Ambient Air Monitoring
Quality Assurance Project Plan

Revision 1

December 11, 2024

Montana Department of Environmental Quality
Air Quality Bureau

1520 East 6th Ave
Helena, MT 59601

Ambient Air Monitoring

Quality Assurance Project Plan

Montana Department of Environmental Quality

DEQ Approval

This Quality Assurance Project Plan is approved for use as the required quality system policy for the Montana Department of Environmental Quality (MTDEQ) Ambient Air Monitoring Program. Approval is established under the authority and direction of the MTDEQ Quality Management Plan dated September 2019 and revised on February 4, 2021.

Air Quality Bureau Chief

Bo Wilkins — Date: 12/11/2024

Air Research and Monitoring Section Supervisor

Kelly Dorsi — Date: 12/11/2024

Air Research and Monitoring Quality Assurance Manager

Hoby Rash — Date: 12/11/2024

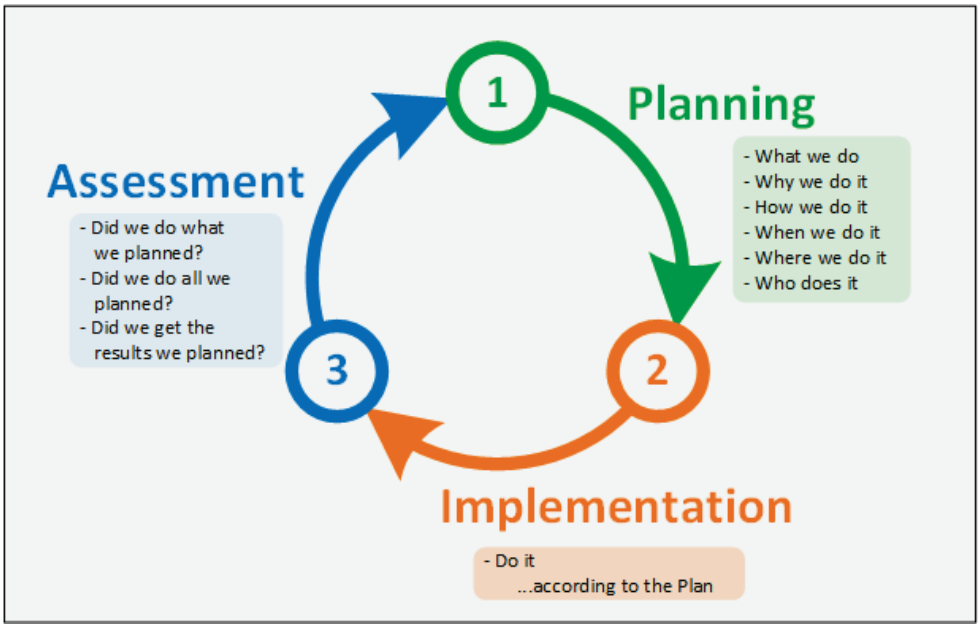
Table of Contents

Introduction

The purpose of the Montana Department of Environmental Quality Air Quality Bureau (MTDEQ/AQB) Ambient Air Monitoring Program is to ***measure concentrations of criteria air pollutants and related meteorological parameters in the ambient air to provide high quality data that informs data users and their decisions.***

Ambient air monitoring data informs significant decisions, many of which assess potential serious human health impacts, significant environmental damage, and millions of dollars of economic impact. Consequently, the data and resulting information produced by MTDEQ's monitoring efforts must be of a consistent quality commensurate with the magnitude of the decisions it will inform. To accomplish that goal, this Quality Assurance Project Plan (QAPP) documents MTDEQ/AQB's engagement in a systematic quality assurance (QA) planning process following the "Data Quality Objective" or DQO process[1]. The DQO process is designed to establish a quality system that produces defensible data that may be used with the greatest confidence.

The quality system resulting from the DQO endeavor reflects a logical process flow for the MTDEQ/AQB Ambient Air Monitoring Project consisting of three broad components as illustrated below:



As reflected in the project flow diagram above, the quality system process is continual and iterative. For example, the answers to the questions in the *Assessment* component inform additional *Planning*, which leads to more effective *Implementation*, which is again assessed, and so on. Thus, the system is intentionally adaptable and designed to promote continuous process and quality improvements over the lifetime of the Project.

This QAPP describes and details Project operations within the context of this overarching process flow. The following table summarizes how each section of the QAPP fits into that larger context.

[1] See: *Guidance for the Data Quality Objectives Process (QA/G-4)*, (EPA 2000b); *EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5)*, (EPA 2001); and *Quality Assurance Handbook for Air Pollution Measurement Systems Volume II Ambient Air Quality Monitoring Program* (January 2017 edition).

Process Step	QAPP Section	Content
1. Planning	**A. Project Management**	Project purpose, history, objectives, participants, roles and responsibilities; approach to be used; and Data Quality Objectives (DQOs).
2. Implementation	**B. Monitoring Network Design, Operation, and Quality Control**	Establishing the network of monitors, sampling process design, sampling methods, quality control (QC) checks, equipment calibration, Standard Operating Procedures (SOPs).
	C. Data Acquisition, Management, and Usability	Data from continuous, manual, and QA/QC methods; data review, validation, reporting, availability and certification; data from exceptional events; data management, storage and retention.
3. Assessment	**D. Assessment and Oversight**	Evaluations to determine if the Project *Implementation* matches and fulfills the *Plan;* and defining *corrective actions* if it does not.

The listed QAPP Sections are developed according to the following outline:

A. Project Management
- A.1 Project Need
- A.2 Project Scope
- A.3 Project Organization
- A.4 Project Quality Objectives and Criteria
- A.5 Project Documents and Records

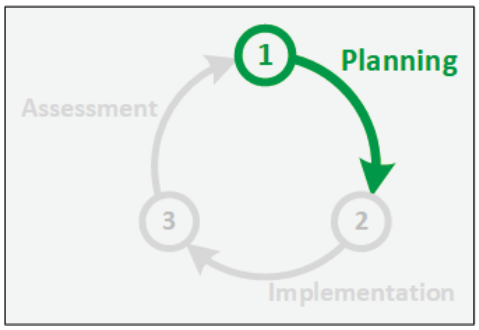
B. Monitoring Network Design, Operation, and Quality Control
- B.1 Monitoring Network Design
- B.2 Monitoring Sampling Methods
- B.3 Standard Operating Procedures
- B.4 Quality Control

C. Data Acquisition, Management, and Usability
- C.1 Data Acquisition
- C.2 Data Management, Retention, and Security
- C.3 Data Review and Validation
- C.4 Data Reporting
- C.5 Data Certification

D. Assessment and Oversight
- D.1 Assessment Types
- D.2 Project Oversight
- D.3 Corrective Action

A. Project Management

Project management communicates the foundational or *planning* step of the process flow for the Project. In this step the *what*, *why*, *how*, *when*, *where*, and *who* of the Project are defined; and data quality objectives are discussed and established.



A.1 Why - Project Need

The negative impacts of air pollution on human health and the environment have been observed for centuries, and efforts to address and reduce those impacts have taken various forms over the years. Montana has engaged in addressing the significance of air pollution and the challenges of mitigating its impacts since the 1880's. The questions: "how much of a pollutant is present" and "what is its impact on humans, animals and the environment?" were topics of substantial debate surrounding industrial development in Montana and continue to be up to the present time. A means to accurately measure air pollutants in ambient air is required to answer those questions, and this Project fulfills that need.

Increasing air pollution emissions and their related negative impacts in Montana and across the nation resulted in the establishment of legislation to address this issue, first through the Montana Clean Air Act in 1967, and then in various pieces of legislation culminating in the national Clean Air Act (CAA) of 1970. The chief process mechanisms of those legislative acts limit emissions of harmful air pollutants. Fundamental to effective implementation of emission limits is the need for a data foundation established by measuring the background concentrations of harmful pollutants in ambient air. Ongoing measurements compared with the background measurements establish whether and to what degree emission control mechanisms reduce and/or maintain protective concentrations of those pollutants. This Project fulfills that need as well.

Implementation of, and subsequent revisions to, the CAA continually increases the need for representative, scientifically collected measurements of pollutants in the ambient air. In Montana, the measurement of fine particulate matter in smoke, and communication of those measured concentrations to the public in near-real time is particularly important and strongly pursued by this Project. In addition, ongoing research to define pollutant patterns, trends, movements, and impacts to human health and the environment requires input of the accurately measured, spatially representative data collected by this Project.

A.2 Project Scope

A.2.1 What – Project Definition

A.2.1.1 Project Purpose

The MTDEQ/AQB Ambient Air Monitoring Program (the Project) is established and conducted to fulfill the following purpose:

The purpose of this Project is to measure concentrations of criteria air pollutants and related meteorological parameters in the ambient air to provide high quality data that informs data users and their decisions.

The term "ambient air" is defined in Title 40 Code of Federal Regulations Part 50.1 (40 CFR 50.1) as "that portion of the atmosphere, external to buildings, to which the general public has access." The Federal CAA requires the United States Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants in the ambient air known as "criteria air pollutants." Criteria air pollutants are the most common air pollutants with known harmful human health effects. The six criteria pollutants are:

- Ozone (O_3);
- Carbon Monoxide (CO);
- Nitrogen Dioxide (NO_2);
- Sulfur Dioxide (SO_2);
- Lead (Pb); and
- Particulate Matter (PM).
  PM concentrations of airborne materials are currently measured in three size fractions: those with an aerodynamic diameter of 10 microns and less (PM_{10}), those with an aerodynamic diameter of 2.5 microns and less ($PM_{2.5}$), and those with an aerodynamic diameter between PM_{10} and $PM_{2.5}$ (PM_{coarse} or $PM_{10\text{-}2.5}$).

For each criteria air pollutant, NAAQS concentration limits in the ambient air have been established to protect public health and the environment. Two types of federally mandated air quality standards may exist. *Primary* standards are limits set to protect public health, including the health of at-risk populations such as people with pre-existing heart or lung disease, children, and older adults. *Secondary* standards are limits set to protect public welfare, including protection against visibility impairment and damage to animals, crops, vegetation, and buildings. Montana has, in the past, adopted similar air quality limits known as the Montana Ambient Air Quality Standards (MAAQS). These standards have been generally, but not completely, superseded by more stringent NAAQS.

A.2.1.2 Project Objectives

This Project measures quantities of the criteria pollutants in the ambient air to meet three objectives:

1. To provide air pollution data to the general public in a timely manner.
2. To support compliance with ambient air quality standards (NAAQS/MAAQS) and emissions strategy development.
3. To support air pollution research studies.

Each monitoring site is uniquely designed, located, equipped, operated, maintained, quality assured, and data is shared based upon which of the three Project objectives are addressed at that site. An individual site may be designed to meet any one or combination of the three objectives.

A.2.1.3 Data Quality Objectives (DQOs)

To ensure that data resulting from Project monitoring operations is of sufficient quantity and quality to fulfill the stated purpose and objectives, this Project engages in a systematic QA planning process following the "Data Quality Objective" or DQO process. DQOs are primarily focused on big picture, project-defining or network-wide objectives. They define the types of data to be collected and establish boundaries for collection errors to limit measurement uncertainty and ensure the monitoring process meets its intended purpose (see Section A.4.1 for more detail). The broadest levels of DQOs for this

Project are addressed in Sections A.1 through A.5 through the establishment of the Project purpose, objectives, scope, organization, and quality goals.

