instruments, at least every 12 days for 15 percent of the sites by method designation. The acceptable annual range for the coefficient of variation (CV) is < 10.1% for data ≥ 3 μg/m^3. At the time of this writing, there are no FEM PM2.5 monitors designated as primary monitors, but most South Coast AQMD FEM PM2.5 monitors are collocated with the primary FRM monitors. The collocation requirement does not apply to PM10 FEM monitors.

2.5.2 Quality Control for Discrete Sampling

This section describes quality control requirements and practices for discrete filter sampling of PM2.5, PM10 and TSP-Pb.

2.5.2.1 Quality Control for Discrete Sample Preparation

Filters are received from U. S. EPA annually for PM2.5 mass, PM10 mass, and TSP-Pb and a subset of the lot is tested for acceptance in accordance with the relevant PM analytical method SOP, as listed previously in Table 2-7.

Filters are accepted or rejected in accordance with the filter acceptance criteria shown in Table 2-23. Accepted filters are assigned a unique Lab ID number or filter number before distribution to the MN Branch Operations Staff. Figure 2-6 shows the process for the quartz filters, and Figure 2-7 provides a flow chart for the filter acceptance process for the Teflon filters.

Table 2-23
Filter Inspection Acceptance Criteria for Discrete Samples

Discrete Sample Preparation				
Activity	**Frequency**	**Responsible Staff**	**Acceptance Criteria**	**Corrective Action**
Unexposed Filter Inspection (filter visual defect check) ***(Critical Criteria)***	Pre-sample All filters	LS/Aerosol Analysis Group AQ Lab Technician	No Pinhole(s), tearing, or other defects	1) Void filters with pinholes, tears, or other defects and use another filter. 2) If another filter is not available, use new field blank filter as the sample filter. 3) Obtain a new filter from lab.

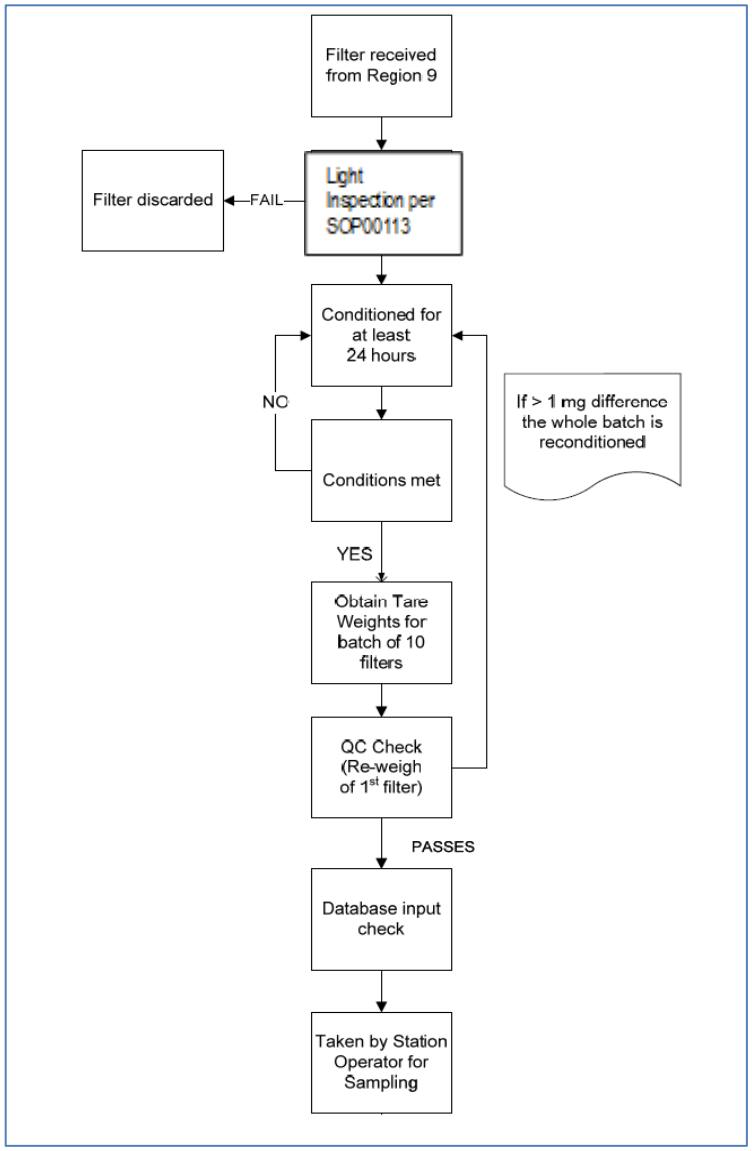


Figure 2-6
Quartz Filter Acceptance Process Flowchart

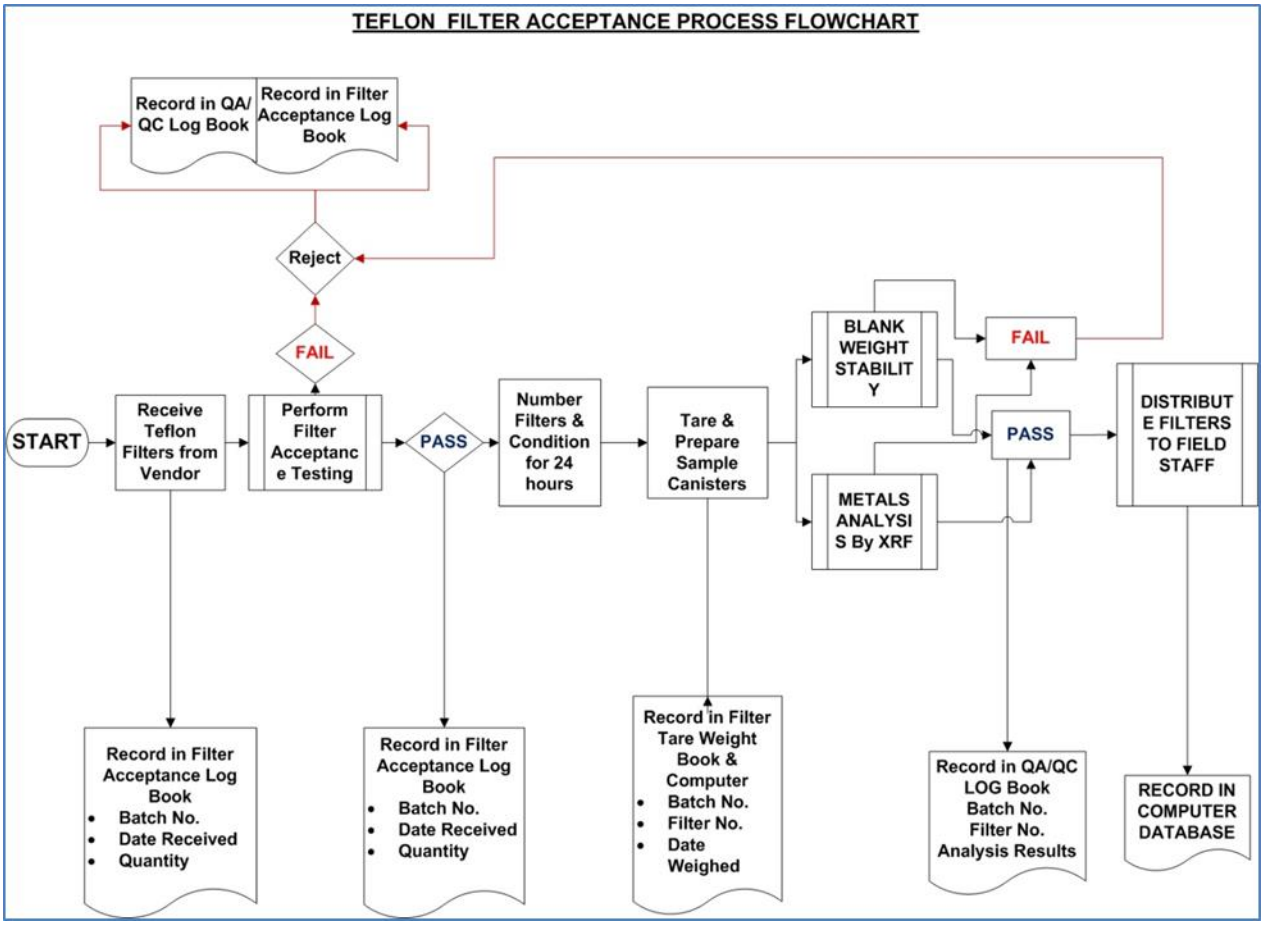


Figure 2-7
Teflon Filter Acceptance Process Flowchart

2.5.2.2 Quality Control for Discrete Sample Collection

This section identifies Criteria Pollutant Monitoring Program discrete sampling collection QC procedures, sampling frequency, and analytic procedures as well as associated acceptance criteria for discrete filter sampling and analysis, per the QA Handbook, Volume II, Appendix D, Validation Template, including, but not limited to, the criteria shown in Table 2-24. As of this writing South Coast AQMD is currently running more frequent (monthly) flow verification QC checks or calibrations for some FRM TSP-Pb, PM10 and PM2.5 samplers for increased confidence and reduced data loss at stations with high decisional value, including design value sites that are not in attainment of the NAAQS or when stations measured unusually high concentrations.

Table 2-24
Quality Control Activities for Discrete Sample Collection

Activity	Frequency	Responsible Staff/Section	Acceptance Criteria	Corrective Action
PM10 FRM Sampler – Hi-Vol, STP				
Sampling Period ***(Critical Criteria)***	All Filters	MN/Operations AQIS; LS/Aerosol Analysis Lab Tech, AQ Chemist	1440 minutes ±60 minutes, (24 ± 1 hours) midnight to midnight local standard time	Investigate/ Invalidate as warranted
Sample Recovery Filter Holding Times ***(Critical Criteria)***	All Filters	MN/Operations AQIS; LS/Aerosol Analysis Lab Tech, AQ Chemist	ASAP	Investigate
Filter Visual Defect Check ***(Critical Criteria*** *for unexposed filters****)***	All filters, unexposed and post-sample	MN/Operations AQIS; LS/Aerosol Analysis Lab Tech or AQ Chemist	Torn or otherwise compromised filter resulting in particulates by-passing the filter	Investigate/ Invalidate, as warranted Note & investigate unusual filter loading
Average Flow Rate ***(Critical Criteria)***	Every 24 hours of operation	MN/Operations AQIS	~1.13 m^3/min (varies with instrument)	Investigate/ Invalidate, as warranted
Flow Verification (One-point flow rate verification) ***(Critical Criteria)***	Every 90 days and 4 times a calendar year	MN/Operations AQIS	< ±7.1% of transfer standard and < ±10.1% from design	Investigate/Invalidate Inform Senior AQIS/ AM Work Order
Flow Rate Multi-Point Verification/ Calibration	Every 365 days and once a calendar year	MN/Support AQIS II	3 of 4 cal points within < ±10.1% of design	Investigate/Repair, note in downtime log; Inform QA
Field Temperature multi-point verification	On installation, then every 365 days and once a calendar year	MN/Support AQIS II	< ±2.1°C	Investigate/Repair, note in maintenance log; Inform QA
Monitor <u>Maintenance</u> Inlet/Downtube Cleaning Motor/housing gaskets Blower motor brushes	 Every 90 days and 4 times a calendar year Every 90 days and 4 times a calendar year 600-1000 hours	MN/Operations AQIS	 Cleaned Inspected replaced Replace	Investigate/Clean, Replace or Repair; note in maintenance log; Inform QA of systemic issues

Activity	Frequency	Responsible Staff/Section	Acceptance Criteria	Corrective Action
PM2.5 FRM Sampler – Local Conditions				
Filter Holding Time (Pre-sampling) ***(Critical Criteria)***	All Filters	LS/AQ Lab Tech/Chemist & MN/Operations/AQIS	≤ 30 days before sampling (from tare weighing to sampling)	Investigate/ Invalidate Communicate issues between Lab and Operations staff
Sample Recovery Filter Holding Time (sample end to lab) ***(Critical Criteria)***	All Filters	MN/Operations AQIS LS/Aerosol Analysis Balance Technician AQ or SAQ Chemist verifies	≤ 7 days 9 hours from sample end date	Investigate/ Invalidate as warranted Communicate issues between Lab and Operations staff
Sampling Period (including multiple power failures) ***(Critical Criteria)***	All Filters	MN/Operations AQIS LS/Aerosol Analysis Balance Technician, AQ or SAQ Chemist verifies	1380-1500 minutes, (24 ± 1 hours) midnight to midnight local standard time <u>or</u> if < 1380 minutes & exceeding NAAQS	Investigate/ Invalidate as warranted (Valid but Flagged if < 1380 minutes & exceeding PM2.5 NAAQS, currently 35 μg/m^3)
Filter Visual Defect Check ***(Critical Criteria** for unexposed filters**)***	All filters, unexposed and post-sample	MN/Operations AQIS LS/Balance Technician	Torn or otherwise compromised filter resulting in particulates by-passing the filter	Investigate/ Invalidate as warranted Note unusual filter loading
Average Flow Rate ***(Critical Criteria)***	Every 24 hours of operation	MN/Operations AQIS LS/Aerosol Analysis SAQ Chemist verification	Within 5% of 16.67 LPM	Investigate/Verify & Repair/Calibrate; Invalidate as warranted
Variability in Flow Rate ***(Critical Criteria)***	Every 24 hours of operation	MN/Operations AQIS LS/Aerosol Analysis SAQ Chemist verification	CV ≤ 2%	Investigate/Verify & Repair/Calibrate; Invalidate as warranted
One-point Flow Rate Verification ***(Critical Criteria)***	every 30 days, separated by 14 days	MN/Operations AQIS	< ± 4.1% of transfer standard (< ± 5.1% of flow rate design value)	Investigate/Verify & Repair/Calibrate; Invalidate as warranted
Design Flow Rate Adjustment ***(Critical Criteria)***	After multi-point calibration or verification	MN/Operations AQIS	< ±2.1% of design flow rate	Investigate/Verify & Repair/Calibrate; Invalidate as warranted
Individual Flow Rates ***(Critical Criteria)***	Every 24 hours of operation	MN/Operations AQIS LS/Aerosol Analysis SAQ Chemist verification	No flow rate excursion > ±5% for > 5 min	Investigate/Correct/Flag Data, as appropriate
Filter Temperature Sensor ***(Critical Criteria)***	Every 24 hours of operation	MN/Operations AQIS LS/Aerosol Analysis SAQ Chemist verification	no excursions of > 5°C lasting longer than 30 minutes	Investigate/Flag Data, as appropriate

Activity	Frequency	Responsible Staff/Section	Acceptance Criteria	Corrective Action
PM2.5 FRM Sampler – Local Conditions (cont.)				
External Leak Check *(Critical Criteria)*	Before each flow rate verification/calibration and before and after PM2.5 separator maintenance	MN/Operations AQIS	< 80.1 mL/min	Investigate/Internal Leak Check/Repair/Invalidate, as appropriate The associated leak test procedure shall require that for successful passage of this test, the difference between the two pressure measurements shall not be greater than the number of mm of Hg specified for the sampler by the manufacturer, based on the actual internal volume of the sampler, that indicates a leak of less than 80 mL/min.
Internal Leak Check *(Critical Criteria)*	If failure of external leak check	MN/Operations AQIS (check); Support AQIS II (calibration/ repair)	< 80.1 mL/min	Investigate/Verify/Repair/Invalidate as appropriate
One-point Temperature Verification	Every 30 days	MN/Operations AQIS	< ±2.1°C	Investigate/Repair
Pressure Verification	Every 30 days	MN/Operations AQIS	< ±10.1 mm Hg	Investigate/Repair
Annual Temperature Multi-Point Verification/ Calibration	On installation, then every 365 days and once a calendar year	MN/Support AQIS II	< ±2.1°C	Investigate/Repair, note in downtime log; Inform QA Branch
Pressure Verification/ Calibration	On installation, and on one-point verification failure	MN/Support AQIS II	< ±10.1 mm Hg	Investigate/Repair, note in downtime log; Inform QA
Annual Flow Rate Multi-Point Verification/ Calibration	Electromechanical maintenance or transport or every 365 days and once a calendar year	MN/Support AQIS II	< ±2.1% of transfer standard	Investigate/Repair, note in downtime log; Inform QA

Activity	Frequency	Responsible Staff/Section	Acceptance Criteria	Corrective Action
Monitor <u>Maintenance</u> Cyclone/PM2.5 Separator Inlet Cleaning Downtube Cleaning Filter Housing Assembly Cleaning Circulating Fan Filter Cleaning	Every 30 days (VSSC) Every 5 sampling events (WINs) Every 30 days Every 90 days Every 30 days Every 30 days	MN/Operations AQIS	Cleaned/Changed	Investigate/Clean, Replace or Repair; note in maintenance log; Inform QA of systemic issues
TSP-Pb Sampler – Hi-Vol, Local Conditions				
Filter Holding Times (Sample Recovery)	All Filters	MN/Operations AQIS	ASAP	Investigate
Sampling Period ***(Critical Criteria)***	All Filters	MN/Operations AQIS	1440 minutes ±60 minutes (24 <u>±</u>1 hour), midnight to midnight local standard time	Investigate/ Invalidate
Filter Visual Defect Check ***(Critical Criteria** for unexposed filters**)***	All filters, unexposed and post-sample	LS/Aerosol Analysis Lab Technician, MN/Operations AQIS	Torn or otherwise compromised filter resulting in particulates by-passing the filter	Investigate/ Invalidate 1) Determine if air stream is bypassing the filter by inspecting area downstream of filter holder in the sampler 2) Inspect the in-line filter mounted before the sample pump and determine if excessive loading has occurred. Replace as necessary.
Average Flow Rate ***(Critical Criteria)***	Every 24 hours of operation	MN/Operations AQIS	1.1-1.70 m^3/min (varies with instrument) in actual condition	Investigate/ Invalidate
One-Point Flow Rate Verification ***(Critical Criteria)***	Required Every 90 days and 4 times a calendar year (Currently done Monthly)	MN/Operations AQIS	< +7.1% from transfer standard	Inform Senior AQIS/ AM Work Order
Flow Rate Multi-Point Verification/ Calibration	After receipt, after motor maintenance or failure of 1- point check and every 365 days and once a calendar year	MN/Support AQIS II	5 points over range of 1.1 to 1.7 m^3/min < ±5.1% limits of linearity	Investigate, note in downtime log; Inform QA

Activity	Frequency	Responsible Staff/Section	Acceptance Criteria	Corrective Action
Monitor Maintenance				
Inlet Cleaning	Every 90 days and 4 times a calendar year	MN/Operations AQIS I & II	Cleaned/Inspect /Replace	Clean or Replace
Motor/housing gaskets	~400 hours			
Blower motor brushes	400-500 hours			

2.5.2.1.1 Blanks and Blank Correction

The objective for collecting blanks at various phases of sample collection is to determine whether contamination is occurring at that phase, be it in the field, during sample transport, or at the analytical laboratory, and to try to reduce this contamination if it is greater than acceptance limits. Some level of contamination is acceptable and values below the acceptance limits do not require corrective action or investigation. Values above this level should be investigated in order to reduce this contamination to acceptable levels. U.S. EPA does not endorse blank correction of data. In rare cases there may be a laboratory or measurement phase that has a measurable, consistent and documented level of contamination that cannot be eliminated, and blank correction may be contemplated to adjust the data for this contamination. In this case, South Coast AQMD would contact U.S. EPA Region 9 for advice before blank correction is implemented.

Discrete sampling for PM2.5 requires field blanks at scheduled frequencies by 40 CFR Part 50, Appendix L and for TSP-Pb, as listed in the QA Handbook Volume II, Appendix D – Validation Templates. This is necessary for determining bias (if any) for all the process post media preparation through South Coast AQMD laboratory drop off. South Coast AQMD trip blanks are only collected if field blanks appear inconsistent. Trip and field blanks are handled without air sampling through the sampling media. Trip blanks are transported but not placed on the sampler. Field blanks are transported to the monitoring site, placed on the sampler, and then retrieved without sampling. If acceptance criteria are exceeded, the sampler and sample transportation methods are investigated and data invalidated, if appropriate. Acceptance criteria are determined from the QA Handbook Volume II, Appendix D – Validation Templates for PM2.5 and TSP-Pb field blanks and through discussion with U.S. EPA Region 9 and other air monitoring organizations for the PM10 field blanks and all trip blanks. Table 2-25 shows the trip and field blank frequency and acceptant criteria for the South Coast AQMD criteria pollutant program.

Table 2-25
Trip and Field Blank Schedule

Sample	Description	Frequency (by site)	Acceptance Criteria
PM10	Field Blank	One per Quarter	N/A
PM2.5	Trip Blank	As indicated, based on field blank inconsistencies	< ±30.1 µg change between weighings
PM2.5	Field Blank	10% or (i.e., Monthly for 1-in-3-day sampling)	< ±30.1 µg change between weighings
TSP-Pb	Field Blank	One per Quarter	< LDL

2.5.2.1.2 Collocated Samples

Collocated samples are collected by placing a sampler in the same location as the primary sampler, as specified in *40 CFR Part 58 Appendix A*. South Coast AQMD collocated PM samples are collected typically on a 1-in-6-day schedule. The collocation for TSP-Pb collocation is required on a 1-in-12-day schedule, but the South Coast AQMD is currently collocating on a 1-in-6-day schedule. If the primary sampler does not operate correctly or collected data was invalid, valid collocated data can be substituted for the particular samples missed by the primary sampler. If the CV values exceed the criteria, then sample and analysis techniques are investigated to determine the cause of the high variability and perform corrective action as necessary. Table 2-26 shows the collocation requirements and criteria from the QA Handbook Volume II, Appendix D – Validation Templates, along with the current South Coast AQMD collocation sampling and frequency. For PM2.5, the goal for acceptable measurement uncertainty is defined for precision as an upper 90 percent confidence limit for the coefficient of variation (CV) of 10 percent and ±10 percent for total bias. FEM continuous PM2.5 monitors require collocation with a combination of discrete sampling FRM and FEM monitors, but FEM continuous PM10 samplers do not require collocation. Further details on the South Coast AQMD collocation monitoring can be found in the current South Coast AQMD Annual Network Plan.

Table 2-26
Collocation Sampling Current Schedule and Criteria

Sample	Minimum Requirement*	Current Stations	Current Frequency	Criteria*
PM10	Every 12 days for 15% of sites by method designation and PQAO	3 Stations	1 in 6 days	CV < 10.1% of samples ≥ 15 µg/m^3
PM2.5	Every 12 days for 15% of sites by method designation and PQAO	5 Stations	1 in 6 days	CV < 10.1% of samples ≥ 3.0 µg/m^3
TSP-Pb	Every 12 days for 15% of sites by method designation and PQAO (not counting non-source oriented NCore sites)	2 Stations	1 in 6 days	CV < 20.1% of samples ≥ 0.02 µg/m^3 (cutoff value)

* Per QA Handbook Volume II, Appendix D – Validation Templates and 40 CFR Part 58, Appendix A.

2.5.3 Quality Control for Discrete Sample Recovery and Analysis

This section identifies QC procedures and frequency for each sampling, analysis, or measurement technique, as well as associated acceptance criteria and corrective action which are based upon the *QA Handbook for Ambient Air Quality Measurement Systems, Volume II*, Section 10 (U.S. EPA, 2017a). The individual SOPs, as listed previously in Table 2-8, provide detailed information on these activities. PM2.5 filters are protected from exposure to temperature above 25°C from sample retrieval to conditioning. The post-sample weighing of these filters must occur ≤ 10 days from the sample end date if shipped at ambient temperature or ≤ 30 days if shipped below average ambient (or 4°C or below for average sampling temperatures < 4°C) from the sample end date.

Upon receipt of the samples, filters are inspected according to the filter inspection criteria from South Coast AQMD SOP00113, as shown in Table 2-27.

Table 2-27
Discrete Sample Filter Inspection Criteria

Recovery				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Filter Integrity Inspection	Post-sample receipt All Filters	LS/Aerosol Analysis AQ Laboratory Technician	Correct type & size; No Pinholes, tearing, unsampled particles, imperfections, or other significant defects; Unusual filter loading	Investigate/Invalidate

The PM filters are conditioned for at least 24 hours in the PM conditioning and weigh room which meets the environmental, conditioning and preparation criteria as outlined in Table 2-28. The South Coast AQMD balances for PM2.5 and PM10 are located in the filter conditioning environment, so that the temperature and relative humidity conditions are maintained for the weighing. This is required for PM2.5 mass and the same room is used for PM10, which generally has less strict requirements. The HVAC system for the weigh room is segregated from the rest of the lab and a HEPA filtration system has been recently (early 2020) installed for that room.

Additional quality control measures for the lab analyses are indicated in Table 2-29. In addition to the analysis of field and trip blanks, the South Coast AQMD Laboratory analyzes blanks for calibration and sequence quality control. For PM mass analyses these include: filter lot blanks, exposure lot blanks, and lab filter blanks. For TSP-Pb ICP-MS analyses the laboratory blanks include: lab blanks, rinse blanks, initial calibration blanks, continuing calibration blanks, reagent blanks method blanks, reagent blank spikes and matrix spikes.

Table 2-28
Quality Control Activities for Discrete Sample Recovery and Analysis – PM Conditioning

Activity	Frequency	Responsible LS Staff	Acceptance Criteria	Corrective Action
Filter Equilibration *(PM Critical Criteria)*	All Filters	Balance Analyst	24 hours minimum	Wait for correct temperature/humidity to be achieved
Room Temperature Range *(PM Critical Criteria)*	Before and during each weighing session (all filters)	Balance Analyst	**PM2.5:** 24-hour mean 20.0-23.0ºC **PM10**: 15.0-30.0ºC	Wait for correct temperature to be achieved; contact the PM2.5 SAQ Chemist; Call the service provider holding the maintenance agreement; Document in the weigh room logbook; Notify the PM2.5 Principal AQ Chemist QA Branch SAQ Chemist, and the MN Branch/Operations Principal AQIS if prolonged issue
Room Temperature Control *(PM Critical Criteria)*	Each Filter	Balance Analyst	**PM2.5:** < 2.1ºC Standard Deviation over 24 hours **PM10:** < 3.1°C SD over 24 hours	Wait for correct temperature to be achieved; contact the PM2.5 SAQ Chemist; Call the service provider holding the maintenance agreement; Document in the weigh room logbook; Notify the PM2.5 Principal AQ Chemist QA Branch SAQ Chemist, and the MN Branch/Operations Principal AQIS if prolonged issue
Room Humidity Range *(PM Critical Criteria)*	Before and during each weighing session (all filters)	Balance Analyst	**PM2.5:** 24-hr mean 30.0%-40.0% RH or within ±5.0% sampling RH but ≥ 20.0% RH **PM10:** 20.0%-45.0% RH	Wait for correct humidity to be achieved; contact the PM2.5 SAQ Chemist; Call the service provider holding the maintenance agreement; Document in the weigh room logbook; Notify the PM2.5 Principal AQ Chemist QA Branch SAQ Chemist, and the MN Branch/Operations Principal AQIS if prolonged issue
Room Humidity Control *(PM Critical Criteria)*	Each Filter	Balance Analyst	< 5.1% Standard Deviation over 24 hours	Wait for correct humidity to be achieved; contact the PM2.5 SAQ Chemist; Call the service provider holding the maintenance agreement; Document in the weigh room logbook; Notify the PM2.5 Principal AQ Chemist QA Branch SAQ Chemist, and the MN Branch/Operations Principal AQIS if prolonged issue
Pre/Post- Sampling RH *(PM Critical Criteria)*	All Filters	Balance Analyst	Difference in 24-hour means < ±5.1% RH	Wait for 24 hours of proper RH equilibration; contact PM2.5 SAQ Chemist and the QA SAQ Chemist; Call Service provider that holds maintenance agreement; Document in weigh room logbook; Notify PM2.5 PAQ Chemist and Principal AQIS
Balance Location *(PM Critical Criteria)*	All Filters	Balance Analyst	Located in filter conditioning room	
Microbalance Auto-Calibration *(PM2.5 Critical Criteria)*	Prior to each weighing session	Balance Analyst	Manufacturer's specification	(1) Contact PM2.5 SAQ Chemist and the QA SAQ Chemist (2) Document in weigh room logbook (3) Contact microbalance service representative (4) Notify PM2.5 Principal AQ Chemist, QA Branch SAQ Chemist, and the MN Branch/Operations Principal AQIS if prolonged issue
Room Temperature Sensor Check	Every 90 days	Balance Analyst	< ±2.1°C	Investigate/Repair or Calibrate/Inform QA of potential for data quality impact
Room Humidity Sensor Check	Every 90 days	Balance Analyst	< ±2.1%	Investigate/Repair or Calibrate/Inform QA of potential for data quality impact

Activity	Frequency	Responsible LS Staff	Acceptance Criteria	Corrective Action
Working Mass Standards Verification – compared to primary standards	Every 90 days	Balance Analyst	< ±2.1 µg	Contact PM2.5 SAQ Chemist and the QA SAQ Chemist; Document in weigh room logbook
Microbalance Audit	Every 365 days and once per calendar year	CARB or QA Branch Auditor	< ±0.003 mg or manufacturer's specs, whichever is tighter	(1) Contact PM2.5 SAQ Chemist and the QA SAQ Chemist (2) Check weights (3) Document in weigh room logbook (4) Notify Microbalance service contract representative if needed
Microbalance Calibration	At installation and every 365 days and once per calendar year	Contracted microbalance service representative	Manufacturer's specs, whichever is tighter	(1) Contact PM2.5 SAQ Chemist and the QA SAQ Chemist (2) Check weights (3) Document in weigh room logbook
Lab Temperature Certification	Every 365 days and once a year	Balance Analyst	< ±2.1°C	(1) Contact PM2.5 SAQ Chemist and the QA SAQ Chemist (2) Document in weigh room logbook
Lab Humidity Certification	Every 365 days and once a year	Balance Analyst	< ±2.1%	(1) Contact PM2.5 SAQ Chemist and the QA SAQ Chemist (2) Document in weigh room logbook
Primary Mass Standards Certification	Every 365 days and once a calendar year	Balance Analyst	0.025 mg tolerance (Class 2)	Contact PM2.5 SAQ Chemist and the QA SAQ Chemist; Document in weigh room logbook
Cleaning weigh room	Monthly, at minimum	Balance Analyst	No visible dust or particles	Clean according to SOP00104
Sticky floor mat (outside weight room entry)	Weekly, or more frequently as needed	Balance Analyst	When floor mat is covered in particulate matter/dirt	Replace mat
Polonium Strips	Semi-Annually	Balance Analyst	6 Months	Replace Polonium Strips
HVAC system preventive maintenance	Yearly, or more frequently as needed	SAQ Chemist	Within specs	Contract for maintenance

Table 2-29
Quality Control Activities for Discrete Sample Analysis

Activity	Frequency	Responsible Section/Staff	Acceptance Criteria	Corrective Action
PM10 Mass				
Sample Recovery Filter Holding Time (Field time from sample to lab) ***(Critical Criteria)***	All sampled filters	MN/Operations AQIS LS/Aerosol Balance Analysis, AQ or SAQ Chemist verifies	ASAP	Investigate/Invalidate sample; communicate issue between Lab and Operations Senior staff; inform QA Branch if recurring issue or significant data loss
Balance Check (working standards)	Beginning, 15th sample or more frequent, end	Balance Analyst	< ±0.51 mg of true zero and < ±0.51 mg 1-5 g check weight	Reweigh; Document in Weigh Room logbook; Contact SAQ Chemist
Duplicate Weighing "Routine"	5-7 per weighing session	Balance Analyst	< ±2.8 mg change from original value	Reweigh; Document in Weigh room logbook; Contact SAQ Chemist
Integrity – Random sample of test field blank filters	10%	Balance Analyst	< ±5.1 µg/m^3	Reweigh; Document in Weigh room logbook; Contact SAQ Chemist
PM2.5 Mass				
Tared Filter Holding Time (Pre-sampling) ***(Critical Criteria)***	All tared filters must be sampled within 30 days	MN/Operations AQIS LS/Aerosol Analysis Balance Analyst, AQ or SAQ Chemist verifies	≤ 30 days after taring	Investigate/Invalidate sample; communicate issue between Lab and Operations Senior staff; inform QA Branch if recurring issue or significant data loss
Sample Recovery Filter Holding Time (Field time from sample to lab) ***(Critical Criteria)***	All sampled filters	MN/Operations AQIS LS/Aerosol Analysis Balance Analysis, AQ or SAQ Chemist verifies	≤ 7 days 9 hours from sample end date	Investigate/Invalidate sample; communicate issue between Lab and Operations Senior staff; inform QA Branch if recurring issue or significant data loss
Post-Sampling Weighing (Sampled filter total holding time) ***(Critical Criteria)***	All sampled filters	MN/Operations AQIS (sample recovery time & temperature) LS/Aerosol Analysis Balance Analysis, AQ or SAQ Chemist verifies	All filters must protected from exposure to temperatures above 25°C from sample retrieval to conditioning. Filters must be weighed: ≤ 10 days from sample end date if shipped at ambient temperature, or ≤ 30 days if shipped below avg ambient (or 4°C or below for avg sampling temps < 4°C) from sample end date	Investigate/Invalidate sample; communicate issue between Lab and Operations Senior staff; inform QA Branch if recurring issue or significant data loss
Sampling Period (including multiple power failures) ***(Critical Criteria)***	All Filters	MN/Operations AQIS LS/Aerosol Analysis Balance Technician, AQ or SAQ Chemist verifies	1380-1500 minutes (24 ± 1 hours) midnight to midnight local standard time or if < 1380 minutes & exceeding NAAQS	Investigate/ Invalidate (Valid but Flagged if < 1380 minutes & exceeding PM2.5 NAAQS, currently 35 µg/m^3)

Activity	Frequency	Responsible Section/Staff	Acceptance Criteria	Corrective Action
PM2.5 Mass (cont.)				
Microbalance Auto-Calibration ***(Critical Criteria)***	Prior to each weighing session	Balance Analyst	Readability 1 µg Repeatability 1 µg	(1) Contact PM2.5 SAQ Chemist and the QA SAQ Chemist (2) Document in weigh room logbook
Balance Check (100 & 200 µg working standards)	beginning, every 10th sample, & end	Balance Analyst	< ±3.1 µg from certified value	(1) Contact PM2.5 SAQ Chemist and the QA SAQ Chemist (2) Check weights (3) Document in weigh room logbook
Filter Integrity (exposed)	Each filter	Balance Analyst	No visual defects; note & investigate unusual filter loading	Investigate/ Invalidate; Inform SAQ Chemist
Blanks **Lot Blanks** **Exposure Lot Blanks** **Lab Filter Blank**	9 filters per lot 3 filters per lot 10% or 1 per weighing session	Balance Analyst	< ±15.1 µg change between weighings	(1) Contact PM2.5 SAQ Chemist and the QA SAQ Chemist (2) Document in weigh room logbook
Field Filter Blank	10% or 1 per weighing session (Unexposed filters from each sampling site are collected monthly)	Balance Analyst	< ±30.1 µg change between weighings	Contact PM2.5 SAQ Chemist and the QA SAQ Chemist; Document in weigh room logbook
Precision **Duplicate filter weighings**	1 per batch of 10 filters	Balance Analyst	< ±15 µg difference	Contact PM2.5 SAQ Chemist and the QA SAQ Chemist; Document in weigh room logbook
Initial Lot Stability Test (to determine the average length of time required to equilibrate filters from a given lot)	3 filters each from 3 different boxes of filters, from a lot to be placed in service	Balance Analyst	Weight change < ±15.1 µg	Contact PM2.5 SAQ Chemist and the QA SAQ Chemist; Document in weigh room logbook
Lot Stability Test Filters	Ten filters are repeatedly weighed to determine the minimum necessary equilibration time for filters from the same lot.	Balance Analyst	Weight trend approaches zero	Contact PM2.5 SAQ Chemist and the QA SAQ Chemist; Document in weigh room logbook
Replicate Filter Weighings	Every tenth filter (both pre-weighing and post-weighing) is reweighed.	Balance Analyst	Weight difference < 15.1 µg	Contact PM2.5 SAQ Chemist and the QA SAQ Chemist; Document in weigh room logbook
TSP-Pb Analysis				
Filter Calibration Reproducibility Checks ***(Critical Criteria)***	Beginning, every 10 samples, and end	Balance Analyst, AQ or AAQ Chemist	±5% of value predicted by calibration curve	Contact SAQ Chemist; repeat analysis; document in logbook

Activity	Frequency	Responsible Section/Staff	Acceptance Criteria	Corrective Action
TSP-Pb Analysis (cont.)				
Daily Calibration *(Critical Criteria)*	Daily (on day of analysis)	Balance Analyst, AQ or AAQ Chemist	until good agreement is obtained among replicates	Contact SAQ Chemist; repeat analysis; document in logbook
Lab Blanks	One per sample run	Balance Analyst, AQ or AAQ Chemist	< LDL	Contact SAQ Chemist; repeat analysis; document in logbook
ICP/MS Tuning	Analysis of a minimum of 10 aliquots of the tuning solution each day of analysis prior to ICAL	AQ or AAQ Chemist	Absolute signal of ten replicates RSD ≤ 3%	1) Use smart tune wizard to do a full optimization tune 2) See manufactures manual
Internal Standards Addition	Added to each analyzed solution	AQ or AAQ Chemist	Recovery within 70-120% of the response of the ICB	1) Repeat analysis 2) Dilute sample 3) Instrument drift - re-start analysis
Rinse Blank	Following each analyzed solution	AQ or AAQ Chemist	Duration of aspiration sufficient to eliminate element carryover as evidenced by successful CCV/CCB combinations	1) Locate and resolve contamination problems before continuing
Initial Calibration (ICAL)	Daily, Minimum of five levels covering desired concentration range plus the calibration blank	AQ or AAQ Chemist	Correlation coefficient r ≥ 0.998; Calibration standards must be reprocessed and fall within 10% of the expected value. Low standard has a 15% range allowed.	1) Repeat analysis of calibration standards. 2) Re-prepare calibration standards and reanalyze.
Initial Calibration Verification (ICV)	Immediately after ICAL	AQ or AAQ Chemist	Recovery 90-110%	1) Repeat analysis of calibration check standard. 2) Repeat analysis of calibration standards. 3) Re-prepare calibration standards and reanalyze
Initial Calibration Blank (ICB)/(IBL) *(Critical Criteria)*	Before first sample, immediately after ICV	AQ or AAQ Chemist	< 0.001 µg/mL Analytes below MDL (for solution)	1) Investigate and resolve before continuing. 2) Reanalyze
Low Level Calibration Verification (LLCV) / (LCV)	Immediately following the ICV and ICB/IBL	AQ or AAQ Chemist	Recovery within 90-110%	1) Repeat analysis 2) Repeat analysis of calibration 3) Re-prepare standards
Continuing Calibration Verification (CCV)	Immediately following IBL, after every 10 samples, and end of the run	AQ or AAQ Chemist	Recovery 90-110%	1) Repeat analysis 2) Re-prepare continuing calibration. 3) Reanalyze samples since last acceptable continuing calibration verification.
Continuing Calibration Blanks (CCB)	After each CCV except at the conclusion of the analysis sequence	AQ or AAQ Chemist	SCAQMD requires all target elements under MDL (for solution). If high, samples must be greater than 10x the blank value; U.S. EPA 40 CFR requires instrument blanks to be <1 ppb.	1) Reanalyze 2) Re-dilute 3) Repeat analyses of all samples since last clean blank

Activity	Frequency	Responsible Section/Staff	Acceptance Criteria	Corrective Action
TSP-Pb Analysis (cont.)				
Reagent Blank (RB)/ (BLK) ***(Critical Criteria)***	1 per 20 samples, a minimum of 1 per every analytical batch	AQ or AAQ Chemist	SCAQMD requires all target elements under MDL (for solution). If high, samples must be greater than 10x the blank value; U.S. EPA 40 CFR requires Reagent blanks to be <1 ppb.	1) Reanalyze 2) Re-dilute 3) Re-extraction required if samples are not > 10x or ND
Method Blank (MB) / (BLK)	1 per 20 samples, a minimum of 1 per batch	AQ or AAQ Chemist	All target elements under MDL (for quartz filter)	1) Re-prepare sample batch. 2) Reanalyze.
Lab Control Standards (LCS) / (BS) (1 µg Pb/ml and a standard between 1-10 µg Pb/ml)	1st, every 10 samples and last sample	AQ or AAQ Chemist	Deviation of < 5.1% from value predicted by calibration curve	1) Repeat analysis of ICS. 2) Re-prepare ICS. 3) Re-extraction required unless failure with flagging approved by Principal AQ Chemist
Reagent Blank Spike (RBS) / (BS)	One per batch of 20 or fewer field collected samples	AQ or AAQ Chemist	Recovery 80-120%	1) Reanalyze 2) Re-dilute 3) Re-extraction required if samples are not > 10x or ND
Duplicate Sample Strip (DUP)	1 per 20 samples, a minimum of 1 per batch	AQ or AAQ Chemist	Precision ≤ 20% RPD for all elements 5x MDL	1) Reanalyze 2) Re-dilute 3) Re-extraction required unless failure approved by Principal AQ Chemist
Matrix Spike (MS)	1 per 20 samples, a minimum of 1 per batch	AQ or AAQ Chemist	Recovery 80-120%	1) Reanalyze 2) Re-dilute 3) Re-extraction required unless failure approved by Principal AQ Chemist
Serial Dilution (SRL)	1 per 20 samples, a minimum of 1 per batch	AQ or AAQ Chemist	Recovery 90-110%	1) Reanalyze 2) Re-dilute
Collocated samples	Each sampling day for sites conducting collocated sampling	AQ or AAQ Chemist	Extractions must agree within ≤ 20% CV between collocated sites for all elements ≥ 0.002 µg/m^3	1) Reanalyze 2) Re-dilute 3) Re-extraction required unless failure approved by principal chemist 4) Investigate and discuss with MN and QA Branch

2.6 Instrument/Equipment Testing, Inspection, and Maintenance

This section describes the testing, inspection and maintenance of field and laboratory analysis equipment used for the criteria pollutant monitoring program. The specific equipment used for the South Coast AQMD criteria pollutant monitoring program is identified in Section 2.2 for field equipment and in Section 2.4 for laboratory analysis equipment.