Within that big picture, additional, more specific DQOs may apply at individual sites based upon which of the *Project Objectives* (Section A.2.1.2) are being pursued at that site. For example, and most notably, if the site exists to demonstrate compliance with one or more NAAQS, then specific DQOs prescribed in 40 CFR 58 Appendix A, Sections 2.3.1.1 through 2.3.1.5 (see Appendix A) apply at that site. Those DQOs are not required at sites established only to provide information to the public. MTDEQ/AQB may elect to use those DQOs at informational or research-only sites as indicators of proper monitor function depending on the location and monitor application.

DQOs are discussed in more detail in Section A.4.

A.2.2 How – Project Means and Methods

MTDEQ/AQB measures concentrations of criteria air pollutants in the ambient air by placing and operating monitoring equipment at select locations across the state of Montana. Most of this equipment operates continuously, and functions by measuring attributes of physics or chemistry that are unique to each individual criteria pollutant. The measurement output of each analyzer (a.k.a. monitor) is electronically stored on site, and then a computerized, cellular-based communication process transmits the data from each station and stores them in central databases in Helena, Montana. Some of the data are immediately made available to the public via the MTDEQ *Today's Air* and EPA *AirNow* internet-based applications. All retrieved data are reviewed and quality assured by Project staff. Depending on the monitoring objective (see Section A.2.1.2), some of the final monitored data and QA parameters are uploaded each calendar quarter to the national EPA Air Quality System (AQS) database.

Because of the significant health, welfare, environmental, and socio-economic impacts associated with ambient air quality measurements, a substantial national QA system has been established to guide data collection and management. The location, type, number, correct application, operation, and reporting from both individual monitors and MTDEQ/AQB's aggregate statewide monitoring network are subject to a quality planning process based on defining, documenting, and operating in accordance with specific DQOs. This QAPP, then, documents MTDEQ/AQB's air monitoring purposes, objectives, practices, and quality assurance integration.

Two broad categories of air pollutant analyzers are employed by this Project:

1. Analyzers deployed specifically, though not always exclusively, to support compliance with ambient air quality standards (**Regulatory Monitors**). These instruments must be nationally designated for this purpose as Federal Reference Methods or their Equivalent (**FRM**/**FEM**) as discussed in the following paragraphs and throughout this document.

2. Analyzers deployed exclusively for providing information to the public or for supporting scientific studies. This category will be broadly referred to as **Non-FEM** instruments throughout this document (see Section B.2.4 for a more complete list of monitor types in this category). An increasingly important subset of this category includes personal sensors and/or low-cost monitors (collectively referred to as **sensors** in this QAPP).

The majority of this QAPP centers around the operation of **FRM**/**FEM** instrumentation according to the requirements of federal rules, related orders, and guidance. However, wherever possible MTDEQ

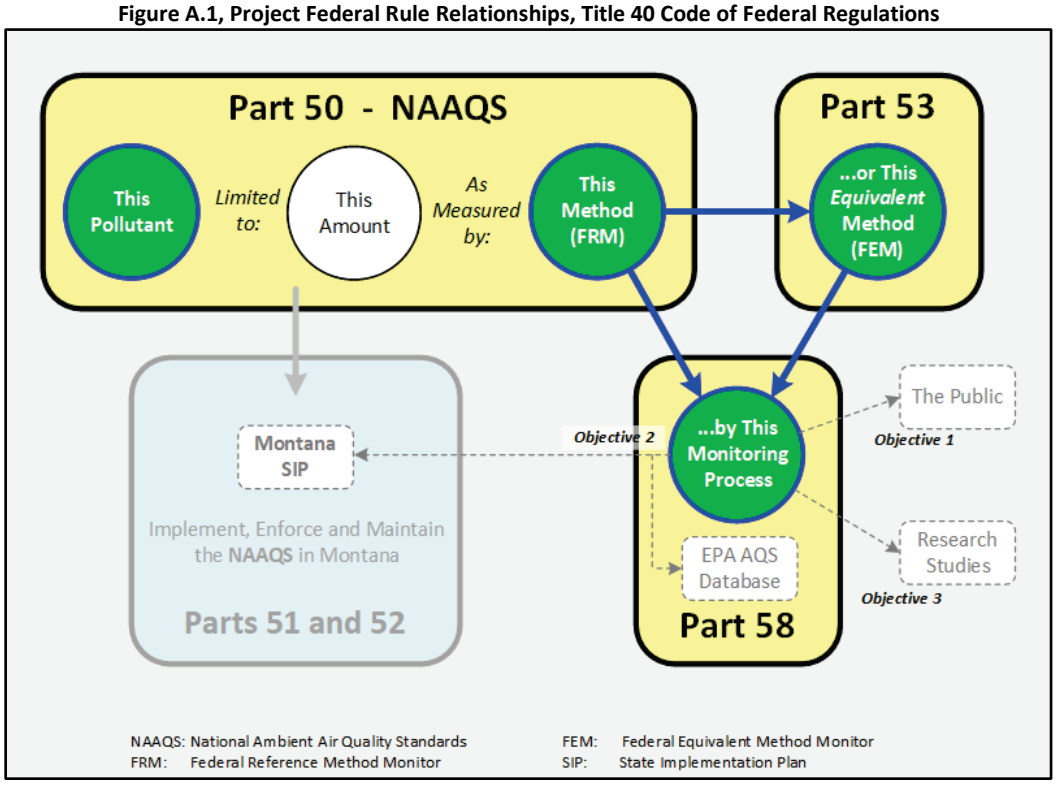
applies the quality assurance *principles* embodied in federal rule and guidance to all instruments in the Project monitoring network.

National requirements, policies, and guidance for the establishment and operation of a monitoring network, and for the quality system integrated within and overseeing such a network are embodied in specific rules and documents. MTDEQ/AQB's development and implementation of this QAPP conforms to the following federal rules:

- 40 CFR 50, National Primary and Secondary Ambient Air Quality Standards;
- 40 CFR 53, Ambient Air Monitoring Reference and Equivalent Methods;
- 40 CFR 58, Ambient Air Quality Surveillance.

Figure A.1 graphically summarizes the relationship between these rules as they apply to this Project and the three Project Objectives established in Section A.2.1.2. Figure A.1 includes a reference to the Montana State Implementation Plan (SIP). The provision of monitoring information to Montana's SIP efforts in implementing, enforcing and maintaining the **NAAQS** is significant, though the details of the SIP process are beyond the scope of this QAPP. The components of Figure A.1. are described in subsequent sections of this QAPP.

Figure A.1, Project Federal Rule Relationships, Title 40 Code of Federal Regulations



In addition, because this Project is a recipient of grant funding from EPA, this QAPP is established to conform with the requirements of EPA Order CIO 2105.0 (formerly 5360.1 A2) *Policy and Program Requirements for the Mandatory Agency-wide Quality System* (May 5, 2000).

This QAPP and its implementation also conform to the following Montana-specific rules:

- Administrative Rules of Montana (ARM) 17.8.204, Ambient Air Monitoring; and
- ARM 17.8.202, Incorporation by Reference.

Further, this QAPP and its implementation also conform to the following EPA guidance documents as applicable:

- *Guidance for the Data Quality Objectives Process (QA/G-4)*, (EPA 2000b);
- *Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan (QA/G-5S),* (EPA 2002);
- *EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5)*, (EPA 2001);
- *EPA Guidance for Quality Assurance Project Plans (QA/G-5)* (EPA 1998);
- *Guidance on Technical Audits and Related Assessments for Environmental Data Operations (EPA QA/G-7)*, (January 2000);
- *Guidance for the Preparation of Standard Operating Procedures for Quality-Related Documents (QA/G-6)*, (EPA 1995);
- *Guidance for Data Quality Assessment: Practical Methods for Data Analysis (QA/G-9)*, (EPA 2000a);
- *Quality Assurance Handbook for Air Pollution Measurement Systems Volume II Ambient Air Quality Monitoring Program* (January 2017 edition); and
- *Quality Assurance Handbook for Air Pollution Measurement Systems Volume I, Principles*, and Volume IV: *Meteorological Measurements*.

In addition, MTDEQ/AQB follows manufacturer's documentation and instrument manuals, along with EPA's statements of Certification and Equivalency in 40 CFR Part 53 to appropriately deploy, operate, and maintain monitoring instruments. These materials are directly referenced in MTDEQ/AQB's written Standard Operating Procedure (SOP) documents (Section B.3 and Appendix C).

Finally, Montana's long history of ambient air monitoring, best practices and institutional knowledge gained with time and experience, and previous QAPP versions influence the development and implementation of this document and its referenced SOPs.

A.2.3 When – Project Schedule

Three levels of scheduling are significant for this Project. First, an overall Project QA framework is formed by a broad schedule of rule-required, recurring components as summarized in Table A.1. Second, schedules of individual QA/QC components and activities establish detail within that larger framework (see Section A.4). Third, an assessment of Project monitoring efforts is made annually and documented in MTDEQ/AQB's annual *Air Monitoring Network Plan* completed by July 1 of each year (see Section B.1.2.1).

Table A.1, Recurring Rule-Required QA Components

Program Component	Description	Frequency	Deadline	Reference	QAPP Section
Gas Monitor One-Point QC Check	Challenge each gas analyzer with a known gas concentration within a prescribed range.	At least once every 2 weeks	--	40 CFR 58 App A Sec 3.1.1	B.4.2.1, D.1.1.1
PM_{10} and $PM_{2.5}$ Flow Rate Verification	Check the operational flow rate of each monitor.	At least once every month separated by 14 days	--	40 CFR 58 App A Sec 3.2.1 and 3.3.1	B.4.2.2, D.1.1.1
AQS Data Submission	All monitored values and QA data uploaded to EPA AQS database	Quarterly	90 days from the end of each quarter	40 CFR 58.16(b)	C.4.1

Program Component	Description	Frequency	Deadline	Reference	QAPP Section
PM_{10} and $PM_{2.5}$ Semi-Annual Flow Rate Audit	Audit the operational flow rate of each monitor.	Semi-annual	Ideally, spaced 5 to 7 months apart.	40 CFR 58 App A Sec 3.2.2	D.1.1.2
Air Monitoring Data Certification	Certification by DEQ that all air monitoring data for the previous year are complete and accurate; accompanied by required assessment reports.	Annual	May 1	40 CFR 58.15	C.5, D.1.1.4
Air Monitoring Network Plan	Document the establishment and maintenance of an air quality surveillance system in compliance with requirements, and propose network modifications.	Annual	July 1	40 CFR 58.10(a) - (c)	B.1.2.1, D.1.1.5
QAPP Review	Review the QAPP for needed changes.	At least Annual	--	EPA QA/R-5, Sec. 2.7*	A.5.1.1
Gas Monitor Performance Evaluation	Challenge each gas analyzer with at least three levels of known audit gas concentrations within prescribed ranges.	Annual	--	40 CFR 58 App A Sec 3.1.2	D.1.1.3
Gaseous Audit Standards Verification	Annually provide information to EPA on the gas producers used. Send one unused gas bottle to a verification laboratory once every 5 years as requested by EPA. Certify ozone and flow measurement devices.	1 and 5 Years	--	40 CFR 58 App A Sec 2.6	B.4.1.1, B.4.1.2.2, B.4.1.2.1.1, D.2.1.3
National Performance Audit Program (NPAP)	Independent audits of gaseous monitors. 20% of network each year; 100% of network every 6 years	1 and 6 years	--	40 CFR 58 App A Sec 3.1.3	D.1.2.1
$PM_{2.5}$ Performance Evaluation Program (PEP)	Independent audits of $PM_{2.5}$ monitors. At least 8 per year. 100% of sites every 6 years (approx. 15% per year)	1 and 6 years	--	40 CFR 58 App A Sec 3.2.4	D.1.2.2
Technical Systems Audit (TSA)	EPA review and inspection of the monitoring network to assess compliance with monitoring regulations.	At least every 3 Years	--	40 CFR 58 App A Sec 2.5	D.1.2.3
Air Monitoring Network Assessment	Document if the network meets the monitoring objectives, whether new sites are needed, whether existing sites are no longer needed, and whether new technologies are appropriate.	5 Years	July 1	40 CFR 58.10(d)	B.1.2.2, D.1.1.6
QAPP Revision	Modify, update, and resubmit the QAPP.	5 Years	--	QA Handbook Vol II, Sec 1.3.1; EPA QA/R-5, Sec. 1.5; EPA 2017 Memo*	A.5.1.1

*Annual QAPP review and 5-year resubmittal are not required by rule. However, *EPA QA/R-5* requires QAPPs and their submittal, review and approval by EPA under these timeframes for organizations that conduct environmental data operations on behalf of EPA through contracts, financial assistance agreements, and interagency agreements. Similarly, the EPA memo from Lewis Weinstock dated July 11, 2017, directs EPA to place a "non-conformance" flag on data in AQS that is collected and certified under a QAPP older than 5 years.

A.2.4 Where – Project Location

This Project and QAPP are limited in scope to those monitors operated by MTDEQ/AQB within the geographic boundaries of the state of Montana. The number, type, and location of the monitors defined by that space are determined by the three objectives listed in Section A.2.1.2. Within that context, additional factors influencing the locations of MTDEQ/AQB monitors include:

- National requirements in 40 CFR 58 Appendix D: *Network Design Criteria for Ambient Air Quality Monitoring*, and related rules and guidance;
- Available resources;
- Known and anticipated areas of significant pollution and related human health impacts; including episodic and emergency events;
- MTDEQ/AQB's objective to directly communicate ambient air quality data to the public;
- Quality assurance needs and data support;
- Input and direction from EPA Headquarters and Region 8;
- Current and anticipated air pollution research by MTDEQ/AQB and partners;
- Data needed to identify and mitigate pollutants in areas not in compliance with NAAQS;
- National monitoring initiatives;
- Protection of Montana's pristine and wilderness areas;
- Needs of Montana City/County Health agencies; and
- Support of Montana's underserved populations.

A listing of the locations, types, and intended spatial representation of MTDEQ/AQB's monitors may be found in the most recent version of MTDEQ/AQB's annual *Air Monitoring Network Plan* completed by July 1 of each year.

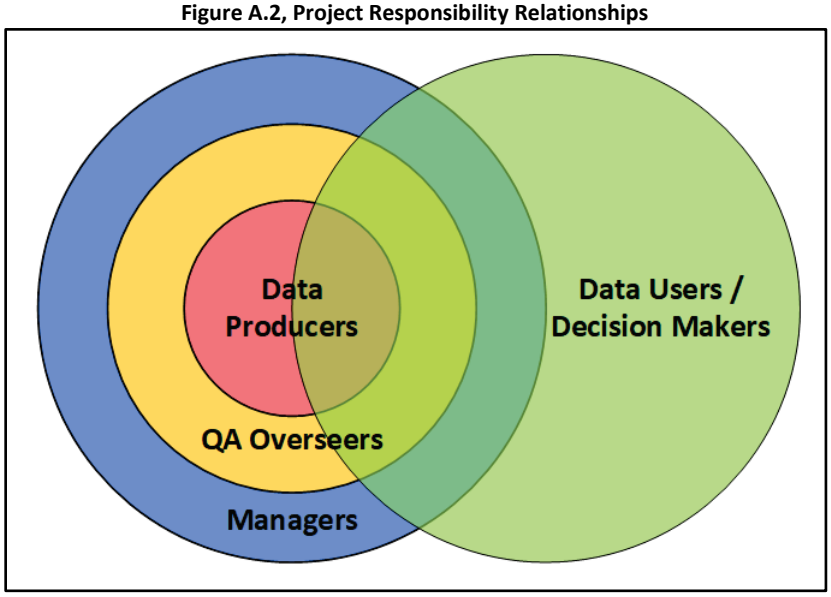
A.3 Project Organization – Who is involved in this Project?

The roles, responsibilities, needs, and activities of the Project involve four interrelated groups of individuals:

1. Data Producers
2. QA Overseers
3. Managers
4. Data Users / Decision Makers

Figure A.2 represents the relationship between the four groups.

Figure A.2, Project Responsibility Relationships



A.3.1 Data Producers

Data Producers are the core of this Project. These individuals work within three functional organizations and perform the following essential functions:

A.3.1.1 MTDEQ/AQB Air Research and Monitoring Section (ARMS) staff.

- Purchase, install, maintain, and repair all monitoring station equipment.
- Collect, review, and edit all produced data.
- Perform regular QA and QC functions.
- Feed data to EPA AQS database and EPA *AirNow* website.
- Assess and recommend monitoring site location and longevity.
- Do not require certification but are expected to have a strong aptitude in the physical sciences, air quality chemistry, NAAQS, instrument operation and maintenance, computer data networking and communication, and overall air quality resource management.

A.3.1.2 City/County Health Department staff.

- Operate select monitoring stations.
- Report to DEQ functionally, but not organizationally.

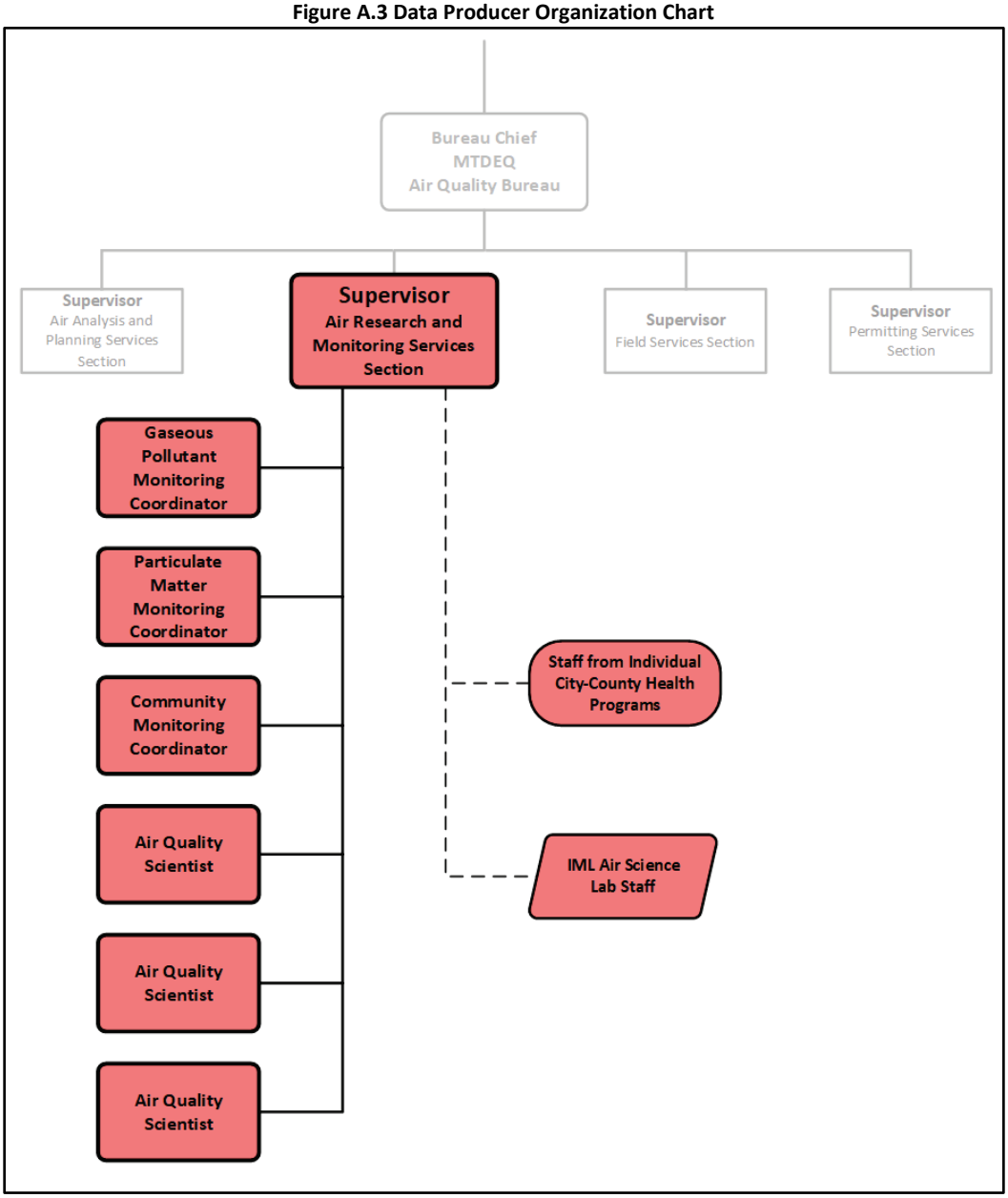
A.3.1.3 Inter-Mountain Labs, Inc. Air Science Laboratory (IML) staff.

- Independent contractor.
- Prepare and weigh particulate matter filters and provide results.
- Required to be a certified lab with a specific QAPP, and subject to EPA QA assessment.

Functions performed by each of the three groups are conducted according to established and approved SOPs per Section B.3.

Figure A.3 displays an organization chart of the Data Producer role and relationships.