2.6.1 Inspection and Acceptance Testing

Instruments used for SLAMS monitoring must be FRM/FEM, and the purchase of an FRM/FEM, provides confidence that the make/model of the instrument itself has passed the 40 CFR Part 53 acceptance testing requirements. However, South Coast AQMD still completes testing of individual instruments, upon receipt, to ensure that they are fully functional and meet performance specifications. If a newly purchased instrument does not pass in-house acceptance testing (e.g., for not meeting purchase requirements or performance specifications), the instrument should be returned to the vendor while still under warranty for repair, replacement, or cancellation of the purchase.

South Coast AQMD has an established Procurement Policy and Procedure (see link in Appendix C) in which the procedures for the purchasing of services, materials, equipment, software, supplies, and fixed assets are documented. This includes the procedures and requirements for preparation of requests for bids through a request for quotations (RFQ) or a request for proposals (RFP) and for the evaluation and award of the bids. Specifications for equipment, evaluation criteria for rating each quotation, acceptance criteria, schedules for delivery, and actions that may be taken when acceptance criteria are not met, are contained in each RFQ. The RFQ contains any requirements established by U.S EPA for monitoring and sampling instrumentation purchased for federally mandated programs, including the criteria pollutant monitoring program. Equipment specifications are prepared by staff, approved by supervisors, management, and, when of significant fiscal impact, by the Governing Board. Final purchases are also approved similarly.

All instrumentation and equipment procured for the criteria pollutant monitoring program undergo inspection and acceptance testing, as appropriate. Acceptance testing of new or upgraded field continuous monitoring instrumentation and sampling systems for the criteria pollutant monitoring program is primarily conducted by the MN Branch Support Group, with additional support of other MN Branch or QA Branch staff as needed. New instrumentation is inspected and evaluated to determine whether all components have been received. In addition, the instrument is given operational checks to determine if it performs according to the specifications as put forth in the initial RFQ. Efforts are made to set up, calibrate, and operate the instrument in a laboratory setting to determine instrument response and stability. Laboratory instrumentation analytic systems are acceptance tested by LS Branch staff and field instrumentation are acceptance tested by MN Branch staff. Acceptance testing is documented in the instrument logbooks and is accessible to staff.

Any inconsistencies related to the quality of manufacturing or system performance are resolved with the manufacturer before final payment is made and equipment are field deployed. All equipment, instrumentation, and supplies must pass inspection, and acceptance testing before deployment and usage. An inventory of all procured capital equipment, with a cost of $5,000 or

greater, is maintained electronically by the South Coast AQMD Finance Division in the South Coast AQMD Capital Outlay and Controlled Item Inventory Database. This equipment is visually verified by Finance and M&A staff every two years, at minimum.

2.6.2 Warranties and Support Contracts

For air monitoring instruments and calibration equipment the MN Branch purchases new instruments, typically with a one- or two-year warranty. MN Branch frequently repairs instruments and equipment in-house or may return them to the manufacturer or other vendor for service, if needed. Purchase orders are used for outside service requests. They do not typically utilize service contracts or maintenance agreements. The responsibility for warranties and warranty or outside repair services is with the MN Branch Support Group under that Principal AQIS and Senior AQIS staff. Audit instruments and equipment maintained by the QA Branch similarly utilize warranties with new equipment and do most repairs in-house with Repair Group assistance if needed, or through services outside vendors or contractors when needed but not though service contracts. These efforts are typically the responsibility of the QA Branch Senior AQIS audit staff under the QA Manager.

The LS Branch purchases new laboratory instruments, typically with one- or two-year warranties. While some repairs may be done in-house, LS Branch maintains service agreements for most laboratory instruments. This includes service contracts for the microbalance and the ICP-MS instruments that are used for the criteria pollutant analyses. These are maintained by the Principal Chemist and Senior Chemists for the Aerosol Group. Service contract are utilized for software support, such as for the DMS, LIMS and EQuIS systems. The DMS support contract is maintained in the QA Branch, monitored by the Staff Specialist, and the laboratory data systems are with the LS Branch, monitored by a Senior Chemist.

2.6.3 Preventative Maintenance

Preventive maintenance is maintaining the equipment within a network to prevent downtime, costly repairs, and data loss. Preventive maintenance is an ongoing element of quality control and is enveloped into the daily routine. In addition to the daily routine, scheduled activities are performed monthly, quarterly, semi-annually and annually. The general operations and support SOPs and specific instrument and method SOPs, along with manufacturer's operation manuals provide preventative maintenance activities for the particular instrument/method.

Preventive maintenance is the responsibility of the monitoring or laboratory staff and the supervisory staff. The supervisors (Senior and Principal staff) review the preventive maintenance work and continually check the schedule. The supervisor is responsible for making sure that preventive maintenance is being accomplished in a timely manner. Preventive maintenance is not a static process; procedures must be updated for many reasons, including, but not limited to, new models or types of instruments and new or updated methods. The preventive maintenance schedule is changed whenever an activity is completed or performed at an alternate time. For instance, if a multi-point calibration is performed in February instead of on the scheduled date in March, then the subsequent six-month calibration date moves from September to August. On a regular basis, the supervisor reviews the preventive maintenance schedule with the station operators. Following all repairs, the instruments must be verified (multi-point) or calibrated. Lists

and spreadsheets facilitate the organization and tracking of tasks and improve the efficiency of preventive maintenance operations. A checklist of regular maintenance activities (e.g., zero-span checks, daily routine checks, data dump/collection, calibrations, etc.) is maintained for station operators. Lists of spare parts and vendors are maintained by the Support Group to facilitate the ordering of replacement parts and to identify the inventory of spare parts on hand.

Station maintenance activities occur both on routine schedules and on an as-needed basis. Station maintenance is documented in the station logbook, as well as in instrument logbooks and the work order system, if relevant. Examples of station maintenance include: floor cleaning; shelter inspection; security inspection (fencing, locks, surveillance cameras, lighting); visual inspection of probes and meteorological gear; air conditioner repair; AC filter replacement; weed abatement and grass cutting; roof repair; general cleaning; inlet and manifold inspection, testing and cleaning; manifold exhaust blower lube; desiccant replacement; and safety inspection, including ladder and guard rails, if applicable. Some of these activities, such as AC service and repair or shelter roof repairs are typically arranged with vendors through purchase orders.

Routine operation checks occur at specified frequencies. These duties are performed and documented in order to operate the monitoring network at optimal levels. Some examples of typical routine operations maintenance and checks include:

- Observations of unusual conditions/events – each visit;
- Review Data – Each Visit;
- Mark charts, where applicable – Each Visit;
- Check Exhaust/Blower/Pump Operation – Each Visit;
- Check Station Exterior – Weekly/Monthly;
- Check/Change Desiccant – Each Visit;
- Manifold Leak Test – Weekly/Monthly
- Clean inlet funnel – Weekly/Monthly
- Inspect tubing – Each Visit
- Clean or Replace Tubing – Annually, sooner if needed;
- Inspect manifold and cane – Each Visit;
- Clean manifold and cane – Every 6 months, or as needed
- Check HVAC systems – Weekly/Monthly
- Check electrical connections – Weekly/Monthly
- Field site supply inventory – Weekly/Monthly
- Residence time calculation – If manifold or inlets are altered.

South Coast AQMD performs periodic preventative maintenance on all instruments and equipment. Some preventative maintenance is accomplished routinely by the MN Branch Operations Group as part of the station operation activities, as included in the General Air Monitoring Station Operations SOP (SOP00116) and specific instrument operations SOPs as listed previously in Tables 2-3, 2-4 and 2-6. The bulk of the preventative maintenance is accomplished by the MN Branch Support Group concurrent with scheduled calibrations. Additional preventative maintenance is accomplished along with repair trips. At times, additional preventative maintenance may result from potential issues identified by through data validation or data review efforts or as the result of corrective actions, such as those addressing audit findings by QA Branch, CARB, U.S. EPA, or contractors. The calibration SOPs, listed previously in Tables 2-4 and 2-6, contain the recommended scheduled maintenance activities. Preventative maintenance of the equipment and instruments in the South Coast AQMD Laboratory is accomplished by LS Branch staff and contractors, in accordance with LS Branch SOPs and manufacturer's manuals.

Calibration and preventative maintenance scheduling are performed according to an overall Calibration Status spreadsheet, maintained by the Support Group and continuously updated. In general, instrument calibrations and maintenance are performed on a three-month, six-month, or annual basis as defined by requirements and guidance. When possible, concurrent calibrations and maintenance are scheduled to avoid instrument downtime in the hours before, during, and after peak readings are anticipated on high-concentration days (e.g., concentrations over 75 percent of the short-term NAAQS), especially for the expected highest stations.

Diagnostic checks are performed before and after maintenance to document the *"as found"* and *"as left"* condition of the instrument. The testing, maintenance and repairs are documented in the instrument logbooks that are kept with each instrument, in maintenance reports, and in the South Coast AQMD Work Order System database. The MN Branch work order system (SOP00116, SOP for General Air Monitoring Station Operations) utilizes the South Coast AQMD email server as a communications hub for information regarding work orders and a Microsoft Access® database for tracking and review of progress, maintained by the MN Branch Office Assistant.

South Coast AQMD maintains critical spare parts for many common instrument repairs, based on repair history and manufacturer recommendations. Other spare parts can be ordered relatively quickly through the South Coast AQMD procurement process, as funding allows. Where feasible and as funding allows, South Coast AQMD maintains spare instruments in the Support Group shop space to swap into the field during troubleshooting and repairs that are best accomplished at South Coast AQMD headquarters or by the manufacturer/vendor. These spare instruments are tested prior to use.

2.6.4 Instrument Method Detection Limits (MDLs)

The Method Detection Limit (MDL) is the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results, as defined in Appendix B of 40 CFR Part 136, Appendix B, *Guidelines Establishing Test Procedures for the Analysis of Pollutants*. As discussed in Section 1.7.2.5, choosing instruments with MDLs that are appropriate to the program DQOs satisfies part of the DQI for sensitivity. The MDLs are used to help identify the low calibration and audit levels. They

also can provide information for identifying the appropriate concentration for 1-point QC checks and the second annual PE audit level (99th percentile). Table 2-30 shows the South Coast AQMD gaseous criteria pollutant instruments and the Federal MDLs that are currently in use. At this time the agency has not evaluated alternate MDLs but may consider this in the future. If used, the alternate MDLs will be submitted to AQS.

Table 2-30
South Coast AQMD Gaseous Criteria Pollutant Instruments and Method Detection Limits

Pollutant (Parameter Code)	Instrument & Model	AQS Method Code	Units	Federal MDL	Federal MDL × 3	Audit Level
O3 (44201)	Thermo 49i	047	ppb	5	15	L2
	Teledyne 400E	087	ppb	5	15	L2
CO (42101)	Horiba APMA-360	106	ppm	0.5	1.5	L4
	Horiba APMA-370	158	ppm	0.5	1.5	L4
	Teledyne 300EU	593	ppm	0.02	0.06	L2
	Thermo 48i	054	ppm	0.5	1.5	L4
NO2 (42602)	Teledyne 200E	099	ppb	2.7	8.1	L4
	Thermo 42i	074	ppb	1	3	L2
	Horiba APNA-370	157	ppb	5	15	L4
S02 (42401)	Thermo 43i-TLE	560	ppb	0.2	0.6	L1

2.7 Instrument/Equipment Calibration and Frequency

Calibration is defined as the 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 by adjustment[25]. Calibration of an ambient air monitoring analyzer adjusts the analytical response of the analyzer to more closely agree with a measurement standard of higher accuracy. In ambient air monitoring, calibrations are considered a type of quality control procedure. As such, related information is discussed previously in Section 2.5.

A calibration is generally a two-part process. The first part involves the actual adjustment of the analyzer: setting the internal zero and span controls, which are adjusted based on known zero and upscale (span) test concentrations, to provide the desired calibration scale. After the adjustment is completed, the analyzer is calibrated. The second part of the process includes conducting a multi-point verification over the analyzer's calibration scale. The multi-point verification does not involve making any additional instrument adjustments, but rather ensures the zero and span settings have been successfully set within the analyzer. The verification also confirms the analyzer's linearity.

[25] *American National Standard Quality Systems for Environmental Data and Technology Programs,* ANSI /ASQ E4. [http://www.asq.org/]

Prior to the implementation of any ambient air monitoring activities in the field, the ambient sampler or analyzer must be verified to ensure the accuracy of its response is within specified tolerances (typically established by the instrument manufacturer in the appropriate operation's manual, and/or in the monitoring organization's QAPP and SOPs). A multi-point verification is conducted in order to make this determination. If the sampler or analyzer's response exceeds the established tolerances during the verification, then the instrument must be appropriately calibrated – by means of an adjustment. When the term "calibration" is used, it is assumed that a multi-point verification is initially performed (sometimes referred to as an "as-is" or "as-found" verification) and the operator has concluded that calibration (i.e., adjustment) is necessary.

Each analyzer should be calibrated as directed by the analyzer's operation or instruction manual and in accordance with the general guidance provided here. For the CO, NO2, SO2 and O3 analyzers for the Criteria Pollutant Monitoring Program, detailed calibration procedures may also be found in the appropriate reference method located within the Appendices of 40 CFR Part 50, as well as within the method guidance and technical assistance documents listed in the fact sheets in Appendix A of the U.S EPA Quality Assurance Handbook, Vol. II.

Once an analyzer's calibration is established, it should be checked at reasonable frequencies to verify that it remains in calibration. The monitoring organization is charged with developing a quality system that includes routine quality control checks to ensure the instrument continues to perform within the calibration tolerances. Multi-point verifications can be performed on a routine schedule (e.g., quarterly) to serve this purpose, in addition to other quality control checks (e.g., 1-point QC, flow rate verifications, etc.). The multi-point verification (often referred to as an "unadjusted calibration") is an optimum QC check, because it challenges the analyzer with known test concentrations across its calibration scale. When performed on an operational analyzer in the field, the verification demonstrates the "as found" status of the analyzer and can be used for data validation purposes. If the analyzer is found to be within the established acceptance limits, adjustments do not need to be made.

Given the advances in current monitoring technology, it is U.S. EPA's position that frequent adjustments (i.e., calibrations) of instruments should not be necessary and may in fact lead to more data quality uncertainty. Therefore, adjustments should be minimized as much as possible. Performing frequent adjustments to provide the "most accurate data possible" can sometimes be self-defeating and result in additional measurement uncertainty. For example, adjusting an instrument based upon a standard that might be degrading or contaminated may cause data to be farther from the true concentration. Moreover, some acceptable level of drift (i.e., deviation from an original or nominal response curve) is expected and therefore allowed before physical adjustments (i.e., calibration) must be made to an analyzer. The recommended acceptance criteria are included in the U.S. EPA QA Handbook, Vol. II, Appendix D, Data Validation Templates. There are times, however, when adjustment (i.e., calibration or recalibration) of an analyzer is necessary. These include:

- upon initial installation;
- following physical relocation;

- after any significant repairs or service that might affect its calibration;
- following an interruption in operation (e.g., power failure) of more than a few days;
- upon any indication of analyzer malfunction or change in calibration (such as a failed QC check or audit); and
- at some prescribed routine interval (e.g., annually).

Procedural details for South Coast AQMD calibrations (recalibrations) are in the SOPs associated with this QAPPs, specifying the circumstances under which adjustments are to be made to the analyzer. Multi-point verifications are performed in conjunction with calibrations (recalibrations) to confirm the linearity of analyzers.

Calibration standards include:

- Reagents of high grade;
- Gaseous standards of known concentrations that are certified as U.S. EPA protocol gases;
- Instruments and/or standards of high sensitivity and repeatability;
- Devices that are used to calibrate air monitoring instruments.

The types of standards and equipment used by South Coast AQMD needing calibration/certification fall into several categories for the field and the lab, include the following:

- Ozone Photometers;
- Gaseous Analyzers – MFCs within gas dilution calibrators, gas (source cylinders);
- Particulates – Flow rate transfer standards, orifices, variable plates, thermometers, barometers, manometers;
- Gravimetric Lab – mass reference standards, RH & Temperature standards;
- Mass Flow Controlled (MFC) devices;
- Standards that meet the 2012 Traceability Protocol for Gaseous Calibration Standards[26];
- Permeation devices;
- Voltage standards for equipment testing;
- Flow measurement devices;
- Barometric pressure measurement devices; and
- Temperature measurement devices.

[26] U.S. EPA *Traceability Protocol for Assay and Certification of Gaseous Calibration Standards* (EPA-600/R-23/531) [http://www.epa.gov/air-research/epa-traceability-protocol-assay-and-certification-gaseous-calibration-standards]

Table 2-31 shows instruments and devices requiring calibration and certification, with acceptable ranges and 40 CFR References, as reproduced the U.S. EPA QA Handbook, Volume II.

Table 2-31
Instruments and Devices Requiring Calibration and Certifications

Criteria	Acceptable Range	40 CFR Reference
Verification/Calibration of Devices in sampler/analyzer/laboratory against an authoritative transfer standard		
Barometric Pressure	< ±10.1 mm Hg	Part 50, App.L, Sec 9.3
Temperature	< ±2.1°C of standard	Part 50, App.L, Sec 9.3
Flow Rate (1-pt. verification)	< ±4.1% of transfer standard	Part 50, App.L, Sec 9.2
Design Flow Rate Adjustment	< ±2.1% of design flow rate	Part 50, App.L, Sec 9.2.6
Clock/timer Verification	1 min/month	Part 50, App.L, Sec 7.4
Microbalance Calibration	Readability 1 µg Repeatability 1 µg	Part 50, App.L, Sec 8.1
Verification/Calibration Standards requiring certification annually		
Standard Reference Photometer (SRP)1	Regression slope = 1.00 + 0.01 and intercept ≤ ±1 ppb	not described
Level 2 ozone standard reverification to SRP	Each individual point difference ≤ ±3%	not described
Flow rate	< ±2.1% of NIST–Traceable Standard	Part 50, App L Sec 9.2
Pressure	±1 mm Hg resolution, ±5 mm Hg accuracy	not described
Temperature	±0.1°C of standard resolution, ±0.5°C accuracy	not described
Gravimetric Standards	Tolerance = Class 2 or better	not described

The reference and equivalent methods define the grades and purities needed for the reagents and gases required in the Ambient Air Quality Monitoring Program. Information for each criteria pollutant can be found in the Appendices of 40 CFR Part 50. Calibration standards utilized should be accompanied by documentation that supports their accuracy and traceability.

2.7.1 NIST Traceability

The highest authority standards lie with the National Institute of Standards and Technology (NIST). The NIST keeps a set of standards that is referenced by all manufacturers of glassware, standard equipment, and electronic primary standards. Traceable is defined in 40 CFR Parts 50 and 58 as meaning that a local standard (i.e., one maintained by a monitoring organization) has been compared and certified, either directly or via not more than one intermediate standard, to a primary standard such as a NIST Standard Reference Material (**NIST SRM**) or an EPA/NIST-approved Certified Reference Material (**CRM**). Similarly, traceability is the "property of a measurement result whereby the result can be related to a stated reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty" (ISO).[27] Standard traceability, therefore, is the process of transferring the accuracy or authority of a primary

[27] International Standards Organization (ISO) – International Vocabulary of Basic Terms in Metrology.

standard to a field-usable standard, resulting in a documented unbroken chain of calibrations/certifications. Recommended timeframes for certifications of various calibration standards are defined in Appendix D of the QA Handbook, Vol. II; however, if not specified, the monitoring organization should follow the manufacturer's recommendation.

Primary Reference Standards

A primary reference standard can be a defined measurement standard designated for the calibration of other measurement standards for quantities of a given kind in a given organization. In short, any standard that is not subordinate to another standard is considered a primary standard. NIST's standard reference materials (SRMs) are examples of primary reference standards. NIST also describes a Primary Reference Standard as a standard that is designated or widely acknowledged as having the highest metrological qualities and whose value is accepted without reference to other standards of the same quality. For example, the NIST-F1 Atomic Clock6 is recognized as a primary standard for time and frequency. A true primary standard like NIST-F1 establishes maximum levels for the frequency shifts caused by environmental factors. By summing or combining the effects of these frequency shifts, it is possible to estimate the uncertainty of a primary standard without comparing it to other standards. NIST maintains a catalog of SRMs that can be accessed through the Internet (http://www.nist.gov). Primary reference standards are usually quite expensive and are often used to calibrate, develop, or assay secondary standards. In order to establish and maintain NIST traceability, the policies posted at the NIST Website should be observed (https://www.nist.gov/calibrations/traceability).

It is important that primary reference standards be maintained, stored, and handled in a manner that protects their integrity. These standards should be kept under secure conditions and records should be maintained that document chain-of-custody information.

Transfer Standards

In a transfer standard, traceability to the more authoritative primary reference standard is "transferred" to a secondary device. In other words, a transfer standard is a device that is certified against a primary standard. The U.S EPA Technical Assistance Document, *Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone*, further defines a transfer standard as, "a transportable device or apparatus which, together with associated operational procedures, is capable of accurately reproducing pollutant concentration standards or of producing accurate assays of pollutant concentrations which are quantitatively related to a higher level and more authoritative standard."[28] Transfer standards can be many different devices. It is recommended that one type of device be used as the principle transfer standard for the monitoring organization. This will eliminate any error that may occur from different types of standards. It is recommended that transfer standards be certified against a primary standard on a set frequency (typically, on an annual basis). Electronic types of transfer standards sometimes have problems with baseline drift. If this appears to be a problem, then verification of the transfer standard should occur more often.

[28] *Transfer Standards for the Calibration of Ambient Air Monitoring Analyzers for Ozone*. Technical Assistance Document. EPA-454/B-13-004. U.S. EPA, Research Triangle Park, NC, October 2013. [http://www3.epa.gov/ttn/amtic/qapollutant.html].

Most organizations will have many transfer standards for use throughout their monitoring network and will probably need to verify them on a staggered schedule.

U.S. EPA recommends, as a best practice, that monitoring organizations maintain calibration standards that are separate from those standards used for routine quality control checks. At a minimum, a monitoring organization must maintain two separate sets of equipment: one designated for calibrations/verifications, and the other designated for independent performance evaluations (audits).

A critical element of calibration and certification for the criteria pollutant monitoring program is the traceability to the National Institute of Standards and Technology (NIST) of the gaseous and flow standards used to calibrate ambient monitoring instruments. The standards used by South Coast AQMD are NIST-traceable and of higher accuracy than that of the operational working standards used to periodically test the instrumentation.

Gaseous pollutant concentration standards (permeation devices or cylinders of compressed gas) used to obtain test concentrations for carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxide (NO), and nitrogen dioxide (NO_2) must be traceable to either a National Institute of Standards and Technology (NIST) Traceable Reference Material (NTRM) or a NIST-certified Gas Manufacturer's Internal Standard (GMIS), certified in accordance with one of the procedures given in the *EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards*. Vendors advertising certification with the procedures provided in this reference and distributing gases as "EPA Protocol Gas" must participate in the U.S. EPA Protocol Gas Verification Program or not use "EPA" in any form of advertising. Monitoring organizations must provide information to the U.S. EPA on the gas producers they use on an annual basis and those PQAOs purchasing standards will be obligated, at the request of the U.S. EPA, to participate in the program at least once every 5 years by sending a new unused standard to a designated verification laboratory.

2.7.2 Reagents

For CO, SO2, NO2, and O3, the reagents defined in the Appendices of 40 CFR Part 50 include gaseous standards and zero air sources. For these pollutants, the field analyzer is able to generate concentrations in situ. For other pollutants, however, a laboratory is required to analyze the samples collected in the field. Towards that end, the analytical instrumentation must be calibrated and maintained – which will often involve preparation of laboratory reagents. In some cases, the reagents are prepared prior to sampling. Some of these reagents will be used to calibrate the equipment, while others will become an integral part of the sample itself. In any case, their integrity must be carefully maintained from preparation through analysis. If there are any doubts about the method by which the reagents for a particular test were prepared, or about the competence of the laboratory technician preparing them, the credibility of the ambient air samples and the test results will be diminished. It is essential that a careful record be kept listing the dates the reagents were prepared, by whom, and their locations at all times from preparation until actual use. Prior to the test, one individual should be given the responsibility of monitoring the handling and the use of the reagents. Each use of the reagents should be recorded in a field or lab notebook.

Chemical reagents, solvents, and gases are available in various grades. All reagent containers are to be properly labeled either with the original label or, at a minimum, the reagent, date prepared, expiration date, strength, preparer, and storage conditions. Leftover reagents used during preparation or analysis should never be returned to bottles. Reagents can be categorized into the following six grades:[29]

1. **Primary standard** – Each lot is analyzed, and the percentage of purity is certified.
2. **Analyzed reagents** – Can fall into 2 classes: (a) each lot is analyzed, and the percentages of impurities are reported; and (b) conformity with specified tolerances is claimed, or the maximum percentages of impurities are listed.
3. **USP and NF Grade** – These are chemical reference standards where identity and strength analysis are ensured.
4. **"Pure," "c.p.," "chemically pure," "highest purity"** – These are qualitative statements for chemicals without numerical meaning.
5. **"Pure," "purified," "practical grades"** – These are usually intended as starting substances for laboratory syntheses.
6. **Technical or commercial grades** – These are chemicals of widely varying purity.

For laboratory analysis for the criteria pollutant program, only the TSP-Pb analyses requires the use of a reagent for Pb. Appendix G to 40 CFR Part 50, Section 7.1 states that the lead standard must be 1000 µg/m^3, NIST traceable, commercially available with a certificate of analysis, meeting High Purity Standards Catalog No. 100028-1, or equivalent. The South Coast AQMD laboratory uses only lead primary standards that meet these requirements for this program.

2.7.3 Gaseous Standards

In general, ambient monitoring instruments should be calibrated by allowing the instrument to sample and analyze test atmospheres of known concentrations of the appropriate pollutant in air. The following is an excerpt from 40 CFR Part 58, Appendix A, Section 2.6.1:

> "Gaseous pollutant concentration standards (permeation devices or cylinders of compressed gas) used to obtain test concentrations for CO, SO2, NO, and NO2 must be traceable to either a NIST-Traceable Reference Material (NTRM) or a NIST-certified Gas Manufacturer's Internal Standard (GMIS), certified in accordance with one of the procedures given in reference 4 of [Appendix A]. Vendors advertising certification with the procedures provided in reference 4 of [Appendix A] and distributing gases as "EPA Protocol Gas" for ambient air monitoring purposes must participate in the EPA Ambient Air Protocol Gas Verification Program or not use "EPA" in any form of advertising. Monitoring organizations must provide information to the EPA on the gas producers they use on an annual basis and those PQAOs purchasing standards will be obligated, at the request of the EPA, to participate in the program at least once every 5 years by sending a new unused standard to a designated verification laboratory."

[29] *Quality Assurance Principles for Analytical Laboratories*, 3rd Edition. By Frederick M. Garfield, Eugene Klesta, and Jerry Hirsch. AOAC International (2000). [http://www.aoac.org/]

Normally, the calibration gas standard used routinely by the monitoring organization for quality control purposes (commonly referred to as the "working" standard) should be certified directly to the SRM or CRM, with an intermediate standard used only when necessary. Direct use of a CRM as a working standard is acceptable, but direct use of an NIST SRM as a working standard is discouraged because of the limited supply and expense of SRMs. At a minimum, the certification procedure for a working standard should:

- establish the concentration of the working standard relative to the primary standard;
- certify that the primary standard (and hence the working standard) is traceable to a NIST primary standard;
- include a test of the stability of the working standard over several days; and
- specify a recertification interval for the working standard.

Certification of the working standard may be established by either the supplier or the user of the standard. As described in CFR, gas suppliers advertising "EPA Protocol Gas" will be required to participate in the EPA Protocol Gas Verification Program. Information on this program, including the gas suppliers participating in the program, can be found on AMTIC. U.S.EPA has developed procedures for the establishment of protocol gases in the document *Traceability Protocol for Assay and Certification of Gaseous Calibration Standards*.[30] Table 2-3 in the *Traceability Document* provides the maximum certification periods for verification and calibration standards used in the ambient air monitoring program. Since these periods sometimes change the table is not presented here. In addition, because monitoring organization move standards about (travel to sites for audits, etc.) and are used in different environments compared to laboratory standards, these maximum certification periods may not be applicable to the manner in which the standards are used. Care should be taken before utilizing standards up to the maximum certification period.

Certification periods decrease for concentrations below the applicable concentration ranges provided in Table 2-3 of the traceability document. For example, the certification period for SO2 standards between 1-50 ppm is 4 years. This value may be applicable to standards that are housed in laboratories under stable temperature and humidity conditions but should be checked more frequently when being used in field situations. Also, tank size may affect stability in low level standards. Some gas manufacturers claim that standards supplied in smaller tanks are stable for longer periods of time than the same concentration in larger tanks. Although this claim has not been verified, if true it may be helpful in making purchasing decisions.

Ozone Standards

Test concentrations for ozone must be obtained in accordance with the ultraviolet photometric calibration procedure specified in Appendix D to 40 CFR Part 50, and by means of a certified

[30] U.S. EPA *Traceability Protocol for Assay and Certification of Gaseous Calibration Standards* (EPA-600/R-23/531) [http://www.epa.gov/air-research/epa-traceability-protocol-assay-and-certification-gaseous-calibration-standards]

NIST-traceable O3 transfer standard.[31] The photometer (reference standard) can be used to assay the output concentration of a generation-type transfer standard. The hierarchy of ozone standards are shown in Table 2-32. The South Coast AQMD Level 2 ozone transfer standard is sent annually to U.S. EPA Region 9 for certification against their primary standards and is then compared to the Level 3 transfer standards.

Table 2-32
Hierarchy of Ozone Standards and Summary of Specifications

Requirement	Frequency	Acceptance Criteria	Information/Action
Regional Standard Reference Photometer (SRP) (Level 1 Standard)			
Verification	1/year	Regression slope = 1.00 ±0.01 and intercept < ±1 ppb	Usually at a Regional Office and compared against the traveling EPA SRP
Ozone Level 2 Transfer Standard			
Qualification	Upon receipt of transfer standard	±4% or ±4 ppb (whichever greater)	Transfer Standard Doc EPA-454/B-10-001 App B
Verification (6x6)	After qualification and upon receipt/adjustment/repair	RSD of six slopes 3.7% Std. Dev. of 6 intercepts 1.5	Transfer Standard Doc EPA-454/B-10-001 Section 4.1
Verification/ reverification to SRP Min- 6 upscale points 7 replicates	After qualification and upon receipt/adjustment/repair 1/year	Each individual point difference ≤ ±3%	Level 2 standard usually transported to EPA Region's SRP for comparison
(if recertified via a transfer standard)	1/year	Regression slopes = 1.00 ±0.03 and two intercepts are 0 ± 3 ppb	
Ozone Transfer Standards Levels 3 and Greater			
Qualification	Upon receipt of transfer standard	±4% or ±4 ppb (whichever greater)	Transfer Standard Doc EPA EPA-454/B-10-001 App B
Verification (6x6)	After qualification and upon receipt/adjustment/repair	RSD of six slopes 3.7% Std. Dev. of 6 intercepts 1.5	Transfer Standard Doc EPA-454/B-10-001 Section 4.1
Reverification to Level 2 standard if transfer standard includes an analyzer (photometer)	Beginning and end of O3 season or 1/6 months whichever less	New slope = ±0.05 of previous and RSD of six slopes 3.7% Std. Dev. of 6 intercepts 1.5	Transfer Standard Doc EPA-454/B-10-001 Section 4.2
Reverification to Level 2 standard if transfer standard is only a generator 2/	Beginning, each quarter and end of O3 season	New slope = + 0.05 of previous and RSD of six slopes 3.7% Std. Dev. of 6 intercepts 1.5	Transfer Standard Doc EPA-454/B-10-001 Section 4.2

For ambient air monitoring activities, zero concentrations can be acquired through zero air generation devices or purchased as standards. Although zero concentrations are not required to be traceable to a primary standard, care should be exercised to ensure that zero device or standards used are adequately free of all substances likely to cause a detectable response from the analyzer and, at a minimum, below the lower detectable limit of the criteria pollutants being measured. Periodically, several different and independent sources of zero should be compared. The one that yields the lowest response can usually (but not always) be assumed to be the "best zero

[31] *Transfer Standards for the Calibration of Ambient Air Monitoring Analyzers for Ozone*. Technical Assistance Document. EPA-454/B-13-004. U.S. EPA, Research Triangle Park, NC, October 2013. [http://www3.epa.gov/ttn/amtic/qapollutant.html].

device/standard." If several independent zero device/standards produce the same response, it is likely that all the standards are adequate. Appendix K of the U.S. EPA QA Handbook, Vol. II provides some additional guidance on testing zero air generators.

2.7.4 Flow Standards

Flow rate measurements must be made by a flow measuring instrument that is NIST-traceable to an authoritative volume or other applicable standard. Guidance for certifying some types of flow meters is provided in the U.S. EPA QA Handbook, Vol. II. Flow meters are certified annually, either in-house or by a vendor, as traceable to NIST standard within ±2 percent.

2.7.5 Calibration of Air Quality and Support Instruments

Air monitoring instrumentation including sampling devices requires calibration at regular intervals. South Coast AQMD follows 40 CFR, U.S. EPA guidance, or program-specific recommendations, as appropriate, with respect to calibration frequency; if not specified, defers to the instrument manufacturer or experience with similar practices or instruments. Table 2-33 shows the South Coast AQMD calibration frequency and acceptance criteria for the Criteria Pollutant Monitoring Program air monitoring instruments, dilution systems, and ozone generators. The MN Branch Support Group is responsible for performing calibrations on all samplers and air monitors within the recommended calibration intervals. The Support Group maintains a spreadsheet as per SOP00156, accessible on the M&A shared drive, that records the latest calibration information with date and assigned calibration staff for each instrument within the South Coast AQMD's air monitoring network. Page two of the spreadsheet calculates *"days since last calibration"*. This spreadsheet toggles the background of items approaching a scheduled calibration or requiring calibration in orange. It also toggles the background of items exceeding the scheduled calibration time window to red. Calibration personnel are responsible for ensuring instruments and samplers are within their recommended calibration intervals.

Table 2-33
South Coast AQMD Calibration Frequency and Acceptance Criteria

Instrument	Calibration Frequency	Calibrations Performed	Acceptance Criteria for Verification/Calibration [As Is = Final (AI=F)]	Acceptance Criteria for Data Validation (percent difference)
Ozone	6 Months	5 Point dynamic	All points < ±2.1% or < ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± 0.05	< ±7.1% or < ±1.5 ppb difference whichever is greater
CO	6 Months	5 Point dynamic	All points < ±2.1% or < ±0.03 ppm difference of best-fit straight line. whichever is greater and Slope 1 ± 0.05	< ±10.1%
CO Trace-Level (NCore)	3 Months	5 Point dynamic	All points < ±2.1% or < ±0.03 ppm difference of best-fit straight line. whichever is greater and Slope 1 ± 0.05	< ±10.1%
SO2	6 Months (3 months for NCore)	5 Point dynamic	All points < ±2.1% or < ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± 0.05	< ±10.1% or < ±1.5 ppb difference whichever is greater
SO2 Trace-Level	6 Months	5 Point dynamic	All points < ±2.1% or < ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± 0.05	< ±10.1% or < ±1.5 ppb difference whichever is greater
NOx	6 Months	5 Point dynamic	Instrument residence time ≤ 2 min; Dynamic parameter ≥ 2.75 ppm-min; All points < ±2.1% or < ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± 0.05	< ±15.1% or < ±1.5 ppb difference whichever is greater
NOy (NCore, not Criteria Pollutant)	3 Months	5 Point dynamic	Instrument residence time ≤ 2 min; Dynamic parameter ≥ 2.75 ppm-min; All points < ±2.1% or < ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± 0.05	< ±15.1% or < ±1.5 ppb difference whichever is greater
Dilution System Flows	6 Months	Adjust Points as Needed	< ±1.1%	< ±2.1%
O3 Generator Certification	6 Months	Adjust Points as Needed	< ±1.1%	0.85 ppm-0.95 ppm
PM2.5 Filter Based	Annual	Temp Pressure Flow	< ±2.1 deg C < ±10.1 mmhg < ±2.1% of transfer standard	< ±2.1 deg C < ±10.1 mmhg < ±4.1% of transfer standard; < ± 5.1% of flow rate design value
PM2.5 Continuous	6 Months	Temp Pressure Flow	< ±2.1 deg C < ±10.1 mmhg < ±2.1% of transfer standard	< ±2.1 deg C < ±10.1 mmhg < ±4.1% of transfer standard; < ± 5.1% of flow rate design value
PM10 Filter Based (SSI)	Annual	Temp Pressure Flow	< ±2.1 deg C < ±10.1 mmhg 3 of 4 cal points within < ±10.1% of design	< ±2.1 deg C < ±10.1 mmhg < ±7.1% of transfer standard and < ±10.1% from design
PM10 Continuous	6 Months	Temp Pressure Flow	< ±2.1 deg C < ±10.1 mmhg 3 of 4 cal points within < ±10.1% of design	< ±2.1 deg C < ±10.1 mmhg < ±7.1% of transfer standard
TSP	6 Months	Flow	5 points over range of 1.1 to 1.7 m^3/min < ±5.1% limits of linearity	< ±7.1% of transfer standard

Calibration activity beyond scheduled calibrations can be initiated by issuance of a work order when needed (SOP00116). Typically, a work order asking for instrument calibration is filed after completion of repair work, whenever instrument drift is outside control limits, when a new or replacement instrument is placed into service, or when an instrument either fails an audit or data approaches an audit acceptance limit. A calibration request work order is typically created by the Station Operator, Principal or Senior AQIS, or in response to a QA Branch Corrective Action Request. Once generated, it is assigned to the appropriate calibration technician. These work orders are tracked using the MN Branch Work Order Data Base from issuance through completion. Work orders are closed by the responsible Senior AQIS. The work order is archived upon completion and the Station Operator and responsible Senior AQIS are notified that calibration has been completed through the work order system email list.

2.7.6 Support Instrument/Equipment Certification

Zero Air Systems and Standards

Zero air systems should be able to deliver 10 liters/min of air that is free of ozone, NO, NO2, and SO2 to 0.001 ppm, and CO and non-methane hydrocarbons to 0.1 ppm or below the instruments method detection limit (whichever is lower). With NCore monitoring and the use of trace-gas monitors, there may be a need to audit and calibrate at lower levels. Therefore, monitoring organizations may need to acquire zero air systems capable of delivering zero air at 20 to 30 liters/min. There are many commercially available systems; however, simple designs can be obtained by using a series of canisters. In addition, the 2012 *Traceability Protocol for Gaseous Calibration Standards* includes a discussion of zero gas standards which are commercially available. Although not required for use under protocol gases, the standards can be used as a check on zero air systems. The U.S. EPA QA Handbook, Vol. II, Appendix K provides further guidance on checking zero air systems.

Field Support Equipment and Certification

Field equipment standards and certification, including tracked dates of recertification, is maintained by the MN Branch Support group, accessible on the M&A shared drive in the *Standard Assignment & Recertification Schedule* MS Excel® spreadsheet. Laboratory certifications for the criteria pollutant monitoring program are maintained by the LS Branch Principal and Senior AQ Chemists.

The certifications are typically done by the manufacturer or a qualified outside entity or laboratory. For all equipment and standards, when acceptance criteria are not met after multiple attempts, the equipment is inspected and repaired or replaced as necessary. When sample data quality is potentially or actually impacted by equipment or standards that do not meet certification, a quality assurance alert is generated by the MN Branch to the QA Branch. In addition, the MN Branch informs the Principal AQ Chemist supervising the LS Branch Aerosol Group, or their designee, about the time frame and issue(s) resulting in data impacts, including loss.

Audit Equipment and Standards

South Coast AQMD maintains differentiation between standards used for routine verifications/calibrations and standards used for audits, such as Performance Evaluations. The QA Branch maintains a fully equipped audit van and additional resources with high quality standards and a zero air system for audits. The QA audit equipment certification is tracked, scheduled and documented by the QA Branch audit staff.

All audit compressed gas standards with remaining usable gas pressure (> 500 psi) are either replaced or recertified annually by the manufacturer using the U.S. EPA Calibration Gas Traceability Protocol (*Traceability Protocol for Assay and Certification of Gaseous Calibration Standards,* Report No. EPA-600/R-12/531, U.S. EPA, Research Triangle Park, NC. 2012). Audit ozone standards are certified semi-annually to the Level 2 transfer standard (slope within ±3% and intercept within ±3 ppb). Audit CO instruments are multi-point calibrated semi-annually to verify the linearity of the instrument (zero and 5 non-zero calibration points within ±2 percent). The audit zero air generator is certified annually. Audit flow standards are certified annually, either in-house or by a vendor, as traceable to NIST standard within ±2 percent.

2.8 Inspection/Acceptance of Supplies and Consumables

Acceptance criteria for supplies and consumables vary with the operation being conducted and are generally described in the relevant SOPs. For regulatory ambient air monitoring, most of the spare parts needed will be procured from the manufacturer or other vendor for the FRM/FEM instrument in use. The Support group also tracks and orders many of the spare parts used by the MN and QA Branches.

Critical supplies and consumables for the criteria pollutant monitoring program include, but are not limited to, the following, that are kept in stock and tracked by the MN or LS Branch Principals and Senior Staff:

- Gas Cylinders – calibration gases, must be U.S. EPA Protocol cylinders;
- Particulate Filters – stocked by the LS Branch Aerosol Group and ordered well in advance of depletion through U.S. EPA Region 9;
- Filter Tapes – kept in stock for continuous particulate samplers;
- Sample lines/Teflon® tubing – kept in stock for repair/replacement as needed;
- Manifolds, inlets and fittings – sufficient spares and parts available for repair/replacement as needed.

Where requirements warrant specific materials (e.g., Teflon or Stainless Steel) or other specifications, the supplies ordered and received are checked against those specifications and fit tested. This ensures that supplies and consumables are adequate and appropriate for the intended purpose. Durability is assessed through testing and field usage. Any issues are raised with the vendor for further remedy or the return of the supplies or consumables for refund.

Supplies and consumables that have expiration dates are clearly labeled on the container or cylinder, typically logged in a tracking sheet, and checked before being used.

Procurement, tracking, and acceptance testing of supplies is typically done through the individual work groups, through the MN, LS or QA Branches for administration and approval. Supplies and consumables are typically stored in the MN Branch shop or workroom areas, the QA Branch shop or audit van, or in the LS Branch laboratory storage rooms at South Coast AQMD headquarters until needed and gas cylinders are stored in a protected tank farm outside the lab building.

Most calibration gases are tracked and ordered by the Principal AQIS for the MN Branch Support Group, with assistance and input from the LS Branch Principal AQ Chemists and the QA Branch. Proper gas cylinder labeling, with expiration dates, and proper storage is monitored by each group with periodic QA oversight. South Coast AQMD does not use expired gases for the criteria pollutant monitoring program.

Procurement of supplies and consumables requires procurement documentation, including Cal-Card invoices and receipts, purchase order request forms, sole-source justification if needed, Board

Letters if Governing Board action is needed, purchase orders, and invoices from the vendor. Most procurements require approval from the supervisor, manager, and the M&A ADEO. In some cases, approvals are required from the STA DEO and possibly the Executive Officer or Governing Board Chair, typically for higher cost items. Expenses are tracked both by M&A and by the Finance Office and compared, to program and grant budgets prior to payment. Calibration/certification documents are maintained by each branch and stored beyond the life of the product, in conjunction with South Coast AQMD Retention Policy.

2.9 Non-Direct Measurements

This section identifies types of data that South Coast AQMD may use to support the ambient air monitoring program that the agency did not directly generate or collect. Such data may support project implementation or decision making and includes the following:

- **Census Data** – to determine the number of sites needed in a metropolitan statistical area (MSA), population counts are obtained from the U.S. Census Bureau.[32]
- **Meteorological Data** – for analysis of weather conditions beyond the meteorological data collected at South Coast AQMD criteria air pollutant monitoring stations and our own supplemental meteorological stations, South Coast AQMD may utilize climate and observational data from the National Weather Service (NWS)[33], National Centers for Environmental Information (NCEI)[34], or Western Regional Climate Center (WRCC)[35] for such things as data validation checks, or the evaluation exceptional events or air flows for instrument siting. Limitations of this data can include siting issues, especially in the urban areas, so it is valuable to review collecting agency documentation prior to relying on this data.
- **Emissions Inventory Data** – for analysis of the potential for air pollution concerns and to help assess the adequacy of or duplication within the air monitoring network design. Applicable emissions inventories include the U.S. EPA National Emissions Inventory (NEI)[36], as well as the gridded regional emissions inventory and growth projections developed for SIP regulatory modeling and performance tracking purposes from the South Coast AQMD Emissions Reporting System, CARB mobile source inventories, and growth and travel activity projections from the Southern California Association of Governments (SCAG), along with input from other stakeholders.[37] A limitation of this data can be the

[32] U.S. Census Bureau data website: https://www.census.gov/data.html

[33] National Oceanic and Atmospheric Administration, National Weather Service website: https://www.weather.gov/

[34] National Oceanic and Atmospheric Administration, National Centers for Environmental Information (NCEI) website: https://www.ncdc.noaa.gov/

[35] Western Regional Climate Center (WRCC) website: https://wrcc.dri.edu/

[36] U.S. EPA National Emissions Inventory (NEI) website: https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei

[37] South Coast AQMD Air Quality Management Plan, Chapter 3, Base Year and Future Emissions: http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/chapter3.pdf?sfvrsn=4.

timeliness of the processed annual data, but future-year projections are often available to help with planning activities.

These data sources follow established QA/QC procedures and there is generally little concern of the data quality. However, secondary data should, at minimum, be evaluated for the purpose it is being used for. The data mentioned above are reviewed for consistency with past and completeness by M&A staff or PRDAS meteorologists or modelers before use in analyses or modeling efforts. The available reports and metadata are also reviewed to provide an understanding of how the data was collected and potential limitations.

2.10 Data Management

Managing the data collected is just as important as correctly collecting the data. The data must be of known quality, reliable and defensible. In order for monitoring organizations to continue to meet those objectives, many sources of information need to be transferred, stored in data bases, archived and reviewed. Much of the air monitoring and QA data collected is also reported to AirNow and other external users, and validated, reported to AQS, and certified.

This section describes how the ambient air monitoring data for the Criteria Pollutant Monitoring Program will be managed, tracing the path from data generation in the field/laboratory to the final data use and end storage in AQS. It includes standard record keeping, data handling procedures, and the equipment used to acquire, process, compile, store, retrieve, and analyze data. Nearly all criteria pollutant monitoring data is either acquired digitally (e.g. computer workstations, data loggers, telemetry system, data servers) or entered into digital storage from laboratory analysis, sample logs or instrument printouts to reside in a computer database. As a result, the computer hardware and software are a critical aspect of this discussion. Also described are procedures for detecting, flagging, and correcting errors/loss during data processing and procedures for assuring that applicable information resource management requirements are satisfied, including the identification of the location of applicable spreadsheets, databases, and reports.

South Coast AQMD field and office desktop and laptop PCs, data loggers, servers, data telemetry network, internet and email systems are managed by M&A along with the Information Management (IM) Division who provides systems support for:

- Operating system and software updates and testing;
- Redundancy to minimize downtime;
- Secure cloud-based storage;
- 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.

Data management for the criteria pollutant program is a joint effort between the MN, LS and QA Branches, along with IM. MN Branch Senior AQIS staff and the QA Branch Staff Specialist monitor and assesses the data telemetry flows through the continuous data system and data that is out of typical ranges, along with the hardware and software (including development, upgrades, troubleshooting and interfacing with IM). MN Branch station operators provide review and Level 1 validation of the data and assess proper operations and data flow, making adjustments and minor repairs as authorized by supervisory staff. The MN Branch Data Management/Validation group provides further data review and Level 2 and 3 validation and the data submission to AQS. MN Branch Operations and Support staff and supervisors oversee the data flow processes and evaluate potential issues, making repairs when needed. LS Branch staff and supervisors prepare and analyze the discrete filter data, maintaining the chain-of-custody and communications with field operations, entering data and QC information into the electronic data system, validating data, and submitting it into AQS. QA Branch staff provide audits for the program or coordination with outside audits, along with review and oversight of the components of the criteria pollutant program and assessments, as well as the annual certification review.

When software or hardware upgrades occur, archived databases that use that software or hardware are assessed for compatibility and, if warranted, upgraded to work in the new system. The South Coast AQMD retention policy governs how long data and supporting information needs to be maintained. Generally, for federal grant programs including the criteria pollutant monitoring program, data are to be retained for a period of 3 years from the date that the grantee submits its final expenditure report unless otherwise noted in the funding agreement. South Coast AQMD final criteria pollutant data is archived with no expiration for use in long-term trend summaries and other analytical or research needs.

While discussions about and examples of the criteria pollutant data, its associated QC, audit data, and its analysis may be transferred by email, either internally or between entities, the South Coast AQMD data for record is not transferred by email. The South Coast AQMD data systems for criteria pollutants provide the complete record of each data point from its collection to finalization in AQS.

Verification of the data trail consists of following a value or values from the monitoring instrument through the data acquisition system, to the central computer and data base, and on to AQS. The accuracy of data reporting is verified routinely. The continuous air monitoring data are reviewed each work day by Operations Group station operators, including the automated QC checks. The Senior staff and the QA Branch Staff Specialist also review the data through the telemetry system and into the DMS every workday. They will conduct a more robust analysis and review, including review of the instrument metadata, if issues are indicated. The MN Branch Data Validation staff traces data from raw values through the final data stored in AQS as part of the data validation process, at least every quarter. They compare the 1-minute data to the hourly values as part of the process. The QA Staff Specialist also audits a portion of the data trail, at least each month and as concerns arise, to verify data accuracy through the data system, checking that the data is consistent through the process and checking that averaging is accurate (e.g., 1-minute to hourly, 8-hour, 24-hour averages). Manually entered and electronic lab analysis, QA/QC data, and COCs are peer reviewed for accuracy, validated by AQ Chemists and Senior AQ Chemists as analyzed and

prepared for quarterly submittal to AQS. All entries are in the Element® LIMS and any data reviews and edits are tracked in LIMS and can be viewed under the Audit Trail menu. The QA Senior Chemist reviews the laboratory performance audit data as submitted and a portion of the air quality data each quarter. QA Branch also assesses the data as part of the data certification process, reviewing AQS reports quarterly and finalizing certification annually.

2.10.1 Data Management for Continuous Monitoring Methods

The flow for processing South Coast AQMD continuous criteria pollutant monitoring data is outlined in Figure 2-8. The South Coast AQMD field continuous instrument data recording devices consist of an Environmental System Corporation (ESC)® 8832 data logger and an Agilaire® 8872 data logger. The ESC data logger is the primary data acquisition for the continuous monitoring and automated QC check data. The Agilaire 8872 provides a backup record of continuous monitor data with data display capabilities that can be utilized by the station operator and support staff. The ESC data logger collects and computes the minute and hourly averages. Some of the gaseous pollutant analyzers and PM monitors also have their own internal data loggers which can be accessed manually to download data into a laptop and transferred to a central storage location at South Coast AQMD, if needed.

The South Coast AQMD data acquisition system polls each air monitoring station data logger once every 3 minutes and hands off the data to the data management system every half hour. Data transmittal is accomplished using a private internet protocol (PIP) data network which links the ESC and Agilaire data loggers through a router at the air monitoring sites with the AirVision server at South Coast AQMD headquarters that runs the Agilaire® AirVision software for polling the stations. The continuous 1-minute data or hourly data, as appropriate to the monitor, are sent from the AirVision server to a server at South Coast AQMD headquarters, which hosts the Sonoma Technology, Inc. Data Management System® (DMS). The data averaging for 1-hour, 8-hour, 24-hour averages and other needed standards is accomplished in DMS. Data from the redundant station data loggers or data from internal instrument data loggers, as available, are used to back-fill missing data, if needed.

Routine data review, verification, and validation process occurs primarily in DMS. Edits, invalidations and data flagging, are performed on the DMS server, which maintains chain-of-custody data records from the original field records, including the user identification of the person who made the change. The validation process is described further in Chapter 4. Any edits or added flags are logged and maintained in the system, which retains the original data history. As such, data cannot be modified without a record of the changes back to the raw, unaltered data. Data deletions are not allowed.

Metadata is information that describes the data and the quality criteria associated with their generation. The South Coast AQMD instrument metadata is collected and stored by the instruments on an hourly basis. The metadata is currently stored for approximately 1 month, or longer when requested by MN Branch Operations or Support Group staff or the QA Branch. It is utilized to help isolate instrument performance problems and for troubleshooting issues, mainly by Operations and Support Group Senior AQIS staff, the QA Staff Specialist, and Data Validation staff. The metadata provides instrument diagnostics for review if performance issues are suspected

with the instruments and staff can remotely connect to the instrument and download the data for review and analysis. Typical metadata parameters include, but are not limited to: flow rate, sample pressure, sample temperature, bench temperature, box temperature, PMT Cooler Temperature. Future plans include collecting certain parameters by the Data Acquisition System (AirVision) and storing them on the AirVision server for a period of one year. The data in AirVision could then be reviewed if there are issues that need investigation through the data validation process.

All continuous air quality data for the criteria pollutant monitoring program is stored in the DMS central relational database at South Coast AQMD headquarters and on back up media. The monthly backup copies are also stored at an offsite storage location. Data storage is managed in accordance to the South Coast AQMD QMP Section 8 (South Coast AQMD, 2016). Access to the telemetry and DMS system is limited to internal staff, with permissions based on the program needs. The continuous air monitoring data is submitted from DMS to the U.S. EPA AQS database when the validation process is complete, prior to the end of the quarter following the quarter in which the data was collected. Figure 2-8 depicts the data management flow for continuous monitors.

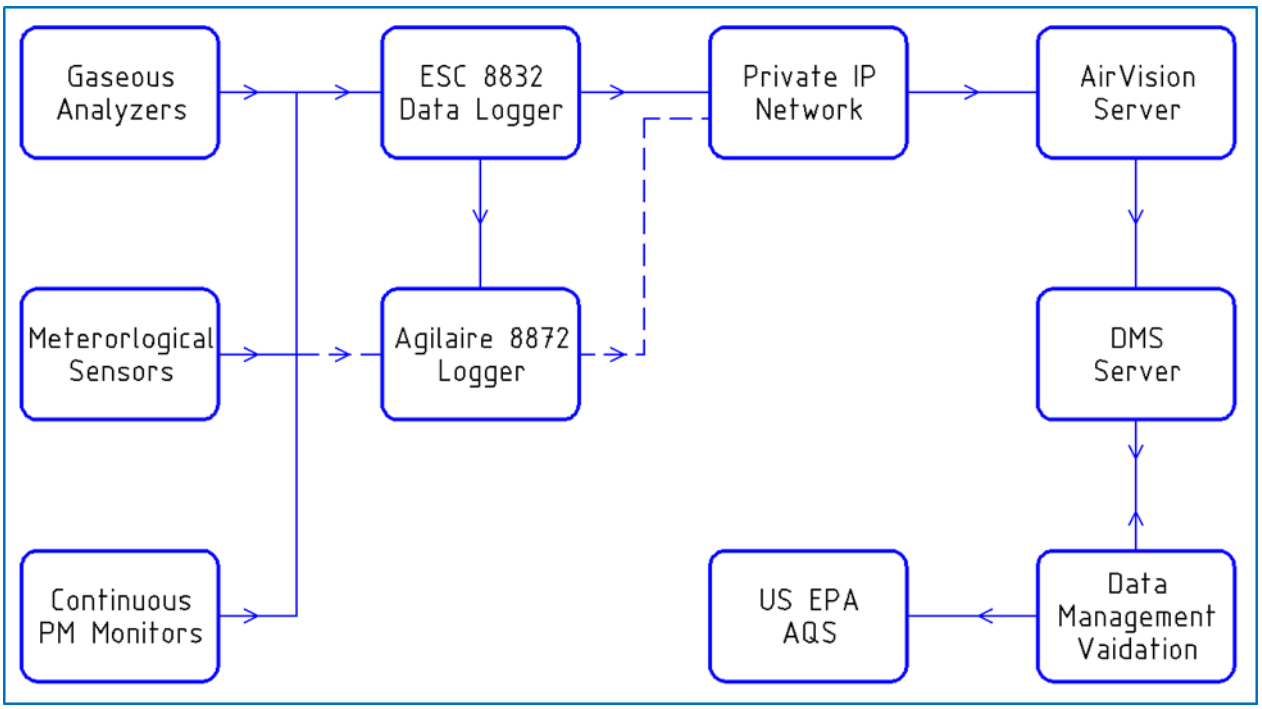


Figure 2-8
Data Management for Continuous Monitors

2.10.2 Data Management for Discrete Monitoring Methods

Quantitation of criteria pollutants (PM2.5, PM10, and TSP-Pb) in discrete samples require the integration of field data from the MN Branch and analytical data from the LS Branch. This is accomplished by a combination of various processes and applications specific to each sampling and analytical method.

2.10.2.1 Data Management Resources for Discrete Monitoring Methods

The resources needed to manage discrete measurement data are the following:

- 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 Laboratory database to calculate concentrations of analyzed species; perform data review; generate reports; and submit to AQS via internet (as applicable);
- Personal desktop and/or laptop to perform data review and generate reports; and submit to AQS 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;
- MN Branch workstation computers for electronic field data placement in the Laboratory shared network drive.

2.10.2.2 Data Flow and Processing

This section describes the flow of data from the analytical instrument to the final archiving and identifies points where data may be modified and/or reformatted.

Element® LIMS is a data management software utilized by the Laboratory for a diverse range of functions, such as scheduling for sample collection, COC creation pre-sample collection, COC archive post-sample collection, field data entry/import, sample tracking, analytical data import, result calculations, data review, data flagging, data reporting, and data storage. Information and data entered in Element® LIMS are stored in a SQL database and are accessible through the Element LIMS interface or by the SQL programming language. Changes made in Element® LIMS are tracked using a built-in audit trail function. Element® LIMS protocols are documented in the South Coast AQMD SOP00108 – *Element® LIMS Data Handling and Processing*. Additional data management procedures are described in the SOPs pertaining to each Laboratory analytical method.

In addition to Element® LIMS, the Laboratory uses a combination of proprietary and customized software for sample analysis, data acquisition, and data management. Instrument specific analytical applications are typically installed on each corresponding instrument PC and provides instrument control during the analytical process. Post-analysis, analytical data are transferred into Element® LIMS with built-in or customized import tools. Native electronic files generated from analytical software are stored on local PCs and may be transferred to the shared network drive, if applicable. Additionally, hard copies and/or PDF instrument data are produced for review. These files are stored in assigned locations in the Laboratory or shared network drive, as appropriate. Handwritten instrument and analytical information are stored in Laboratory notebooks located at each station.

Data flow and processing is divided into pre- and post-sampling procedures. Pre-sampling processes in the Laboratory may include, but are not limited to, sampling media light inspection, conditioning sampling media within defined temperature and humidity control requirements for 24 hours, conducting gravimetric analysis to obtain tare weights, packaging sampling media for pickup, and performing Element® LIMS related tasks (sample scheduling,

lab number generation, and COC and label creation). The MN Branch field staff acquires the COC and sampling media from the Laboratory and departs to the designated sampling locations to setup for sampling. While in the field, the field staff follows procedures outlined by the MN Branch SOPs and OAGs. The South Coast AQMD OAG #QA0045 – *Communication of Sampler QC Data to Laboratory* documents the procedures for field staff providing relevant information from the field to the Laboratory.

Post-sampling protocols can be separated into field sample collection, Laboratory sample preparation, sample analysis, data processing, data review, and reporting. After sampling is complete, field operators record sampling information on sample logs, COC sheets, sampler printouts, and digital sampler outputs. COCs and sampler printouts are submitted to the Laboratory along with the corresponding samples. Field data are initially evaluated by the field staff and then reviewed and flagged by Laboratory staff using QC criteria defined in the SOPs. Electronic sampler data are placed in a shared drive within the South Coast AQMD secure network by the field staff, as applicable. Depending on the type of sample, sampler data transfer to Element® LIMS is accomplished by either manual entry or utilizing an import function via Element® LIMS. Ideally, field data import is either performed prior to sample analysis. or imported together with analytical data.

After the COCs and sampler data are reviewed and entered in Element® LIMS, samples and QCs are prepared for analysis. Sample preparation and analytical protocols are described in the SOPs pertaining to each method. Samples and QCs may be conditioned within defined temperature and humidity control requirements for 24 hours and/or extracted in solution for analysis. Sample and QC preparation information are recorded in logbooks. Samples and QCs are then analyzed using instrumentation controlled by designated computers. These computer systems control the analysis cycle and can include control of automated samplers for unattended operation. These computers have the ability to display data such that the operator can determine whether the analytical process is proceeding appropriately. Also, these computers can be used to process raw data, import data to Element LIMS, conduct data review, and produce reports for discrete analyses.

Post-analysis, the raw data file that is created is imported in Element® LIMS. Target analyte concentrations are calculated using field sampler data (if applicable), and data are reviewed and flagged in Element LIMS using automated QC criteria specified in the SOPs. Additional software tools such as Access and/or Excel can be used to assist in the data import/review process. Raw data is retained on the computer for the period specified in the South Coast AQMD *Records Retention Policy* or according to programmatic requirement, whichever is longer. These data processing/review tasks can also be performed at other workstations and/or personal desk/lap top computers. Data validation is a multi-tiered review process, consisting of Level 1, Level 2, and Level 3 validation. Data validation is performed in Element LIMS but 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 then is available for extraction and reporting.

Data management occurs in the LIMS Data System as shown in Figure 2-9 and described in detail in SOP00121, *Standard Operating Procedure for Data Processing and Validation*, which details the processes and procedures used to collect, transmit, store, validate, and report discrete sample data for the criteria pollutant measurement program.

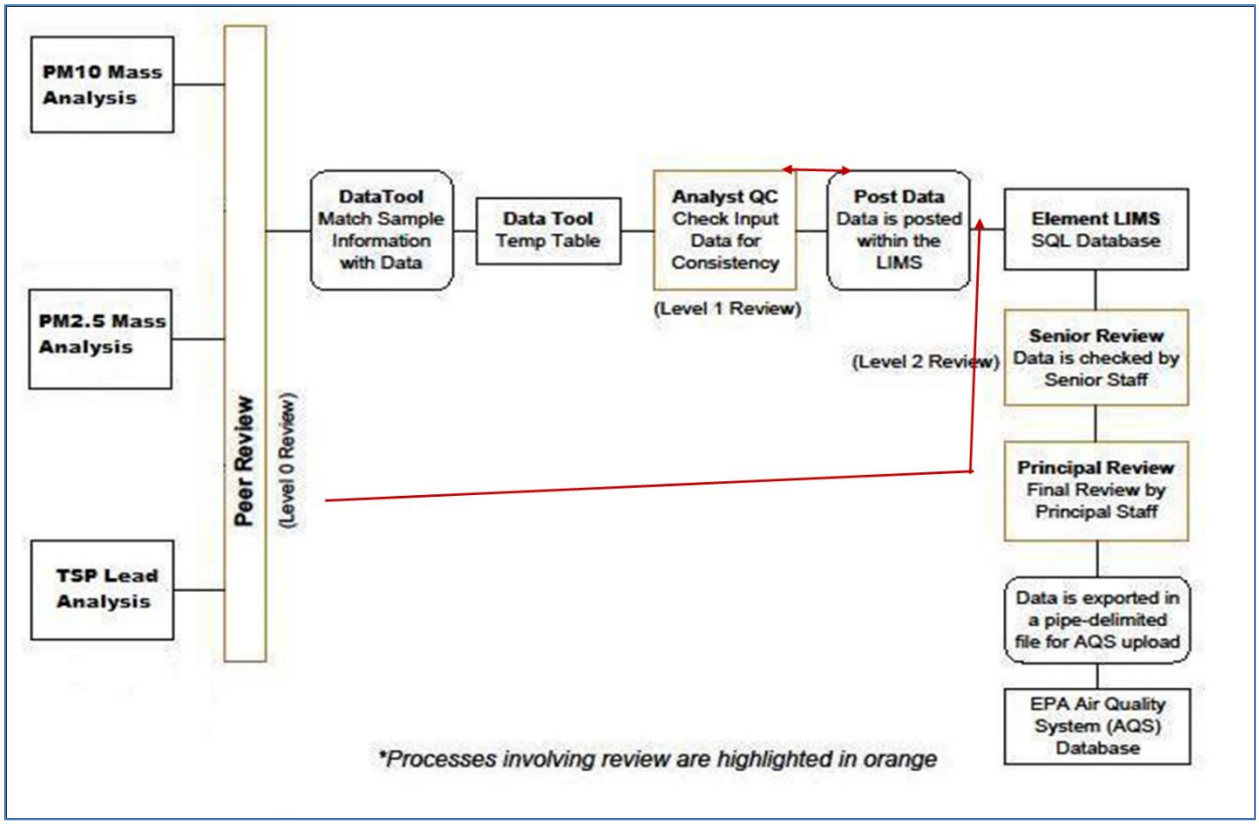


Figure 2-9
Laboratory Operations Data Flow Diagram

An example of this process is illustrated in the PM2.5 FRM program. Gravimetric PM2.5 measurements are collected using a customized balance software interface connected directly to a custom-built SQL database located on the Laboratory SQL server. $PM_{2.5}$ mass data are accessible using the weight acquisition application or by SQL programming language. Prior to sampling, Laboratory staff (typically a Laboratory Technician) light-inspects and conditions Teflon filters for 24 hours in a temperature- and humidity-controlled room. The Teflon filter IDs are entered into the balance application to start the 24-hour time counter. Once the filters have been conditioned under acceptable limits, they are weighed using the balance application connected to a microbalance. The balance application contains built-in QC procedures that require calibration and QC checks at specified increments. The tare weights obtained during the analytical process are automatically stored in the SQL database and handwritten in a logbook. At the completion of gravimetric analysis, the Teflon filters are placed in cassettes

and are packaged according to sampling location and frequency and placed in designated pickup locations in the Laboratory.

The filters are retrieved by the field operators who depart to each station to setup for sampling. Sampling information, including filter ID, sampler ID, location, date, and operator name, are written on the COCs. Any station or instrument related information is entered in the station or instrument logbooks. The samplers are then programmed for sample collection at scheduled frequencies pertaining to that particular location. At the conclusion of sampling, the operator transcribes the sampler data onto the COC and completes other sampling related information on the form. The operator downloads all sampler data from the data loggers and transfers these files to the Laboratory shared network drive. The operator relinquishes the sample by signing and dating the COC and placing the sample and COC in designated Laboratory drop-off locations.

The samples and COCs are received and reviewed in the Laboratory and prepared for final weight acquisition by Laboratory staff, usually the Laboratory Technician. The cassettes are dissembled, and the Teflon filters are placed in the conditioning room for 24 hours. Each filter is time stamped for conditioning and weighed using the balance application. Again, the weights are also handwritten in a logbook. The sampler data and mass data are reviewed by Laboratory staff, usually a Senior AQ Chemist. Any issues regarding sampler data are addressed at this stage in the process. The next stage in this process is importing sampler data and mass data into Element® LIMS. As part of the data processing procedure, electronic PM2.5 FRM sampler field data and gravimetric Laboratory data are combined and exported to csv files using customized Access software. The data in the csv files are then imported into Element® LIMS for final calculations and review. Additional software tools, for instance, like Excel may also be used to aid in the review process.

Once review is complete, the PM2.5 mass concentrations are exported from Element LIMS to a pipe delimited AQS format that includes concentrations, sample volumes, sampler flow rates, and sampling period. The data from the pipe delimited file is then uploaded to AQS by Laboratory staff, typically a Senior AQ Chemist in the section responsible for the review and submission of data to AQS.

2.10.3 Data Submission, Verification and Evaluation

Sections 2.10.1 and 2.10.2 describe activity from data or sample collection up to AQS submission. The data files are prepared for upload to AQS from DMS for continuous data or from LIMS or other laboratory databases for the discrete data and these files are screened for completeness, accuracy and format. The data is generally batch loaded to AQS, but individual data points can be added or updated in the U.S. EPA data system, when needed. The U.S. EPA AQS User Guide (U.S EPA, 2018b) describes the submittal process, as well as changing site and monitor information. The chain-of-custody and security of the data is maintained by limiting access to AQS for uploading or editing data. AQS tracks uploads and edits by user. These user assignments are controlled by AQS screening groups through the user application process and the South Coast AQMD AQS coordinator.

The data submitter also reviews the data AQS standard reports to ensure that the submittal was properly uploaded and as an additional check for incomplete or unusual data. The data in AQS is also reviewed and verified after submittal as part of the QA Branch quarterly assessments and the annual certification. AQS reports are run to ensure that errors do not occur during data formatting and transmission and that audit and QC checks are complete in the system. Final evaluation of criteria pollutant design values and other analytical metrics are either done in AQS or by South Coast AQMD/PRA staff using the final data from AQS with tested programs they maintain.

SECTION 3. ASSESSMENT AND OVERSIGHT

This section describes the assessments South Coast AQMD performs or participates in to ensure the criteria air monitoring and laboratory analysis activities are being conducted as planned and described in this QAPP and its associated SOPs and that they are generating acceptable data. It incorporates the oversight of an independent QA Branch and describes reports to management on the criteria air pollutant monitoring program and data quality.

This section includes the following assessment and oversight elements:

3.1 Assessment and Response Actions

South Coast AQMD participates in air monitoring station and laboratory assessments or proficiency programs conducted by or reviewed by the South Coast AQMD QA Branch, including audits by U.S. EPA or CARB, in some cases auditors contracted by South Coast AQMD or U.S. EPA. These assessments are summarized in Table 3-1. South Coast AQMD is committed to maintaining staffing, hardware, and facility certifications needed for performance of the criteria pollutant monitoring program and the related assessments.

The QA Manager, or designee, performs or arranges for, periodic performance and technical systems audits of South Coast AQMD activities. Numerous audit activities occur throughout each year. Combined, these audits cover all aspects of South Coast AQMD's criteria pollutant monitoring work, including: safety, siting, documentation, training, field operations, instrument/sampler performance, sample receipt, custody, calibration standards, conditioning, weighing, chemical/speciation analysis, shipping, data reduction, data management, validation, reporting, and QA oversight.

Prior to larger audits, especially a U.S. EPA Technical Systems Audit (TSA), a checklist is prepared, based on this QAPP, SOPs, applicable guidance documents, communication with the audit team, and past audits to help guide staff through the audit and the advance preparation. After the audit, the results and findings are typically reported by the audit team to the QA Manager or designee. After the preliminary audit results are released by the auditor, the QA Manager or designee summarizes the preliminary results in a memorandum or email to the managers and Principal staff of the impacted Branches (typically MN and LS Branches) in a timely manner. When the final audit report is received, this is also provided to the impacted group managers and the ADEO in a timely manner. These memoranda or email clearly specify areas in which corrective actions are to be addressed for non-conforming conditions and may be in the form of, accompanied by, or followed by one or more Corrective Action Requests (CARs) issued and tracked by the QA Branch. Each CAR is issued to the responsible Branch Manager and Principal staff and tracked in electronic form by the QA Branch on the protected Quality Assurance area of

the M&A Division shared drive. Each Branch Manager or designated staff is responsible to address findings and to provide written documentation of the resolution to the QA Branch and the auditor in a timely manner.

The QA Manager will assess the effectiveness of a corrective action issue to determine if it successfully addressed the issue, in consultation with QA Branch staff and the Manager and senior staff of the impacted group, as needed. If a corrective action is disputed and/or unresolved, the QA Manager will mediate a resolution and may seek further advice and guidance from the U.S. EPA Region 9 office and may elevate the issue to the STA/M&A ADEO, if necessary.

The timeline for completion of a corrective action varies by the severity of the issue and the timeline is proposed in the initial preparation discussion. When an audit or inspection identifies a serious issue requiring immediate action, the QA Manager or designee informs the responsible manager or designee about the matter verbally and through electronic mail. If a stop work order is warranted for a serious QA or safety issue, the information will also be communicated directly to all impacted staff and management. The initial notification is followed by issuance of a CAR for documentation and tracking the issue, a plan for resolution, the resolution and the minimization of recurrence. 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. Corrective action activity and administration follows the corrective action process as described in the South Coast AQMD QMP (South Coast AQMD, 2016) and in OAG QA0001 (Corrective Action Request Process).

Any South Coast AQMD M&A staff can report the need for corrective actions. Quality Assurance Alerts (QAAs) forms are used by staff to inform the QA Branch of potential issues or changes that could impact the data or safety, as documented in OAG QA0002 (Quality Assurance Alert Process). Corrective Action Requests (CARs) are issued by the QA Branch for findings that could impact data quality or safety, often in response to QAAs, in order to:

- Inform impacted personnel;
- Open discussion for determining a resolution and a reasonable deadline;
- Track progress of resolving the finding to achieve deadline;
- Document the problem, its resolution and steps to keep the issue from recurring.

The South Coast AQMD has a Continuity of Operations Plan (COOP) that guide the agency's response and essential or critical agency efforts, including air monitoring, during and after emergency situations that may arise (e.g., natural disasters, severe weather, wildfires, pandemic, terrorism, etc.). This allows for varying levels of response based on evolving conditions, safety and the public need. Generally, air monitoring of criteria pollutants is considered a high priority – with a hierarchy of keeping continuous monitoring operational, then filter-based measurements and laboratory analysis depending on resources and needs for regulatory actions. As situations arise requiring COOP-related action, the STA DEO and M&A management meet to determine the best course of action to recommend to the Executive Officer regarding monitoring efforts and to

adjust as the situation evolves. Once a plan is in place, U.S. EPA Region 9 is kept informed of changes to the implementation of federal programs. Similarly, if an assessment shows that data quality/quantity is in jeopardy, for example, due to pending emergency conditions like severe weather, the QA Manager, or designee, would work with the M&A management and appropriate monitoring and/or laboratory staff to discuss and recommend changes such as an increased/altered schedule to mitigate the impact on data quality/quantity.

Table 3-1
Criteria Pollutant Monitoring Program Assessments

Audit Name	Description	Frequency	Agency
U.S. EPA Technical Systems Audit (TSA)	All lab and field instrumentation, practices and procedures used to collect data for Federal Programs	Typically, At least every 3 years	U.S. EPA Region 9
National Performance Evaluation Program (NPEP – PM2.5)	PM2.5 collected on appropriate filters from FRM samplers and analyzed by independent, certified, U.S. EPA-approved laboratory (Region 9 Laboratory)	8 Collocated Audits Annually	U.S EPA OAQPS/ Region 9
National Performance Evaluation Program (NPEP – Pb)	TSP collected on appropriate filters from FRM samplers and analyzed by independent, certified, U.S. EPA-approved laboratory (Region 9 Laboratory)	2 Collocated Audits, 6 Filter strips collected by South Coast AQMD (4 from one site, 2 from another, alternating between three sites over two years) and filters sent to Region 9 Lab	U.S EPA OAQPS/ Region 9
National Performance Audit Program (NPAP) – Pb Analysis	Technical evaluation of Pb Analysis from strips; Monthly audit strip analysis	Monthly	U.S. EPA OAQPS/Battelle; South Coast AQMD QA Branch
Standard Reference Photometer (SRP) Certification Program	Level 1 South Coast AQMD Primary Ozone Standard compared to Level 0 SRP in accordance to U.S. EPA methods	Annually	U.S. EPA Region 9; Richmond Laboratory
National Performance Audit Program (NPAP) – criteria gaseous air pollutants monitors	Through the probe (TTP) performance evaluation of continuous criteria gaseous pollutant monitors	Annually – 20% of the network	CARB QA Branch
CARB Audit Program for Continuous PM2.5 and PM10 monitors	Performance Evaluation of PM2.5 & PM10 continuous FEM monitors	Annually – 20 % of the network	CARB QA Branch
CARB Audit Program for Discrete Sample Monitors	Performance evaluation (flow) of FRM PM2.5, PM10, & TSP field samplers	Annually – 20% of the network	CARB QA Branch
Weighing Room Evaluation – PM10 & PM2.5	Gravimetric mass analysis performance evaluation & conditioning room audit	Annually	CARB QA Branch
Meteorological Evaluation	Technical evaluation of surface meteorology instruments	Annually – 20% of the network (conducted with other CARB audits)	CARB QA Branch
Annually Performance Evaluation (PE) and Systems Evaluations for criteria gaseous monitors	Performance Evaluation and System Evaluation for Criteria Gaseous Air Pollutants Monitors	Annually, 25% of the analyzers each calendar quarter	South Coast AQMD QA Branch

Audit Name	Description	Frequency	Agency
Internal Semi-Annual Performance (PE) & Systems Evaluations – continuous PM2.5 & PM10 FEM monitors	Technical evaluation of continuous PM2.5 & PM10 FEM monitors. In addition, safety, documentation, and other QA elements are checked	Semi-Annual 5-7 months apart for continuous FEM PM2.5 & PM10 monitors	South Coast AQMD QA Branch
Internal Semi-Annual Performance Audits of TSP-Pb Samplers	Technical evaluation of TSP-Pb samplers. In addition, safety, documentation, and other QA elements are checked	Semi-Annual, 5-7 months apart	South Coast AQMD QA Branch
Internal Quarterly Performance Evaluation (PE) – TSP-Pb	Technical evaluation on manual filter TSP-Pb samplers	Semi-Annual, 5-7 months apart	South Coast AQMD QA Branch
Internal Annual Performance Evaluation (PE) – PM2.5 & PM10	Technical evaluation on manual filter samplers (PM2.5 & PM10) FRM	Semi-annual, 5-7 months apart	South Coast AQMD QA Branch
Internal Weighing Room Evaluation – PM10 & PM2.5	Gravimetric mass conditioning/weigh room audit	Annually	South Coast AQMD QA Branch & CARB QA Branch
Annual Network Plan (ANP)	Network design, detailed site information, siting criteria evaluation, recent or proposed modifications & waivers	Annually	South Coast AQMD MN Branch
5-year Network Assessment	Detailed assessment of the criteria monitoring network, instrumentation, needs, & potential changes	Every 5 years	South Coast AQMD MN Branch
Data Quality Assessments (DQAs)	Ongoing review & assessment of ambient & QC against criteria	Daily, Quarterly & Annual	South Coast AQMD MN, LS & QA Branches
Audits of Data Quality (ADQs)	Internal: Ongoing review with in-depth ADQ when indicated by issues, anomalies, or corrective actions External: ADQ is part of the U.S. EPA TSA	Ongoing review, ADQ when indicated Every 3-5 years with TSA	South Coast AQMD QA Branch U.S. EPA
Annual Data Certification	Assesses and certifies the complete submittal and accuracy of criteria pollutant data, including consideration of QA findings.	Annually	South Coast AQMD QA Branch

3.1.1 Technical Systems Audits (TSAs)

The South Coast AQMD QA Branch performs annual program-specific internal systems audits of the criteria pollutant monitoring program. Due to the size of the network and staff resources, the field portion of these audits are routinely conducted as an ongoing process during the field performance evaluation audits to include all monitoring stations once per year. This includes assessments of documentation and recordkeeping, maintenance, calibrations, repairs and siting criteria. The QA Branch also routinely reviews work orders and timely completion of repairs, training logs, data validation concerns, collocation requirements, and data quality indicator metrics. An internal systems audits of the PM Laboratory are also conducted annually, with components assessed periodically as time allows. The internal audits, or a portion thereof, may be conducted under contract with an independent consulting firm working under the oversight of the

QA Branch, as needed and subject to South Coast AQMD *Procurement Policy and Procedures* (Appendix C).

External systems audits are carried out by the U.S. EPA and CARB, at their discretion and using either agency staff or through independent consultants working under the oversight of the U.S. EPA or CARB. CARB performs annual PM2.5 FRM laboratory and field audits and may occasionally perform a comprehensive TSA as resources allow.

U.S. EPA Region 9 performs a comprehensive Federal Programs Technical Systems Audit (TSA) typically every 3 years for the criteria pollutant program and other program groups (e.g., CSN, NATTS or PAMS programs) may perform TSAs of specific monitoring programs from time to time. U.S. EPA may, at their discretion, conduct technical assistance audits (TAAs) for specific monitoring programs, which are designed to focus on teaching and training of staff on the program.

TSAs are typically scheduled several months in advance. They include reviews of documentation and data summaries by the audit team, typically starting in advance of the visit to the agency. The U.S. EPA audit team will request a TSA Questionnaire one or two months ahead of the visit to the agency. They will trace data flow, including associated QA/QC data, from most raw initial form to its final form as residing in the AQS data base. During the visit to the agency, typically over a one-week period, the audit team will visit a few air monitoring stations and the laboratory. They will interview staff at all levels including questions related to their knowledge of the procedures they follow in their job.

The U.S. EPA TSA includes an Audit of Data Quality (ADQ), which includes a review of supporting documentation and records, maintained by the auditee and not available in AQS, in order to ensure the data reported to U.S. EPA is accurate, traceable, and defensible. While on site, the lead auditor will have limited time to complete the audit of data quality, which is typically a lengthy process, so this process is typically started prior to arrival. This review is typically done for a 3-year time period. The ADQ is a central focus of the TSA. Additional information on the ADQ can be found in Section 3.1.3, below.

Once finalized by U.S. EPA Region 9 staff, a letter is sent to South Coast AQMD with the TSA Findings Report that describes the details of each finding and recommendations for resolution. The QA Manager and affected work groups review the findings and determine corrective actions to resolve each one. A TSA Finding Corrective Action Plan (CAP), provided by the U.S. EPA audit team, is completed by South Coast AQMD to address the corrective action for each finding, including the following information:

- Actions taken or planned to correct the cause of the finding;
- Timetable for the actions taken or planned to correct the cause;
- Deliverables to demonstrate implementation (e.g., documentation such as SOPs, waiver requests, photos, etc.); and
- Corrective Action Author and Point-of-Contact.