Figure A.3 Data Producer Organization Chart



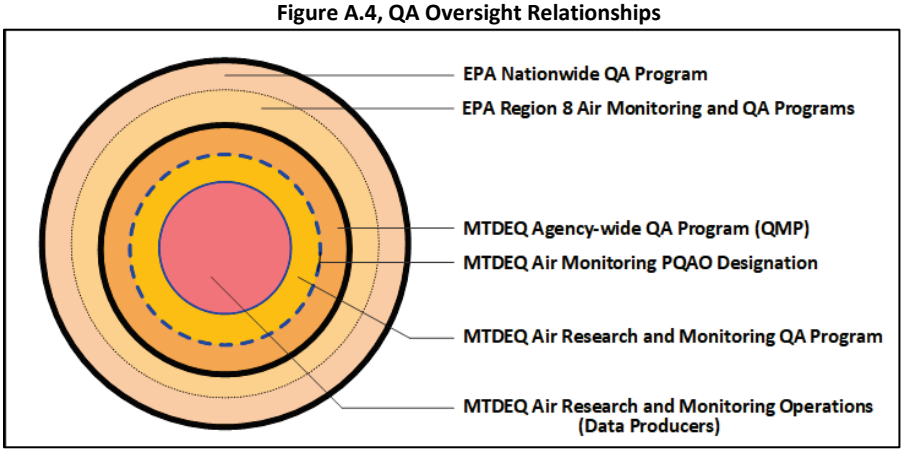
A.3.2 QA Overseers

The Project is conducted within a recognized, multi-tiered quality planning and oversight system to limit measurement uncertainty and ensure the Project meets its intended purpose and objectives. Individuals engaged in Project QA oversight work in one of four responsibility groups:

1. EPA Nationwide QA Program
2. EPA Region 8 Air Monitoring and QA Programs
3. MTDEQ Agency-wide QA Program; and
4. MTDEQ/AQB Ambient Air Monitoring QA program

The relationships between these groups and the overall Project are represented in Figure A.4.

Figure A.4, QA Oversight Relationships



The functions of the four groups may be summarized as follows.

A.3.2.1 EPA Nationwide QA Program

The EPA Office of Air Quality Planning and Standards (OAQPS) institutes QA requirements, standards, and guidance that are applied to NAAQS-related ambient air monitoring programs nation-wide. This effort establishes a level of consistency, comparability, and certainty across all Project data streams. EPA's quality program consists of three tiers: Policy, Program/Organization, and Project levels.

A.3.2.2 EPA Region 8 Air Monitoring QA Program

Under the umbrella of the nationwide QA program, EPA Region 8 staff specifically implement the established QA requirements among the states within the region. Region 8 states include Colorado, Utah, Wyoming, North Dakota, South Dakota, and Montana. Performing this implementation from the regional EPA office promotes a better, more direct, relationship and information exchange between EPA and state/local/tribal monitoring programs.

A.3.2.3 MTDEQ Agency-wide QA Program

MTDEQ has established a centralized, agency-wide QA program embodied in an EPA-approved Quality Management Plan (QMP) defining the agency's quality system policies and management guidelines. The QMP defines the agency's QA organization as a "Quality System Core Team" consisting of an "Agency Lead" responsible for the QMP, along with "Program Leads" responsible for conducting detailed QA activities specific to the various environmental media and related programs in MTDEQ. The MTDEQ/AQB Ambient Air Monitoring QA Program derives its QA oversight authority through the agency's EPA-approved QMP.

A.3.2.4 MTDEQ/AQB Ambient Air Monitoring QA Program

The Air Monitoring QA Program is organized in conformity with two broad concepts defined in EPA requirements and related guidance documents.

A.3.2.4.1 Primary Quality Assurance Organization (PQAO)

As detailed in 40 CFR Part 58 Appendix A, Sec. 1.2, a PQAO is a recognized monitoring organization or agency that is responsible for a set of stations at which a pollutant or pollutants are monitored and at which the assessment of data quality can be pooled. This pooled assessment is possible because measurement uncertainty among all stations in the PQAO is expected to be reasonably homogeneous because the stations are operated according to the following common factors:

1. Operation by a common team of field operators according to a common set of procedures (i.e., SOPs and Quick Guides);

2. Use of a common QAPP;
3. Common calibration facilities and standards;
4. Oversight by a common quality assurance organization; and
5. Support by a common management organization (*e.g.,* a state agency) or laboratory.

The PQAO is required to develop and implement a quality system that provides for the clear assessment and documentation of the quality of all monitored data. For that reason, most of the requirements and direction for a quality air monitoring system contained in 40 CFR Part 58 and related documents, including the generation and upkeep of a QAPP, are specifically directed to PQAOs.

The MTDEQ/AQB Ambient Air Monitoring Program is an EPA-recognized PQAO, nationally established as PQAO number 0730.

A.3.2.4.2 Independent Quality Assurance Management.
40 CFR Part 58 Appendix A, Sec. 2.2 and EPA Order CIO 21050 require each PQAO to provide for a quality assurance management function to determine, implement, and report on the PQAO's quality policy. The function must include:

1. Strategic planning;
2. Allocation of resources;
3. Systematic planning activities (*e.g.,* planning, implementation, assessing and reporting) pertaining to the quality system;
4. Sufficient technical expertise and management authority to conduct independent oversight and assure the implementation of the organization's quality system (see 40 CFR Part 58 Appendix A, Sec. 2.4); and
5. Organizational independence from the data generation function and activities.

In the MTDEQ/AQB Ambient Air Monitoring Program these requirements are fulfilled by a QA Manager position. This position performs the following duties:

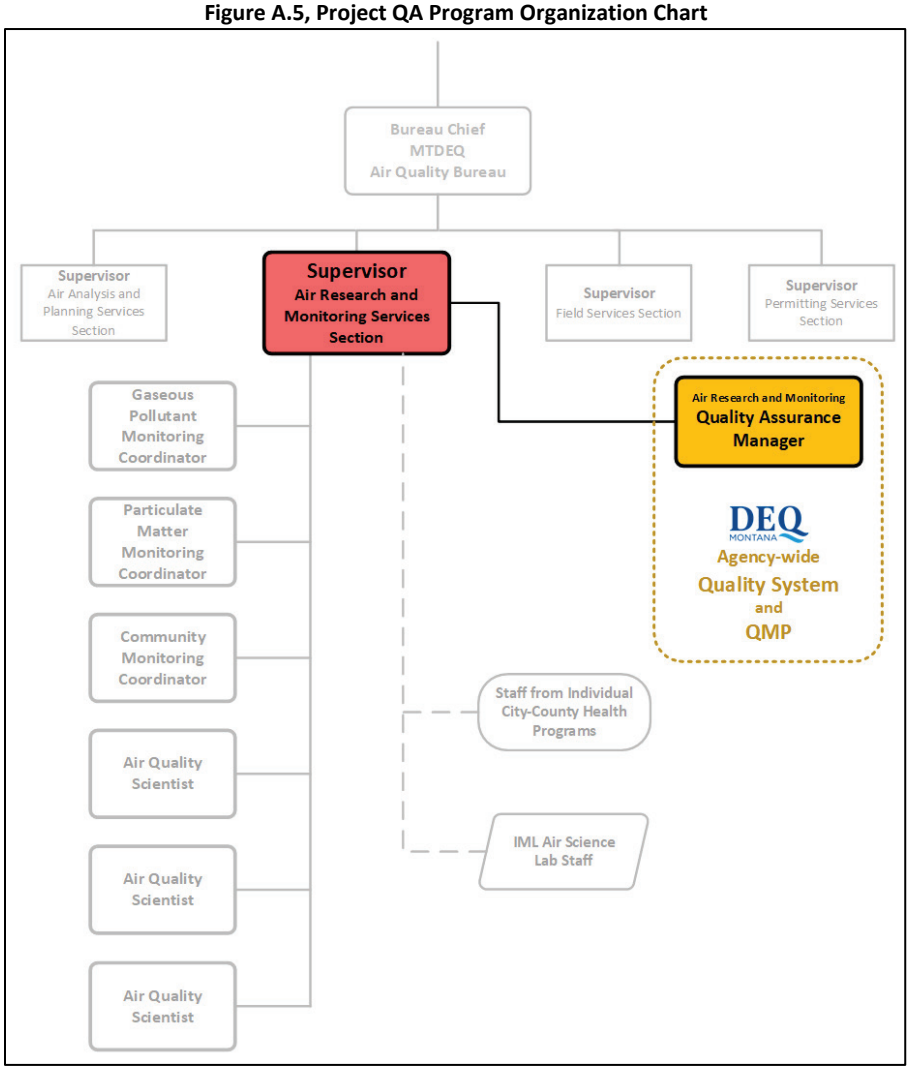
1. Designs and implements the required state quality system for the ambient air monitoring program;
2. Develops, evaluates and approves in-house ambient air monitoring SOPs;
3. Performs system audits through on-site inspection and evaluation of entire measurement systems to assess compliance with established regulations and documented QA objectives;
4. Uses scientific and statistical evaluations to perform data quality assessments and determine if data are the right type, quality, and quantity to support the DQOs; and
5. Functions as the principal investigator/author of the Annual Monitoring Network Plan and Data Certification.

Administratively, the QA Manager reports to the Supervisor of the Air Research and Monitoring Section in the Air Quality Bureau, which facilitates continuous communication and collaboration between the monitoring data producers, the air monitoring QA program and MTDEQ Managers. However, the QA Manager position fulfills the QA “Program Lead” function specified in the MTDEQ QMP and derives its agency QA authority from that structure. In that manner, the

QA Manager functionally operates independently of the monitoring data producers while staying administratively connected.

Figure A.5 displays an organization chart of the MTDEQ/AQB Air Monitoring QA Program.

Figure A.5, Project QA Program Organization Chart

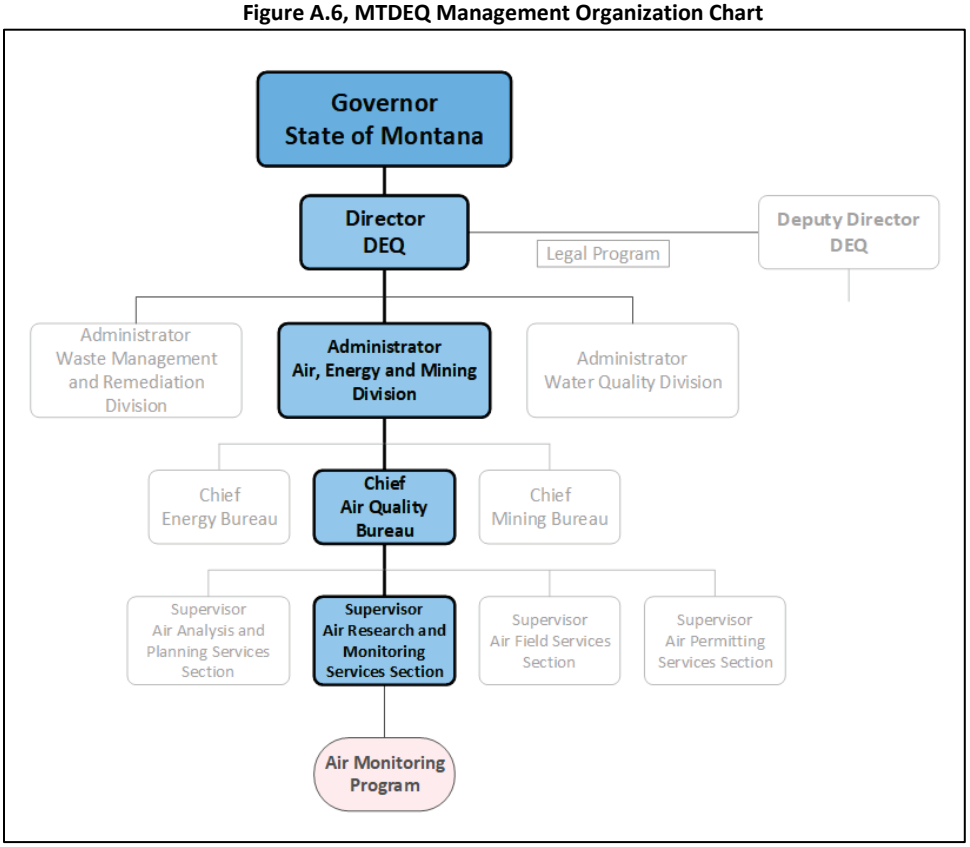


A.3.3 Managers

The Project functions under both indirect and direct managing authority. Indirect management influence is exercised by EPA through the establishment of the NAAQS, the promulgation of directive rules and standards, the provision of funding grants, and the approval or disapproval of the Project QAPP, Data Certification, Annual Network Plan, and independent audits. The Montana Legislature also provides indirect influence on the program through lawmaking, oversight, and funding decisions.

Direct management influence on the Project is exercised through a chain of command organizational hierarchy of executive leadership of the MTDEQ. This influence is exercised through policy, staffing, QMP, overall mission direction, and day-to-day work prioritization decisions. Figure A.6 displays an organization chart of the Montana executive leadership structure directing this Project.

Figure A.6, MTDEQ Management Organization Chart



A.3.4 Data Users / Decision Makers

As stated in Section A.2.1.1., the purpose of this Project is to provide high quality ambient air monitoring data to inform data users and their decisions. Data users, also referred to as decision makers, are the ultimate focus of this Project. Data users are by far the largest and most diverse group of individuals associated with the Project, and as represented in Figure A.1, include all the individuals from the functions described in previous Sections a. through c., plus an array of other groups including the following:

- Members of the public;
- MTDEQ/AQB Planning, Permitting, and Compliance programs;
- State of Montana and statewide City-County health programs;
- EPA decision makers (e.g. attainment/non-attainment designations, NAAQS establishment);
- Public health advocates;
- Federal and state natural resource agencies;
- Educators;
- Researchers;
- Legislators
- Environmental advocacy groups;
- Industry representatives; and
- Science and engineering consultants.

A.4 Project Quality Objectives and Criteria

A.4.1 Defining Measurement Uncertainty

Fundamental to the scientific data collection in the real world is the principle that perfect data of an unlimited quantity is impossible to attain. As a result, it is necessary to establish criteria for both the *performance* of air quality monitoring and the *acceptability* of the produced data to ensure that those data are of sufficient quality and quantity to fulfill the Project purpose, objectives, and DQOs.

Two *sources* of variability or error influence Project data quality: sampling error, and measurement error, as defined in following sections. Both sample and measurement errors can be of two *types*: ***random***, arising from normal variability of our physical world from unknown and/or unpredictable causes; or ***systematic***, a consistent (non-random) bias between the observed and true values of a measurement. Significantly, all sources and types of error compound with one another. The combined/total error from all sources and types is referred to as ***measurement uncertainty***. MTDEQ/AQB employs the DQO quality system planning process to establish the criteria and means to limit measurement uncertainty so that the resulting data meets the Project purpose and objectives.

A.4.2 Categorizing Quality Actions

As used in this QAPP, activities conducted to determine and assess measurement uncertainty and Project quality are categorized into two types: QA and QC. While some overlap of the definitions and processes naturally occurs, an intentional distinction between the two is valuable to direct and conduct a graded and independently ensured quality system.

A.4.2.1 QA describes the whole process of planning, systematizing and implementing a quality program. More specific to this Section, QA refers to independent quality assessments (audits) of Project equipment, certification of measurement instrumentation, final quality assessment of annual produced data and QA/QC results, and approval of SOPs. QA is principally conducted by the Project QA Manager as defined in Section A.3.2.4.2, and by EPA staff. The performance of quality assessments is discussed in Section C, *Assessment and Oversight*.

A.4.2.2 QC describes operational processes and techniques, prescribed maintenance, and regular quality assessments and calibrations on Project equipment; as well as continual review of produced data. QC is normally conducted by data producers as defined in Section A.3.1 above.

A.4.3 Sampling Error

Sampling error as it applies to this Project results from the variability of *external* influences on the quantity of pollutant concentrations in ambient air. These influences can range from very broad in scope, such as the spatial impacts from isolating mountain ranges and valleys, to much smaller-scale impacts, such as those resulting from airflow-modifying trees or buildings. The very near proximity of a pollutant source to a monitor, such as a major highway or an industrial facility, can also result in sampling error. Similarly, temporal variability in pollutant concentrations can influence Project data collection. For example, smoke from an unpredictable wildfire in a distant state that impacts a monitor or monitors is a temporal sampling error.

A.4.3.1 Addressing Sampling Error

In this Project MTDEQ/AQB identifies and addresses sampling error measurement uncertainty through nine mechanisms:

- Application of and adherence to national *Probe and Monitoring Path Siting Criteria for Ambient Air Quality* found in 40 CFR 58 Appendix E. See also the discussion of DQIs in Section A.4.4.2.2)
- Application of and adherence to national *Network Design Criteria for Ambient Air Quality Monitoring* found in 40 CFR 58 Appendix D.
- Application of and adherence to EPA *Guidance on Choosing a Sampling Design for Environmental Data Collection, EPA QA/G-5S,* December 2002.
- Application of and adherence to EPA *Quality Assurance Handbook for Pollution Air Measurements, Volume II, Section 6.0 - Monitoring Network Design*, January, 2017.
- Application of and adherence to EPA *Quality Assurance Handbook for Pollution Air Measurements, Volume I and IV.*
- MTDEQ/AQB internal Project spatial and population assessments.
- Ongoing efforts to increase the number and spatial representation of Project monitoring sites.
- Ongoing efforts to appropriately deploy and collect data from low-cost personal sensors (see EPA: A Guide to Siting and Installing Air Sensors).

A.4.4 Measurement Error

Measurement error is the difference between the measurement value an instrument reports and what the true value is. This type of error results from *internal* causes such as instrument wear or malfunction, electrical power variability, sample flow problems, needed maintenance, electronic drift over time, operator error, laboratory analysis error, or a data communication problem.

A.4.4.1 Identifying and Quantifying Measurement Error

Fundamentally, the assessment of measurement error assures and documents that "the instrument is consistently telling the truth" about what it is measuring. The DQO quality process (Section 4.1.3) establishes a standardized process by which that determination can be made consisting of four components:

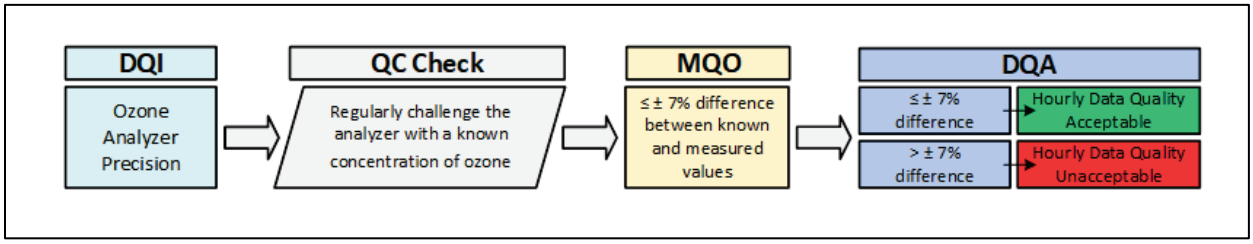
1. **Data Quality Indicators (DQI)** are *attributes* of correct instrument operation. *Precision* and required data recovery or *completeness* are examples of DQI attributes.
2. **Method Quality Objectives (MQO)** are the statistical *limits of acceptability* for a DQI *attribute*. For example, for the DQI of *precision*, an MQO might be ≤ ±7%. Similarly, for the DQI of *completeness*, the MQO might be >75%.

3. **QA/QC Checks** are physical tests or statistical evaluations to determine if the instrument meets the MQO limits for a DQI. A gas analyzer one-point precision check is an example of a QC check.

4. **Data Quality Assessments (DQA)** evaluate the impact of instrument measurement error on the collected data. For example, how the measured *result of a precision check* compares to the MQO reflects whether measured *hourly average concentrations* are acceptable or unacceptable.

Figure A.7 illustrates the relationships between these four components.

Figure A.7 Example DQI – MQO – DQA Relationships



Specific DQIs, QA/QC checks, MQOs and DQAs for this project are discussed in the following sections and listed in Appendices A and B.

A.4.4.2 DQIs - Data Quality Indicators

This Project employs four types of DQIs to address measurement error.

A.4.4.2.1 Primary DQIs

1. **Precision** is the degree of agreement among repeated measurements of the same property under identical, or substantially similar conditions. It is often referred to as “repeatability”.

2. **Bias** is the systematic or persistent (non-random) distortion of a measurement process that causes errors in one direction.

   Precision and bias and are measured by QC checks such as regular 1-point gas analyzer checks, and by the collocation of particulate matter monitors.

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

4. **Sensitivity** is the capability of a method or instrument to discriminate between measurement responses representing different levels of the pollutant of interest. *Detection Limit* is a means of communicating sensitivity and is defined as the lowest concentration or amount of the target pollutant that can be determined to be different from zero by a single measurement at a stated level of probability. It is normally expressed as the *Method Detection Limit* (*MDL)*.

A.4.4.2.2 Programmatic DQIs

Programmatic DQIs determine the type, siting (Section A.4.3.1), and technical installation of each analyzer. These DQIs are related to the Project objectives (Section A.2.1.2) being addressed by each instrument. For example, only FRM or FEM instruments will be employed for NAAQS compliance monitoring, though non-designated instruments may be used for scientific studies, and personal sensors for community informational monitoring.

A.4.4.2.3 Process DQIs

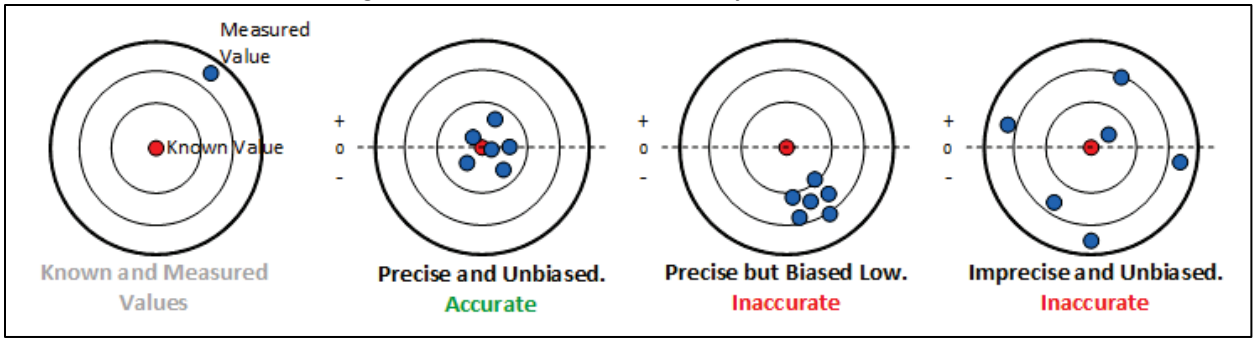
Process DQIs determine the type and frequency of QA/QC checks (Section A.4.4.1) to be performed. Examples include particulate matter (PM) and gas analyzer QA audits.