The CAP response should be timely and a schedule for the response is typically included in the finding letter from U.S. EPA audit team. The CAP responses are not required to be submitted together as a complete package. The CAP responses to U.S. EPA are also not expected to all have finalized resolutions when initially submitted to U.S. EPA. The CAP should lay out the steps and timeline to resolve the finding even if it will still take some time to implement and document. The CAP responses are prepared by the affected work group(s), then reviewed and approved by the impacted branch manager(s), the QA Manager, and the M&A ADEO or designee. Once submitted to Region 9, the audit team may provide feedback on the CAP, approve it as adequate to be implemented, or approve it as complete if satisfactorily resolved. The QA Manager will periodically update Region 9 on the progress or completion of ongoing CAPs for each finding. Once satisfied with the corrective action and supporting documentation for a finding CAP, U.S. EPA audit team will approve it as complete. Further information on the TSA process, including the ADQ, can be found in the U.S. EPA Quality Assurance Guidance Document, *Conducting Technical Systems Audits of Ambient Air Monitoring Programs* (U.S. EPA, 2017c).

3.1.2 Performance Evaluations (PEs)

Performance evaluations (PEs) are conducted for determining the accuracy and precision of monitoring and analytical instrumentation and procedures. These audits may be internal and/or external. All performance audits, whether performed by South Coast AQMD QA Branch staff, independent consultants or other entities, including U.S. EPA and CARB, are required to satisfy requirements under the appropriate QAPPs and SOPs and federal regulations. Performance evaluations are conducted on a nearly on-going basis due to the large number of stations and programs the South Coast AQMD administers.

Internal performance audits are typically conducted by QA Branch staff. The South Coast AQMD QA Branch maintains independence from the criteria pollutant monitoring and laboratory analysis functions, since the QA Branch is not under the MN or LS Branch management structure. Per 40 CFR Part 58, Appendix A, internal performance audits for the gaseous criteria pollutant monitoring instruments involve auditing one fourth of the monitoring instruments each calendar quarter. Table 3-2 show the 2019 annual audit schedule for the South Coast AQMD gaseous audits.

Table 3-2
QA Branch Annual Gaseous Performance Evaluation Audit Schedule (2019)

No.	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1	Pomona	Pico Rivera	LAX Hastings	Santa Clarita
2	Reseda	Lake Elsinore	Glendora	Palm Springs
3	Long Beach Signal Hill	Anaheim	Pasadena	Redlands
4	Azusa	I-5 Near Road (Anaheim)	Perris	Indio
5	Fontana	Compton	Upland	Temecula
6	Rubidoux	La Habra	Banning	Mira Loma Van Buren
7	San Bernardino	West L.A.	Central L.A.	CA-60 Near Road (Ontario)
8		North Hollywood	I-710 Near Road (Long Beach)	I-10 Near Road (Ontario Etiwanda)
9		Crestline		
Total	**7 Sites**	**9 Sites**	**8 Sites**	**8 Sites**

The gaseous PE is made by challenging the analyzer with an audit gas standard of known concentration from at least three consecutive audit levels. The audit levels should represent or bracket 80 percent of ambient concentrations measured by the analyzer being evaluated. An additional fourth level is recommended for those monitors that have the potential for exceeding the concentration ranges described by the initial three selected audit levels. Both the evaluation concentrations of the audit gases and the corresponding measured concentration, as indicated or produced by the analyzer being tested, are reported to AQS. The percent differences between these concentrations are used to assess the quality of the monitoring data. Additional information on the gaseous audit levels and stability was presented previously in Section 2.5.1 and the gaseous audit procedures are in SOP00135, *Field Station Criteria Pollutant Ambient Air Instrument Performance Evaluation*.

For criteria FRM and FEM instruments and samplers measuring PM2.5, PM10, and TSP-Pb, South Coast AQMD QA Branch conducts internal performance audits semi-annually. Every 6 months (between 5 and 7 months apart), audits are conducted of the flow rate of these particulate analyzers and samplers. The audit is made by measuring the analyzer's normal operating flow rate using a flow rate transfer standard certified in accordance Section 2.6 of CFR Part 58, Appendix A. The flow rate standard used for auditing must not be the same flow rate standard used to calibrate the

analyzer. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. Great care must be used in auditing the flow rate to be certain that the flow measurement device does not alter the normal operating flow rate of the analyzer. The audit flow rate of the transfer standard and the corresponding flow rate measured (indicated) by the analyzer are reported to AQS. The percent differences between these flow rates are used to validate the one-point flow rate verification checks used to estimate bias.

Annual laboratory audit activity targets evaluation of the combined instrument-analyst-analysis-data submission system. Each calendar quarter, the TSP-Pb Reference Method analytical procedure is audited using filters containing a known quantity of Pb. These audit filters are prepared by depositing a Pb solution on unexposed filters and allowing them to dry thoroughly. The audit samples must be prepared using batches of reagents different from those used to calibrate the Pb analytical equipment being audited. Pb audit samples are prepared two concentration ranges: (1) 30-100% of the Pb NAAQS and (2) 200-300% of the Pb NAAQS. The audit samples must be extracted using the same extraction procedure used for exposed filters, following the procedure in Section 2.2.4.2 of 40 CFR Part 58, Appendix A.

External performance evaluations are carried out by U.S. EPA and CARB, at their discretion and using either staff from that agency or independent consultants working under the oversight of U.S. EPA or CARB. The externally conducted audits include the National Performance Audit Program (NPAP),[38] the PM2.5 Performance Evaluation Program (PEP)[39], and the Lead Performance Evaluation Program (Pb-PEP)[40] audits that are conducted by U.S. EPA or its contractors. These audits are designed to be independent, objective and comparable nationally. The PEP is an independent assessment used to estimate total measurement system bias. For primary quality assurance organizations such as South Coast AQMD with greater than five monitoring sites, eight valid performance evaluation audits should be collected and reported each year. Every FRM or FEM sampler is required to have a method designation evaluation each year and is subject to a PEP audit at least once every six year (approximately 15 percent of the locations audited each year). A valid performance evaluation audit means that both the primary monitor and PEP audit concentrations are valid and above 3 $\mu g/m^3$ .For PQAOs with greater that five Pb sites, such as South Coast AQMD, two Pb PEP audits are performed each year. In addition, six collocated Pb samples are sent to the independent PEP laboratory for analysis. Table 3-3 shows the audit frequency and acceptance criteria, as reproduced from the U.S. EPA QA Handbook, Vol. II, Appendix D, Validation Templates.

[38] U.S. EPA Quality Assurance Project Plan for the Federal National Performance Evaluation Program (NPAP) for NAAQS Gasses, 2015: https://www3.epa.gov/ttn/amtic/files/ambient/npap/npapnattsqapp.pdf

[39] U.S. EPA Quality Assurance Project Plan for the Federal PM2.5 Performance Evaluation Program (NPEP), 2009: https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/pepqapp.pdf

[40] U.S. EPA Quality Assurance Project Plan for the Federal Lead (Pb) Performance Evaluation Program (Pb-PEP), 2014: https://www3.epa.gov/ttn/amtic/files/ambient/pb/PbPEPQAPP2014Revision.pdf

Table 3-3
Audit Frequency and Acceptance Criteria Requirements for Performance Evaluation (PE), NPAP and NPEP for Criteria Pollutants

Activity	Frequency	Acceptance Criteria
Ozone		
Annual Performance Evaluation Single Analyzer	Every site every 365 days and 1/calendar year within period of monitor operation	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1 & 2 < ±1.5 ppb difference or < ± 15.1%
Federal Audits (NPAP)	20% of sites audited in calendar year	Audit levels 1 & 2 < ±1.5 ppb difference, all other levels percent difference < ±10.1%
CO		
Annual Performance Evaluation Single Analyzer	Every site every 365 days and 1/calendar year	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1 & 2 < ±0.031 ppm difference or < ± 15.1%
Federal Audits (NPAP)	20% of sites audited in a calendar year	Audit levels 1 & 2 < ±0.031 ppm difference, all other levels percent difference < ±15.1%
NO2		
Annual Performance Evaluation Single Analyzer	Every site every 365 days and 1/calendar year	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1 & 2 < ±1.5 ppb difference or < ± 15.1%
Federal Audits (NPAP)	20% of sites audited in calendar year	Audit levels 1 & 2 < ±1.5 ppb difference, all other levels percent difference < ±15.1%
SO2		
Annual Performance Evaluation Single Analyzer	Every site every 365 days and 1/calendar year	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1 & 2 < ±1.5 ppb difference or < ± 15.1%
Federal Audits (NPAP)	20% of sites audited in calendar year	Audit levels 1 & 2 < ±1.5 ppb difference, all other levels percent difference < ±15.1%
FRM PM2.5 (Filter-Based)		
Semi Annual Flow Rate Audit	Twice a calendar year and between 5-7 months apart	< ±4.1% of audit standard < ±5.1% of design flow rate
Performance Evaluation Program (PEP) (for Bias)	5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites	< ±10.1% for values ≥ 3.0 µg/m^3
FEM PM2.5 (Continuous)		
Temperature Audit	every 180 days and at time of flow rate audit	< ±2.1°C
Pressure Audit	every 180 days and at time of flow rate audit	< ±10.1 mm Hg
Semi Annual Flow Rate Audit	Twice a calendar year and 5-7 months apart	< ±4.1% of audit standard < ±5.1% of design flow rate
Performance Evaluation Program (PEP) (for Bias)	5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites	< ±10.1% for value > 3 µg/m^3

Activity	Frequency	Acceptance Criteria
FRM PM10 (Filter-Based, Hi-Volume)		
Semi Annual Flow Rate Audit	Every 180 days and twice a calendar year	< ±7.1% of transfer standard and < ±10.1% from design
Laboratory Filter Weighing Audit	Every 365 days and once a calendar year	< ±5.1 mg change from original value
Laboratory Balance Audit	Every 365 days and once a calendar year	Observe weighing technique and check balance with ASTM Class 1 standard
FEM PM10 (Continuous)		
Semi Annual Flow Rate Audit	Twice a calendar year and 5-7 months apart	< ±10.1% of audit standard
TSP-Pb (Hi-Volume)		
Semi Annual Flow Rate Audit	Every 180 days and twice a calendar year	< ±7.1% of audit standard
Laboratory Analysis Audit	6 strips/quarter 3 at each concentration range	< 10.1% (percent difference)
Performance Evaluation Program (PEP) (for Bias) (The PEP includes 1 or independent collocated audits and 4 or 6 samples from the monitoring organizations collocated monitor sent to the independent National PEP Laboratory.)	5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites	95% CL Absolute Bias < ±15.1% ≥ 0.02 µg/m^3

South Coast AQMD may also contract with independent consultants to conduct external audits of selected portions of the criteria pollutant monitoring program. Independent consultant contracts through South Coast AQMD subject to oversight of the QA Manager and subject to South Coast AQMD Procurement Policy (Appendix D). Details as to how audits are conducted are specified in the Request for Proposal (RFP) and the contract statement of work. South Coast AQMD consultants wishing to apply non-South Coast AQMD SOPs are required to demonstrate the equivalency of their SOPs to the comparable South Coast AQMD SOPs, where applicable, and to submit documentation confirming that these SOPs are referenced in the consultants' QAPP before a performance audit is conducted. Final approval for use of alternate SOPs rests with the QA Manager with the concurrence of the impacted Branch manager(s). The QA Branch documents the approval with an email or letter that is kept with a copy of the SOP(s) in the QA Branch file storage (electronic or hard-copy).

3.1.3 Audits of Data Quality (ADQs)

As described in Section 3.1.1, external Audits of Data Quality (ADQs) occur during U.S. EPA Technical Systems Audits (TSAs) to ensure that data reported to U.S. EPA is accurate, traceable, and defensible. The South Coast AQMD QA Branch periodically conducts internal ADQs, including:

- Ongoing weekly and monthly review of 1-point QC checks and continuous data concerns with in-depth ADQ where issues or anomalies are indicated or suspected;

- Quarterly reviews of select validated data, in-depth ADQ where issues or anomalies are indicated or suspected;
- Annual reviews of final data as submitted to AQS and in preparation for data certification, with in-depth ADQ where issues or anomalies are indicated or suspected;
- Data quality will also be scrutinized in depth ADQs when issues are raised in audits or through the corrective action process.

The ADQ involves an overall evaluation of the data, often starting with AQS standard reports, then selecting critical data points to scrutinize in detail, including supporting documentation and records, such as station and instrument logbooks, COC forms, maintenance sheets, work order/repair history, calibration history, audit results, and data flags or null codes used. The data is typically traced from its raw form as monitored or sampled through processing and data validation and flagging. The ADQ looks for systemic issues, highlighting any issues or anomalies observed. For example, by reading the null codes and flags in the AQS data, the auditor can generally surmise whether or not SOPs appear to be followed. The auditor will be able to see through the data coding, for example, an analyzer malfunction, followed by maintenance/repair activities by the site operator, followed by a recalibration of the analyzer before ambient data collection resumes. This would be the anticipated sequence of events following a malfunction. Similarly, the codes for calibrations and QC checks should be visible in the data and spaced at the frequencies established in the SOPs. If the data coding illustrates unusual events, or anticipated codes are missing (such as those for the QC checks), the auditor may decide that further investigation into the associated data points is warranted.

3.1.4 Data Quality Assessments and Certification

Per Section 15.4 of the U.S. EPA Quality Assurance Handbook, Volume II (U.S. EPA, 2017a), a data quality assessment (DQA) is the statistical analysis of environmental data, to determine whether the quality of data is adequate to support the decisions which are based on the DQOs. Data are appropriate if the level of uncertainty in a decision, based on the data, is acceptable. The DQA process includes:

1. **Review the data quality objectives (DQOs) and sampling design of the program:** Review the DQO and develop one, if it has not already been done. Define statistical hypothesis, tolerance limits, and/or confidence intervals.
2. **Conduct preliminary data review:** Review QA data and other available QA reports, calculate summary statistics, and develop plots/graphs. Look for patterns, relationships, or anomalies.
3. **Select the statistical test:** Select the best test for analysis based on the preliminary review, and identify underlying assumptions about the data for that test.
4. **Verify test assumptions:** Decide whether the underlying assumptions made by the selected test hold true for the data and the consequences.
5. **Perform the statistical test:** Perform test and document inferences. Evaluate the performance for future use.

Many DQA statistical tests were developed by U.S. EPA, as presented in Section 1.7.2. Several of these metrics are available in standard reports in AQS. South Coast AQMD reviews these metrics and the criteria pollutant monitoring data to perform DQAs at least annually as part of the data certification process. Currently U.S. EPA has created Data Assessment Statistical Calculators (DASC) software to assist in calculating precision and bias statistics and in evaluating calibration data. These are posted on the U.S. EPA AMTIC website,[41] can also be found as automated reports on the U.S. EPA AirData website.[42]

In addition, South Coast AQMD DMS software provides daily statistical summaries of automated zero and precision checks and weekly span results for the gaseous instruments. These automated summaries are reviewed by MN and QA Branch staff daily and ongoing issues are further assessed. Monthly summaries are also created and reviewed by the MN and QA Branch staff.

3.1.4.1 Annual Data Certification

Annually, typically before May 1 of the following annual calendar year, the criteria pollutant monitoring data is reviewed and certification is recommended by the Quality Assurance (QA) Manager with final approval by the STA/ADEO, according to OAG #QA0017, *Data Certification Process for Federal Programs*. Certification signals that the monitoring agency has uploaded all its data for the year into AQS and has completed their normal data validation process. The responsible official certifies that: (1) the ambient concentration data and the quality assurance data are completely submitted to AQS, and that (2) the ambient data are accurate to the best of their knowledge taking into consideration the quality assurance findings.

Completeness, precision, data flagging, anomalous points, and responses to corrective action are reviewed. Also, random samples may be selected for data tracking review. Data of concern are documented and discussed with the appropriate groups until resolution of the concerns are addressed. The latest certification procedures and tools are typically presented by U.S. EPA in a webinar near the beginning of April and posted to the U.S. EPA AMTIC website.[43] The process generally includes the following reviews:

1. Generation and review of AQS reports, especially the AMP600 (Certification, Evaluation and Concurrence Report) and the AMP450NC (Quicklook Non-Criteria Parameters Report – for 5-minute SO_2 data), as well as other AQS reports as needed for:

    a. Percent Completion by station;
    b. Comparison of highest four (4) maxima concentrations by pollutant for large "jumps" or values that are very outside typical ambient concentrations;
    Check semi-annual flow rate audits to verify that monitoring type (MT) observed QA audits are spaced apart by one (1) quarter and that percent complete is > 75%;
    c. Verify that collocation data meets required frequency and QC criteria;

[41] U.S. EPA Quality Indicator Assessment Reports, AMTIC Website: https://www3.epa.gov/ttn/amtic/qareport.html

[42] U.S. EPA Air Data Website: https://www.epa.gov/outdoor-air-quality-data

[43] U.S. EPA AMTIC Data Certification Website: https://www3.epa.gov/ttn/amtic/qacert.html

   d. Verify AQS data summary sheet is consistent with pipe delimited data report;
   e. Examine Flag Codes, Station ID, and Date in the AQS Data Summary sheet and investigate, as necessary;
   f. Identify and investigate dates that were flagged in the data but do not appear in the AQS Data Summary sheet;
   g. Identify and investigate dates that were flagged in the AQS Data Summary sheet but not flagged in the data;
   h. Look for Systematic Trends.

2. Meet with MN and LS Branch staff and/or supervisors as needed, including those responsible for data validation and AQS submittal, to:
   a. Discuss results from the certification and
      i. Attempt to reach consensus on changes or adjustments needed in the AQS data submission;
      ii. Request follow up on missing or incorrect data flags and qualifier codes; air quality, QC or QA audit data, or other issues, if any.
3. Verify that appropriate changes have been made in AQS, including the AMP600 summary report data certification and evaluation flag values and any certification change requests and supporting information, applied online with the AMP600 input tool.
4. Draft the Certification Letter for STA/M&A ADEO, or designee, signature.
5. Submit:
   a. Certification Letter to U.S. EPA;
   b. Finalized AMP600 Summary Report and other reports, if required.
6. Review AMP600 for prior few years to determine if past data has been changed such that re-certification is needed.

3.1.5 Standard Operating Procedures for Assessment and Response Actions

Critical to the quality system is the process of independent review and implementing corrective action. The independent review may include scheduled periodic review and assessments such as performance evaluations and technical system audits or just on a day to day basis through interactions with staff and observations. If there is a finding that could potentially affect data quality, systems are in place for review and documentation of the finding. If the review indicates that data quality has been affected, then the process of corrective action to address the data impacted and also the long-term process are implemented. Table 3-4 identifies the documentation for methods used for implementing the corrective action processes, documentation formatting, and also for conducting performance evaluations by the QA Branch and/or approved qualified contractor.

Table 3-4
SOPs for Quality Assurance Branch

OAG/ SOP #	OAG/ SOP Title
QA0001	Operational Assistance Guide for Corrective Action Request Process
QA0002	Operational Assistance Guide for Quality Assurance Alert Process
QA0003	Operational Assistance Guide for OAG Formatting
QA0017	Data Certification Process for Federal Programs
QA0051	Station/Monitor Shutdown or Replacement Procedure
QA0061	OAG & SOP Review and Revision Process and Guidelines
SOP00100	Standard Operating Procedure for SOP Process
SOP00135	Field Station Criteria Pollutant Ambient Air Instrument Performance Evaluation
SOP00153	Thermo Partisol PM2.5 Samplers Model 2000i and 2025i PA
SOP00154	Hi Vol. SSI PM10 Sampler Performance Audit
SOP00155	HI-Q Hi Vol TSP Performance Audit
SOP00168	Auditing Continuous PM2.5 and PM10 Met One Instruments (BAM 1020)
SOP00179	Thermal BAM 5014i Continuous Particulate Monitor Performance Evaluation

3.2 Reports to Management

This section describes how the results of assessments are communicated up the management chain, so that all parties of the criteria pollutant monitoring program are aware of data quality issues or concerns. The management structure of the program, including the South Coast AQMD Executive Officer, is described in Section 1.4, Table 1-1, and organizational charts are included in Appendix D.

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. The M&A Branch managers meet regularly to discuss project status, plans and issues, including 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:

- Assessment results;
- Findings of systems and performance audits and their resolution;
- 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);
- Status of waiver request to U.S. EPA Region 9;
- Annual Network Plan or 5-year Assessment;
- Summary statistic reports of monitoring and QA activities; and
- Criteria pollutant data certification.

As part of the data validation process by the LS and MN Branches, the QA Branch assessment and certification reviews, and the PRA NAAQS evaluations and SIP modeling efforts, the criteria pollutant data is reviewed by multiple staff. Overall, this occurs on at least a quarterly basis as data is prepared and submitted to AQS and as the annual data is finalized in AQS and certified. Combined, these reviews consider collaborative data and statistical assessments and trends from different staff perspectives, including comparison to the NAAQS and initial evaluation of exceptional events. When data issues or questions are found, they are reported to the appropriate QA and LS or MN managers and principal staff for further evaluation, with unresolved or significant issue reported higher in the management chain.

The QA Branch coordinates the response to both internal and external assessment findings with the impacted staff and management and may issue corrective action requests (CARs) when warranted. Written reports from internal or external performance audits or technical systems

audits are distributed to impacted staff including the manager(s) of the appropriate branch or branches. For the U.S. EPA TSA, the *Finding Corrective Action Form,* as supplied by the U.S. EPA audit team, is prepared to separately address the resolution of each finding. The corrective actions are coordinated by the QA Branch with input from the affected Branch managers and senior staff. Meetings are held to discuss any findings or recommendations. The affected branch or branches are responsible for the following:

- Propose resolutions and timelines to address and resolve the findings;
- Implement corrective actions; and
- Document the finding, completed resolution and a response to the auditor.

The QA Branch reviews the criteria pollutant data quarterly, after it is validated and submitted to AQS, and prepares the Annual Data Certification once the full calendar year of data has been submitted. QA and MN Branch staff query AQS reports quarterly, or more frequently, to generate completeness reports and keep management informed of potential issues. The annual certification effort includes evaluations of: data completeness; 1-point QC completeness, precision and bias; annual PE completeness and bias; NPAP audit completeness; and adequate collocation of instruments. The QA Branch also uses this process to review data extremes or outliers, the validation process, and the proper flagging of exceptional events, coordinating with staff to correct any issues noted prior to certification.

Based on the certification evaluation, the QA Manager reports to South Coast AQMD management and recommends that the STA/M&A ADEO, or designee, approve a letter of certification to the U.S. EPA Region 9 Regional Administrator that certifies: (1) the ambient concentration data and the quality assurance data are completely submitted to AQS, and (2) the ambient data are accurate to the best of his or her knowledge taking into consideration the quality assurance findings. The submittal of the letter of certification and completion of a report in AQS is typically due on or near May 1 of each year. U.S. EPA reviews the certification response for concurrence.

Regulatory required assessment documents that are routed through the agency's chain-of-command for approval and then to Region 9 for U.S. EPA review and approval include: the annual criteria pollutant data certification letter, TSA finding resolution, QAPPs, QMP, the ANP, the 5-year Network Assessment. Waivers may be submitted as part of the ANP or submitted by letter to Region 9. Table 3-5 shows the highest South Coast AQMD approval level for these documents.

Table 3-5
South Coast AQMD Management Approval Level for Criteria Pollutant Monitoring Documents Submitted to U.S. EPA

Document	Highest Approval Level (or authorized designee)
Quality Management Plan (QMP)	Executive Officer
Quality Assurance Project Plan (QAPP)	Executive Officer
Annual Network Plan (ANP)	Deputy Executive Officer, STA
5-Year Network Assessment	Deputy Executive Officer, STA
U.S. EPA TSA Finding Corrective Action Form Submittal	Assistant Deputy Executive Officer, STA/M&A
Annual Criteria Pollutant Data Certification	Assistant Deputy Executive Officer, STA/M&A

SECTION 4. DATA VALIDATION AND USABILITY

This section explains the process by which that data are deemed usable for their intended purpose, that is, whether the agency has met it is overall goals and that the resulting data can be used with confidence for the intended purpose.

This section includes the following assessment and oversight elements:

4.1 Data Review, Verification and Validation
4.2 Verification and Validation Methods
4.3 Reconciliation with User Requirements

South Coast AQMD employs several tools to analyze the data validation and usability, including:

- Report and data visualization tools built into the South Coast AQMD Data Management System (DMS) and Laboratory Information Management System (LIMS);
- Reports built into the U.S. EPA AQS database system or AQS Data Mart website as queries and reports; and
- Software or spreadsheet tools developed and tested by South Coast AQMD or by U.S. EPA, such as the U.S. EPA Data Assessment Statistical Calculators (DASC)[44] that assist in calculating precision and bias statistics and it evaluating calibration data.

Data validation staff review the AQS data summary reports and address qualifier flags, including those for exceptional events as identified by the PRA Air Quality Assessment and Meteorology Unit staff. Results from performance evaluation and any corrective actions are reviewed. The QA Branch conducts "spot checking" of data submitted to AQS for data completeness and timely data submission on at least an annual basis or more frequently, reviewing AQS reports and supporting information including the data in DMS or LIMS and logbooks and other reports. When issues are identified, QA Branch staff investigate and the QA Manager may then direct QA staff to prepare a CAR for recording, tracking, and seeing that the finding is satisfactorily addressed and avoided in the future.

4.1 Data Review, Verification and Validation

Section 17 of U.S. EPA Quality Assurance Handbook, Volume II (U.S. EPA, 2017a) describes data review, verification and validation methods. These are the techniques used to accept, reject, or qualify data in an objective and consistent manner. Verification confirms that specified requirements were met (e.g., 1-point QC checks were performed every two weeks, at minimum) and validation confirms that requirements met for usability of the data for its specified intended use (e.g., QC checks are within the limits specified in the QAPP), using the following definitions:

[44] U.S. EPA Quality Indicator Assessment Reports website: https://www3.epa.gov/ttn/amtic/qareport.html

Verification – defined as confirmation, through provision of objective evidence, that specified requirements have been fulfilled.

Validation – confirmation, through provision of objective evidence, that the particular requirements for a specific *intended use* are fulfilled.

The verification and validation assessments of the criteria pollutant monitoring data are performed routinely by staff that are implementing the data operations (i.e., MN and LS Branches), as well as by staff that are independent of the operation (including the MN Branch Data Validation Group and the QA Branch). For the MN Branch, data verification and validation are part of the daily routine for both the station field operators and the Data Validation Group, who routinely assesses the data, in preparation for the quarterly data submittals to AQS. The LS Branch also completes data validation prior to the quarterly data submittal of laboratory data to AQS. The QA Branch independently reviews the data validation results periodically prior to submittal to AQS and further assesses data in AQS as part of the quarterly reviews and the annual certification process.

Data review, validation and verification are necessary to identify data with errors, biases, and physically unrealistic values before they are used to fulfill the DQOs, such as determining NAAQS exceedances, assessing and informing the public of air quality, or modeling efforts and other strategies to attain the NAAQS. Using the criteria pollutant MQOs as included in the U.S. EPA QA Handbook, Volume II, Appendix D, *Measurement Quality Objectives and Validation Templates*, South Coast AQMD can ensure that the data is suitable for the intended purposes. For example, the automated frequent QC checks for continuous gaseous data, provide confidence that the data is of high quality, consistent and correct, including data reported to the public in real time. For the criteria pollutant monitoring program, South Coast AQMD follows the specifications and requirements for these elements in 40 CFR Part 58 and in the U.S. EPA QA Handbook, Volume II. The following components, as detailed further in Section 2, all affect the validity and usability of the criteria pollutant monitoring network data and are considered in the validation process.

4.1.1 Sampling Design

The South Coast AQMD air monitoring stations are monitored for changes that may affect siting requirements. By noting the deviations in sufficient detail, subsequent data users will be able to determine the data's usability under scenarios different from those included in project planning. Deviations from regulatory requirements and from specifications in the QAPP should be noted on sample documentation (e.g., chain of custody forms, field data forms, or logbooks) in a manner conducive to subsequent data entry. For example, development of a detailed set of data qualifiers (flags) makes data aggregation and assessment in information management systems much easier, can help identify how often a qualifier is used, and whether the identified deviation has an effect on data quality.

For the South Coast AQMD criteria pollutant monitoring program, monitoring methodology, network design, and probe and monitoring path siting criteria follow the federal requirements, as

detailed in *40 CFR Part 58 Subpart G, Appendices C, D and E*.[45] Using properly maintained and operated FRM/FEM instruments and methods for the criteria pollutant monitoring network, as listed in the U.S. EPA *List of Designated Reference and Equivalent Methods* (U.S. EPA, 2018c), provides a measure of confidence that the collected data is acceptable for the South Coast AQMD program.

4.1.2 Sample Collection Procedures

Details of how a sample is collected are important for properly interpreting the measurement results. Sampling methods and field SOPs provide these details, which include sampling and ancillary equipment and procedures (including equipment decontamination). Acceptable departures (for example, alternate equipment) from the QAPP, and the action to be taken if the requirements cannot be satisfied, should be specified for each critical criterion. Validation activities should note potentially unacceptable departures from the QAPP. Comments or findings on deviations from written sampling plans made during field technical systems audits or reviews should be noted.

By following established standard operating procedures with well-trained staff, provides confidence that the collected data is acceptable for this criteria pollutant monitoring program. QC checks, calibration records, chain-of-custody forms, maintenance sheets, logbooks and other records are routinely checked by MN Branch senior staff and the Data Validation Group to verify that SOPs have been followed when collecting samples/data and procedural concerns are reviewed with staff. The QA Branch routinely assesses this effort and conducts, or reviews results of, technical systems audits, providing feedback on any noted procedural deviations from the SOPs or departures from this QAPP.

4.1.3 Sample Handling Procedures

Details of how a sample is physically treated and handled during transportation to and from the field site, and through all laboratory handling stages prior to final analysis/reporting, are extremely important. Correct interpretation of the subsequent measurement results requires that deviations from the sample handling section of the QAPP/SOPs, and the actions taken to minimize or control the changes, be detailed. Data collection SOPs should indicate events that occur during sample handling that may affect the integrity of the samples.

The MN and LS Branch staff responsible for reviewing/verifying/validating data confirm that the appropriate sample containers and the preservation methods are appropriate to the nature of the sample and the type of data generated from the sample. Checks on the identity of the sample (e.g., proper labeling and chain-of-custody records) as well as proper physical/chemical storage conditions (e.g., chain of custody and storage records) are made to ensure that the sample continues to be representative of its native environment as it moves through the analytical process. The QA Branch staff routinely assesses sample handling procedures and any issues raised, conducting, or reviewing results of, technical systems audits and providing feedback on any noted procedural deviations.

[45] 40 CFR Part 58. [https://www.ecfr.gov/cgi-bin/retrieveECFR?n=40y6.0.1.1.6]

4.1.4 Analytical Procedures

Each sample is verified to ensure that the procedures used to generate the data were implemented as specified. Acceptance criteria are in place for important components of the procedures, along with suitable codes (qualifiers) for characterizing each sample's deviation from the procedure. Data validation activities determine how seriously a sample deviated beyond the acceptable limit so that the potential effects of the deviation can be evaluated during the Data Quality Assessments (DQAs). The results of laboratory assessments, including periodic performance evaluations and systems audits, are reviewed by the LS Branch and the QA Branch and noted issues are addressed with corrective actions including procedural changes, when needed. Data is not invalidated without good reason as ascertained through the systematic review and validation process. In cases where data for public information shows unusually high or hazardous levels of air pollution, staff takes immediate steps to verify data quality to timely provide confidence in the data that can have serious impacts to public health.

4.1.5 Quality Control Procedures

Section 2.5 (Quality Control) specifies the QC checks that are to be performed during sample collection, handling, and analysis. These checks include, for example, the 1-point QC checks for gaseous pollutants and flow rate verifications for particulate samplers to ensure they meet the established criteria for the monitoring program. They also include analyses of check standards, blanks, and replicates, which provide indications of the quality of data being produced by specified components of the measurement process. For each QC check, the procedure, acceptance criterion, and corrective action and any subsequent changes are specified. Data validation documents the corrective actions that were taken, which samples were affected, and the potential effect of the actions on the validity of the data. The QA Branch also routinely reviews and the QC procedures and summaries of the QC checks, assessing and initiating corrective actions for significant or ongoing deviations from the criteria monitoring program QC criteria that may impact data quality.

4.1.6 Calibration Procedures

Proper calibration of instruments and equipment are routinely verified for the South Coast AQMD criteria pollutant monitoring program. South Coast AQMD has a rigorous program for the calibration of instruments and certification of equipment and standards for the criteria monitoring program, as described in Section 2. When calibration checks are found to be outside the acceptable limits prescribed in Section 2 of this QAPP or in the U.S. EPA *QA Handbook, Appendix D, Measurement Quality Objectives and Validation Templates* (U.S. EPA, 2017b), raw data sampled between this calibration and the previous calibration(s) may be flagged or invalidated back to the previous good calibration unless compelling evidence in the data sequence demonstrates that the problem started at particular time or with a specific event (e.g., power outage) that signals the start of the instrument drift or other calibration issue. Standardized data flagging techniques are used for subsequent data evaluation. The calibration information is reviewed as part of the routine verification and validation process, with QA oversight and corrective actions when warranted, to ensure that the calibrations:

- were performed before sampling began and at frequencies specified in the QAPP;

- were performed in the proper sequence (i.e., there may be a sequence of checks or other implementation activities that must take place prior to calibration);
- included the proper number of calibration points;
- were performed using standards that "bracketed" the range of reported measurement results (otherwise, results falling outside the calibration range should be flagged as such); and
- had acceptable linearity checks and other checks to ensure that the measurement system was stable when the calibration was performed.

4.1.7 Data Reduction and Processing

Data reduction/processing may be an irreversible process that involves a loss of detail in the data and may involve averaging across time (e.g., 5-minute, hourly or daily averages) or space (e.g., compositing results from samples thought to be physically equivalent). Since this summarizing process produces few values to represent a group of many data points, its validity is tested and well-documented. Data verification includes performing the data reduction process with a subset of raw data by hand to verify that automated reduction/processing techniques are performing as outlined in the Data Management/Data Validation SOPs. For the continuous criteria pollutant data, this is done by comparing the 1-minute data with the averaged data in DMS during the validation process. It is tracked by staff in the data validation checklist maintained by validation staff. The information generation step involves the synthesis of the results of previous operations and the construction of tables and charts suitable for use in reports. In many cases these types of reports are generated on a frequent basis. When software or processes in software packages, such as AirVision, DMS, LIMS, or EQuIS, are developed or modified, the changes are tracked and documented by staff, often in the software, and verifying that the reports are being properly generated. This can include generating a subset of the report and reviewing and verifying the programming code used to generate the reports, by hand or with other verified software.

The South Coast AQMD data review, verification, validation, certification and reporting process will also generally asses the following functions to help ensure quality of data completeness, quality and consistency:

- **Completeness Checks** – When data are processed, certain completeness criteria must be met. For example, each sample must have a start time, an end time, an average flow rate, dates analyzed, and operator and technician names. The minimum valid data recovery objective for the criteria pollutant monitoring program is ≥ 75%. For 8-hour ozone during the ozone season, ≥ 90% of valid 8-hour averaged daily maximum concentrations is required.
- **Statistical Data Checks** – Potentially aberrant data found during statistical screening are traced back to original data entry files and to the raw data, as necessary. These checks are performed prior to data submission to AQS. Data verification and validation includes the process by which raw data are screened and assessed before they are included in the main data base. Near-real-time statistical screening checks of the continuous data and supporting

daily QC checks allows issues to be flagged for further review for data being reported to the website, smartphone applications, AirNow, or by automated email/text notifications.

- **Data Retention** – Raw data and data sheets are retained on file as per the *South Coast AQMD Records Retention Policy* for a minimum of ten 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 may be followed.

4.2 Verification and Validation Methods

This section describes the methods or procedures that South Coast AQMD uses when verifying and validating data, including a multi-level, tiered approach to the data review that involves multiple staff members. This hierarchy in the data review process ensures that multiple sets of eyes review the data and include adequate independence during the data validation. The process to accept, qualify, or reject (invalidate) data and how qualified and rejected data are identified is included. This process will involve reviewing the field operations and laboratory analyses procedures and their implementation, including calibrations, quality control checks, maintenance and repair records, and data processing and reduction. Verification includes both self-review and peer-review of data and records. Some South Coast AQMD verification processes are automated through the use of data logger, AirVision, DMS or laboratory system programming and set-up, such as out-of-range warnings or the daily 1-point precision and zero QC checks and 7-day span checks for continuous data. Such information informs the verification and validation process, but are reviewed and checked by staff. Data validation is more independent of the data generation process and involves a more in-depth review to ensure that data meets its intended use.

When problems are identified in the criteria air pollution monitoring program, the data can be corrected, flagged, or invalidated, and corrective actions can be taken to resolve issues and minimize their reoccurrence. The data verification and validation process can identify operational deviations and data issues. The goal of the data verification and validation 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 criteria pollutant monitoring program requirements and goals, by: (1) evaluating the internal, spatial, temporal, and physical consistency of the data; and (2) assessing the data to identify errors, biases, or outliers.

4.2.1 Measurement Quality Objectives (MQOs) and Validation Template

Section 1.7 of this QAPP describes the MQOs against which the data will be validated. For criteria pollutant monitoring program measurement objectives, including NAAQS decisions, these were developed and organized in the form of validation templates for each pollutant listed in the U.S. EPA *Quality Assurance Handbook for Air Pollution Measurement Systems Vol. II, Ambient Air*

Quality Monitoring Program, Appendix D, Measurement Quality Objectives and Validation Templates (U.S. EPA, 2017b).[46]

4.2.1.1 Critical Criteria

Criteria that were deemed by U.S. EPA as critical to maintaining the integrity of a sample or group of samples a shown in the validation templates by pollutant as Critical Criteria. Observations that do not meet each and every criterion on the Critical Criteria should be invalidated unless there are compelling reason and justification for not doing so. In most cases, this criterion can identify a distinct group of measurements and time period. For example, a flow rate exceedance represents a single sampler for a particular period of time (and therefore distinct number of samples), whereas a field blank or QA collocation exceedance is harder to identify what samples the exceedance may represent. In most cases the requirement, the implementation frequency of the criteria, and the acceptance criteria are found in CFR and are therefore regulatory in nature. The sample or group of samples for which one or more of these criteria are not met is invalid until proven otherwise. The cause of not operating in the acceptable range for each of the violated criteria must be investigated and minimized to reduce the likelihood that additional samples will be invalidated. Typically, U.S. EPA Regional Offices will be in the best position to assess whether there are compelling reasons and justification for not deleting the data. The evaluation will be informed by a weight of evidence approach, consider input from States/local agencies and EPA's national office, and be documented.

4.2.1.2 Operational Criteria

Criteria that are important for maintaining and evaluating the quality of the data collection system are included in the validation templates by pollutant under Operational Criteria. Violation of a criterion or a number of criteria may be cause for invalidation. The decision maker should consider other quality control information that may or may not indicate the data are acceptable for the parameter being controlled. Therefore, the sample or group of samples for which one or more of these criteria are not met are suspect unless other quality control information demonstrates otherwise and is documented. The reason for not meeting the criteria MUST be investigated, mitigated or justified.

4.2.1.3 Systematic Criteria

Those criteria which are important for the correct interpretation of the data but do not usually impact the validity of a sample or group of samples are included in the validation templates by pollutant as Systematic Criteria. For example, the data quality objectives are included in this table. If the data quality objectives are not met, this does not invalidate any of the samples but it may impact the uncertainty associated with the attainment/non-attainment decision.

The validation template tables include: (1) the requirement; (2) the frequency with which compliance is to be evaluated; (3) the acceptance criteria; and (4) information where the

[46] U.S. EPA *Quality Assurance Handbook for Air Pollution Measurement Systems Vol. II, Ambient Air Quality Monitoring Program, Appendix D* (U.S. EPA, 2017).
[https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/APP_D%20validation%20template%20version%2003_2017_for%20AMTIC%20Rev_1.pdf]

requirement can be found or additional guidance on the requirement. The validation tables were developed based on the current state of knowledge. The designation of quality control checks as Operational or Systematic, as opposed to Critical, do not imply that these quality control checks need not be performed. Not performing an operational or systematic quality control check that is required by regulation (in CFR) can be a basis for invalidation of all associated data. In most cases, U.S. EPA has been consistent in their application of invalidating data not meeting regulations, i.e., data not meeting critical and, in some cases, operational criteria.

Using the QC checks, South Coast AQMD will apply a bracketing concept to data invalidation, such that when a QC check exceeds an acceptance criterion, data will be invalidated back to the last known passing QC check and forward to the time of successful corrective action and recalibration. However, weight-of-evidence may be applied to make judgement calls as to the overall validity and determination of whether data meets the needs of the end user. For example, if QC checks on an ozone analyzer are performed at a frequency that does not meet the biweekly requirement in the CFR (i.e., a critical criterion), but the results of the QC checks show that the analyzer operated within its established acceptance criteria, the agency may determine that the data is valid because, for its end use (e.g., NAAQS comparisons), the passing QC results provide enough empirical evidence to support the data's overall validity. As another example, when a sample has been found to deviate from multiple operational criteria, the agency may determine the data should be invalidated (as opposed to qualified) because too many operational deviations jeopardize the ability to defend the validity of the sample (and likely do not meet the needs of the end data user). In both of these scenarios, the data validator must "weigh" the evidence in order to make a final decision.

4.2.2 Data Qualifier Codes

For the criteria pollutant monitoring program, South Coast AQMD employs the current U.S. EPA AQS qualifier codes[47] when data is null (no sample or invalidated for cause) or otherwise qualified, as shown in Table 4-1. Qualifiers codes are identified through the verification and validation process and are used when reporting data to AQS to further explain the data, as follows:

- **NULL Qualifiers** are required when submitting a null sample measurement parameter (i.e., nothing was collected).
- **QA Qualifiers** are used optionally when data is valid, but there may be value in noting additional information about the measurement (i.e., if a measurement was below the lowest calibration level).
- **REQEXC Qualifiers** are required for data that is affected by an exceptional event that the agency is flagging to request exclusion in regulatory decision making, pending further analysis and submittal of supporting documentation and subject to U.S. EPA concurrence under the U.S. EPA Exceptional Event Regulation. Commonly used REQEXC qualifiers include those for high-wind events, wildfires, or cultural event (e.g., Independence Day fireworks) that lead to exceedances of the NAAQS.

[47] See Qualifiers in the AQS Code List, U.S. EPA Website: https://www.epa.gov/aqs/aqs-code-list

- **INFORM Qualifiers** are optional informational qualifiers that can be used in place of a REQEXC qualifier. These are used when the data is affected by an exceptional event that did not cause and exceedance of the NAAQS or other regulatory issue. It is typically used when the exclusion of the submitted data is not being requested or if that determination has not yet been made.

Table 4-1
Current U.S. EPA Data Qualifier Codes (2019)

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	QC Control Points (zero/span).	NULL
AZ	QC Audit.	NULL
BA	Maintenance/Routine Repairs.	NULL
BB	Unable to Reach Site.	NULL

Qualifier Code	Qualifier Description	Qualifier Type Code
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
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

Qualifier Code	Qualifier Description	Qualifier Type Code
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
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
RA	African Dust.	REQEXC
RB	Asian Dust.	REQEXC
RC	Chemical Spills & Industrial Accidents.	REQEXC
RD	Cleanup After a Major Disaster.	REQEXC
RE	Demolition.	REQEXC
RF	Fire - Canadian.	REQEXC
RG	Fire - Mexico/Central America.	REQEXC
RH	Fireworks.	REQEXC

Qualifier Code	Qualifier Description	Qualifier Type Code
RI	High Pollen Count.	REQEXC
RJ	High Winds.	REQEXC
RK	Infrequent Large Gatherings.	REQEXC
RL	Other.	REQEXC
RM	Prescribed Fire.	REQEXC
RN	Seismic Activity.	REQEXC
RO	Stratospheric Ozone Intrusion.	REQEXC
RP	Structural Fire.	REQEXC
RQ	Terrorist Act.	REQEXC
RR	Unique Traffic Disruption.	REQEXC
RS	Volcanic Eruptions.	REQEXC
RT	Wildfire-U. S.	REQEXC
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
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

4.2.3 Verification and Validation Procedures

Detailed descriptions of the South Coast AQMD verification and validation procedures for accepting, invalidating, or qualifying data can be found in the relevant SOPs, as listed in Table 4-2.

Table 4-2
SOPs for Data Verification and Validation

SOP #	SOP Title
SOP00104	Weigh Room Operations and Weighing of PM2.5 Samples
SOP00108	Element® LIMS Data Handling and Processing
SOP00112	The Gravimetric Determination of PM10 Mass
SOP00121	Data Processing and Validation (LS Branch)
SOP00124	Data Management Group: Backfilling Data in the Data Management System (DMS)
SOP00127	Data Management Group: Backfilling Data in the Data Management System (DMS)

4.2.4 Data Review, Verification and Validation for Continuous Monitoring Methods

There are four data verification and validation levels within the South Coast AQMD continuous monitoring data screening and validation process, as follows:

- **Level 0 Validation** is automated screening that may be performed by the ESC data loggers, AirVision, or DMS, which can provide data or 1-point QC check warnings and indicators to help inform Level 1 through 3 efforts and may impact the data that is reported in near-real-time on the South Coast AQMD and U.S. EPA AirNow websites and other platforms. The Level 0 Validation includes the following:

    - Times that the instrument was down due to calibration, repair or auditing activity;
    - Hourly data containing less than 45 minutes;
    - Negative concentration values that are below AQS acceptable threshold;

- **Level 1 Validation** is performed on each work day by the MN Branch Operations Group, station operators, including the following:

    - Meteorology sensor checks;
    - Maintenance sheet checks and observations;
    - Fill out Downtime Log;

- Review telemetry data;
- Data ranging above typical maximum ambient values;
- Notable or exceptional event observations (e.g., rain, strong winds, nearby construction, etc.);
- Review of data over the warning and acceptance criteria limits; and
- Review of data warning indicators for issues from any Level 0 automated screening.

- **Level 2 Validation** is performed on an ongoing schedule by the MN Branch Operations Group, Data Validation Assistant AQIS, AQIS I or AQIS II staff, including the following:

    - Review issues identified in Level 1 Validation; Review and verify repeated (sticking) data values.
    - Review plotted data to identify extreme values and outliers, constant values, block of zeros, QC criteria, or missing values and investigate the validity of values;
    - Flag data as necessary for exceptional events or other informational reasons in coordination with the PRA/Air Quality Assessment group;
    - Investigate and invalidate data that are outside the acceptance criteria according to Section 2.5 of this QAPP and the current U.S. EPA QA Handbook, Vol. II, Appendix D – Validation Templates;
    - Invalidate data if the shelter temperature criteria were exceeded;
    - Adjust or invalidate data if NO + NO2 > NOx; and
    - Check for consistency with normal data ranges, including typical season, day-of-week, time-of-day values and investigate and flag data as necessary.

- **Level 3 Validation** is performed quarterly, or more often, by the MN Branch Operations Group, Data Validation Senior AQIS, including the following:

    - Review issues identified in Level 2 Validation and apply additional informational flags or invalidations, as necessary;
    - Compare suspect pollutant data to meteorology (wind direction, wind speed, weather conditions such as rain, cloud cover, etc.);
    - Compare data from nearby sites, including FRM or special purpose monitoring; and
    - Review all invalidated data and the rationale for invalidation.

Data validation staff review graphs of the tabular and raw data in DMS and may review other supporting information when the data is suspect. Anomalies or indications of systematic issues (low completeness, unusual data points, etc.) are reported to the QA Branch, which may issue a Corrective Action Request (CAR) to document the issue and subsequent corrective action activity and a plan to minimize reoccurrence.

Once the continuous data validation is completed for a particular quarter, a formatted data file is generated for submittal to AQS. Summary reports are run on AQS and reviewed by data validation staff to identify values that exceed the historical maximum readings in AQS or other issues for further investigation. If these data are found to be invalid or require further flagging or editing, the changes are addressed and logged in DMS and re-uploaded to AQS. While such changes can be made directly in DMS, this is generally not done, so that any changes are tracked through DMS. The AQS database documents such changes in a log which states the time period for the data in question, the action taken, and the reason for the edit. At the end of every quarter following that in which the data was collected, or more frequently, data validation staff also submits the bi-weekly precision data for all gaseous instruments and the QA Branch submits the quarterly QA field audit results to AQS.

4.2.5 Data Review, Verification and Validation for Discrete Monitoring Methods

4.2.5.1 FRM PM10 and TSP-Pb Data Validation

Figure 4-1 shows the PM10 filter sample analysis and validation process, starting after the laboratory receives the filter after collection. Note that TSP-Pb is analyzed from filter strips and the filters are not weighed.

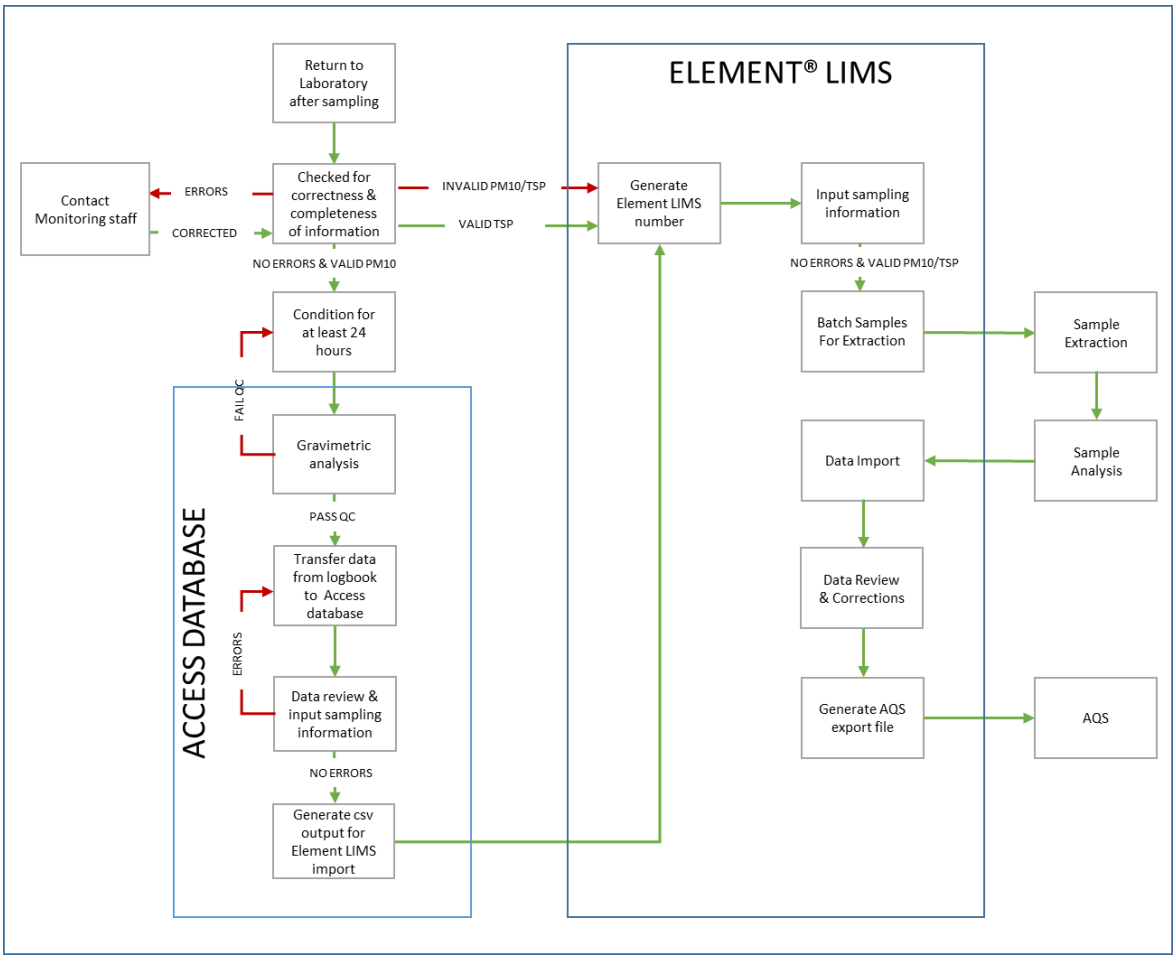


Figure 4-1
FRM PM10 and TSP-Pb Analysis and Data Validation Processes
(Note: TSP-Pb filters are not weighed)

- **Level 0 Validation** is performed by the MN Branch station operations staff (Assistant AQIS or AQIS) who checks the COC sheet on the envelope against the criteria listed below in Table 4-3 and the following information, as field samples are collected and transported to the laboratory:

  - Filter number;
  - Date;
  - Station;
  - Start and Stop times of collection;
  - Elapsed time of collection;
  - Flow rate (average rate, CV); and
  - Observation of sampling conditions;
  - Filter handling, storage and transport parameters and filter condition observations.

Level 1 Validation is performed by the assigned laboratory staff (AQ Lab Technicians, Assistant AQ or AQ Chemist) as the filter samples are accepted, conditioned and weighed, including the following:

- Review and verify the Level 0 Validation information when the samples are received and before post-sampling conditioning;
- Review and verify the COC forms, including the criteria listed in Table 4-3;
- Filter condition and appearance and operator notes of sampling conditions;
- Preliminary filter weight out of range with other samples; and
- Communicate concerns to MN Branch Operations staff, as appropriate.

Table 4-3
Summary of Requirements for FRM PM10 Sample and Document Acceptance

Criteria	Acceptance Tolerance	Corrective Action
Filter number	Envelope number and filter number match	Check the previous and next samples from the impacted site, then e-mail the station operator to confirm when cannot be resolved
Sample date	Sample date should correspond to U.S. EPA Sampling Schedule	When there is no note in the comment section as to a reason for an unscheduled sample, e-mail the station operator to confirm the sampling date and reason an unscheduled sample was collected.
Run time	1440 min. ± 60 min.	E-mail the station operator to confirm the time, as the timer tumblers may be sticky. Place copy of their reply email in the envelope and make notes in the comments section of the COC envelope.
Start/stop time	Midnight ± 30 min.	E-mail the station operator to confirm the record.. Place a copy of their reply in the envelope and make comments on the envelope. In updated samplers, check the timer setup.

- **Level 2 and Level 3 Validation** are performed by the Senior Air Quality Chemist along with the Principal AQ Chemist responsible for the data prior to each quarterly AQS data submittal, or more frequently, and include the following:

  - Review of the process, issues and resolutions previously identified in Level 0 and 1 validation or Level 2 steps and in accordance with Table 4-2;
  - 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 PRA/Air Quality Assessment Group and STA/MN Branch Data Validation staff and the results of corrective action from QA Branch;
- Check data for consistency with normal data ranges, including season, day-of-week, and time-of-day variability and investigate as necessary;
- Compare suspect PM data to meteorology (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 FRM or FEM particulate data, including both PM10 and PM2.5;
- Communicate sampling concerns with appropriate MN Branch Operations staff;, Investigate and invalidate or flag data that are outside the acceptable criteria; and
- Review all invalidated data and the rationale for invalidation.

4.2.5.2 FRM PM2.5 Data Validation

Figure 4-2 shows the PM2.5 filter sample mass analysis and data validation process, starting after the laboratory receives the filter after collection.

- **Level 0 Validation** is performed by the MN Branch station operations staff (Assistant AQIS or AQIS I) who checks the chain-of-custody sheet on the envelope against the criteria listed in Table 4-3 (above) and the following, as field samples are collected and transported to the laboratory:

    - Filter number;
    - Date;
    - Station;
    - Start and Stop times of collection;
    - Elapsed time of collection;
    - Flow rate and monthly flow checks in bounds (average rate, CV); and
    - Filter handling, storage and transport parameters (e.g., temperature control) and filter condition observations.

- **Level 1 Validation** is performed by the assigned laboratory staff (AQ Lab Technician) as the filter samples are accepted, conditioned and weighed, including the following:
    - Review and verify the Level 0 Validation information when the samples are received and before post-sampling conditioning;
    - Filter condition and appearance and operator notes of sampling conditions;
    - Preliminary filter weight out of range with other samples; and
    - Communicate concerns to MN Branch Operations staff, as appropriate.

- **Level 2** and **Level 3 Validation** are performed by the SAQ Chemist and Principal Air Quality (PAQ) Chemist or his/her designee responsible for the data prior to each quarterly AQS data submittal, or more frequently, and include the following:

    - Review issues identified in Level 0 and 1 or 2 validation steps;
    - Check for data completeness
    - Check flow rate information (CV, actual flow rate)
    - Compare PM2.5 and PM10 mass data
    - Compare collocated samples
    - Check Laboratory Analysis QC data;
    - Check for exceptional events in coordination with PRA/Air Quality Assessment Group and STA/MN Branch Data Validation staff and the results of corrective action from QA Branch;
    - Check data for consistency with normal data ranges, including season, day-of-week, and time-of-day variability and investigate as necessary;
    - Compare suspect pollutant data to meteorology (wind direction, wind speed, weather conditions such as rain, cloud cover, etc.), coordinating with PRA/Air Quality Assessment Group as needed;
    - Compare data from nearby sites, including the FEM particulate data;
    - Communicate sampling concerns with appropriate MN Branch Operations staff; Investigate and invalidate or flag data that are outside the acceptable criteria;
    - Compare collocated data or data from nearby sites, including FRM or FEM particulate data, including both PM10 and PM2.5;
    - Communicate sampling concerns with appropriate MN Branch Operations staff, especially when the data validation indicates data quality or documentation issues;
    - Investigate and invalidate or flag data that are outside the acceptable criteria; and
    - Review all invalidated data and the rationale for invalidation.

For both PM10 and PM2.5 filter data, review and verification that data has been uploaded into the AQS data base correctly and accurately is performed as part of the Level 3 Validation. Summary reports are run on AQS and reviewed by the LS Branch staff responsible for data validation and AQS submittal to identify values that exceed the historical maximum readings in AQS or other issues for further investigation. If these data are found to be invalid or require further flagging or editing, the changes are either made and logged directly in AQS or in the LIMS system and resubmitted to AQS. Both LIMS and AQS databases documents these changes in a log which states the time period for the data in question, the action taken, and the reason for the edit. Common data validation queries, acceptance criteria, and corrective actions for PM2.5 are presented in Table 4-4.

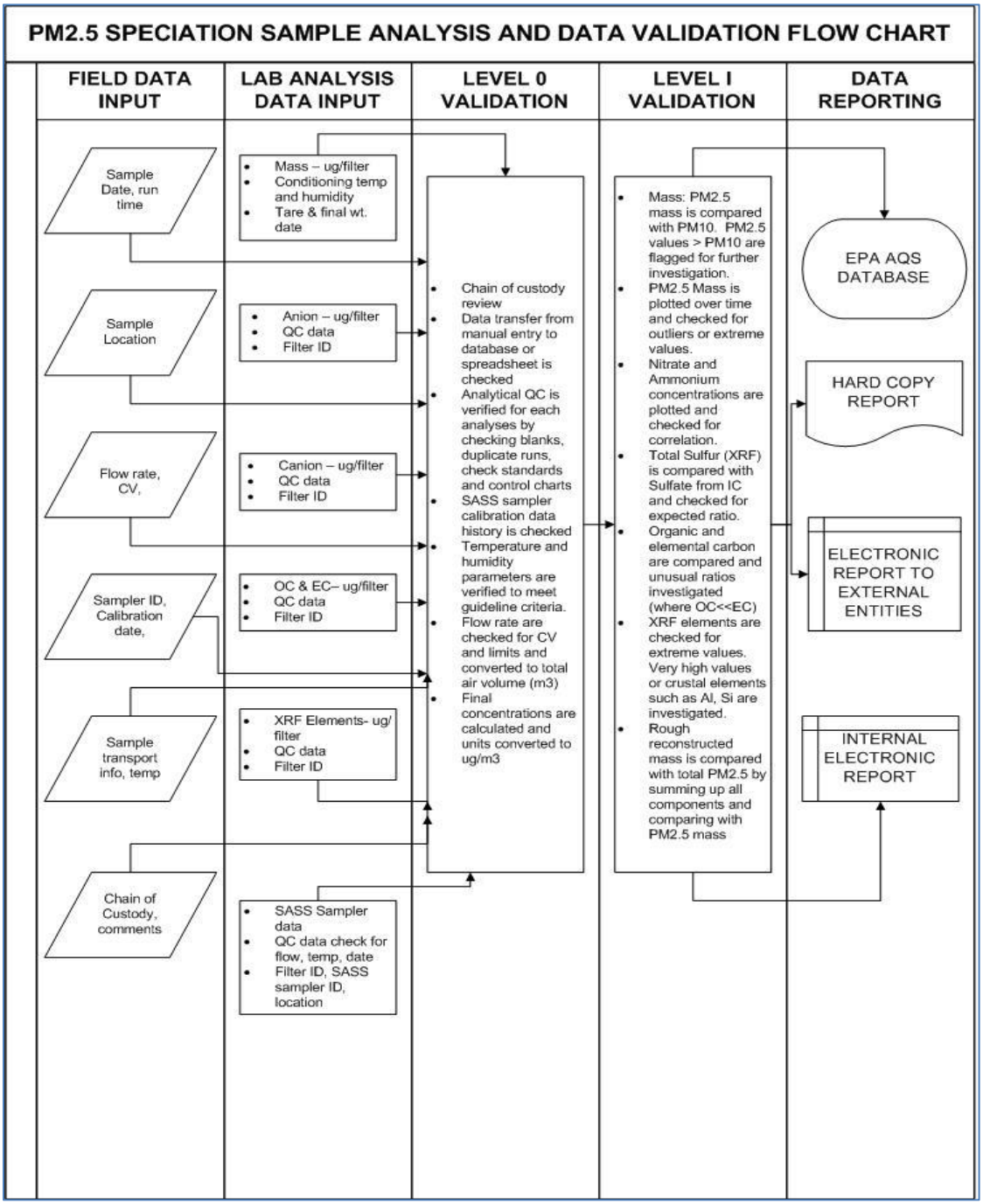


Figure 4-2
Data Validation Pathway for PM2.5 and SASS Analysis

Table 4-4
Data Validation Queries

Check	Acceptance Criteria	Corrective Action
Missing Sampler Data	Query returns nothing	Determine why data is missing. Input data values, or invalidate sampling day
Duplicate Data	Query returns nothing	Determine why duplicate data exists. Check data and remove duplicate data point.
Mass data analysis and null data check	All fields are populated or invalidated and values are within historical max and min	If data point is missing determine why, populate or invalidate. Otherwise, determine why value exceeds historical max or min, either flag or invalidate

4.3 Reconciliation with User Requirements

This final section describes how the sample results obtained from the South Coast AQMD criteria pollutant monitoring program will be reconciled with the data quality objectives (DQOs), after having been reviewed, verified, and validated against the MQOs. The DQOs (see Section 1.7) are the qualitative and quantitative statements that describe the intended use of the data, the types of data needed, and the set tolerable limits on the amount of uncertainty in the data sets so that decision makers can use the resulting data with a reasonable amount of confidence. The goal of this effort is to determine whether or not the big-picture goals for the project are achieved and how the agency plans to continuously reassess and improve, by looking at the results of the various assessments and instituting modifications as needed.

U.S. EPA conducts assessments based upon guidelines for establishing the assessment of DQOs on a national scale as depicted in the QA Handbook (EPA, 2017) for NAAQS designations. South Coast AQMD works with U.S. EPA to address findings or implementation issues that impact South Coast AQMD criteria pollutant monitoring program data based upon these assessments. Typically, the criteria established by the U.S. EPA for the federal criteria monitoring program will also meet or exceed South Coast AQMD criteria required for forecasting, modeling and AQMP development. If the data quality criteria for the criteria pollutant monitoring program are not an acceptable fit for South Coast AQMD purposes, a special monitoring project QAPP is prepared with appropriate DQOs and Measurement Quality Objectives (MQO)s as per guidance provided by the South Coast AQMD QMP and/or the U.S. EPA *Guide to Writing Quality Assurance Project Plans* for Ambient Air Monitoring Networks.

The reconciliation with the DQOs occurs largely in the data quality assessment process, as discussed in Section 3. It includes the review of the DQOs with the sampling design and network configuration to assure that the sampling design and data collection methods are consistent with the needs for the DQOs. This is initiated annually with the Annual Network Plan prepared by the MN Branch, which results from ongoing communications with QA Branch and the internal and external data users (including U.S. EPA and the PRA data analysis, AQMP, forecasting and modeling groups). Since national requirements for monitoring may change as per U.S. EPA or

additional local monitoring needs may develop, the annual network plan will reflect the sampling design to address those changes. This allows the program to evolve and improve to continue to generate relevant data. A thorough analysis is conducted through the 5-year network assessment where statistical tools are conducted to conduct station correlations, review of station objectives and scales, etc. for which analyses conclusions may affect the DQOs.

While assessments over longer periods of time (e.g., 3-years or more) have value and may be conducted by South Coast AQMD, the annual data certification process is the key identifier used by South Coast AQMD as to whether or not DQOs are being met (or are on target to be met). If DQOs are not met during annual data certification, then the assessment should serve as a catalyst within the agency to prompt investigation and corrective action. The reconciliation process with DQOs also involves a review of the MQOs through the QA annual certification process as outlined in Section 3.4. The certification process uses AQS as a statistical tool thorough the use of AQS standard reports and other tools may also be utilized to further assess the ability to meet the DQOs (as listed at the start of Section 4). If findings indicate that the program objectives have not been met or if data anomalies are found, then a further review of the impacted measurements is conducted and corrective actions taken to address improvements and changes within the monitoring network.

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

- Was the data within the QC limits?
- Is the data more or less variable (coefficient of variation) either in time or in space than expected? (This could imply that the sampling frequency or sampling network may need to be increased or decreased);
- Do the results of monitoring indicate a measured concentration consistently far above, far below, or near the NAAQS? Levels near the standard may indicate the need for additional and/or more frequent monitoring.
- Do the monitoring data design values indicate that monitoring may no longer be necessary?
- Have the correct amount of resources been allocated to monitoring?

The South Coast AQMD QAPP implementation and oversight for the criteria pollutant monitoring program is designed to be proactive and to address potential issues before large issues can occur, such as a pollutant not meeting its DQO. However, if a criteria pollutant did not meet its DQO, it would result in multiple questions by South Coast AQMD M&A upper management and the QA Branch and would lead to an investigation as to why the data didn't meet the objective. This investigation would address the application of relevant program requirements to assess the root cause(s) of the problem, such as effective training, proper adherence to protocols, or equipment operational/maintenance problems (e.g., issues with a new model or older equipment). As a result of the investigation, corrective action measures would be planned and initiated to result in

improvements, such that the DQOs can be achieved for the next year. The corrective actions could include, for example, increased training of the operators or laboratory analysts if they did not adhere to protocols, or switching out the make/model of instrumentation that did not produce the desired results. It could also involve modifications to SOPs or to the QAPP itself.

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, 2018a).

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 30. Code of Federal Regulations, U.S. EPA, *Grants and Agreements with Institutions of Higher Education, Hospitals, and Other Non-Profit Organizations*.
[https://www.gpo.gov/fdsys/granule/CFR-1999-title40-vol1/CFR-1999-title40-vol1-part30]

40 CFR 31. Code of Federal Regulations, U.S. EPA, *Uniform Administrative Requirements for Grants and Cooperative Agreement to State and Local Governments*.
[https://www.gpo.gov/fdsys/granule/CFR-1999-title40-vol1/CFR-1999-title40-vol1-part31]

40 CFR 35. Code of Federal Regulations, U.S. EPA, Grants and other Federal Assistance, *State and Local Assistance*. [https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr35_main_02.tpl]

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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]

South Coast AQMD *Public Records Request Form*
[South Coast AQMD website: http://www.aqmd.gov/nav/online-services/public-records]

South Coast AQMD *Quality Assurance Project Plan for Criteria Pollutant Monitoring Program* (November 2012), Revision 0.
[https://www.arb.ca.gov/aaqm/qa/pqao/repository/district_sops/south_coast/quality_assurance/qapp_criteria_pollutants.pdf?_ga=2.72513430.409116254.1539974811-1317872409.1537370855]

South Coast AQMD *Quality Assurance Project Plan for Criteria Pollutant Monitoring Program* (May 2016), Revision 1. *[Copies provided upon request]*

South Coast AQMD *Quality Management Plan for Environmental Measurement Programs, Revision 0* (January 2009)
[https://www.arb.ca.gov/aaqm/qa/pqao/repository/district_sops/south_coast/quality_assurance/quality_%20management_%20plan.pdf?_ga=2.36392997.409116254.1539974811-1317872409.1537370855]

South Coast AQMD *Quality Management Plan for Environmental Measurement Programs* Revision 1 (April 2016) *[Copies provided upon request]*

South Coast AQMD *Records Retention Policy and Schedule* (South Coast AQMD Administrative Code, Section 90, Revised March 2, 2018)
[https://www.aqmd.gov/docs/default-source/Career/administrative-code.pdf?sfvrsn=16]

APPENDIX D
SOUTH COAST AQMD ORGANIZATIONAL CHARTS
Reporting Structure for the Monitoring & Analysis Division

For a recent overview of the entire South Coast AQMD organizational structure see:
http://www.aqmd.gov/docs/default-source/default-document-library/organizational-chart.pdf

Note: These organizational charts in this Appendix include several approved State program and rule-specific positions that may be currently unfilled or underfilled.

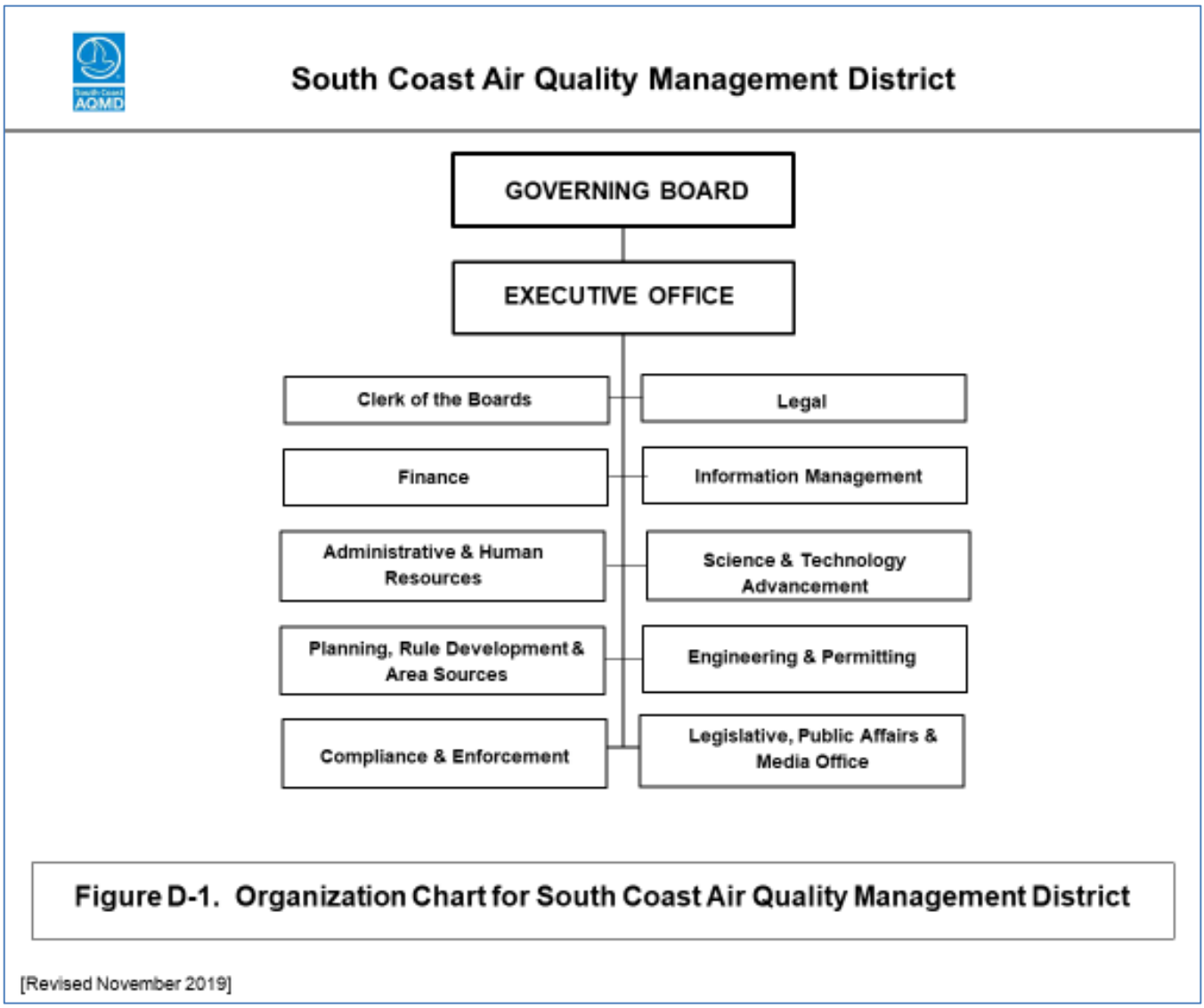

Figure D-1. Organization Chart for South Coast Air Quality Management District

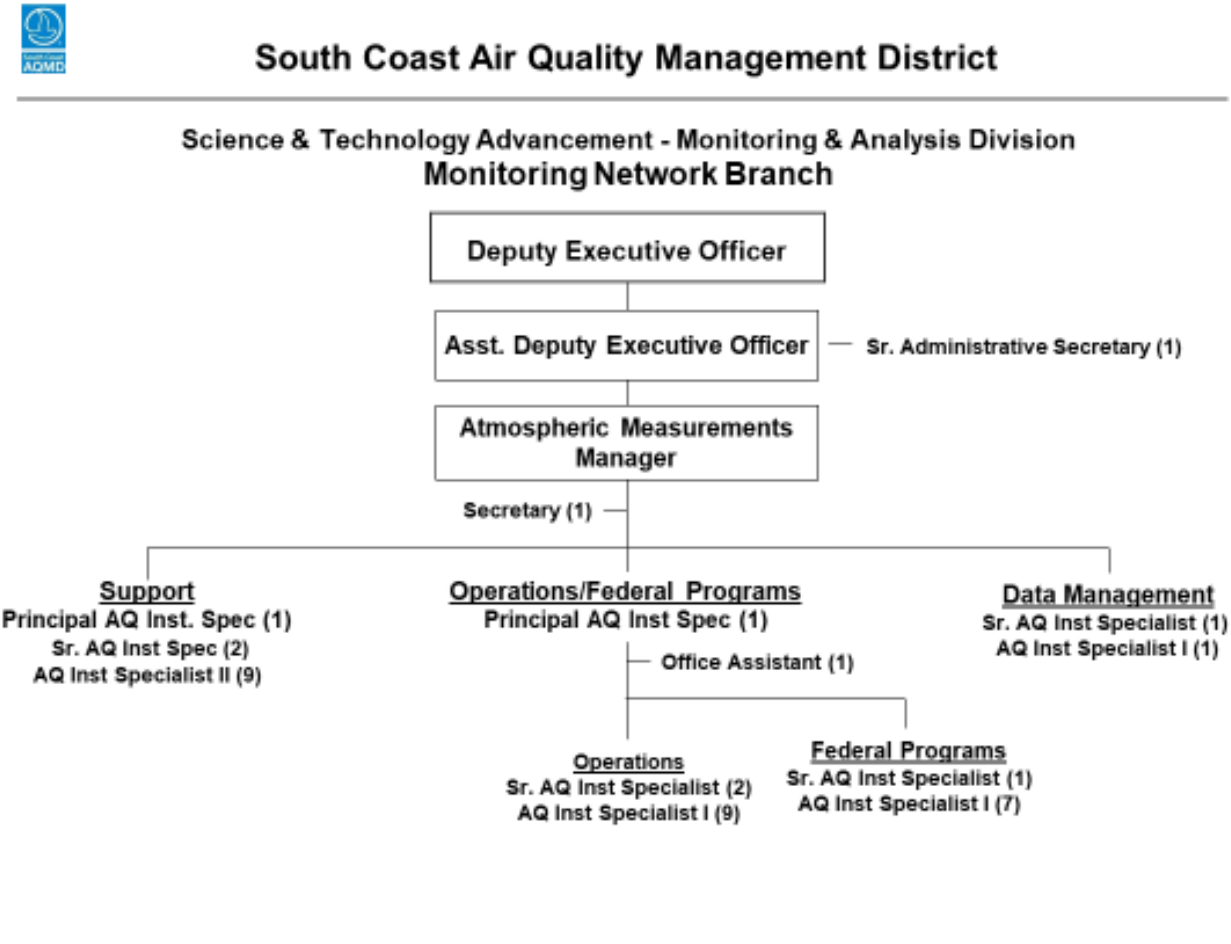

Figure D-2. Organization Chart for Monitoring Network Branch

[Revised November 2019]

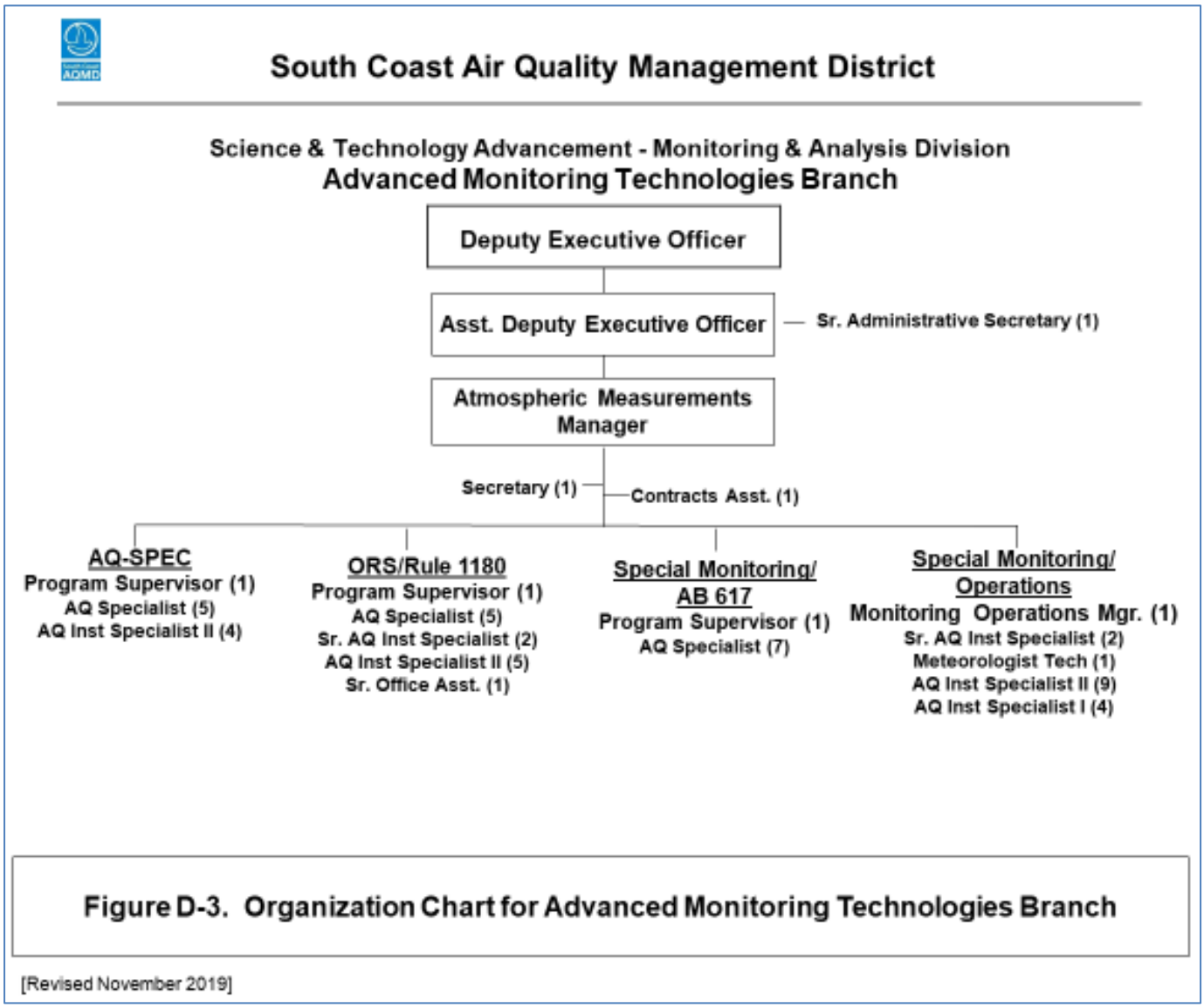

Figure D-3. Organization Chart for Advanced Monitoring Technologies Branch

[Revised November 2019]

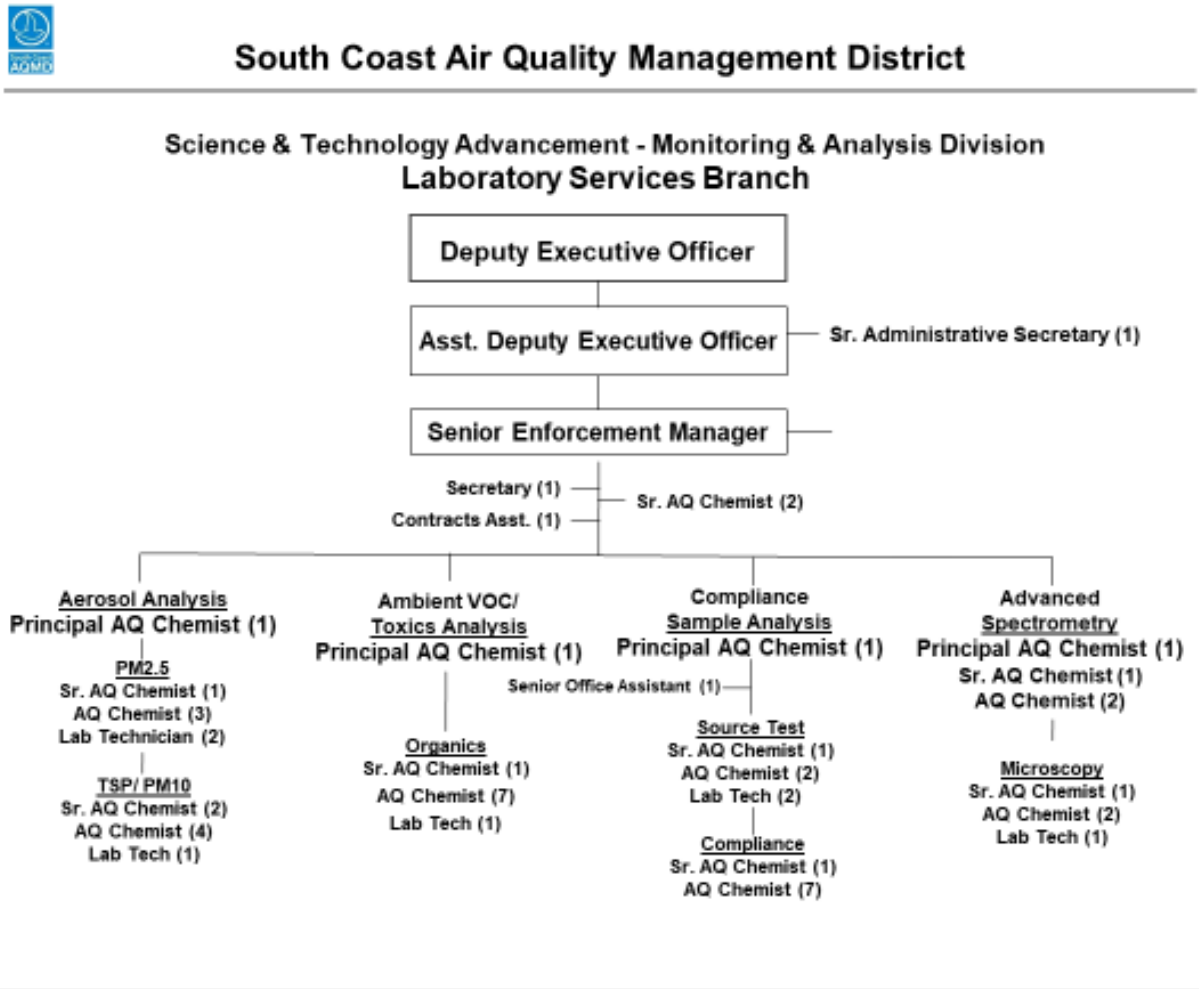

Figure D-4. Organization Chart for Laboratory Services Branch

[Revised November 2019]