A.4.4.2.4 Derived DQIs

Derived DQIs are qualitative in nature and used to describe data quality rather than assess its quality. Derived DQIs are never used to void measured data.

1. **Accuracy** is a generic term that is broadly used to describe data quality and refers to how well a measurement agrees with a known value or standard. Technically, accuracy is the combination of precision and bias as defined above, and so is a *derived* DQI. Figure A.8 portrays this relationship graphically.

Figure A.8, Precision, Bias, and Accuracy DQIs Illustrated

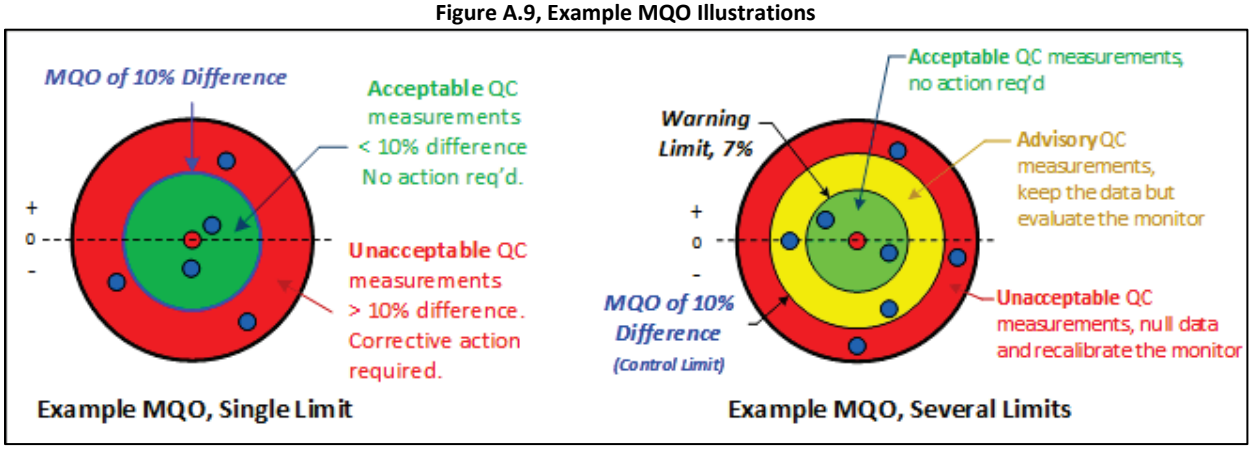


2. **Comparability** is an indication of the confidence with which one data set or monitoring method can be compared to another. It is a derived DQI that qualitatively summarizes the degree to which the objectives of the Primary, Programmatic and Process DQI's are being fulfilled.

A.4.4.3 MQOs - Method Quality Objectives

As introduced in Section A.4.4.1, MQOs are statistically based *limits* that define the acceptability of monitor performance quantified by each of the QC/QA checks. In some cases, an MQO is established with several limits to define different actions corresponding to the degree of difference measured in a QC/QA check. Two types of MQOs are illustrated in Figure A.9.

Figure A.9, Example MQO Illustrations



The MQOs for this Project originate from regulatory requirements, analyzer or sensor manufacturer's technical requirements, operating experience, and the monitor objective (Section A.2.1.3).

A.4.4.4 Minimizing Measurement Error

Project measurement error is *prevented* or *minimized* by operating and maintaining each monitor or sensor according to manufacturer specifications as documented in instrument manuals, and according to written, instrument-specific Project SOPs and Quick Guides. SOPs and Quick Guides are discussed in Section B.3 and listed in Appendix C.

A.4.5 Data Validation Templates

EPA has consolidated DQOs, DQIs, MQOs, and other operational requirements into a single document for each criteria pollutant known as a *Validation Template*. These documents are published by EPA in Appendix D of the *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II Ambient Air Quality Monitoring Program.* It is the SOP for this Project to reference the most recent/current online version of the EPA handbook.

MTDEQ/AQB has edited and reformatted the EPA Validation Templates for the pollutants that are part of this Project. These revised templates are maintained to establish and summarize the relevant DQIs and MQOs for this Project, and are included in Appendix A. Validation templates exclusive to Montana's National Core monitoring site (NCore) are included in Appendix B.

Each Validation Template is comprised of three sections:

1. **Critical Criteria**, elements deemed critical to maintaining the integrity of a sample or group of samples. Observations that do not meet *all* the critical criterion *must* be invalidated unless there are compelling reasons and justification for not doing so.

2. **Operational Criteria,** elements that are important for maintaining and evaluating the quality of the data collection system. Violation of one or more Operational criteria *may* be cause for data invalidation after consideration of other QC information.

3. **Systematic Criteria,** elements that are important for the correct interpretation of data but do not usually impact the validity of a sample or group of samples.

In addition, the Validation Templates discriminate between those elements that are *required* by rule, and those that are *recommended* by air monitoring experts as good operating practice.

A.4.6 Implementing Quality Criteria

The goal of establishing and employing quality criteria is to determine and document that the produced monitoring data are of sufficient quality and quantity to meet the Project purpose and objectives. That goal is realized as the criteria are integrated into the monitoring program and consistently implemented.

- Project quality criteria are listed in Validation Templates discussed in Section A.4.5 and listed in Appendices A and B.
- The process of performing QA/QC assessments is discussed in Section *C., Assessment and Oversight*.
- The process of applying quality assessment results to the monitored data in this Project is discussed in Section B*., Monitoring Network Design, Operation and Quality Control,* and Section D*., Assessment and Oversight*.
- Project SOPs and Quick Guides (Section B.3 and Appendix C) provide specific implementation procedures.

A.5 Project Documents and Records

Five types of documents and records are produced and maintained in this Project:

a. Quality Program Documents;
b. Certifications and Reports;
c. Monitoring Data;
d. Field QA/QC Data; and
e. Equipment and Network Support Information.

This Section focuses on Quality Program Documents. Additional Project document and record types are discussed in Section B, Monitoring Network Design, Operation, and Quality Control; Section C, Data Acquisition, Management and Usability; and Section D, Assessment and Oversight.

A.5.1 Quality Program Documents

A.5.1.1 QAPP

Once finalized and approved via the MTDEQ QMP process, the QAPP document is stored in pdf form on an MTDEQ/AQB network drive. It is subsequently made available to EPA Region 8 via an email submission. The approved QAPP is then made available on the MTDEQ website for public access. Previous QAPP versions are also accessible on the website for historical comparison.

Several mechanisms are employed to ensure that users are referencing the most recent version of the QAPP. First, the document contains version information at the top of each page. Second, when the QAPP is updated, users and interested parties are notified of the version change via email. Third, a list of

document modifications by version is maintained in Appendix F of this QAPP. Finally, the current version is posted on the MTDEQ website as noted above.

The QAPP is reviewed at least annually for needed changes. It is modified, updated and resubmitted every 5 years.

A.5.1.2 SOPs

Written SOPs are stored in pdf form on an MTDEQ/AQB network drive. Version information is recorded in each document. The most recent (active) versions are stored separately from superseded versions and are accessed via an index system to ensure users are referencing the current documents. SOPs are discussed in **Section B.3.** A list of active Project SOPs is included in Appendix C.

A.5.1.3 Instrument Manuals

While not generated by this Project, instrument manuals establish manufacturer specified and EPA approved operating conditions and processes that help define acceptable, quality data outputs. In this Project, Instrument Manuals are stored in pdf form in a dedicated folder on an MTDEQ/AQB network drive.

A.5.1.4 MTDEQ QMP

The MTDEQ Agency QMP (Section A.4.3.2.3) is stored on the MTDEQ *Sharenet* site where it is available to all MTDEQ staff and managers. It is available to the public on request.

A.5.1.5 Project Reports and Certifications

Each year the Project researches and compiles an *Air Monitoring Data Certification* (Data Cert) package and an *Air Monitoring Network Plan* (AMNP) per the requirements and schedule listed in Table A.1 and the processes listed in Sections B.1.2.1-2, and D.1.1.4-5. Both documents are submitted to EPA Region 8. The final version of the AMNP is stored in pdf format on a DEQ shared network drive for reference by MTDEQ staff and managers. It is made available to the public via a link on the MTDEQ website. The Data Cert is stored in pdf format on a MTDEQ network drive.

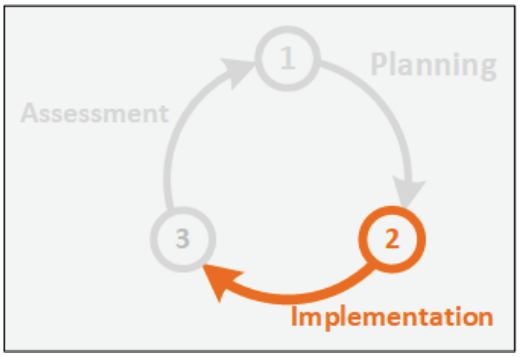
Every five years the Project researches and compiles an *Air Monitoring 5-year Periodic Assessment* (see Sections B.1.2.3, and D.1.1.6) which is also submitted to EPA Region 8, stored in pdf format on a DEQ shared network drive, and made available to the public.

Supporting materials for these documents are stored on an MTDEQ network drive. No retention schedule is defined for either the documents or their background documentation as they are stored without anticipating a deletion date, providing an accessible history for the Project.

B. Monitoring Network Design, Operation and Quality Control

This Project measures concentrations of criteria pollutants in the ambient air to provide high quality data that informs data users and their decisions. In the process flow of the Project, Section A of this QAPP focuses on the *planning* or overall management of the Project. Section B is the first of two sections describing the *implementation* of the Project. This Section focuses on the design, implementation, operation, and quality control of the Project's ambient air monitoring network in four elements:

1. Monitoring Network Design;
2. Monitoring Sampling Methods;
3. Monitoring Standard Operating Procedures; and
4. Monitoring Quality Control.



B.1 Monitoring Network Design

B.1.1 Design Inputs

The first step in implementing this Project is to correctly determine the appropriate target ***pollutants*** and the related ***types***, ***methods***, ***numbers***, ***locations*** and operating ***duration*** of ambient air quality monitors in the MTDEQ network. That determination is accomplished through a deliberate network assessment and design process. Inputs to the Project monitoring network design include:

1. National rule requirements;
2. Communicated information needs;
3. Geophysical and sociological influences; and
4. Available resources.

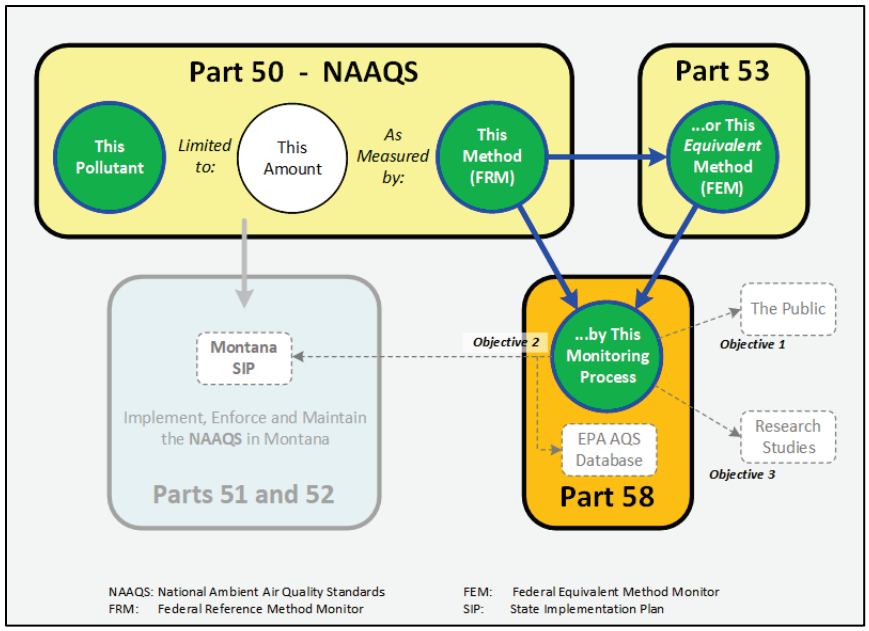
B.1.1.1 National Rule Requirements

Rules published in the Code of Federal Regulations (CFR) establish national requirements for pollutants to be monitored in the ambient air; and the methods, numbers, types, locations, operation, QA/QC, and data reporting from monitors. These rules are principally contained in the following references:

- 40 CFR Part 50, *National Primary and Secondary Ambient Air Quality Standards;*
- 40 CFR Part 53, *Ambient Air Monitoring Reference and Equivalent Methods*; and
- 40 CFR Part 58, *Ambient Air Quality Surveillance*.

Figure B.1 graphically summarizes the relationship between these rules as they apply to this Project. As highlighted there, most of the essential rule foundation for the *process* or "*how*" to monitor, along with essential QA direction, is contained in 40 CFR Part 58.

Figure B.1, Project Federal Rule Relationships, Title 40 Code of Federal Regulations



B.1.1.1.1 Monitoring Objectives

The Project Objectives established in 40 CFR 58 Appendix D Section 1.1 and presented in Section A.2.1.2 are foundational to the design of the monitoring network. These Project objectives are restated here, in a non-priority order of equal importance:

1. Provide air pollution data to the general public in a timely manner.
2. Support compliance with ambient air quality standards and emissions strategy development.
3. Support for air pollution research studies.

The pollutants that are measured by the Project, the types of networks, monitors and sites employed, and the spatial scale represented by each monitor are established by design based on the Project objectives. An individual monitor or monitoring site may be established and operated to fulfill these objectives individually or in any combination.

B.1.1.1.2 Criteria Pollutants

As introduced in Section A.2.1.1, 40 CFR Part 50 establishes health and welfare-based National Ambient Air Quality Standards (NAAQS) for six common air pollutants in the ambient air:

1. Ozone (O_3);
2. Carbon Monoxide (CO);
3. Nitrogen Dioxide (NO_2);
4. Sulfur Dioxide (SO_2);
5. Lead (Pb); and
6. Particulate Matter (PM); consisting of
   - PM of 10 microns and less (PM_{10});
   - PM of 2.5 microns and less ($PM_{2.5}$); and
   - PM between PM_{10} and $PM_{2.5}$ (PM_{coarse} or $PM_{10\text{-}2.5}$).

Monitoring designed by this Project to address Objective number 2, the support of compliance with ambient air quality standards, focuses exclusively on the measurement of only these six pollutants and related meteorological parameters. Monitoring designed by this Project to address Objectives 1 and 3 is also focused on these pollutants, but may include other airborne contaminants (e.g. asbestos, or chemical components of PM) on a project-specific basis.

B.1.1.1.3 Network Types

The Project monitoring network is largely designed to address Objective 2. As a result, the Project's principal *network type* is designated for that purpose by 40 CFR 58 Appendix D as a State or Local Air Monitoring Stations (SLAMS) network. This Project follows the design criteria specific to individual NAAQS pollutant monitoring at SLAMS sites as established in 40 CFR Appendix D, Section 4.

Beyond NAAQS compliance monitoring, subsets of the SLAMS network can include the following additional *network types*, each with its own specific design criteria:

- National Core Monitoring Stations (NCore), 40 CFR 58 Appendix D Section 3;
- $PM_{2.5}$ Chemical Speciation Network Stations (CSN), 40 CFR 58 Appendix D Section 4.7.4; and
- Photochemical Assessment Monitoring Stations (PAMS), 40 CFR 58 Appendix D Section 5.

Of these three, this Project operates sites within the NCore and CSN network types.

B.1.1.1.4 Monitor Types

The following types of *monitors* may be included in the network as discussed in 40 CFR Part 58, and defined Parts 50 and 53:

- Federal Reference Method monitors (FRM);
- Federal Equivalent Method monitors (FEM); and
- Approved Regional Method monitors (ARM, not used in this Project); and
- Special Purpose Monitors (SPM).

In addition, experimental monitors or personal sensors which do not have an EPA designation may be employed by the Project in efforts to address Objectives 1 and 3.

B.1.1.1.5 Site Types

40 CFR 58 Appendix D Section 1.1.1 states that "a network must be designed with a variety of types of monitoring sites" to provide a range of specific information to fulfill the individual Project Objectives. Network design establishes sites to collect data according to six general *site types* as specified by the CFR:

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 NAAQS standards**.
6. Sites located to measure air pollution impacts on visibility, vegetation damage, or other **welfare-based** impacts.

B.1.1.1.6 Site Spatial Scales

Based upon the *site type*, matrices of attributes are applied to assess and define the geographic extent or *spatial scale* that a monitor or monitoring station can represent. The following three tables work together to inform that network design assessment using information from 40 CFR 58 Appendix D:

- Table B.1 **defines** six *spatial scale* categories based on the geographic area each category represents.
- Table B.2 **assigns** *spatial scale* categories that each *site type* may represent.
- Table B.3 **applies** *spatial scale* categories to the measurement of individual criteria pollutants and *network types* (Section B.1.1.1.3).

Table B.1, Spatial Scales Defined

Geographic Area	Spatial Scale
Several meters to ~100 meters	Micro
100 meters to 0.5 kilometers	Middle
0.5 to 4.0 kilometers	Neighborhood
4 to 50 kilometers, urban areas	Urban
10's to 100's of kilometers; rural areas	Regional
Characterizing the entire nation or globe	National and Global

Table B.2, Network Design Matrix for Monitor Types and Spatial Scales

Site Type	Appropriate Spatial 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

(See Table B.3, next page…)

Table B.3, Spatial Scales by Pollutant and Network Type

Spatial Scale	SLAMS Sites					NCore Sites	CSN Sites
	SO_2	O_3	NO_2	PM_{10}	$PM_{2.5}$		
Micro	✓		✓	✓	✓		
Middle	✓		✓	✓	✓		
Neighborhood	✓	✓	✓	✓	✓	✓	✓
Urban	✓	✓	✓		✓	✓	✓
Regional		✓			✓	✓	

B.1.1.2 Rule Application When Not Required

Wherever possible and appropriate, the Project applies rule-designated design criteria to monitors where it is not required, such as applying the rule-based criteria established for Project Objective 2 monitoring sites to sites or monitors established distinctly to address Project Objectives 1 and 3. For example, the Project applies rule-based *siting criteria* (Section A.4.3.1) to the installation of experimental monitors or personal sensors. This approach promotes the greatest possible quality, representativeness, comparability, and scientific credibility of all collected data.

B.1.1.3 Communicated Information Needs

Project network design may be influenced by the need for specific ambient monitoring communicated to the Project by members of the public or other regulatory partners. These entities may include the Bureau of Land Management, National Park Service, United States Forest Service, Tribal governments, or Montana city/county governments or health agencies.

Other types of monitoring may also be desirable or requested to support programs within Montana DEQ such as Regional Haze, Smoke Management, air quality nonattainment or maintenance plan monitoring, or asbestos remediation.

B.1.1.4 Geophysical and Sociological Influences

Multiple factors influence air quality and its impacts on people. These dynamic elements can affect local, statewide, regional, and even global scale air quality, and must be accounted for in Project network design. Some of the most significant factors include:

- Population and demographics;
- Physical topography and meteorology;
- Air pollution transport from other areas;
- Pollutant sources and emission rates; and
- Emergency episodes such as wildfires and structure fires.

B.1.1.5 Available Resources

The resources required to establish, operate, maintain, QA/QC, and manage data from Project monitors are significant. Consequently, network design includes the review and prioritization of both existing and proposed monitors to define what can be supported with available funding and personnel while continuing to provide the highest quality information that meets the Project purpose and objectives.

B.1.2 Design Process

Network design is conducted through both informal and formal processes. Network design takes place *informally* and continuously as Project staff, QA staff, and Management evaluate and respond to day-to-day network operation issues. These matters can include such things as instrument maintenance needs, emergency pollution episodes, instrument downtime, power failures, new monitoring methods, pollutant source changes, significant data requests, or other things that have the potential to influence the near-term makeup, quality, or operation of the network.

Network design is also conducted in a *formal* process that aggregates, analyzes and documents the ongoing informal review processes into regular, required, structured, and approved network plans and actions. The formal network design process is conducted under three national rule programs:

B.1.2.1 Annual Network Plan

Each year this Project reviews its monitoring network as required by 40 CFR 58.10(a). The documentation of that review is known as an *Annual Network Plan* which must include the following components:

1. Documentation of the establishment and maintenance of an air quality surveillance system consisting of SLAMS monitoring stations.

   The plan must include a statement of whether the operation of each monitor meets the requirements of the following appendices of 40 CFR Part 58 as applicable:

   - *Appendix A: Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards*;
   - *Appendix B: Quality Assurance Requirements for Prevention of Significant Deterioration (PSD) Air Monitoring*;
   - *Appendix C: Ambient Air Quality Monitoring Methodology*;
   - *Appendix D: Network Design Criteria for Ambient Air Quality Monitoring*; and
   - *Appendix E: Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring*.

2. Documentation of the establishment and maintenance of monitors designated as Special Purpose Monitors (SPMs) per 40 CFR 58.20. SPMs do not count towards the fulfillment of the minimum number or siting of monitors required be 40 CFR 58 Appendix D, but still must meet the QA requirements of 40 CFR 58 Appendix A.
3. Documentation of proposed changes to monitors operating to determine NAAQS compliance.
4. A plan for establishing required NCore multipollutant stations.
5. A plan for establishing source-oriented Pb monitoring sites when required by Appendix D.
6. Plans for acceptable monitoring of each criteria pollutant.
7. A list of specific information describing each site in the monitoring network.
8. A plan for review of changes to a $PM_{2.5}$ monitoring network that impact the location of a violating $PM_{2.5}$ monitor. The plan must document the process for obtaining public comment and include any comments received (see 40 CFR 58.10(a)(1)).
9. An annual report of compliance with the SO_2 Data Requirements Rule as required in 40 CFR 51.1205.