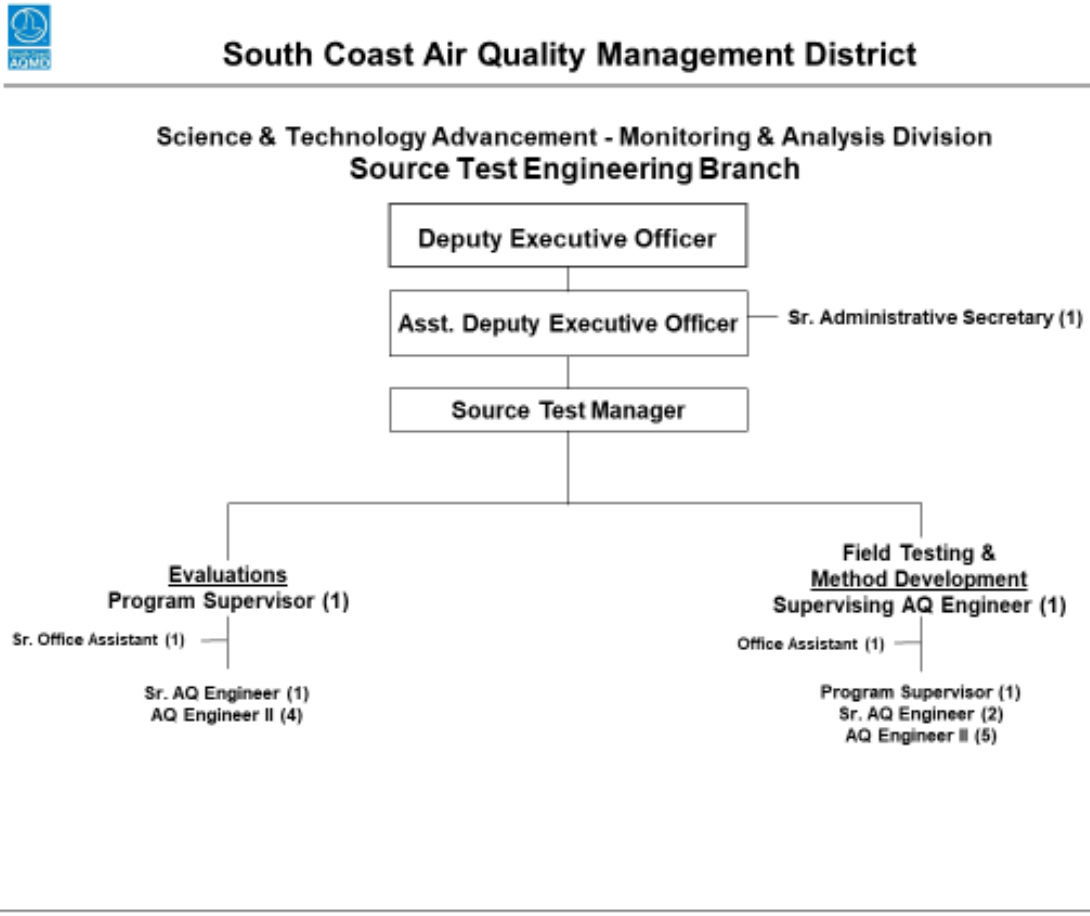

Figure D-5. Organization Chart for Source Test Engineering Branch

[Revised November 2019]

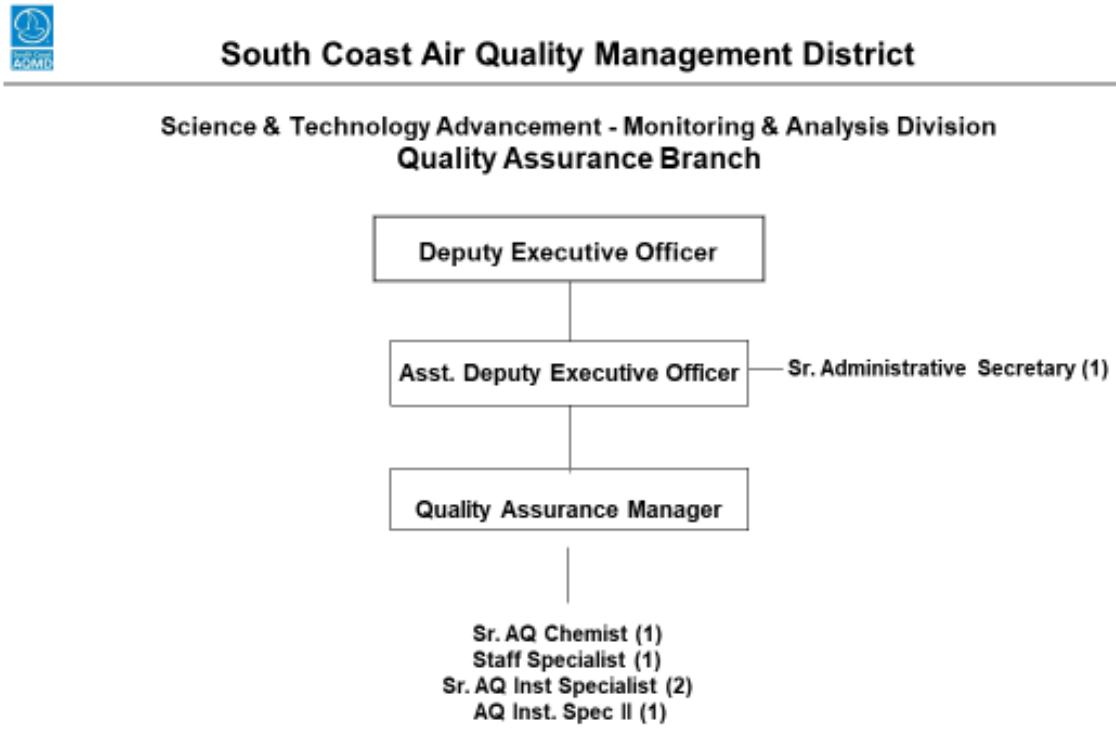

Figure D-6. Organization Chart for Quality Assurance Branch

[Revised November 2019]

APPENDIX E
SUMMARY OF SOUTH COAST AQMD STANDARD OPERATING PROCEDURES (SOPs) AND OPERATIONAL ASSISTANCE GUIDES (OAGs)

SOP/OAG Number	SOP/OAG Title
SOP00051	Carbon Monoxide (CO), Horiba 370
SOP00051A	Carbon Monoxide (CO), Horiba 360
SOP00054	Horiba CO Analyzer Calibrations (Series APMA-360 or APMA-370)
SOP00055	Operations of API/Teledyne 200E NO/NOx/NO2
SOP00055A	Nitrogen Oxides (NO, NO2, NOx), API Teledyne 200A
SOP00056	Thermo 42i NO/NOx Instrument Calibrations
SOP00057	Sulfur Dioxide (SO2), Thermo
SOP00058	Operations of API/Teledyne 400E Ozone Analyzer
SOP00060	Installation and Calibration for the Met One BAM 1020 PM2.5 and PM10 Monitor
SOP00061	Andersen RAAS PM2.5 Sequential Sampler Model 300
SOP00062	Rupprecht & Patashnick TEOM Series 1400a PM10 Monitor
SOP00063	Continuous PM10, BAM
SOP00064	Environics 9100 Calibrator
SOP00068	API/Teledyne 400E Ozone Instrument Calibration
SOP00070	Operation of Meteorological Systems
SOP00072	Operations of Met One BAM 1020 PM2.5 FEM, PM2.5 Non-FEM, and PM10
SOP00075	Operations of Thermo 42i NO/NOx/NO2 Analyzer
SOP00078	Operating and Calibrating the Tisch HIGH VOL+ TSP Sampler Controller (V6 firmware)
SOP00081	Hi-Q SSI PM10 Sampler Operations & Calibration
SOP00082	Hi-Q TSP Sampler Operations & Calibration
SOP00083	Data Management for Continuous Instruments
SOP00096	Determination of Metals in Ambient Particulate Matter by Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
SOP00100	Preparing Standard Operating Procedures (SOPs)
SOP00104	Weigh Room Operations and Weighing of PM2.5 Samples
SOP00108	Element® LIMS Data Handling and Processing
SOP00109	Operations of Thermo 49i Ozone Analyzer
SOP00112	The Gravimetric Determination of PM10 Mass

SOP/OAG Number	SOP/OAG Title
SOP00113	Selection, Preparation & Extraction of Quartz Filters for Metals Analysis
SOP00116	General AMS Station Operations
SOP00117	Gas Calibrations System Station Operations (Teledyne API Mode 701H and T700, and Environics 100 and 9100)
SOP00118	Data Collection System Station Operations
SOP00121	Data Processing and Validation (Laboratory)
SOP00122	Teledyne T700/T700U Dynamic Dilution Calibrator Setup and Calibration
SOP00124	Data QC using Data Management System (DMS)
SOP00126	Thermo-Scientific 43i TLS SO2 Trace Level Analyzer Operations and Calibration
SOP00129	Thermo Model 5014i Beta Continuous Particulate Monitor
SOP00132	Teledyne-Scientific 300EU CO Trace Level Analyzer (NCore) Operations and Calibration
SOP00135	Field Station Criteria Pollutant Ambient Air Instrument Performance Evaluation
SOP00136	Laboratory Performance and Capability
SOP00139	Thermo 48i Trace Level – Enhanced CO Analyzer
SOP00140	Installation of Environmental Systems Corporation Series 8832 Data System Controller
SOP00148	Horiba APNA-370 NOx/NO Analyzer
SOP00149	Thermo 49i Ozone Instrument Calibration
SOP00151	Partisol FRM PM2.5 Samplers Model 2000i and 2025i
SOP00153	Performance Audit of Thermo Partisol PM2.5 Samplers Model 2000i and 2025i
SOP00154	High Volume SSI PM10 Sampler Performance Audit
SOP00155	High Total Suspended Particulate (TSP) HI-Q Performance Audit
SOP00156	Air Monitoring Station Calibrations
SOP00159	Agilaire Digital Site Platform Setup and Installation (Series 8872)
SOP00164	Operating and Calibrating the Tisch PM10 + Sampler Controller
SOP00165	Thermo Model 5014i Beta Continuous Particulate Monitor Calibration
SOP00166	Teledyne/API 200E NO/NOx Instrument Calibrations
SOP00167	Horiba APNA 370 NOx Calibrations

SOP/OAG Number	SOP/OAG Title
SOP00168	Auditing Continuous PM2.5 and PM10 Met One Instruments (BAM 1020)
SOP00179	Thermo BAM 5014i Beta Continuous Particulate Monitor Performance Evaluation
OAG QA0001	Operational Assistance Guide for Corrective Action Request Process
OAG QA0002	Operational Assistance Guide for Quality Assurance Alert Process
OAG QA0003	Operational Assistance Guide for OAG Formatting
OAG QA0017	Data Certification Process for Federal Programs
OAG QA0022	PM10 and TSP Sample Login/Quality Control and Generation of Work Order Bar Codes
OAG QA0044	Selection, Visual Inspection and Acceptance of Filters
OAG QA0051	Station/Monitor Shutdown or Replacement Procedure
OAG QA0057	Perkin Elmer Inductively Coupled Plasma-Mass Spectrometer (PE ICP-MS) Instrument Operation & Maintenance
OAG QA0061	OAG & SOP Review and Revision Process and Guidelines

Appendix F
Example South Coast AQMD Training Forms

South Coast Air Quality Management District
Monitoring and Analysis Division
Training_Sheet_Template_1.3.docx

Version 1.3
March 2018

NAME OF TRAINEE: _____

POSITION TITLE: _____

CLASS/TRAINING TITLE: _____

SOP TITLE OR # (if applicable): _____ **VERSION:** _____

DATE(S) OF INSTRUCTION: _____

PERSON/ORGANIZATION CONDUCTING INSTRUCTION:

_____

SHORT DESCRIPTION OF TRAINING/SKILLS ACQUIRED:

_____

_____

_____

_____

_____

TRAINEE
SIGNATURE _____ **DATE** _____

INSTRUCTOR
SIGNATURE _____ **DATE** _____

SUPERVISOR
SIGNATURE **DATE**

QA REVIEW
SIGNATURE _____ **DATE** _____

COMMENTS:

_____

_____

South Coast Air Quality Management District
Monitoring and Analysis Division
Group_Training_Class_Template

Training Class Form
Version 1.3
March 2018

CLASS/TRAINING TITLE: _____

SOP TITLE OR # (if applicable):_____**VERSION:**_____

DATE(S) OF INSTRUCTION:_____

PERSON/ORGANIZATION CONDUCTING INSTRUCTION:
_____

SHORT DESCRIPTION OF TRAINING/SKILLS ACQUIRED:
_____
_____
_____
_____

Name (Please Print)	Position	Signature

INSTRUCTOR SIGNATURE _____ **DATE** _____

SUPERVISOR SIGNATURE **DATE**

QA REVIEW SIGNATURE _____ **DATE** _____

COMMENTS:
_____
_____

Training_Class_Template_v1.3 for groups.docx

APPENDIX G

CRITERIA POLLUTANT MONITORING PROGRAM MEASUREMENT QUALITY OBJECTIVES AND VALIDATION TEMPLATES

The information and tables in this appendix are reproduced directly from the U.S. EPA *Quality Assurance Handbook for Air Pollution Measurement Systems Vol. II, Ambient Air Quality Monitoring Program* (U.S. EPA, 2017a), Appendix D – *Measurement Quality Objectives and Validation Templates*, Revision No. 1, dated March 2017, This is the latest version available on the AMTIC website[48] as of the writing of this QAPP. South Coast AQMD criteria pollutant measurements and analyses are expected to meet or exceed these requirements and guidelines. U.S. EPA may make periodic revisions, to the *Validation Templates*, with notice provided to the state, local and tribal monitoring agencies. These revisions are to be considered for the South Coast AQMD criteria monitoring program within a reasonable assessment and implementation period.

[48] U.S. EPA QA Handbook Volume II, Appendix D – *Measurement Quality Objectives and Validation Templates, Revision No. 1, March 2017,* AMTIC website (available separately from full QA Handbook Volume II document): [https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/APP_D%20validation%20template%20version%2003_2017_for%20AMTIC%20Rev_1.pdf]

Measurement Quality Objectives and Validation Templates

Source: QA Handbook Volume II, Appendix D

Table of Contents

In June 1998, a workgroup was formed to develop a procedure that could be used by monitoring organizations that would provide for a consistent validation of PM2.5 mass concentrations across the US. The workgroup included personnel from the monitoring organizations, EPA Regional Offices, and OAQPS who were involved with assuring the quality of PM2.5 mass; additionally, the workgroup was headed by a State and local representative. The workgroup developed a table consisting of three criteria: critical, operational, and systematic criteria, where each criterion had a different degree of implication about the quality of the data. The criteria included on the tables were from 40 CFR Part 50 Appendices L and N, 40 CFR Part 58 Appendix A, and Method 2.12; a few criteria were also added that were neither in CFR nor Method 2.12, but which the workgroup felt should be included. Upon completion and use of the table, it was decided that a "validation template" should be developed for all the criteria pollutants.

To determine the appropriate table for each criterion, the members of the workgroup considered how significantly the criterion impacted the resulting concentration. This was based on experience from workgroup members, experience from non-workgroup members, and feasibility of implementing the criterion.

Criteria that were deemed critical to maintaining the integrity of a sample or group of samples were placed on the first table. Observations that do not meet each and every criterion on the **Critical Criteria** should be invalidated unless there are compelling reason and justification for not doing so. In most cases, this criterion can identify a distinct group of measurements and time period. For example, a flow rate exceedance represents a single sampler for a particular period of time (and therefore distinct number of samples), whereas a field blank or QA collocation exceedance is harder to identify what samples the exceedance may represent. In most cases the requirement, the implementation frequency of the criteria, and the acceptance criteria are found in CFR and are therefore regulatory in nature. The sample or group of samples for which one or more of these criteria are not met is invalid until proven otherwise[49]. The cause of not operating in the acceptable range for each of the violated criteria must be investigated and minimized to reduce the likelihood that additional samples will be invalidated. Typically, EPA Regional Offices will be in the best position to assess whether there are compelling reasons and justification for not deleting the data. The evaluation will be informed by a weight of evidence approach, consider input from States/locals and EPA's national office, and be documented.

Criteria that are important for maintaining and evaluating the quality of the data collection system are included under **Operational Criteria**. Violation of a criterion or a number of criteria may be cause for invalidation. The decision maker should consider other quality control information that may or may not indicate the data are acceptable for the parameter being controlled. Therefore, the sample or group of samples for which one or more of these criteria are not met are suspect unless other quality control information demonstrates otherwise and is documented. The reason for not meeting the criteria MUST be investigated, mitigated or justified.

Finally, those criteria which are important for the correct interpretation of the data but do not usually impact the validity of a sample or group of samples are included on the third table, the **Systematic Criteria**. For example, the data quality objectives are included in this table. If the data quality objectives are not met,

[49] In a number of cases precedence has been set with invalidating data based on failure of critical criteria.

this does not invalidate any of the samples but it may impact the uncertainty associated with the attainment/non-attainment decision.

NOTE: The designation of quality control checks as Operational or Systematic do not imply that these quality control checks need not be performed. Not performing an operational or systematic quality control check that is required by regulation (in CFR) can be a basis for invalidation of all associated data. Any time a CFR requirement is identified in the Requirement, Frequency or Acceptance Criteria column it will be identified by ***bold*** and ***italics*** font. Many monitoring organization/PQAOs are using the validation templates and have included them in QAPPs. However, it must be mentioned that diligence must be paid to its use. Data quality findings through data reviews and technical systems audits have identified multiple and concurrent non-compliance with operational criteria that monitoring organization considered valid without any documentation to prove the data validity. The validation templates were meant to be applied to small data sets (single values or a few weeks of information) and should not be construed to allow a criterion to be in non-conformance simple because it is operational or systematic.

Following are the tables for all the criteria pollutants. For each criterion, the tables include: (1) the requirement (2) the frequency with which compliance is to be evaluated, (3) acceptance criteria, and (4) information where the requirement can be found or additional guidance on the requirement.

The validation templates have been developed based on the current state of knowledge. The templates should evolve as new information is discovered about the impact of the various criteria on the uncertainty in the resulting mass estimate or concentration. In recent years there has been a number of circumstances where critical criteria and in some cases operational criteria that were in regulation (had a frequency and acceptance criteria) where not met. In these cases, EPA has been consistent in their application of invalidating data not meeting regulations. Interactions of the criteria, whether synergistic or antagonistic, should also be incorporated when the impact of these interactions becomes quantified. Due to the potential misuse of invalid data, data that are invalidated should not be uploaded to AQS, but should be retained on the monitoring organization's local database. This data will be invaluable to the evolution of the validation template.

Use of Bold Italics Font to Identify CFR Requirements.

The criteria listed in the validation templates are either requirements that can be found in the Code of Federal Regulations, guidance found in a variety of guidance documents, or recommendations by the QA Workgroup or EPA. As mentioned above any time a CFR requirement is identified in the Requirement, Frequency or Acceptance Criteria column it will be identified by ***bold and italics*** font and can be used for data invalidation depending on the infraction. The Information/Action column will provide the appropriate references for CFR or guidance documents.

Hyperlink References

Where requirements or guidance documents are found on the web, a hyperlink is created which will lead the user to the closest URL address. Any links to CFR are directed to the electronic CFR document (eCFR) which is the most up-to-date. E-CFR will not get you to an individual section. Therefore, e-CFR is only hyperlinked once on each page.

Change in Acceptance Criteria

In order to provide more consistent guidance in the use of acceptance criteria we have developed more definitive information on rounding. The acceptance criteria will show more digits than might otherwise be found in regulations or guidance. For example, where in the past the one-point flow rate verification was ± *4% of transfer standard*, some monitoring organizations equated a flow rate of < ± 4.5% as acceptable while others considered anything < ± 4.1% acceptable. Therefore, in order to ensure consistency, EPA has provided more definitive information of these acceptance limits. In this case, the acceptance criteria for the flow rate verification is < ± 4.1%. In the cases where the CFR lists a requirement (as is the case with the flow rate verification which is listed as ± 4%), EPA will interpret the acceptance criteria to a level that will provide a more consistent application of the template across the ambient air monitoring network. The rounding policy is included in Appendix L of the QA Handbook.

Truncation

Under no circumstances should quality measurements for comparison to acceptance criteria be truncated, rather than rounded.

PM_{10} Note of Caution

The validation templates for PM_{10} get complicated because PM_{10} is required to be reported at standard temperature and pressure (STP) for comparison to the NAAQS (and follow 40 CFR Part 50 App J) and at local conditions if using it to monitor for $PM_{10-2.5}$ (and follow 40 CFR Part 50 App O). Moreover, PM_{10} can be measured with filter-based sampling techniques as well as with automated methods. The validation templates developed for PM_{10} try to accommodate these differences, but monitoring organizations are cautioned to review the operations manual for the monitors/samplers they use and augment the validation template with QC information specific to their EPA reference or equivalent method designation and instrument.
https://www.epa.gov/sites/production/files/2019-08/documents/designated_reference_and-equivalent_methods.pdf

Ozone Validation Template

1) Requirement (O_3)	2) Frequency	3) Acceptance Criteria	Information /Action
CRITICAL CRITERIA-OZONE			
Monitor	NA	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
One Point QC Check Single analyzer	***Every 14 days***	< ±7.1% (percent difference) or < ±1.5 ppb difference whichever is greater	1 and 2) 40 CFR Part 58 App A Sec. 3.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.2. QC Check Conc range 0.005 - 0.08 ppm and 05/05/2016 Technical Note on AMTIC
Zero/span check	Every 14 days	Zero drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24hr-14 day) Span drift < ± 7.1 %	1 and 2) QA Handbook Volume 2 Sec. 12.3 3) Recommendation and related to DQO
OPERATIONAL CRITERIA -OZONE			
Shelter Temperature Range	Daily (hourly values)	20.0 to 30.0° C. (Hourly avg) or per manufacturers specifications if designated to a wider temperature range	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2 Generally, the 20-30.0° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance. FRM/FEM list found on AMTIC provides temp. range for given instrument. FRM/FEM monitor testing is required at 20-30° C range per 40 CFR Part 53.32
Shelter Temperature Control	Daily (hourly values)	< 2.1° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Shelter Temperature Device Check	Every 182 days and 2/ calendar year	<± 2.1° C of standard	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Annual Performance Evaluation Single analyzer	***Every site every 365 days and 1/ calendar year within period of monitor operation,***	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1&2 < ± 1.5 ppb difference or <± 15.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.2 3) Recommendation- 3-audit concentrations not including zero. AMTIC guidance 2/17/2011 AMTIC Technical Memo
Federal Audits (NPAP)	***20% of sites audited in calendar year***	Audit levels 1&2 < ± 1.5 ppb difference all other levels percent difference < ± 10.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.3 3) NPAP QAPP/SOP
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	All points < ± 2.1 % or < ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± .05	1) 40 CFR Part 50 App D 2) Recommendation 3) 40 CFR Part 50 App D Sec 4.5.5.6 Multi-point calibration (0 and 4 upscale points) Slope criteria is a recommendation

	Every 365 day and 1/ calendar year if continuous zero/span performed daily		
Zero Air/Zero Air Check	Every 365 days and 1/calendar year	Concentrations below LDL	1) 40 CFR Part 50 App D Sec. 4.1 2 and 3) Recommendation
Ozone Level 2 Standard			
1) Requirement (O_3)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Certification/recertification to Standard Reference Photometer (Level 1)	Every 365 days and 1/calendar year	single point difference < ± 3.1%	1) 40 CFR Part 50 App D Sec. 5.4 2 and 3) Transfer Standard Guidance EPA-454/B-10-001 Level 2 standard (formerly called primary standard) usually transported to EPA Regions SRP for comparison
Level 2 and Greater Transfer Standard Precision	Every 365 days and 1/calendar year	***Standard Deviation less than 0.005 ppm or 3.0% whichever is greater***	1) 40 CFR Part 50 Appendix D Sec. 3.1 2) Recommendation, part of reverification 3) 40 CFR Part 50 Appendix D Sec. 3.1
(if recertified via a transfer standard)	Every 365 days and 1/calendar year	Regression slopes = 1.00 ± 0.03 and two intercepts are 0 ± 3 ppb	1, 2 and 3) Transfer Standard Guidance EPA-545/B-10001
Ozone Transfer standard (Level 3 and greater)			
Qualification	Upon receipt of transfer standard	< ±4.1% or < ±4 ppb (whichever greater)	1, 2 and 3) Transfer Standard Guidance EPA-545/B-10001
Certification	After qualification and upon receipt/adjustment/repair	RSD of six slopes ≤ 3.7% Std. Dev. of 6 intercepts ≤ 1.5	1, 2 and 3) Transfer Standard Guidance EPA-545/B-10001 1
Recertification to higher level standard	Beginning and end of O3 season or every 182 days and 2/calendar year whichever less	New slope = ± 0.05 of previous and RSD of six slopes ≤3.7% Std. Dev. of 6 intercepts ≤ 1.5	1, 2 and 3) Transfer Standard Guidance EPA-545/B-10001 recertification test that then gets added to most recent 5 tests. If does not meet acceptability certification fails
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements. It is recommended that monitoring organizations perform the LDL test to minimally confirm and establish the LDL of their monitor. Performing the LDL test will provide the noise information.			
Noise	Every 365 days and 1/ calendar year	***≤ 0.0025 ppm (standard range) ≤ 0.001 ppm (lower range)***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation- info can be obtained from LDL 3) 40 CFR Part 53.20 Table B-1
Lower detectable limit	Every 365 days and 1/calendar year	***≤ 0.005 ppm (standard range) ≤ 0.002 ppm (lower range)***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1
SYSTEMATIC CRITERIA-OZONE			
Standard Reporting Units	***All data***	***ppm (final units in AQS)***	1, 2 and 3) 40 CFR Part 50 App U Sec. 3(a)

Rounding convention for design value calculation	***All routine concentration data***	***3 places after decimal with digits to right truncated***	1, 2 and 3) 40 CFR Part 50 App U Sec. 3(a) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual hourly values.
Completeness (seasonal)	***3-Year Comparison***	***≥ 90% (avg) daily max available in ozone season with min of 75% in any one year.***	1,2,3) 40 CFR Part 50 App U Sec 4(b)
	8- hour average	***≥ if at least 6 of the hourly concentrations for the 8-hour period are available***	1) 40 CFR Part 50 App U 2 and 3) 40 CFR Part 50 App U Sec. 3(b)
	Valid Daily Max	***≥ if valid 8-hour averages are available for at least 13 of the 17 consecutive 8-hour periods starting from 7:00 a.m. to 11:00 p.m.***	1) 40 CFR Part 50 App U 2,3) 40 CFR Part 50 App U Sec. 3(d)
Sample Residence Time Verification	Every 365 days and 1/calendar year	***≤ 20 Seconds***	1) 40 CFR Part 58 App E, Sec. 9 (c) 2) Recommendation
1) Requirement (O_3)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
			3) 40 CFR Part 58 App E, Sec. 9 (c)
Sample Probe, Inlet, Sampling train	***All sites***	***Borosilicate glass (e.g., Pyrex®) or Teflon®***	1) 40 CFR Part 58 App E, Sec. Sec. 9 (a) 2) Recommendation 3) 40 CFR Part 58 App E, Sec. Sec. 9 (a) FEP and PFA have been accepted as an equivalent material to Teflon. Replacement or cleaning is suggested as 1/year and more frequent if pollutant load or contamination dictate
Siting	Every 365 days and 1/calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-6 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-6
EPA Standard Ozone Reference Photometer (SRP) Recertification (Level 1)	Every 365 days and 1/calendar year	Regression slope = 1.00 ± 0.01 and intercept < 3 ppb	1, 2 and 3) Transfer Standard Guidance EPA-454/B-10001 This is usually at a Regional Office and is compared against the traveling SRP
Precision (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	**90% CL CV < 7.1%**	1) 40 CFR Part 58 App A 2.3.1.2 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.2
Bias (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	**95% CL < ± 7.1%**	1) 40 CFR Part 58 App A 2.3.1.2 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.3

CO Validation Template

1) Requirement (CO)	2) Frequency	3) Acceptance Criteria	Information /Action
CRITICAL CRITERIA-CO			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
One Point QC Check Single analyzer	***Every 14 days***	< ±10.1% (percent difference)	1 and 2) 40 CFR Part 58 App A Sec. 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1. QC Check Conc range 0.5 – 5 ppm
Zero/span check	Every 14 days	Zero drift < ± 0.41 ppm (24 hr) < ± 0.61 ppm (>24hr-14 day) Span drift < ± 10.1 %	1 and 2) QA Handbook Volume 2 Sec. 12.3 3) Recommendation
OPERATIONAL CRITERIA-CO			
Shelter Temperature range	Daily (hourly values)	20.0 to 30.0° C. (Hourly avg) or per manufacturers specifications if designated to a wider temperature range	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2 Generally, the 20-30.0 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance. FRM/FEM list found on AMTIC provides temp. range for given instrument. FRM/FEM monitor testing is required at 20-30 ° C range per 40 CFR Part 53.32
Shelter Temperature Control	Daily (hourly values)	< 2.1° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Shelter Temperature Device Check	Every 182 days and 2/ calendar year	< ± 2.1° C of standard	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Annual Performance Evaluation Single Analyzer	***Every site every 365 days and 1/ calendar year***	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1&2 < ± 0.031 ppm difference or < ±15.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.2 3) Recommendation- 3-audit concentrations not including zero. AMTIC Technical Memo
Federal Audits (NPAP)	***20% of sites audited in a calendar year***	Audit levels 1&2 < ± 0.031 ppm difference all other levels percent difference < ± 15.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.3 3) NPAP QAPP/SOP
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving Every 182 day and 2/ calendar year if manual zero/span performed biweekly Every 365 days and 1/ calendar year if continuous zero/span performed	All points < ± 2.1 % or < ± 0.03 ppm difference of best-fit straight line. whichever is greater and Slope 1 ± .05	1) 40 CFR Part 50 Appendix C Sec. 4 2 and 3) Recommendation See details about CO2 sensitive instruments Multi-point calibration (0 and 4 upscale points) Slope criteria is a recommendation

	daily		
1) Requirement (CO)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Gaseous Standards	All gas cylinders	**NIST Traceable** (e.g., EPA Protocol Gas)	1) 40 CFR Part 50 Appendix C Sec. 4.3.1 2) NA Green Book 3) 40 CFR Part 50 Appendix C Sec. 4.3.1 See details about CO2 sensitive instruments Gas producer used must participate in EPA Ambient Air Protocol Gas Verification Program 40 CFR Part 58 App A Sec. 2.6.1
Zero Air/Zero Air Check	Every 365 days and 1/ calendar year	***< 0.1 ppm CO***	1) 40 CFR Part 50 App C Sec. 4.3.2 2) Recommendation 3) 40 CFR Part 50 App C Sec. 4.3.2
Gas Dilution Systems	Every 365 days and 1/ calendar year or after failure of 1 point QC check or performance evaluation	Accuracy < ± 2.1 %	1, 2 and 3) Recommendation based on SO2 requirement in 40 CFR Part 50 App A-1 Sec. 4.1.2
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements. It is recommended that monitoring organizations perform the LDL test to minimally confirm and establish the LDL of their monitor. Performing the LDL test will provide the noise information.			
Noise	Every 365 days and 1/ calendar year	***≤ 0.2 ppm (standard range) ≤ 0.1 ppm (lower range)***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation- info can be obtained from LDL 3) 40 CFR Part 53.20 Table B-1
Lower detectable level	Every 365 days and 1/ calendar year	***≤ 0.4 ppm (standard range) ≤ 0.2 ppm (lower range)***	1) 40 CFR Part 53.23 (c) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1
SYSTEMATIC CRITERIA-CO			
1) Requirement (CO)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Standard Reporting Units	***All data***	***ppm (final units in AQS)***	1, 2 and 3) 40 CFR Part 50.8 (a)
Rounding convention for design value calculation	***All routine concentration data***	***1 decimal place***	1, 2 and 3) 40 CFR Part 50.8 (d) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual hourly values.

Completeness	***8-hour standard***	***75% of hourly averages for the 8-hour period***	1) 40 CFR Part 50.8(c) 2) 40 CFR Part 50.8(a-2) 3) 40 CFR Part 50.8(c)
Sample Residence Time Verification	Every 365 days and 1/ calendar year	≤ 20 Seconds	1, 2, and 3) Recommendation. CO not a reactive gas but suggest following same methods other gaseous criteria pollutants.
Sample Probe, Inlet, Sampling train	All Sites	Borosilicate glass (e.g., Pyrex®) or Teflon®	1, 2, and 3) Recommendation. CO not a reactive gas but suggest following same methods other gaseous criteria pollutants. FEP and PFA have been accepted as an equivalent material to Teflon. Replacement/cleaning is suggested as 1/year and more frequent if pollutant load dictate.
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-6 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-6
Precision (using 1-point QC	***Calculated annually and as***	***90% CL CV < 10.1%***	1) 40 CFR part 58 App A Sec. 3.1.1
checks)	***appropriate for design value estimates***		2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.2
Bias (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***95% CL < ± 10.1%***	1) 40 CFR Part 58 App A Sec. 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.3

NO_2, NOx, NO Validation Template

1) Requirement (NO_2)	2) Frequency	3) Acceptance Criteria	Information /Action
CRITICAL CRITERIA- NO_2			
Sampler/Monitor	***NA***	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
One Point QC Check Single analyzer	***Every 14 days***	< ±15.1% (percent difference) or < ± 1.5 ppb difference whichever is greater	1 and 2) 40 CFR Part 58 App A Sec. 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.5 QC Check Conc range 0.005 - 0.08 ppm and 05/05/2016 Technical Note on AMTIC
Zero/span check	Every 14 days	Zero drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24hr-14 day) Span drift < ± 10.1 %	1 and 2) QA Handbook Volume 2 Sec. 12.3 3) Recommendation and related to DQO
Converter Efficiency	During multi-point calibrations, span and audit Every 14 days	***(≥96%)*** 96% – 104.1%	1) 40 CFR Part 50 App F Sec. 1.5.10 and 2.4.10 2) Recommendation 3) 40 CFR Part 50 App F Sec. 1.5.10 and 2.4.10 Regulation states ≥ 96%, 96 – 104.1% is a recommendation.
OPERATIONAL CRITERIA- NO_2			
Shelter Temperature Range	Daily (hourly values)	20.0 to 30.0° C. (Hourly avg) or per manufacturers specifications if designated to a wider temperature range	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2 Generally, the 20-30.0 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance. FRM/FEM list found on AMTIC provides temp. range for given instrument. FRM/FEM monitor testing is required at 20-30 ° C range per 40 CFR Part 53.32
Shelter Temperature Control	Daily (hourly values)	< 2.1° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Shelter Temperature Device Check	every 182 days and 2/calendar year	< ± 2.1° C of standard	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Annual Performance Evaluation Single Analyzer	***Every site every 365 days and 1/ calendar year***	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1&2 < ± 1.5 ppb difference or < ±15.1%	1) 40 CFR Part 58 App A Sec. 3.1.2 2) 40 CFR Part 58 App A Sec. 3.1.2 3) Recommendation - 3 audit concentrations not including zero. AMTIC Technical Memo

Federal Audits (NPAP)	20% of sites audited in calendar year	Audit levels 1&2 < ± 1.5 ppb difference all other levels percent difference < ± 15.1%	1 & 2) 40 CFR Part 58 App A Sec. 3.1.3 3) NPAP QAPP/SOP
1) Requirement (NO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
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 Dynamic parameter ≥ 2.75 ppm-min All points <± 2.1 % or ≤ ± 1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± .05	1) 40 CFR Part 50 App F 2 and 3) Recommendation Multi-point calibration (0 and 4 upscale points) Slope criteria is a recommendation
Gaseous Standards	All gas cylinders	**NIST Traceable** (e.g., EPA Protocol Gas) 50-100 ppm of NO in Nitrogen with < 1 ppm NO_2	1) 40 CFR Part 50 App F Sec. 1.3.1 2) NA Green Book 3) 40 CFR Part 50 App F Sec. 1.3.1. A technical memo may change the concentration requirement. Gas producer used must participate in EPA Ambient Air Protocol Gas Verification Program 40 CFR Part 58 App A Sec. 2.6.1
Zero Air/ Zero Air Check	Every 365 days and 1/ calendar year	Concentrations below LDL	1) 40 CFR Part 50 App F Sec. 1.3.2 2 and 3) Recommendation
Gas Dilution Systems	Every 365 days and 1/ calendar year or after failure of 1-point QC check or performance evaluation	Accuracy < ± 2.1 %	1, 2 and 3) Recommendation based on SO2 requirement in 40 CFR Part 50 App A-1 Sec. 4.1.2
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements. It is recommended that monitoring organizations perform the LDL test to minimally confirm and establish the LDL of their monitor. Performing the LDL test will provide the noise information.			
Noise	Every 365 days and 1/ calendar year	***≤ 0.005 ppm***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation- info can be obtained from LDL 3) 40 CFR Part 53.20 Table B-1
Lower detectable level	Every 365 days and 1/ calendar year	***≤ 0.01 ppm***	1) 40 CFR Part 53.23 (c) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1
SYSTEMATIC CRITERIA- NO_2			
Standard Reporting Units	***All data***	***ppb (final units in AQS)***	1, 2 and 3) 40 CFR Part 50 App S Sec. 2 (c)
Rounding convention for data reported to AQ S	***All routine concentration data***	***1 place after decimal with digits to right truncated***	1, 2 and 3) 40 CFR Part 50 App S Sec. 4.2 (a) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual hourly values.

Completeness	***Annual Standard***	***≥ 75% hours in year***	1) 40 CFR Part 50 App S Sec. 3.1(b) 2) 40 CFR Part 50 App S Sec. 3.1(a) 3) 40 CFR Part 50 App S Sec. 3.1(b)
	1-hour standard	***1) 3consecutive calendars years of complete data 2) 4 quarters complete in each year 3) ≥75% sampling days in quarter 4) ≥ 75% of hours in a day***	1) 40 CFR Part 50 App S Sec. 3.2(b) 2) 40 CFR Part 50 App S Sec. 3.2(a) 3) 40 CFR Part 50 App S Sec. 3.2(b) More details in 40 CFR Part 50 App S
1) Requirement (NO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Sample Residence Time Verification	Every 365 days and 1/ calendar year	***≤ 20 Seconds***	1) 40 CFR Part 58 App E, Sec. 9 (c) 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 9 (c)
Sample Probe, Inlet, Sampling train	***All sites***	***Borosilicate glass (e.g., Pyrex®) or Teflon®***	1, 2 and 3) 40 CFR Part 58 App E Sec. 9 (a) FEP and PFA have been accepted as equivalent material to Teflon. Replacement or cleaning is suggested as 1/year and more frequent if pollutant load or contamination dictate
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Secs 2-6 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-6
Precision (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***90% CL CV < 15.1%***	1) 40 CFR Part 58 App A Sec. 2.3.1.5 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.2
Bias (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***95% CL < ± 15.1%***	1) 40 CFR Part 58 App A Sec. 2.3.1.5 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.3

SO_2 Validation Template

1) Requirement (SO_2)	2) Frequency	3) Acceptance Criteria	Information /Action
CRITICAL CRITERIA- SO_2			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
One Point QC Check Single analyzer	***Every 14 days***	< ±10.1% (percent difference) or < ± 1.5 ppb difference whichever is greater	1 and 2) 40 CFR Part 58 App A Sec. 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.2 QC Check Conc range 0.005 - 0.08 ppm and 05/05/2016 Technical Note on AMTIC
Zero/span check	Every 14 days	Zero drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24hr-14 day) Span drift < ± 10.1 %	1 and 2) QA Handbook Volume 2 Sec. 12.3 3) Recommendation and related to DQO
OPERATIONAL CRITERIA- SO_2			
Shelter Temperature Range	Daily (hourly values)	20.0 to 30.0° C. (Hourly avg) or per manufacturers specifications if designated to a wider temperature range	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2 Generally, the 20-30.0 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance. FRM/FEM list found on AMTIC provides temp. range for given instrument. FRM/FEM monitor testing is required at 20-30 ° C range per 40 CFR Part 53.32
Shelter Temperature Control	Daily (hourly values)	< 2.1° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Shelter Temperature Device Check	every 180 days and 2/calendar year	< ± 2.1° C of standard	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Annual Performance Evaluation Single Analyzer	***Every site every 365 days and 1/ calendar year***	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1&2 < ± 1.5 ppb difference or < ±15.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.2 3) Recommendation - 3-audit concentrations not including zero. AMTIC Technical Memo
Federal Audits (NPAP)	20% of sites audited in calendar year	Audit levels 1&2 < ± 1.5 ppb difference all other levels percent difference < ± 15.1%	1&2) 40 CFR Part 58 App A Sec. 3.1.3 3) NPAP QAPP/SOP
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	All points < ± 2.1 % or < ± 1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± .05	1) 40 CFR Part 50 App A-1 Sec. 4 2 and 3) Recommendation Multi-point calibration (0 and 4 upscale points) Slope criteria is a recommendation

Gaseous Standards	***All gas cylinders***	***NIST Traceable (e.g., EPA Protocol Gas)***	1) 40 CFR Part 50 App A-1 Sec. 4.1.6.1 2) NA Green Book 3) 40 CFR Part 50 App F Sec. 1.3.1 Producers must participate in Ambient Air Protocol Gas
1) Requirement (SO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
			Verification Program 40 CFR Part 58 App A Sec. 2.6.1
Zero Air/ Zero Air Check	Every 365 days and 1/ calendar year	Concentrations below LDL < 0.1 ppm aromatic hydrocarbons	1) 40 CFR Part 50 App A-1 Sec. 4.1.6.2 2) Recommendation 3) Recommendation and 40 CFR Part 50 App A-1 Sec. 4.1.6.2
Gas Dilution Systems	Every 365 days and 1/ calendar year or after failure of 1point QC check or performance evaluation	***Accuracy < ± 2.1 %***	1) 40 CFR Part 50 App A-1Sec. 4.1.2 2) Recommendation 3) 40 CFR Part 50 App A-1 Sec. 4.1.2
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements. It is recommended that monitoring organizations perform the LDL test to minimally confirm and establish the LDL of their monitor. Performing the LDL test will provide the noise information.			
Noise	Every 365 days and 1/ calendar year	***≤ 0.001 ppm (standard range) ≤ 0.0005 ppm (lower range)***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation- info can be obtained from LDL 3) 40 CFR Part 53.20 Table B-1
Lower detectable level	Every 365 days and 1/ calendar year	***≤ 0.002 ppm (standard range) ≤ 0.001 ppm (lower range)***	1) 40 CFR Part 53.23 (c) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1
SYSTEMATIC CRITERIA- SO_2			
Standard Reporting Units	***All data***	***ppb (final units in AQS)***	1, 2 and 3) 40 CFR Part 50 App T Sec. 2 (c)
Rounding convention for design value calculation	***All routine concentration data***	***1 place after decimal with digits to right truncated***	1, 2 and 3) 40 CFR Part 50 App T Sec. 2 (c) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual hourly values.
Completeness	***1 hour standard***	Hour – 75% of hour ***Day- 75% hourly Conc*** ***Quarter- 75% complete days*** ***Years- 4 complete quarters*** ***5-min value reported only for valid hours***	1, 2 and 3) 40 CFR Part 50 App T Sec. 3 (b), (c) More details in CFR on acceptable completeness. 5-min values or 5-min max value (40 CFR part 58.16(g)) only reported for the valid portion of the hour reported. If the hour is incomplete no 5-min or 5-min max reported.
Sample Residence Time Verification	Every 365 days and 1/ calendar year	***≤ 20 Seconds***	1) 40 CFR Part 58 App E, Sec. 9 (c) 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 9 (c)

Sample Probe, Inlet, Sampling train	***All sites***	***Borosilicate glass (e.g., Pyrex®) or Teflon®***	1, 2 and 3) 40 CFR Part 58 App E Sec. 9 (a) FEP and PFA have been accepted as equivalent material to Teflon. Replacement or cleaning is suggested as 1/year and more frequent if pollutant load or contamination dictate
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-6 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-6
Precision (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***90% CL CV < 10.1%***	1) 40 CFR Part 58 App A Sec. 2.3.1.6 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.2
1) Requirement (SO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Bias (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***95% CL < ± 10.1%***	1) 40 CFR Part 58 App A Sec. 2.3.1.6 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.3

$PM_{2.5}$ Filter Based Local Conditions Validation Template

1) Criteria (PM2.5 LC)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- $PM_{2.5}$ Filter Based Local Conditions			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Filter Holding Times			
Pre-sampling	***all filters***	***≤ 30 days before sampling***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.5
Sample Recovery	***all filters***	***≤ 7 days 9 hours from sample end date***	1, 2 and 3) 40 CFR Part 50, App. L 10.10
Sampling Period (including multiple power failures)	***all filters***	***1380-1500 minutes, or if value < 1380 and exceedance of NAAQS 1/ midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App L Sec. 3.3 and 40 CFR Part 50 App N Sec. 1 for the midnight to midnight local standard time requirement See details if less than 1380 min sampled
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***average within 5% of 16.67 liters/minute***	1, 2 and 3) Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV ≤ 2%***	1, 2 and 3) 40 CFR Part 50, App L Sec. 7.4.3.2
One-point Flow Rate Verification	***every 30 days each separated by 14 days***	***< ± 4.1% of transfer standard*** < ± 5.1% of flow rate design value	1, 2 and 3) 40 CFR Part 50, App L, Sec. 9.2.5 and 7.4.3.1 and 40 CFR Part 58, Appendix A Sec. 3.2.1
Design Flow Rate Adjustment	***After multi-point calibration or verification***	***< ± 2.1% of design flow rate***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6
Individual Flow Rates	***every 24 hours of op***	***no flow rate excursions > ±5% for > 5 min. 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.1
Filter Temp Sensor	***every 24 hours of op***	***no excursions of > 5° C lasting longer than 30 min 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.11.4
External Leak Check	***Before each flow rate verification/calibration*** and before and after $PM_{2.5}$ separator maintenance	***< 80.1 mL/min*** (see comment #1)	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50 App L Sec. 9.2.3 and Method 2-12 Sec. 7.4.3 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1
Internal Leak Check	If failure of external leak check	***< 80.1 mL/min***	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12, Sec. 7.4.4 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2

Laboratory Activities			
1) Criteria (PM2.5 LC)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Post-sampling Weighing	***all filters***	***Protected from exposure to temperatures above 25C from sample retrieval to conditioning*** ***≤10 days from sample end date if shipped at ambient temp, or*** ***≤ 30 days if shipped below avg ambient (or 4° C or below for avg sampling temps < 4° C) from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 8.3.6 and L Sec. 10.13. See technical note on holding time requirements at : https://www3.epa.gov/ttn/amtic/pmpolgud.html
Filter Visual Defect Check (unexposed)	***all filters***	***Correct type & size and for pinholes, particles or imperfections***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 10.2
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.5
Temp. Range	***all filters***	***24-hr mean 20.0-23.0° C***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.1
Temp. Control	***all filters***	***< 2.1° C SD* over 24 hr.***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.2 SD use is a recommendation
Humidity Range	***all filters***	***24-hr mean 30.0% - 40.0% RH or Within ±5.0 % sampling RH but ≥ 20.0%RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.3
Humidity Control	***all filters***	***< 5.1 % SD* over 24 hr.***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.4 SD use is recommendation
Pre/post Sampling RH	***all filters***	***difference in 24-hr means < ± 5.1% RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.3
Balance	***all filters***	***located in filter conditioning environment***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.2
Microbalance Auto-Calibration	***Prior to each weighing session***	Manufacturer's specification	1) 40 CFR Part 50, App. L, Sec. 8.1 2) 40 CFR Part 50, App. L, Sec. 8.1 and Method 2.12 Sec. 10.6 3) NA
OPERATIONAL EVALUATIONS TABLE $PM_{2.5}$ Filter Based Local Conditions			
Field Activities			

One-point Temp Verification	every 30 days	< ± 2.1°C	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.5 and Table 6-1 3) Recommendation
Pressure Verification	every 30 days	< ± 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.6 and Table 6-1 3) Recommendation
Annual Multi-point Verifications/Calibrations			
Temperature multi-point Verification/Calibration	on installation, then every 365 days and once a calendar year	< ± 2.1°C	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4.4 Table 6-1
1) Criteria (PM2.5 LC)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Pressure Verification/Calibration	on installation, and on one-point verification failure	< ± 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 Sampler BP verified against independent standard verified against a lab primary standard that is certified as NIST traceable 1/year
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport*** or every 365 days and once a calendar year	< ± 2.1% of transfer standard	1) 40 CFR Part 50, App. L, Sec. 9.2. 2) 40 CFR Part 50, App. L, Sec. 9.1.3, Method 2.12 Sec. 6.3 & Table 6-1 3) Recommendation
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	1, 2 and 3) Recommendation
Precision			
Collocated Samples	***every 12 days for 15% of sites by method designation***	CV < 10.1% of samples ≥ 3.0 µg/m^3	1) and 2) Part 58 App A Sec. 3.2.3 3 Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.1
Accuracy			
Temperature Audit	every 180 days and at time of flow rate audit	< ± 2.1°C	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 180 days and at time of flow rate audit	< ±10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and between 5-7 months apart***	< ± 4.1% of audit standard < ± 5.1% of design flow rate	1 and 2) Part 58, App A, Sec. 3.2.2 3) Method 2.12 Sec. 11.2.1
Monitor Maintenance			
$PM_{2.5}$ Separator (WINs)	every 5 sampling events	cleaned/changed	1, 2, and 3) Method 2.12 Sec. 8.2.2
$PM_{2.5}$ Separator (VSCC)	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3.3
Inlet Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3

Downtube Cleaning	every 90 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.4
Filter Housing Assembly Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Laboratory Activities			
Filter Checks			
Lot Blanks	9 filters per lot	< ±15.1 µg change between weighings	1, 2, 3) Recommendation and used to determine filter stability of the lot of filters received from EPA or vendor. Method 2.12 Sec. 10.5
Exposure Lot Blanks	3 filters per lot	< ±15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.5 Used for preparing a subset of filters for equilibration
Filter Integrity (exposed)	each filter	no visual defects	1, 2 and 3) Method 2.12 Sec. 10.7 and 10.3
Lab QC Checks			
1) Criteria (PM2.5 LC)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Field Filter Blank	10% or 1 per weighing session	<± 30.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.1 2 and 3) Method 2.12 Table 7-1 & Sec.10.5
Lab Filter Blank	10% or 1 per weighing session	<± 15.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.2 2 and 3) Method 2.12 Sec. 10.5
Balance Check (working standards)	beginning, 10th sample, end	< ±3.1 µg from certified value	1, 2 and 3) Method 2.12 Sec. 10.6 Standards used should meet specifications in Method 2.12, Sec. 4.3.7
Routine Filter re-weighing	1 per weighing session	<± 15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.8
Microbalance Audit	every 365 days and once a calendar year	<± 0.003 mg or manufacturers specs, whichever is tighter	1, 2 and 3) Method 2.12 Sec. 11.2.7
Lab Temp Check	Every 90 days	< ± 2.1°C	1, 2 and 3) Method 2.12 Sec. 10.10
Lab Humidity Check	Every 90 days	< ± 2.1%	1, 2 and 3) Method 2.12 Sec. 10.10
Verification/Calibration			
Microbalance Calibration	***At installation*** every 365 days and once a calendar year	Manufacturer's specification	1) 40 CFR Part 50, App. L, Sec. 8.1 2) 40 CFR Part 50, App. L, Sec. 8.1 and Method 2.12 Sec. 10.11 3) NA
Lab Temperature Certification	every 365 days and once a year	< ± 2.1°C	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4
Lab Humidity Certification	every 365 days and once a year	< ± 2.1%	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4

Calibration & Check Standards -			
Working Mass Stds. Verification Compared to primary standards	Every 90 days	< ± 2.1 ug	1, 2 and 3) Method 2.12 Sec. 9.7
Primary standards certification	every 365 days and once a calendar year	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
SYSTEMATIC CRITERIA -$PM_{2.5}$ Filter Based Local Conditions			
Siting	every 365 days and once a calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-5
Data Completeness	***Annual Standard***	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
	24- Hour Standard	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
Reporting Units	***all filters***	***µg/m³ at ambient temp/pressure ($PM_{2.5}$)***	1, 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b)
Rounding convention for design value calculation	***all filters***	***to one decimal place, with additional digits to the right being truncated***	1, 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
1) Criteria (PM2.5 LC)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Annual 3-yr average	***all concentrations***	***nearest 0.1 µg/m³*** (≥ 0.05 round up)	1, 2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
24-hour, 3-year average	***all concentrations***	***nearest 1 µg/m³*** (≥ 0.5 round up)	1, 2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
Detection Limit			
Lower DL	***all filters***	***□≤□2 µg/m³***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.1
Upper Conc. Limit	***all filters***	***≥ 200 µg/m³***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.2
Precision			
Single analyzer (collocated monitors)	every 90 days	Coefficient of variation (CV) < 10.1% for values ≥ 3.0 µg/m³	1, 2 and 3) Recommendation in order to provide early (quarterly) evaluation of achievement of DQOs.
Primary Quality Assurance Org.	***Annual and 3 year estimates***	***90% CL of CV < 10.1 % for values ≥ 3.0 µg/m³***	1, 2 and 3) 40 CFR Part 58, App A, Sec. 4.2.1 and 2.3.1.1
Bias			

Performance Evaluation Program (PEP)	***5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites***	***< ± 10.1% for values ≥ 3.0 µg/m³***	1, 2 and 3) 40 CFR Part 58, App A, Sec. 3.2.4, 4.2.5 and 2.3.1.1
Field Activities			
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< ± 2.1% of NIST Traceable Std.***	1) 40 CFR Part 50, App. L Sec. 9.1 & 9.2 2) Method 2-12 Sec. 4.2.2 & 6.4.3 3) 40 CFR Part 50, App. L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Clock/timer Verification	Every 30 days	***1 min/mo***	1 and 2) Method 2.12 Sec. 4.2.1 3) 40 CFR Part 50, App. L Sec. 7.4.12
Laboratory Activities			
Microbalance Readability	***At purchase***	***1 µg***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.1
Microbalance Repeatability	At purchase	1 µg	1) Method 2.12 Sec. 4.3.6 2) Recommendation 3) Method 2.12 Sec. 4.3.6
Primary Mass/Working mass Verification/Calibration Standards	At purchase	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
1) Criteria (PM2.5 LC)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Comment #1 The associated leak test procedure shall require that for successful passage of this test, the difference between the two pressure measurements shall not be greater than the number of mm of Hg specified for the sampler by the manufacturer, based on the actual internal volume of the sampler, that indicates a leak of less than 80 mL/min.			

1/ value must be flagged SD * = standard deviation CV= coefficient of variation

Continuous PM2.5 Local Conditions Validation Template

NOTE: This validation template attempts to provide the critical criteria, annual multipoint verifications/calibrations, and verification/calibration standards recertification frequencies and acceptable ranges for PM2.5 continuous FEMs and ARMs. At the time this validation template was most recently updated (January 2016) there were eleven continuous monitors designated as a Federal Equivalent Method (FEM) and none designated as an Approved Regional Method (ARM). For the most widely used continuous FEMs we have added select method specific operational criteria. However, due to limited available information, we do not have operational criteria for all approved FEMs, especially those methods with just a handful or less of monitors that have been implemented. Where we do list operational criteria for a specific method, we only list the criteria believed to be the most important. More detailed information on operational criteria is available for the most widely used PM2.5 continuous FEMs in Technical System Audit Supplementary Checklists for PM Continuous Monitors. These files are available on the web at: https://www3.epa.gov/ttn/amtic/contmont.html.

Technical Systems Audit Checklists

- PM continuous TSA checklist – Met One BAM – Draft (PDF)
- PM continuous TSA checklist – Thermo TEOM-FDMS – Draft (PDF)

Where appropriate, 40 CFR Part 58 App A and 40 CFR Part 50 App L requirements apply to Continuous PM2.5 FEMs; however, not all criteria may apply to each continuous FEM and ARM due to the nature of the measurement principle and design of the instrument. Also, while this validation template is designed to apply to PM2.5 continuous FEMs and ARMs, it may also apply to PM2.5 continuous methods that are not specifically approved as FEMs or ARMs and used to meet SLAMS monitoring requirements in support of the AQI, but not the NAAQS.

1) Criteria (PM2.5 Cont.)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- $PM_{2.5}$ Continuous, Local Conditions			
Sampler/Monitor Designation	NA	***Meets requirements listed in FRM/FEM/ARM designation*** Confirm method designation on front panel or just inside instrument.	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Firmware of monitor	At setup	1. Must be the firmware (or later version) as identified in the published method designation summary. 2. ***Firmware settings must be set for flowrate to operate and report at "local conditions" (i.e., not STP).***	40 CFR Part 50 App N. sec. 1 (c)

Data Reporting Period	Report every hour	1. The calculation of an hour of data is dependent on the design of the method. 2. ***A 24-hour period is calculated in AQS if 18 or more valid hours are reported for a day*** [1/].	See operator's manual. Hourly data are always reported as the start of the hour on local standard time 40 CFR Part 50 App N. Sec 3 (c)
1) Criteria (PM2.5 Cont.)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Sampling Instrument			
PM10 Inlet (if applicable to method designated)	At Setup	Must be a Louvered PM10 size selective inlet as specified in 40 CFR 50 appendix L, Figures L-2 through L-19	
PM2.5 second stage separator (if applicable to method designated)	At Setup	Must be a BGI Inc. Very Sharp Cut Cyclone (VSCC™) or equivalent second stage separator approved for the method.	The other approved second stage separator option for select FEMs is the Dichot. Only the GRIMM 180 and Teledyne T640 and T640X are known to not have a second stage separator as part of the method.
Average Flow Rate	***every 24 hours of operation; alternatively, each hour can be checked***	***average within 5% of 16.67 liters/minute at local conditions***	1, 2 and 3) Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV ≤ 2%***	1, 2 and 3) 40 CFR Part 50, App L Sec. 7.4.3.2
One-point Flow Rate Verification	***every 30 days each separated by 14 days***	***< ± 4.1% of transfer standard*** < ± 5.1% of flow rate design value	1, 2 and 3) 40 CFR Part 50, App.L, Sec. 9.2.5, 40 CFR Part 58, Appendix A Sec. 3.2.3 & 3.3.2
Design Flow Rate Adjustment	***After multi-point calibration or verification***	***< ± 2.1% of design flow rate***	1,2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6
External Leak Check	***Before each flow rate verification/calibration*** and before and after $PM_{2.5}$ separator maintenance	Method specific. See operator's manual.	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50 App L Sec.t 9.2.3 and Method 2-12 Sec. 7.4.3 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1
Internal Leak Check	If failure of external leak check	Method specific. See operators manual.	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12 7.4.4 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2
Annual Multi-point Verifications/Calibrations			
Leak Check	every 30 days	< 1.0 lpm BAM (Not Thermo BAMS) ± 0.15 lpm TEOM	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) Recommendation 3) BAM SOP Sec. 10.1.2 TEOM SOP Sec. 10.1.6 Thermo BAM leak check should not be attempted. Foils could be ruptured.

Temperature multi-point Verification/Calibration	on installation, then Every 365 days and 1/ calendar year	< ± 2.1°C	1) 40 CFR Part 50, App.L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4.4
One-point Temp Verification	every 30 days	< ± 2.1°C	1) 40 CFR Part 50, App.L, Sec. 9.3 2) Method 2.12 Sec. 7.4.5 and Table 6-1 3) Recommendation
Pressure Verification/Calibration	on installation, then Every 365 days and 1/ calendar year	< ± 10.1 mm Hg	1) 40 CFR Part 50, App.L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 BP verified against independent standard verified against a lab primary standard that is certified NIST traceable 1/year
1) Criteria (PM2.5 Cont.)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport or*** Every 365 days and 1/ calendar year	< ± 2.1% of transfer standard	1) 40 CFR Part 50, App.L, Sec. 9.2. 2) 40 CFR Part 50, App.L, Sec. 9.1.3, Method 2.12 Sec. 6.3 & Table 6-1 3) Recommendation
Other Monitor Calibrations/checks	per manufacturers' op manual	Annual zero test on Met One BAM 1020 and BAM 1022	per manufacturers' operating manual. Note: more frequent zero tests may be appropriate in areas with seasonal changes in dew-points.
Precision			
Collocated Samples	***every 12 days for 15% of sites by method designation***	CV < 10.1% of samples ≥ 3 µg/m^3	1) and 2) Part 58 App A Sec. 3.2.3 3 Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.1
Accuracy			
Temperature Audit	every 180 days and at time of flow rate audit	< ± 2.1°C	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 180 days and at time of flow rate audit	< ±10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	< ± 4.1% of audit standard < ± 5.1% of design flow rate	1 and 2) Part 58, App A, Sec. 3.3.3 3) Method 2.12 Sec. 11.2.1
Shelter Temperature			
Temperature range	At setup	per operator manual	
Temperature Control	Daily (hourly values)	< 2.1° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Temperature Device Check	every 180 days and twice a calendar year	< ± 2.1° C	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Monitor Maintenance			
$PM_{2.5}$ Separator (WINS)	every 5 sampling events	cleaned/changed	1, 2,and 3) Method 2.12 Sec. 8.2.2
$PM_{2.5}$ Separator (VSCC)	every 30 days	cleaned/changed	1,2 and 3) Method 2.12 Sec. 8.3.3

Inlet Cleaning	every 30 days	cleaned	1,2 and 3) Method 2.12 Sec. 8.3
Downtube Cleaning	every 90 days	cleaned	1,2 and 3) Method 2.12 Sec. 8.4
Filter Housing Assembly Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
TEOM-FDMS Specific Operational Criteria			
Total Flow Verification	every 30 days	Sum of flow rates from 3 paths equal design flow rate $< \pm 5.1\%$	1,2 and 3) TEOM SOP Sec. 10.1.2
Bypass leak check (TEOM)	every 30 days	$\pm$ 0.60 lpm	1,2 and 3) TEOM SOP Sec. 10.1.6 or TEOM Operating Manual Sec. 5-4
Replace TEOM filters	as needed	Change TEOM filter as filter loading approaches 90%, but must be changed before reaching 100%.	1,2 and 3) TEOM SOP Sec. 10.1.8
Replace the 47-mm FDMS (Purge) filters	every 30 days or any time TEOM filters are replaced	replaced	1,2 and 3) TEOM SOP Sec. 10.1.10
1) Criteria (PM2.5 Cont.)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Internal/External Data Logger Data	Every 30 days 10 randomly selected values	agree exactly (digital) and $\pm$ 1 µg/m^3 (analog). Note: digital is expected and should be used unless there is no capacity to utilize digital in the monitoring agencies' data system.	1, 2 and 3) TEOM SOP Sec. 10.1.24
Replace In-line filters	every 180 days and twice a calendar year	replaced	1, 2 and 3) TEOM SOP Sec. 10.2
Clean cooler assembly	every 365 days and once a calendar year	cleaned	1, 2 and 3) TEOM SOP Sec. 10.3.1
Clean/Maintain switching valve	every 365 days and once a calendar year	cleaned	1, 2 and 3) TEOM SOP Sec. 10.3.2
Clean air inlet system of mass transducer enclosure	every 365 days and once a calendar year	cleaned	1, 2 and 3) TEOM SOP Sec. 10.3.3
Replace the dryers	1/yr or due to poor performance	Review dryer dew point data to determine acceptable performance of dryer	1, 2 and 3) TEOM SOP Sec. 10.3.4
Calibration (KO) constant verification	every 365 days and once a calendar year	Pass or Fail ($\leq$ 2.5%)	1, 2 TEOM SOP Sec. 10.3.6 3) 1405-DF operating guide. Verification software either passes or fails the verification. Acceptance criteria is $\leq$ 2.5 %
Rebuild sampling pump	18 months	< 66% of local pressure	1, 2 and 3) TEOM SOP Sec. 10.4
GRIMM Specific Operational Criteria			

Internal rinsing air filter	After a few years	Changed	1, 2 and 3) GRIMM SOP Sec. 12.4 May require a trained service staff to change. May only require changing if a message reads "check nozzle and air inlet"
Change Dust Filter	Every 365 days and 1/ calendar year	Changed	1, 2 and 3) GRIMM SOP Sec. 12.3
Relative Humidity Setting	At Setup	Per Operators manual (55%) unless otherwise directed and approved to use at a different value	
Calibration of spectrometer	Yearly	+/- 5% for mass	Operators' Manual section 5.2
Cleaning or changing of the Nafion in inlet	As needed	We are seeking clarification from GRIMM on this	Operators' Manual section 11.4.2
Thermo BAM Specific Operational Criteria			
Cleaning Nozzle and Vane (BAM)	Minimally every 30 days	cleaned	1, 2 and 3) BAM SOP Sec. 10.1.3
Leak Check	every 30 days	$\leq$ 0.42 L/min	1) BAM 5014i Instruction Manual 2) 3) BAM 5014i Instruction Manual
Replace or clean pump muffler	every 180 days and twice a calendar year	Cleaned or changed	
1) Criteria (PM2.5 Cont.)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Internal/External Data Logger Data (BAM)	Every 30 days 10 randomly selected values	agree exactly (digital) and $\pm$ 1 µg/m^3 (analog). Note: digital is expected and should be used unless there is no capacity to utilize digital in the monitoring agencies' data system.	1, 2 and 3) BAM SOP Sec. 10.1.9
Clean/replace internal debris filter	Every 365 days and 1/ calendar year		
MetOne BAM Specific Operational Criteria			
BAM check of membrane span foil	Daily	Avg. < $\pm$ 5.1% of ABS	1, 2 and 3) BAM SOP Sec. 10.4.3. Applies on the BAM 1020
BAM electrical grounding	At setup	1. Is the chassis of the BAM grounded? Is the downtube grounded to the chassis at the collar (i.e., with setscrews)	Per operator manual
Nozzle cleaning	Every 30 days, or more often as needed	cleaned	Per operator manual
Zero test	Yearly	Standard deviation of the data from a 72-hour zero test < 2.4 µg/m^3	Per operator manual

SYSTEMATIC CRITERIA- $PM_{2.5}$ Continuous, Local Conditions			
Siting	every 365 days and once a calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-5
Data Completeness	***Annual Standard***	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
	24- Hour Standard	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
Reporting Units	***all filters***	***µg/m³ at ambient temp/pressure ($PM_{2.5}$)***	1. 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b)
Rounding convention for data reported to AQS	***all filters***	***to one decimal place or as reported by instrument***	1. 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b)
Annual 3-yr average	***all concentrations***	***nearest 0.1 µg/m³*** (≥ 0.05 round up)	1,2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
24-hour, 3-year average	***all concentrations***	***nearest 1 µg/m³*** (≥ 0.5 round up)	1,2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
Verification/Calibration Standards Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< ± 2.1% of NIST Traceable Std.***	1) 40 CFR Part 50, App.L Sec. 9.1 & 9.2 2) Method 2-12 Sec. 4.2.2 & 6.4.3 3) 40 CFR Part 50, App.L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
1) Criteria (PM2.5 Cont.)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Clock/timer Verification	Every 30 days	***1 min/mo****	1 and 2) Method 2.12 Sec. 4.2.1 3) 40 CFR Part 50, App.L Sec. 7.4.12
Precision			
Single analyzer (collocated monitors)	every 90 days	Coefficient of variation (CV) < 10.1% for values ≥ 3.0 µg/m³	1,2 and 3) Recommendation in order to provide early (quarterly) evaluation of achievement of DQOs.
Primary Quality Assurance Org.	***Annual and 3 year estimates***	***90% CL of CV < 10.1 % for values ≥ 3.0 µg/m³***	1,2 and 3) 40 CFR Part 58, App A, Sec. 4.2.1 and 2.3.1.1
Bias			

Performance Evaluation Program (PEP)	***5 audits for PQAOs with ≤ 5 sites*** ***8 audits for PQAOs with > 5 sites***	***< ±10.1% for value > 3 µg/m³***	1,2 and 3) 40 CFR Part 58, App A, Sec. 3.2.7, 4.3.2 and 2.3.1.1

1/ 24 hour average value must be flagged if not meeting criteria
SD= standard deviation , CV= coefficient of variation
**** = need to ensure data system stamps appropriate time period with reported sample value**

PM10c for $PM_{10-2.5}$ Low –Volume, Filter-Based Local Conditions Validation Template

NOTE: The following validation template was constructed for use of PM_{10} at local conditions where PM_{10c} is used in the calculation of the $PM_{10-2.5}$ measurement or for objectives other than comparison to the PM_{10} NAAQS. Although the PM $_{10-2.5}$ method is found in 40 CFR Part 50 Appendix O, Appendix O references Appendix L (the $PM_{2.5}$ Method) for the QC requirements listed below. Therefore, the information action column, in most cases, will reference 40 CFR Part 50 App L. Monitoring organizations using PM_{10} data for a NAAQS comparison purposes should refer to the PM_{10} validation template for STP (standard temperature and pressure correction). In addition, since the samplers are very similar to the PM2.5 samplers, Guidance Document 2.12 *Monitoring PM2.5 in Ambient Air Using Designated Reference or Class 1 Equivalent Methods* is referred to where appropriate.

1) Criteria (PM10c)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM10c Filter Based Local Conditions			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Filter Holding Times			
Pre-sampling	***all filters***	***≤ 30 days before sampling***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.5
Sample Recovery	***all filters***	***≤7 days 9 hours from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 10.10
Sampling Period (including multiple power failures)	***all filters***	***1380-1500 minutes, or value if < 1380 and exceedance of NAAQS 1/ midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App L Sec. 3.3 See details if less than 1380 min sampled
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***average within 5% of 16.67 liters/minute***	1, 2 and 3) Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV ≤ 2%***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.2
One-point Flow Rate Verification	***every 30 days each separated by 14 days***	***± 4% of transfer standard*** ± 5% of flow rate design value	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.5, 40 CFR Part 58 App A Sec. 3.3.1
Design Flow Rate Adjustment	***After multi-point calibration or verification***	***< ± 2.1% of design flow rate***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6
Individual Flow Rates	***every 24 hours of op***	***no flow rate excursions > ±5% for > 5 min. 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.1
Filter Temp Sensor	***every 24 hours of op***	***no excursions of > 5° C lasting longer than 30 min 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.11.4

External Leak Check	***Before each flow rate verification/calibration*** and before and after $PM_{2.5}$ separator maintenance	***< 80.1 mL/min*** (see comment #1)	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50 App L Sec.t 9.2.3 and Method 2-12 Sec. 7.4.3 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1
1) Criteria (PM10c)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Internal Leak Check	If failure of external leak check	***< 80.1 mL/min***	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12, Sec. 7.4.4 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2
Laboratory Activities			
Post-sampling Weighing	***all filters***	***Protected from exposure to temperatures above 25C from sample retrieval to conditioning*** ***≤10 days from sample end date if shipped at ambient temp, or*** ***≤30 days if shipped below avg ambient (or 4° C or below for avg sampling temps < 4° C) from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 8.3.6
Filter Visual Defect Check (unexposed)	***all filters***	***Correct type & size and for pinholes, particles or imperfections***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 10.2
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.5
Temp. Range	***all filters***	***24-hr mean 20.0-23.0° C***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.1
Temp. Control	***all filters***	***< 2.1° C SD* over 24 hr***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.2 SD use is a recommendation
Humidity Range	***all filters***	***24-hr mean 30.0% - 40.0% RH or within ±5.0% sampling RH but > 20.0%RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.3
Humidity Control	***all filters***	***< 5.1% SD* over 24 hr.***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.4 SD use is recommendation
Pre/post Sampling RH	***all filters***	***difference in 24-hr means ≤ + 5.1% RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.3
Balance	***all filters***	***located in filter conditioning environment***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.2
OPERATIONAL EVALUATIONS TABLE- PM10c Filter Based Local Conditions			
Field Activities			
Sampling Instrument			
Routine Verifications			

One-point Temp Verification	every 30 days	<+ 2.1°C	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.5 and Table 6-1 3) Recommendation
Pressure Verification	every 30 days	< + 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.6 and Table 6-1 3) Recommendation
Annual Multi-point Verifications/Calibrations			
Temperature multi-point Verification/Calibration	on installation, then every 365 days and once a calendar year	<+ 2.1°C	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4.4 Table 6-1
1) Criteria (PM10c)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Pressure Verification/Calibration	on installation, then every 365 days and once a calendar year	<+ 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 Sampler BP verified against independent standard verified against a lab primary standard that is certified as NIST traceable 1/year
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport or*** every 365 days and once a calendar year	<+ 2.1% of transfer standard	1) 40 CFR Part 50, App. L, Sec. 9.2. 2) 40 CFR Part 50, App. L, Sec. 9.1.3, Method 2.12 Sec. 6.3 & Table 6-1 3) Recommendation
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	1, 2 and 3) Recommendation
Precision			
Collocated Samples	***every 12 days for 15% of sites by method designation***	CV < 10.1% of samples > 3.0 µg/m^3	1) and 2) Part 58 App A Sec. 3.2.3 3 Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.1
Accuracy			
Temperature Audit	every 180 days and at time of flow rate audit	<+ 2.1°C	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 180 days and at time of flow rate audit	<+10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	<+ 4.1% of audit standard <+ 5.1% of design flow rate	1 and 2) Part 58, App A, Sec. 3.2.2 3) Method 2.12 Sec. 11.2.1
Monitor Maintenance			
$PM_{2.5}$ Separator (WINs)	every 5 sampling events	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.2.2
$PM_{2.5}$ Separator (VSCC)	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3.3
Inlet Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Downtube Cleaning	every 90 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.4

Filter Housing Assembly Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Laboratory Activities			
Filter Checks			
Lot Blanks	9 filters per lot	< ±15.1 µg change between weighings	1, 2, 3) Recommendation and used to determine filter stability of the lot of filters received from EPA or vendor. Method 2.12 Sec. 10.5
Exposure Lot Blanks	3 filters per lot	< ±15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.5 Used for preparing a subset of filters for equilibration
Filter Integrity (exposed)	each filter	no visual defects	1, 2 and 3) Method 2.12 Sec. 10.7 and 10.3
Lab QC Checks			
1) Criteria (PM10c)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Field Filter Blank	10% or 1 per weighing session	<± 30.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.1 2 and 3) Method 2.12 Table 7-1 & Sec.10.5
Lab Filter Blank	10% or 1 per weighing session	<± 15.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.2 2 and 3) Method 2.12 Sec. 10.5
Balance Check (working standards)	beginning, 10th sample, end	< ±3.1 µg from certified value	1, 2 and 3) Method 2.12 Sec. 10.6 Standards used should meet specifications in Method 2.12, Sec. 4.3.7
Routine Filter re-weighing	1 per weighing session	<± 15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.8
Microbalance Audit	every 365 days and once a calendar year	<± 0.003 mg or manufacturers specs, whichever is tighter	1, 2 and 3) Method 2.12 Sec. 11.2.7
Lab Temp Check	Every 90 days	< ± 2.1°C	1, 2 and 3) Method 2.12 Sec. 10.10
Lab Humidity Check	Every 90 days	< ± 2.1%	1, 2 and 3) Method 2.12 Sec. 10.10
Verification/Calibration			
Microbalance Calibration	***At installation*** every 365 days and once a calendar year	Manufacturer's specification	1) 40 CFR Part 50, App. L, Sec. 8.1 2) 40 CFR Part 50, App. L, Sec. 8.1 and Method 2.12 Sec. 10.11 3) NA
Lab Temperature Certification	every 365 days and once a year	< ± 2.1°C	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4
Lab Humidity Certification	every 365 days and once a year	< ± 2.1%	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4
Calibration & Check Standards -			
Working Mass Stds. Verification Compared to primary standards	Every 90 days	< ± 2.1 ug	1, 2 and 3) Method 2.12 Sec. 9.7

Primary standards certification	every 365 days and once a calendar year	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
SYSTEMATIC CRITERIA - PM10c Filter Based Local Conditions			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-5
Data Completeness	NA	≥ 75% scheduled sampling days in each quarter	1, 2 and 3) Recommendation based on PM2.5 requirements in 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
Reporting Units	***all filters***	***µg/m³ at ambient temp/pressure ($PM_{2.5}$)***	1, 2 and 3) 40 CFR Part 50 App N
Rounding convention for design value calculation	***all filters***	***to one decimal place, with additional digits to the right being truncated***	1, 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Lower DL	***all filters***	***≤ 3 µg/m³***	1, 2 and 3) 40 CFR Part 50, App O Sec. 3.1
Upper Conc. Limit	***all filters***	***≥200 µg/m³***	1, 2 and 3) 40 CFR Part 50, App O Sec. 3.2
1) Criteria (PM10c)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Precision			
Single analyzer (collocated monitors)	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 10.1% for values ≥ 3 µg/m³	1, 2 and 3) Recommendation in order to provide early evaluation of achievement of DQOs.
Primary Quality Assurance Org.	***Annual and 3 year estimates***	***90% CL of CV < 10.1% for values ≥ 3 µg/m³***	1, 2 and 3) Recommendation in order to provide early evaluation of achievement of DQOs.
Bias			
Performance Evaluation Program (PEP)	Once every 6-7 years	***< ±10.1% for values ≥ 3 µg/m³***	1, 2 and 3) Recommendation based on pending guidance.
Field Activities			
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< ± 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50, App. L Sec. 9.1 & 9.2 2) Method 2-12 Sec. 6.3.3 and Table 3-1 3) 40 CFR Part 50, App. L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2

Verification/Calibration Clock/timer Verification	every 30 days	***1 min/mo***	1 and 2) Method 2.12 Sec 4.2.1 3) 40 CFR Part 50, App. L, Sec. 7.4.12
Laboratory Activities			
Microbalance Readability	***at purchase***	***1 µg***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 8.1
Microbalance Repeatability	at purchase	1 µg	1) Method 2.12 Sec. 4.3.6 2) Recommendation 3) Method 2.12 Sec. 4.3.6
Primary Mass. Verification/Calibration Standards	at purchase	0.025 mg tolerance (class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
Comment #1 The associated leak test procedure shall require that for successful passage of this test, the difference between the two pressure measurements shall not be greater than the number of mm of Hg specified for the sampler by the manufacturer, based on the actual internal volume of the sampler, that indicates a leak of less than 80 mL/min.			

1/ value must be flagged, SD= standard deviation, CV= coefficient of variation

PM_{10} Filter Based Dichot STP Conditions Validation Template

1) Criteria (PM10 Dichot STP)	2) Frequency	3) 3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM_{10} Filter Based Dichot			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Sample Recovery	***all filters***	***ASAP***	1, 2 and 3) 40 CFR Part 50 App J Sec. 9.15
Sampling Period	***all filters***	***1440 minutes ± 60 minutes midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App J Sec. 7.1.5
Sampling Instrument			
Average Flow Rate	every 24 hours of op	average 16.67 liters/minute	1, 2 and 3) Method 2.10 Sec. 2.1
Verification/Calibration			
One-point Flow Rate Verification	***every 30 days each separated by 14 days***	< ± 7.1% of transfer standard	1, 2 40 CFR Part 58 App A Sec. 3.3.1 and 3) Method 2.10 Table 3-1
Lab Activities			
Filter			
Visual Defect Check (unexposed)	all filters	see reference	1, 2 and 3) Method 2.10 Sec. 4.2
Collection efficiency	***all filters***	***≥ 99 %***	1, 2 and 3) Part 50, App J Sec. 7.2.2
Alkalinity	***all filters***	***< 25.0 microequivalents/gram***	1, 2 and 3) 40 CFR Part 50, App J Sec. 7.2.4
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App. J Sec. 9.3
Temp. Range	***all filters***	***15-30.0º C***	1, 2 and 3) 40 CFR Part 50, App. J Sec. 7.4.1
Temp. Control	***all filters***	***< 3.1º C*** SD* over 24 hr	1, 2 and 3) 40 CFR Part 50, App. J Sec. 7.4.2 SD use is recommendation
Humidity Range	***all filters***	***20% - 45.0% RH***	1, 2 and 3) 40 CFR Part 50, App. J Sec. 7.4.3
Humidity Control	***all filters***	***<5.1% SD**** over 24 hr	1, 2 and 3) 40 CFR Part 50, App. J Sec. 7.4.4 SD use is recommendation
Pre/post Sampling RH	all filters	difference in 24-hr means < ± 5.1% RH	1, 2 and 3) Recommendation based on 40 CFR Part 50, App. L Sec. 8.3.3
Balance	all filters	located in filter conditioning environment	1, 2 and 3) Recommendation based on 40 CFR Part 50, App. L Sec. 8.3.2
OPERATIONAL EVALUATIONS TABLE PM_{10} Filter Based Dichot			

Field Activities			
Verification/Calibration			
System Leak Check	During precalibration check	Vacuum of 10 to 15 in. & rate of decline to 0 in >60 seconds	1, 2 and 3) Method 2.10 Sec. 2.2.1
1) Criteria (PM10 Dichot STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
FR Multi-point Verification/Calibration	every 365 days and once a calendar year	Correlation coefficient of >.990 with no point deviating more than 0.5 L/min for total or 0.05 L/min for coarse	1) 40 CFR Part 50, App. J, Sec. 8.0 2 and 3) Method 2.10 Sec. 2.2.4
Field Temp M-point Verification	on installation, then every 365 days and once a calendar year	< ± 2.1°C	1, 2 and 3) Recommendation based on Part 50, App. L
Precision			
Collocated Samples	***every 12 days for 15% of sites***	<5.1 ***µg/m³ for concentrations below 80µg/m³ and <7.1% for concentrations above 80µg/m³***	1 and 2) 40 CFR Part 58 App A Sec. 3.3.4 3) Part 50, App J Sec. 4.1
Semi Annual Flow Rate Audit	every 180 days and twice a calendar year	< ± 10.1% of audit standard	1 and 2) 40 CFR Part 58, App A, Sec. 3.3.3 3) Method 2.10 Sec. 7.1.5
Monitor Maintenance			
Impactor	every 90 days and 4 times a calendar year	cleaned/changed	1, 2 and 3) Method 2.10 Sec. 6.1.2
Inlet/downtube Cleaning	every 90 days and 4 times a calendar year	cleaned	1, 2 and 3) Method 2.10 Sec. 6.1.2
Vacuum pump	every 365 days and once a calendar year	Replace diaphragm and flapper valves	1, 2 and 3) Method 2.10 Sec. 6.1.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Lab Activities			
Balance Check	beginning, 10th sample, end	< 4.1 µg of true zero < 2.1 µg of 10 mg check weight	1, 2 and 3) Method 2.10 Sec. 4.5
"Standard" filter QC check	10%	< ± 20.1 µg change from original value	1, 2 and 3) Method 2.10 Sec. 4.5 From standard non-routine filter
"Routine" duplicate weighing	5-7 per weighing session	< ± 20.1 µg change from original value	1, 2 and 3) Method 2.10 Sec. 4.5 From routine filter set
Integrity- Random sample of test field blank filters	10%	***± 5 µg/m³***	1) 40 CFR Part 50 App J Sec. 7.2.3 2 and 2) Recommendation 3) 40 CFR Part 50 App J Sec. 7.2.3
Lab Temperature Calibration	every 180 days and twice a calendar year	± 2°C	1, 2 and 3) Recommendation related to 40 CFR Part 50, App .L

Lab Humidity Calibration	every 180 days and twice a calendar year	± 2%	1, 2 and 3) Recommendation related to 40 CFR Part 50 App L Sec. 5.8.1
Microbalance Calibration	every 365 days and once a calendar year	Manufacturer's specification	1, 2 and 3) Recommendation related to 40 CFR Part 50 App L
Filter Weighing Audit	every 365 days and once a calendar year	< ± 20.1 µg change from original value	1, 2 and 3) Method 2.10 Table 7-1
Balance Audit	every 365 days and once a calendar year	Observe weighing technique and check balance with ASTM Class 1 standard	1, 2 and 3) Method 2.10 Table 7-1 Sec. 7.2.2
1) Criteria (PM10 Dichot STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Primary Mass Stds. (compare to NIST-traceable standards)	every 365 days and once a calendar year	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	1, 2 and 3) Method 2.10 Sec. 9
SYSTEMATIC CRITERIA - PM_{10} Filter Based Dichot			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	***24- Hour Standard***	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50 App. K, Sec. 2.3b
Reporting Units	all filters	µg/m³ at standard temperature and pressure	1, 2 and 3) 40 CFR Part 50 App K
Rounding convention for design value calculation	***Each routine concentration***	***Nearest 10 µg/m³ (≥ 5 µg/m3 round up)***	1, 2 and 3) 40 CFR Part 50 App K Sec. 2. The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 10.1% for values ≥ 3 µg/m³	1, 2 and 3) Recommendation 3 µg/m³ cut off in 40 CFR part 58 App A Sec. 4
Single analyzer	1/ yr	CV < 10.1% for values ≥ 3 µg/m³	1, 2 and 3) Recommendation 3µg/m³ cut off in 40 CFR part 58 App A Sec. 4
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV < 10.1% for values ≥ 3 µg/m³	1, 2 and 3) Recommendation 3µg/m³ cut off in 40 CFR part 58 App A Sec. 4
Field Activities			
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< ± 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50 App J Sec. 7.3 2 Method 2.10 Table 2-1 (1997 version) 3) 40 CFR Part 50 App J Sec. 7.3
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.1° C accuracy	1, 2 and 3) Method 2.10 Sec. 1.1.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.10 Sec. 1.1.2

Clock/timer Verification	every 180 days and twice a calendar year	***15 min/day***	1) 40 CFR Part 50 App J Sec. 7.1.5 2) Method 2.10 Sec. 9 3) 40 CFR Part 50 App J Sec. 7.1.5
Lab Activities			
Microbalance	at purchase	Readability 1 µg, Repeatability1 µg	1, 2 and 3) Method 2.10 Sec. 4.4
Primary Mass Stds. (compare to NIST-traceable standards)	at purchase	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	1, 2 and 3) Method 2.10 Sec. 9

***SD= standard deviation CV= coefficient of variation**

PM_{10} Filter Based High Volume (HV) STP Conditions Validation Template

1) Criteria (PM10 Hi-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM_{10} Filter Based Hi-Vol			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Filter Holding Times			
Sample Recovery	***all filters***	***ASAP***	1, 2 and 3) 40 CFR Part 50 App J Sec. 9.15
Sampling Period	***all filters***	***1440 minutes ± 60 minutes midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App J Sec. 7.1.5
Average Flow Rate	every 24 hours of op	~1.13 m^3/min (varies with instrument)	1, 2 and 3) Method 2.11
Verification/Calibration			
One-point Flow Rate Verification	***every 90 days and 4 times a calendar year***	<± 7.1% of transfer standard and <±10.1% from design	1 and 2) 40 CFR Part 58, App A, Sec. 3.3.2 3) Method 2.11 Sec. 3.5.1, Table 2-1
Lab Activities			
Filter			
Visual Defect Check (unexposed)	***all filters***	***see reference***	Method 2.11 Sec. 4.2
Collection efficiency	***all filters***	***99 %***	1, 2 and 3) 40 CFR Part 50, App J Sec. 7.2.2
Alkalinity	***all filters***	***< 25.0 microequivalents/gram***	1, 2 and 3) 40 CFR Part 50, App J Sec. 7.2.4
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 9.3
Temp. Range	***all filters***	***15.0-30.0° C***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 7.4.1
Temp. Control	***all filters***	***< 3.1° C SD* over 24 hr***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 7.4.2 SD use is recommendation
Humidity Range	***all filters***	***20.0% - 45.0% RH***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 7.4.3
Humidity Control	***all filters***	***< 5.1% SD* over 24 hr***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 7.4.4 SD use is recommendation
Pre/post Sampling RH	all filters	difference in 24-hr means < ± 5.1% RH	1, 2 and 3) Recommendation based on Part 50, App. L Sec. 8.3.3
Balance	all filters	located in filter conditioning environment	1, 2 and 3) Recommendation based on Part 50, App. L Sec. 8.3.2
OPERATIONAL EVALUATIONS TABLE PM_{10} Filter Based Hi-Vol			
Field Activities			
Verification/Calibration			
System Leak Check	During precalibration check	Auditory inspection with faceplate blocked	1, 2 and 3) Method 2.11 Sec. 2.3.2

FR Multi-point Verification/Calibration	every 365 days and once a calendar year	3 of 4 cal points within < ± 10.1% of design	1, 2 and 3) Method 2.11 Sec. 2.3.2
Field Temp M-point Verification	on installation, then every 365 days and once a calendar year	< ± 2.1°C	1, 2 and 3) Recommendation
Precision			
1) Criteria (PM10 Hi-Vol STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Collocated Samples	***every 12 days for 15% of sites***	CV < 10.1% of samples ≥ 15 µg/m^3	1) and 2) 40 CFR Part 58 App A Sec. 3.3.4 3) Recommendation
Semi Annual Flow Rate Audit	***every 180 days and twice a calendar year***	< ± 7.1% of transfer standard and< ± 10.1% from design	1 and 2) 40 CFR Part 58, App A, Sec. 3.3.3 3) Method 2.11 Sec. 7 Table 7-1
Monitor Maintenance			
Inlet/downtube Cleaning	every 90 days and 4 times a calendar year	cleaned	1, 2 and 3) Method 2.11 Sec. 6
Motor/housing gaskets	every 90 days and 4 times a calendar year	Inspected replaced	1, 2 and 3) Method 2.11 Sec. 6
Blower motor brushes	600-1000 hours	Replace	1, 2 and 3) Method 2.11 Sec. 6
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	NA
Lab Activities			
Lab QC Checks			
Balance Check (Standard Weight Check and Calibration Check)	beginning, 15th sample, end	< ± 0.51 mg of true zero and < ± 0.51 mg 1-5 g check weight	1, 2, and 3) Method 2 .11 Sec. 4.5.1 and 4.5.2
"Routine" duplicate weighing	5-7 per weighing session	< ± 2.8 mg change from original value	1, 2 and 3) Method 2.11 Sec. 4.5.3 From routine filter set
Integrity- Random sample of test field blank filters	10%	***< ± 5.1 µg/m^3***	1) 40 CFR Part 50 App J Sec. 7.2.3 2) Recommendation 3) 40 CFR Part 50 App J Sec. 7.2.3
Lab Temperature Calibration	every 180 days and twice a calendar year	< ± 2.1°C	1, 2 and 3) Recommendation related to 40 CFR Part 50, App. L
Lab Humidity Calibration	every 180 days and twice a calendar year	< ± 2.1%	1, 2 and 3) Recommendation related to 40 CFR Part 50 App L
Microbalance Calibration	every 365 days and once a calendar year	Manufacturer's specification	
Primary Mass Stds. (compare to NIST-traceable standards)	every 365 days and once a calendar year	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	1, 2 and 3) Method 2.11 Sec. 9
Audits			

Filter Weighing	every 365 days and once a calendar year	< ± 5.1 mg change from original value	1) Method 2.11 Table 7-1 2) Recommendation 3) Method 2.11 Table 7-1
Balance Audit	every 365 days and once a calendar year	Observe weighing technique and check balance with ASTM Class 1 standard	1) Method 2.11 Table 7-1 2) Recommendation 3) Method 2.11 Table 7-1
SYSTEMATIC CRITERIA - PM_{10} Filter Based Hi-Vol			
1) Criteria (PM10 Hi-Vol STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	quarterly	≥ 75%	1, 2 and 3) 40 CFR Part 50 App. K, Sec. 2.3b & c
Reporting Units	all filters	µg/m³ at standard temperature and pressure	1, 2 and 3) 40 CFR Part 50 App K Sec. 1
Rounding convention for design value calculation	***Each routine concentration***	***nearest 10 µg/m³ (≥ 5 round up)***	1, 2 and 3) 40 CFR Part 50 App K Sec. 1 The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) ≤ 10% ≥ 15 µg/m³	1, 2 and 3) Recommendation
Single analyzer	1/ yr	CV < 10.1% ≥ 15 µg/m³	1, 2 and 3) Recommendation
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV < 10.1% ≥ 15 µg/m³	1, 2 and 3) Recommendation
Field Activities			
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< ± 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50, App.J Sec. 7.3 2) Method 2.11 Sec. 1.1.3 3) 40 CFR Part 50, App.J Sec. 7.3
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.11 Sec. 1.1.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.11 Sec. 1.1.2
Clock/timer Verification	4/year	***15 min/day***	1) 40 CFR Part 50, App.J Sec. 7.1.5 2) Recommendation 3) 40 CFR Part 50, App.J Sec. 7.1.5

Lab Activities			
Microbalance	***at purchase***	Readability 0.1 mg Repeatability0.5 mg (HV)	1 and 2) 40 CFR Part 50, App.J Sec. 7.5 3) Method 2.11 Sec. 4.4
Primary Mass Stds. (compare to NIST-traceable standards)	at purchase	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	1, 2 and 3) Method 2.11 Sec. 9

SD= standard deviation CV= coefficient of variation

Continuous PM10 STP Conditions Validation Template

NOTE: There are a number of continuous PM10 monitors that are designated as FEM. These monitors may have different measurement or sampling attributes that cannot be identified in this validation template. Monitoring organizations should review specific instrument operating manuals and augment the validation template with QC information specific to their EPA reference or equivalent method designation and instrument (https://www3.epa.gov/ttn/amtic/criteria.html). In general, 40 CFR Part 58 App A and 40 CFR Part 50 App J requirements apply to Continuous PM10. Since a guidance document was never developed for continuous PM10, many of the requirements reflect a combination of manual and continuous PM2.5 requirements and are therefore considered recommendations.

1) Criteria (PM_{10} Cont.)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM_{10} Continuous			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Sampling Period	**all filters**	**1440 minutes ± 60 minutes midnight to midnight local standard time**	1, 2 and 3) 40 CFR Part 50 App J Sec. 7.1.5
Average Flow Rate	every 24 hours of op	Average within < ± 5.1% of design	recommendation
Verification/Calibration			
One-point Flow Rate Verification	***every 30 days each separated by 14 days***	< ± 7.1% of transfer standard	1 and 2) 40 CFR Part 58, App A, Sec. 3.3 3) Method 2.10 Table 3-1
OPERATIONAL EVALUATIONS TABLE PM_{10} Continuous			
Verification/Calibration			
System Leak Check	During precalibration check	Auditory inspection with faceplate blocked	1, 2 and 3) Method 2.11 Sec. 2.3.2
FR Multi-point Verification/Calibration	every 365 days and once a calendar year	3 of 4 cal points within < ± 10.1% of design	1) 40 CFR Part 50 App J Sec. 8.0 2 and 3) Method 2.10 Sec. 2.2.4
Audits			
Semi Annual Flow Rate Audit	***Twice a calendar year and 57 months apart***	< ± 10.1% of audit standard	1, 2) Part 58, App A, Sec. 3.3.3 3) Method 2.10 Sec. 7.1.5
Monitor Maintenance			
Inlet/downtube Cleaning	every 90 days and 4 times a calendar year	cleaned	1, 2 and 3) Method 2.10 Sec. 6.1.2
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
SYSTEMATIC CRITERIA - PM_{10} Continuous			

Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	24-hour quarterly	≥ 75%	1, 2 and 3) 40 CFR Part 50 App. K, Sec. 2.3b & c
1) Criteria (PM_{10} Cont.)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Reporting Units	all filters	µg/m³ at standard temperature and pressure (STP)	40 CFR Part 50 App K
Rounding convention for design value calculation			
24-hour, 3-year average	***quarterly***	***nearest 10 µg/m³ (≥ 5 round up)***	1, 2 and 3) 40 CFR Part 50 App K Sec. 1 The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< ± 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50, App.J Sec. 7.3 2) Method 2.11 Sec. 1.1.3 3) 40 CFR Part 50, App.J Sec. 7.3
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.1° C accuracy	1, 2 and 3) Method 2.10 Sec. 1.1.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.10 Sec. 1.1.2
Clock/timer Verification	every 180 days and twice a calendar year	***15 min/day***	1) 40 CFR Part 50, App.J Sec. 7.1.5 2) Recommendation 3) 40 CFR Part 50, App.J Sec. 7.1.5

PM_{10} Low Volume STP Filter-Based Local Conditions Validation Template

Monitoring organizations can use low-volume PM instruments for PM_{10} monitoring. However, PM_{10} data collection for NAAQS purposes must be reported in standard temperature and pressure (STP). 40 CFR Part 50 App J describes the reference method for PM_{10} but this method was promulgated for dichot and high volume methods that have improved over the years. Since monitoring organization may be able to use the low volume methods for multiple uses (PM_{10c}, PM_{10}-Pb) it is suggested that the validation criteria for this method follow the method requirements associated with the $PM_{2.5}$ which is Appendix L. Where there are particular requirements directly related to the NAAQS evaluation App J will be used.

1) Criteria (PM10 Lo-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA – PM_{10} Lo-Vol Filter Based STP			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Sample Recovery	***all filters***	***≤7 days 9 hours from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 10.10
Pre-sampling	***all filters***	***≤ 30 days before sampling***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.5
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***average within < 5.1% of 16.67 liters/minute***	1, 2 and 3) Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV < 2.1%***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.2
One-point Flow Rate Verification	***every 30 days each separated by 14 days***	***< ± 4.1% of transfer standard*** < ± 5.1% of flow rate design value	1) 40 CFR Part 50, App. L, Sec. 9.2.5, 40 CFR Part 58, App A Sec. 3.3.1 2) Part 58, App A, Sec. 3.3.1 3) 40 CFR Part 50, App. L, Sec. 9.2.5 & 7.4.3.1
Design Flow Rate Adjustment	***at one-point or multi-point verification/calibration***	***< ± 2.1% of design flow rate***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6
Individual Flow Rates	***every 24 hours of op***	***no flow rate excursions > ±5.1% for > 5 min. 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.1
Filter Temp Sensor	***every 24 hours of op***	***no excursions of > 5° C lasting longer than 30 min 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.11.4
External Leak Check	***Before each flow rate verification/calibration*** and before and after maintenance	***< 80.1 mL/min*** (see comment #1)	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50, App. L Sec. 9.2.3 Method 2-12 Sec. Table 8-1 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1

Internal Leak Check	every 5 sampling events	***< 80.1 mL/min***	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12 Table 8-1 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2
Laboratory Activities			
1) Criteria (PM10 Lo-Vol STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Post-sampling Weighing	***all filters***	***Protected from exposure to temperature ≤10 days from sample end date if shipped at ambient temp, or ≤30 days if shipped below avg ambient (or 4° C or below for avg sampling temps < 4° C) from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 8..3.6
Filter Visual Defect Check (unexposed)	***all filters***	***Correct type & size and for pinholes, particles or imperfections***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 10.2
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.5
Temp. Range	***all filters***	***24-hr mean 20.0-23.0° C***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.1
Temp. Control	***all filters***	***< 2.1° C SD* over 24 hr***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.2 SD use is recommendation
Humidity Range	***all filters***	***24-hr mean 30.0% - 40.0% RH or <5.1% sampling RH but ≥ 20.0%RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.3
Humidity Control	***all filters***	***< 5.1% SD* over 24 hr.***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.4 SD use is recommendation
Pre/post Sampling RH	***all filters***	***difference in 24-hr means < ± 5.1% RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.3
Balance	***all filters***	***located in filter conditioning environment***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.2
OPERATIONAL EVALUATIONS TABLE PM_{10} Lo-Vol Filter Based STP			
Field Activities			
Sampling Instrument			
Routine Verifications			
One-point Temp Verification	every 30 days	< ± 2.1°C	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.5 and Table 6-1 3) Recommendation

Pressure Verification	every 30 days	< ± 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec 7.4.6 and Table 6-1 3) Recommendation
Annual Multi-point Verifications/Calibrations			
Temperature multi-point Verification/Calibration	on installation, then every 365 days and once a calendar year	< ± 2.1°C	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4.4 and Table 6-1
Pressure Verification/Calibration	on installation, then every 365 days and once a calendar year	< ± 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 Sampler BP verified against independent standard verified against a lab primary standard that is certified as NIST traceable 1/year
1) Criteria (PM10 Lo-Vol STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport or*** every 365 days and once a calendar year	< ± 2.1% of transfer standard	1) 40 CFR Part 50, App. L, Sec. 9.2. 2) 40 CFR Part 50, App. L, Sec. 9.1.3, Method 2.12 Sec. 6.3 Table 6-1 3) Recommendation
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	1, 2 and 3) Recommendation
Precision			
Collocated Samples	***every 12 days for 15% of sites***	CV < 10.1% of samples ≥ 3.0 µg/m^3	1) and 2) 40 CFR Part 58 App A Sec. 3.3.4 3) Recommendation
Accuracy			
Temperature Audit	every 180 days and at time of flow rate audit	< ± 2.1°C	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 180 days and at time of flow rate audit	< ±10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	< ± 4.1% of audit standard < ± 5.1% of design flow rate	1 and 2) Part 58, App A, Sec. 3.3.3 3) Method 2.12 Sec. 11.2.1
Monitor Maintenance			
Inlet Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Downtube Cleaning	every 90 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.4
Filter Chamber Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Laboratory Activities			

Filter Checks			
Lot Blanks	9 filters per lot	< ±15.1 µg change between weighings	1, 2, 3) Recommendation and used to determine filter stability of the lot of filters received from EPA or vendor. Method 2.12 Sec. 10.5
Exposure Lot Blanks	3 filters per lot	< ± 15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.5 Used for preparing a subset of filters for equilibration
Filter Integrity (exposed)	each filter	no visual defects	1, 2 and 3) Method 2.12 Sec. 10.3 and 10.7
Lab QC Checks			
Field Filter Blank	10% or 1 per weighing session	< ± 30.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.1 2 and 3) Method 2.12 Table 7-1 & Sec. 10.5
Lab Filter Blank	10% or 1 per weighing session	< ± 15.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.2 2 and 3) Method 2.12 Sec. 10.5
Balance Check (working standards)	beginning, 10th sample, end	< ± 3.1 µg from certified value	1, 2 and 3) Method 2.12 Sec. 10.6 Standards used should meet specifications in Method 2.12, Sec. 4.3.7
Routine Filter re-weighing	1 per weighing session	< ± 15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.8
1) Criteria (PM10 Lo-Vol STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Microbalance Audit	every 365 days and once a calendar year	< ± 0.003 mg or manufacturers specs, whichever is tighter	1, 2 and 3) Method 2.12 Sec. 11.2.7
Lab Temp Check	Every 90 days	< ± 2.1°C	1, 2 and 3) Method 2.12 Sec. 10.10
Lab Humidity Check	Every 90 days	< ± 2.1%	1, 2 and 3) Method 2.12 Sec. 10.10
Verification/Calibration			
Microbalance Calibration	***At installation*** every 365 days and once a calendar year	Manufacturer's specification	1) 40 CFR Part 50, App. L, Sec. 8.1 2) 40 CFR Part 50, App. L, Sec. 8.1 and Method 2.12 Sec. 10.11 3) NA
Lab Temperature Certification	every 365 days and once a year	< ± 2.1°C	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4
Lab Humidity Certification	every 365 days and once a year	< ± 2.1%	1, 2 and 3) Method 2.12 Sec.4.3.8 and 9.4
Calibration & Check Standards -			
Working Mass Stds. Verification Compared to primary standards	Every 90 days	< ± 2.1 ug	1, 2 and 3) Method 2.12 Sec. 9.7
Primary standards certification	every 365 days and once a calendar year	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7

SYSTEMATIC CRITERIA - PM_{10} Lo-Vol Filter Based STP			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-5
Data Completeness	***24- Hour Standard***	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50 App. K, Sec. 2.3b
Reporting Units	all filters	µg/m³ at standard temperature and pressure	1, 2 and 3) 40 CFR Part 50 App K Sec. 1
Rounding convention for design value calculation	***Each routine concentration***	***nearest 10 µg/m³ (≥ 5 round up)***	1, 2 and 3) 40 CFR Part 50 App K Sec. 1 The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Detection Limit			
Lower DL	***all filters***	***≤ 2 µg/m³***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.1
Upper Conc. Limit	***all filters***	***≥200 µg/m³***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.2
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 10.1% ≥ 3.0 µg/m³	1, 2 and 3) Recommendation
Single analyzer	1/ yr	CV < 10.1% ≥ 3.0 µg/m³	1, 2 and 3) Recommendation
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV < 10.1% ≥ 3 µg/m³	1, 2 and 3) Recommendation
Field Activities			
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards			
1) Criteria (PM10 Lo-Vol STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Flow Rate Transfer Std.	**every 365 days and once a calendar year**	***< ± 2.1% of NIST Traceable Std.***	1) 40 CFR Part 50, App. L Sec. 9.1 & 9.2 2) Method 2.12 Sec.4.2.2 & 6.4.3 3) 40 CFR Part 50, App. L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Clock/timer Verification	every 30 days	***1 min/mo***	1and 2) Method 2.12 Sec. 4.2.1 3) 40 CFR Part 50, App. L Sec. 7.4.12
Laboratory Activities			
Microbalance Readability	***at purchase***	***1 µg***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.1
Microbalance Repeatability	at purchase	1 µg	1) Method 2.12 Sec. 4.3.6 2) Recommendation 3) Method 2.12 Sec. 4.3.6

Primary Mass. Verification/Calibration Standards Recertifications	at purchase	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
Comment #1 The associated leak test procedure shall require that for successful passage of this test, the difference between the two pressure measurements shall not be greater than the number of mm of Hg specified for the sampler by the manufacturer, based on the actual internal volume of the sampler, that indicates a leak of less than 80 mL/min.			

Pb High Volume (TSP) Local Conditions Validation Template

Note: in 2008, the NAAQS was lowered for Pb and new monitoring rules were promulgated which allowed for the use of federal equivalent analytical methods and the use of PM_{10} sampling in certain circumstances. The following information is guidance based on the current FRM which is sampling by TSP and analysis by atomic absorption. Information is this table is derived from the TSP sampling method in 40 CFR Part 50 App B, and QA Handbook Method 2.2 (1977). The analytical requirements/guidance are derived from 40 CFR Part 50, App G and QA Handbook Method 2.8 (1981). Monitoring for Pb based on the new NAAQS requirements will begin in calendar year 2010. **Revised and/or additional Pb validation templates will be included in this Sec. (if published before this version of the Handbook) or posted on AMTIC**

1) Criteria	2) Frequency	3) Acceptable Range	4) Information/Action
CRITICAL CRITERIA- Pb in TSP Local Conditions			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list Also described in 40 CFR Part 50 App B Sec. 7.2
Filter Holding Times			
Sample Recovery	***all filters***	***ASAP***	1, 2 and 3) 40 CFR Part 50 App B Sec. 6.3
Sampling Period	***all filters***	***1440 minutes ± 60 minutes midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App B Sec. 8.15
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***1.1-1.70 m^3/min (varies with instrument) in actual condition***	1, 2 and 3) 40 CFR Part 50 App B Sec. 8.8
One-point Flow Rate Verification	***every 90 days and 4 times a calendar year***	< ±7.1% from transfer standard	1 and 2) 40 CFR Part 58 App A Sec. 3.4.2 3) Method 2.2 Sec. 2.6
Lab Activities			
Filter			
Visual Defect Check (unexposed)	***all filters***	***Initial backlight inspection- no pinholes or imperfections. Visual inspection prior to shipping to analytical lab***	1, 2 and 3) 40 CFR Part 50 App B Sec. 8.2
Collection Efficiency	***all filters***	***99 %***	1, 2 and 3) 40 CFR Part 50 App B Sec. 7.1.4
Pressure Drop Range	***all filters***	***42-54 mm Hg***	1, 2 and 3) 40 CFR Part 50 App B Sec. 7.1.5
pH	***all filters***	***6-10***	1, 2 and 3) 40 CFR Part 50, App B Sec. 7.1.6
Pb Content	***all filters pre-sampling batch check***	***< 75 µg/filter***	1, 2 and 3) 40 CFR Part 50, App G Sec. 6.1.1.1 Method 2.8 Sec. 6.2.1. More information relative to whether filters should be corrected for blanks.

Calibration Reproducibility Checks	***Beginning, every 10 samples and end***	***± 5% of value predicted by calibration curve***	1, 2 and 3) 40 CFR Part 50, App G Sec. 9.3 May be FEM dependent
Initial Calibration Blank	***Before first sample***	***< 0.001 µg/mL***	1, 2 and 3) 40 CFR Part 50, App G Sec.8.8
1) Criteria	**2) Frequency**	**3) Acceptable Range**	**4) Information/Action**
Reagent Blank	Every analytical batch	< LDL	1, 2 and 3) Recommendation
Daily Calibration	Daily (on day of analysis)	until good agreement is obtained among replicates	1, 2 and 3) Method 2.8 Sec. 2.8.5
OPERATIONAL EVALUATIONS TABLE Pb in TSP Local Conditions			
Field Activities			
Verification/Calibration			
System Leak Check	During precalibration check	Visual and Auditory inspection with faceplate blocked	1, 2 and 3) Recommendation
FR Multi-point Verification/Calibration	After receipt, after motor maintenance or failure of 1point check and every 365 days and once a calendar year	5 points over range of 1.1 to 1.7 m^3/min ≤ 5.1% limits of linearity	1, 2 and 3) Method 2.2 Sec. 2.6
Precision			
Collocated Samples	***15% of each method code in PQAO Frequency - every 12 days***	CV < 20.1% of samples ≥ 0.02 µg/m^3 (cutoff value)	1 and 2) 40 CFR Part 58 App A Sec. 3.3.4.3 3) Recommendation for early evaluation of DQOs
Semi Annual Flow Rate Audit	***every 180 days and twice a calendar year***	< ± 7.1% of audit standard	1 and 2) 40 CFR Part 58, App A, Sec. 3.4.3 3) Method 2.2 Table 8.2
Monitor Maintenance			
Inlet cleaning	every 90 days and 4 times a calendar year	cleaned	1, 2 and 3) Recommendation
Motor/housing gaskets	~400 hours	Inspected replaced	1, 2 and 3) Method 2.2 Sec. 7
Blower motor brushes	400-500	Replace	1, 2 and 3) Method 2.2 Sec. 7
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	NA
Lab Activities			
Analysis Audits	***6 strips/quarter 3 at each concentration range***	<10.1% (percent difference)	1 and 2) 40 CFR Part 58, App A, Sec. 3.4.6 3) Recommendation
Field Filter Blank	1/quarter	< LDL	1, 2 and 3) Recommendation
Lab Blanks	1/ sample run	< LDL	1, 2 and 3) Recommendation

Control Standards (1 µg Pb/ml and a standard between 1-10 µg Pb/ml)	1st, every 10 samples and last sample.	Deviation of < 5.1% from value predicted by calibration curve	1, 2 and 3) Method 2.8 Sec. 5.7.3
SYSTEMATIC CRITERIA - Pb Filter Based Hi-Vol Local Conditions			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	***3-year standard***	***average of the 3 constituent monthly means ≥ 75% .***	1, 2 and 3) 40 CFR Part 50 App. R, Sec. 4. In addition there are substitution tests that can be used for data not meeting completeness criteria.
1) Criteria	**2) Frequency**	**3) Acceptable Range**	**4) Information/Action**
Reporting Units	***all filters***	***µg/m³ at local temperature and pressure.***	1, 2 and 3) 40 CFR Part 50 App R Sec. 3 (b)
Rounding convention for design value calculation (3-month arithmetic mean)	***quarterly***	***Report data to 3 decimal places (data after 3 are truncated.***	1, 2 and 3) 40 CFR Part 50 App R Sec. 3 (b) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Lower Detectable Limit (AA)	***all samples***	***0.07 µg Pb/m³***	1, 2 and 3) 40 CFR Part 50 App G Sec. 2.3
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 20.1% ≥0.02 µg/m³	1 and 2) 40 CFR Part 58 App A Sec. 3.4.4 3) Recommendation related to DQO
Primary Quality Assurance Org.	***Annual and 3 year estimates***	***90% CL of CV < 20.1% ≥ 0.02 µg/m³***	1, 2 and 3) 40 CFR Part 58 App A Sec. 3.4.4 and Sec. 2.3.1.3
Bias			
Performance Evaluation Program (PEP)	***5 audits for PQAOs with ≤ 5 sites*** ***8 audits for PQAOs with > 5 sites***	***95% CL Absolute bias < ±15.1% ≥ 0.02 µg/m³***	1, 2 and 3) 40 CFR Part 58 App A Sec. 3.4.7 and Sec. 2.3.1.3 The PEP include 1 or independent collocated audits and 4 or 6 samples from the monitoring organizations collocated monitor sent to the independent National PEP Laboratory.
Field Activities			
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***Resolution 0.02 m³/min ± 2% reproducibility***	1) 40 CFR Part 50, App. B Sec. 7.8 2) Method 2.2 Sec. 2.5 3) 40 CFR Part 50, App. B Sec. 7.8
Field Thermometer	every 365 days and once a calendar year	***2° C resolution***	1) 40 CFR Part 50, App. B Sec. 7.5 2) Recommendation 3) 40 CFR Part 50, App. B Sec. 7.5

Field Barometer	every 365 days and once a calendar year	***± 5 mm Hg resolution***	1) 40 CFR Part 50, App. B Sec. 7.6 2) Recommendation 3) 40 CFR Part 50, App. B Sec. 7.6
Clock/timer Verification	every 90 days and 4 times a calendar year.	± 2 min/24-hour	R1, 2 and 3) Method 2.2. Sec. 2.3
Lab Activities			
Analytical Standards			
Reagents (HNO_3 and HCL)	***all***	***ACS reagent grade***	1, 2 and 3) 40 CFR Part 50 App G Sec.6.2.1
Pb nitrate Pb $(NO_3)_2$	***all***	***ACS reagent grade (99.0% purity)***	1, 2 and 3) 40 CFR Part 50 App G Sec.6.2.8

SD= standard deviation
CV= coefficient of variation

PM_{10} -Pb Low Volume Filter-Based Local Conditions Validation Template

NOTE: The following validation template was constructed for use of PM_{10}-Pb at local conditions where PM_{10c} method in 40 CFR Part 50 Appendix O is referenced. Although the PM $_{10-2.5}$ method is found in 40 CFR Part 50 Appendix O, Appendix O also references Appendix L (the $PM_{2.5}$ Method) for the QC requirements listed below. Therefore, the information action column, in most cases, will reference 40 CFR Part 50 App L. In addition, since the PM10 samplers are very similar to the PM2.5 samplers, Guidance Document 2.12 *Monitoring PM2.5 in Ambient Air Using Designated Reference or Class 1 Equivalent Methods* is referred to where appropriate. At present the only analytical FRM is XRF. Therefore, quality control criteria are associated with the XRF method which is promulgated in 40 CFR Part 50 Appendix Q.

1) Criteria (PM10-Pb Lo-Vol)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM10-Pb Filter Based Local Conditions			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Filter Holding Times ***Sample Recovery***	***all filters***	***ASAP***	1, 2 and 3) 40 CFR part 50 App B Sec. 6.3 If filters are used for more than one purpose (i.e., Pb and PM10) the sample recovery is dictated by the most stringent requirement.
Filter Holding Times ***Pre-sampling***	***all filters***	***≤ 30 days before sampling***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.5 Required only if filters will be used for PM10c mass as well as Pb. If only used for Pb then 30 day pre-sampling holding time not required
Sampling Period (including multiple power failures)	***all filters***	***1440 minutes ± 60 minutes midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App B Sec. 8.15 If filters are used for more than one purpose (i.e., Pb and PM10) the sample recovery is dictated by the most stringent requirement.
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***average within 5% of 16.67 liters/minute***	1, 2 and 3) 40 CFR Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV ≤ 2%***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.2

One-point Flow Rate Verification	every 30 days	***< ± 4.1% of transfer standard*** < ± 5.1% of flow rate design value	1) 40 CFR Part 50, App. L, Sec. 9.2.5, 40 CFR Part 58, Appendix A Sec. 3.4.1 2) Recommendation 3) 40 CFR Part 50, App. L, Sec. 9.2.5
Design Flow Rate Adjustment	***After multi-point calibration or verification***	***< ± 2.1% of design flow rate***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6
1) Criteria (PM10-Pb Lo-Vol)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Individual Flow Rates	***every 24 hours of op***	***no flow rate excursions > ±5% for > 5 min. 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.1
Filter Temp Sensor	***every 24 hours of op***	***no excursions of > 5° C lasting longer than 30 min 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.11.4
External Leak Check	***Before each flow rate verification/calibration*** and before and after $PM_{2.5}$ separator maintenance	***< 80.1 mL/min*** (see comment #1)	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50 App L Sec. 9.2.3 and Method 212 Sec. 7.4.3 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1
Internal Leak Check	If failure of external leak check	***< 80.1 mL/min***	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12 7.4.4 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2
Laboratory Activities (XRF Analysis)			
Filter Visual Defect Check (unexposed)	***all filters***	***Correct type & size and for pinholes, particles or imperfections***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 10.2
Pb blank filter Acceptance Testing	***~ 20 test filters per lot***	***90% of filters < 4.8 ng Pb/cm²***	1, 2 and 3) 40 CFR Part 50 App Q Sec. 6.1.2
OPERATIONAL EVALUATIONS TABLE- PM10-Pb Filter Based Local Conditions			
Field Activities			
Routine Verifications			
One-point Temp Verification	every 30 days	<± 2.1°C	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Table 6-1 3) Recommendation
Pressure Verification	every 30 days	<± 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Table 6-1 3) Recommendation
Annual Multi-point Verifications/Calibrations			
Temperature multi-point Verification/Calibration	on installation, then every 365 days and once a calendar year	<± 2.1°C	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4

Pressure Verification/Calibration	on installation, then every 365 days and once a calendar year	<± 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 Sampler BP verified against independent standard verified against a lab primary standard that is certified as NIST traceable 1/year
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport or*** every 365 days and once a calendar year	<± 2.1% of transfer standard	1) 40 CFR Part 50, App. L, Sec. 9.2. 2) 40 CFR Part 50, App. L, Sec. 9.1.3, Method 2.12 Sec. 6.3 and Table 6-1 3) Recommendation
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	1, 2 and 3) Recommendation
Precision			
1) Criteria (PM10-Pb Lo-Vol)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Collocated Samples	***15% of each method code in PQAO Frequency - every 12 days***	CV < 20.1% of samples ≥ 0.02 µg/m^3 (cutoff value)	1 and 2) 40 CFR Part 58 App A Sec. 3.4.4 3) Recommendation for early evaluation of DQOs
Accuracy			
Temperature Audit	every 365 days and once a calendar year	<± 2.1°C	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 365 days and once a calendar year	<±10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	<± 4.1% of audit standard <± 5.1% of design flow rate	1 and 2) 40 CFR Part 58 App A, Sec. 3.4.3 3) Method 2.12 Sec. 11.2.1
Monitor Maintenance			
Impactor (WINs)	every 5 sampling events	cleaned/changed	1, 2, and 3) Method 2.12 Sec. 8.2.2
Very Sharp Cut Cyclone	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec.8.3.3
Inlet Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Downtube Cleaning	every 90 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.4
Filter Chamber Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Laboratory Activities (XRF Analysis)			
Analysis Audits	***6 filters/quarter 3 at each concentration range***	<10.1% (percent difference)	1 and 2) 40 CFR Part 58, App A, Sec. 3.4.6 3) Recommendation
Field Filter Blank	1/quarter	< 0.01 µg/m^3	1) 40 CFR Part 50 App Q Sec. 6.1.2.1 2 and 3) Recommendation

Lab Filter Blank	1/ sample run	<.003 µg/m^3	1 40 CFR part 50 App Q Sec. 6.1.2.1 2 and 3) Recommendation
Thin Film Standards (standard reference materials)	Beginning and end of each analytical run	XRF conc. ± 3x the 1 sigma uncertainty overlaps the NIST certified conc. + 1x its reported uncertainty.	1) 40 CFR Part 50 App Q Sec. 6.2.3 2 and 3) recommendation
Run time quality control standards Checking peak areas, background areas, centroid and FWHM	Beginning and end of each analytical run	Target value 3 SD	1, 2,and 3) Recommendation Target values and SD of QC samples established prior to analysis.
XRF analyzer calibration	***Every 365 days and 1/ calendar year or when significant repairs*** or changes occur or QC limits exceeded	XRF conc. ± 3x the 1 sigma uncertainty overlaps the NIST certified conc. + 1x its reported uncertainty.	1 and 2) 40 CFR Part 50 App Q Sec. 6.2.4 3) Recommendation
Background Measurement and Correction	***20 clean blank filters for each filter lot used***	NA	1 and 2) 40 CFR Part 50 App Q Sec. 6.2.4.2
1) Criteria (PM10-Pb Lo-Vol)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
SYSTEMATIC CRITERIA - PM10-Pb Filter Based Local Conditions			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	***3-year standard***	***average of the 3 constituent monthly means ≥ 75%***	1, 2 and 3) 40 CFR Part 50 App. R, Sec. 4. In addition, there are substitution tests that can be used for data not meeting completeness criteria.
Reporting Units	***all filters***	***µg/m^3 at local temperature and pressure.***	1, 2 and 3) 40 CFR Part 50 App R Sec. 3 (b)
Rounding convention for design value calculation (3-monthmean)	***quarterly***	***Report data to 3 decimal places (data after 3 are truncated.***	1, 2 and 3) 40 CFR Part 50 App R Sec. 3 (b) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Lower DL	***all filters***	***< 0.001 µg/m^3***	1, 2 and 3) 40 CFR Part 50 App. Q Sec. 2.2
Upper Conc. Limit	***all filters***	***≥200 µg/m^3***	1, 2 and 3) 40 CFR Part 50, App. Q Sec. 3.1
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 20.1% ≥ 0.02 µg/m^3	1 and 2) 40 CFR Part 58 App A Sec. 3.2.4, 4.2.5 and 2.3.1.1 3) Recommendation related to DQO

Primary Quality Assurance Org.	***Annual and 3 year estimates***	***90% CL of CV < 20.1% ≥ 0.02 µg/m³***	1, 2 and 3) 40 CFR Part 58 App A Sec. 3.4.5 and Sec. 2.3.1.3
Bias			
Performance Evaluation Program (PEP)	***5 audits for PQAOs with ≤ 5 sites*** ***8 audits for PQAOs with > 5 sites***	***95% CL Absolute bias <±15% ≥ 0.02 µg/m³***	1, 2 and 3) 40 CFR Part 58 App A Sec. 3.4.7 and Sec. 2.3.1.3 The PEP includes 1 or 2 independent collocated audits and 4 or 6 samples from the monitoring organizations collocated monitor sent to the independent National PEP Laboratory.
Field Activities			
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	**every 365 days and once a calendar year**	***<± 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50, App. L Sec. 9.1 & 9.2 2) Method 2-12 4.2.2 and 6.4.3 3) 40 CFR Part 50, App. L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Verification/Calibration Clock/timer Verification	every 30 days	***1 min/mo***	1 and 2) Method 2.12 Sec. 4.2.1 3) 40 CFR Part 50, App. L, Sec. 7.4.12
1) Criteria (PM10-Pb Lo-Vol)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Comment #1 The associated leak test procedure shall require that for successful passage of this test, the difference between the two pressure measurements shall not be greater than the number of mm of Hg specified for the sampler by the manufacturer, based on the actual internal volume of the sampler, that indicates a leak of less than 80 mL/min.			

1/ value must be flagged SD= standard deviation CV= coefficient of variation