The Annual Network Plan process provides a valuable opportunity for the MTDEQ/AQB to formally review the ambient air monitoring network and to solicit, evaluate, and respond to comments and input from the public, county agencies, and other interested parties. The final draft of the Plan document is made available to the public for at least 30 days for this purpose, and the final version includes and addresses, as appropriate, any comments or input received during this period. The final document must be submitted to the EPA Regional Administrator by July 1 of each year. The EPA Regional Administrator must approve or disapprove a complete plan within 120 days of submission.

B.1.2.2 Periodic Network Assessment

Every 5 years, as required by 40 CFR 58.10(d), the Project must assess:

1. If the network meets the monitoring objectives defined in 40 CFR 58 Appendix D;
2. Whether new monitoring sites are needed;
3. Whether existing sites are no longer needed and can be terminated;
4. Whether new technologies are appropriate for incorporation into the ambient air monitoring network;
5. Whether the network supports air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma);
6. The effect that proposed discontinuance of sites will have on data users other than the agency itself, such as nearby states and tribes, or ongoing health effects studies.

In addition, 40 CFR 58.14(a) requires the Project to assemble a *Network Modification Plan and Schedule* that reflects the network changes planned within the Network Assessment process. This modification must be submitted with the first Annual Monitoring Plan after the 5-Year Assessment.

In practice, the Project typically evaluates these components annually and includes documentation of that evaluation in the Annual Network Plan. However, the 5-year Periodic Assessment focuses more specifically on longer-term trends and planned network changes that are proposed as a result. The 5-year Assessment must be submitted to the EPA Regional Administrator along with the Annual Network Plan by July 1 of the plan year.

B.1.2.3 Network Modification

As described in the previous two sections, Project network design processes may result in proposals to modify the existing monitoring network. These proposals typically focus on establishing a new monitor or moving/discontinuing an existing monitor. Those change proposals are most often documented in the Annual Network Plan and/or the Periodic (5-year) Network Assessment, though circumstances may arise that dictate network changes outside the timeframes or scope of those documents. In each of these three cases, changes to SLAMS network monitors (see Section B.1.1.2 and B.1.2.1 bullet 3) require the review and approval of the EPA Regional Administrator per 40 CFR 58.14(b). Desired changes requested outside the Annual Network Plan or Network Assessment must be communicated in writing to the Administrator, typically on forms provided by EPA.

In addition, 40 CFR 58.14(c) establishes criteria under which SLAMS monitor discontinuations are justified and will be approved by the Regional Administrator. When SLAMS discontinuations are desired, this Project evaluates the status of these conditions at the stations under scrutiny and incorporates a discussion of the outcomes in requests for SLAMS network modifications.

The desired establishment, moving or discontinuance of non-SLAMS monitors does not require EPA approval. However, the Project typically includes these proposed changes in the Annual Network Plan for public input and comment and for communication of the network design to EPA.

B.1.3 Design Outputs

Project design *outputs*, like the design process, are both informal and formal. Informal design outputs include responses to immediate needs where EPA approval is not required. For example, the establishment of a temporary monitor to evaluate the impacts of wildfire smoke on a community is an informal design output.

Formal design outputs are established in documents intended for public comment and EPA review and approval. These documents are generated through the deliberative Annual Network Plan and Five-Year Network Assessment processes described in Section B.1.2. They communicate the degree to which the existing network meets requirements for the appropriate ***method***, ***number***, ***type***, ***location*** and operating ***duration*** of monitors in the Project network, detail the degree to which previously approved network changes were accomplished, and propose plans for any needed or desired network modifications in the next review period. Annual Network Plan and Five-Year Network Assessment documents may be found on the Montana DEQ Website.

B.2 Monitoring Sampling Methods

Ambient air monitoring instruments function according to different mechanisms and have different applications. The selection and deployment of the most appropriate sampling methods within this Project depends on three factors:

1. The Project Objective(s) for which monitoring is being performed (Sections A.2.1.2 and B.1.1.1.1);
2. The needed/required data period and frequency; and
3. The monitoring operations that result in the most representative and consistent results, with the lowest errors and highest levels of reliability and comparability within each individual instrument and across the monitoring network.

B.2.1 FRM – FEM Methods for NAAQS Monitoring

The foundation for selecting appropriate Project sampling methods is established in 40 CFR Part 50. When an objective of the desired monitoring includes support of NAAQS compliance (Project Objective 2), the CFR requires that the monitoring be performed by the method determined by EPA as the *Federal Reference Method* (FRM) for each individual Criteria Pollutant as established within the NAAQS rule for that pollutant. Optionally, the monitoring may be performed by a method determined by EPA to be *equivalent* to the FRM and designated as a *Federal Equivalent Method* (FEM). The *processes* for designating monitoring methods as FRM or FEM are detailed in 40 CFR part 53.

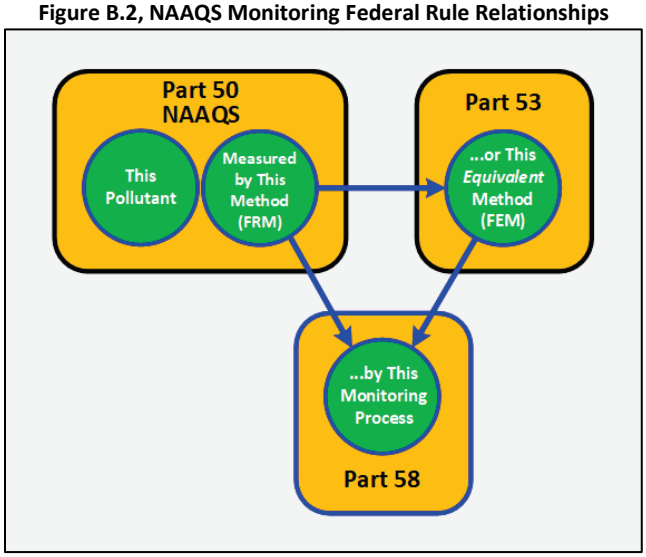
For example, the national primary and secondary NAAQS for $PM_{2.5}$ is established in 40 CFR 50.18(a)…

- as measured by "*a reference method based on appendix L*" of part 50 (40 CFR 50.18(a)(1)), ***or***
- by "*an equivalent method designated in accordance with part 53…*" (40 CFR 50.18(a)(2)).

Each of the NAAQS rules and related appendices in Part 50 establish requirements for the *form* of the NAAQS, its *interpretation* for compliance assessment purposes, and *analytical processes* of the FRM.

Section 2.1 of Appendix C of 40 CFR 58, *Ambient Air Quality Surveillance*, states: "Except as otherwise provided in this appendix, a criteria pollutant monitoring method used for making NAAQS decisions at a SLAMS site must be a *reference or equivalent method* as defined in § 50.1 of this chapter" (emphasis added). Thus, 40 CFR parts 50, 53, and 58 together form an aggregate body of direction for selecting sampling methods for Project monitoring. Figure B.2 graphically represents the relationships between these rules.

Figure B.2, NAAQS Monitoring Federal Rule Relationships



For $PM_{2.5}$ monitors, further discrimination of FEM types is made in 40 CFR Part 53. The rules embodied there define Class I, Class II, and Class III equivalent $PM_{2.5}$ monitoring methods. This Project employs only automated continuous Class III methods for its $PM_{2.5}$ FEM measurements.

EPA provides a list of monitoring methods that it has designated as either FRMs or FEMs on its *Ambient Monitoring Technology Information Center* (AMTIC) website. The list is updated regularly as new methods achieve designation. For methods designated as FEMs, the list includes the specific equipment configuration and operating parameters that must be employed in the field for the instrument measurements to be acceptable for NAAQS compliance determination purposes.

The EPA *Air Quality System (AQS) Code List website* provides a related list in a table entitled "*Sampling Methods for Criteria Pollutants*" that provides additional information about the various methods.

Appendix D contains a *Method Table* which aggregates the information from the AMTIC and AQS lists into a summary of the monitor and parameter method codes for just the monitors employed within the Project network.

Both lists include a variety of different manufacturers' instrumentation that have received an FRM or FEM designation. This Project typically employs no more than two different manufacturers' FEM methods for any given pollutant to manage operation, maintenance, and spare parts processes; and to maintain instrument measurement comparability throughout the state monitoring network. However,

the Project does sometimes temporarily employ different manufacturers' equipment for comparative, trial examinations.

This Project only uses FRM or FEM designated monitors for measuring concentrations of criteria pollutants in ambient air in support of NAAQS compliance (Project Objective 2).

B.2.2 SPM Methods

SPMs, or special purpose monitors, are employed by the Project in support of Objective 1: *provide air pollution data to the general public*, and Objective 3: informing *air pollution research studies*, but ***not*** Objective 2: supporting *compliance with ambient air quality standards and emissions strategy development*. The Project-employed SPM instrument methods are normally not FRMs, and may or may not be FEMs, as determined on a site-by-site basis through the network design processes discussed in Section B.1.

B.2.2.1 SPMs with FEM Instruments

The operation of FEM instruments as SPMs must meet specific requirements embodied throughout 40 CFR Part 58. Table B.4 summarizes these requirements.

Table B.4, Requirements for FEMs* Operated as SPMs

Requirement	40 CFR 58 Reference
Does not count for compliance with required number of monitors in Part 58 Appendix D	58.1
Must be designated as an SPM in AQS	58.1
Must be included in the periodic assessments and annual monitoring network plan	58.10
Must follow the QA criteria in Part 58 Appendix A	58.11(a)
Appendix C (Ambient Air Quality Monitoring Methodology) criteria are optional	58.11(b)
SPM designation is subject to approval of the Regional Administrator	58.11(c)
Changes in SPM stations do not require Administrator approval	58.11(c)
Adherence to Appendix E (siting criteria) is optional	58.11(d)
Must be included in annual air monitoring data certification and network data summary	58.15
Must be included in the periodic assessments and annual monitoring network plan	58.20(a)
Must meet the technical and operating schedule requirements of 58.11 and 58.12, and Appendix A.	58.20(b)
Collected data must be submitted to AQS	58.20(b)
After operating for more than 24 months all data are eligible for comparison to the relevant NAAQS (except as provided in 58.20(d).	58.20(c)
Prior approval from EPA is not required for discontinuance	58.20(f)

*These requirements also apply to FRMs and Approved Regional Methods (ARMs) operated as SPMs.

B.2.2.2 SPMs with non-FEM Instruments

The rules in 40 CFR Part 58 do not directly apply to the operation of non-FEM instruments operated as SPMs (see 40 CFR 58.11(b)). However, this Project applies the principles and practices of the 40 CFR 58 Appendix A QA requirements and Appendix E siting requirements to the greatest degree possible at *all* monitoring sites to obtain the highest quality data and maintain instrument measurement comparability throughout the state monitoring network.

B.2.3 NCore and Other Methods

Several additional method categories are referred to in 40 CFR Part 58 for air monitoring associated with the NCore, CSN, and PMS networks (see Section B.1.1.1.3). In addition, 40 CFR Part 58 provides for the establishment of unique Approved Regional Methods (ARM) that, when approved by the EPA regional administrator, may be used for NAAQS compliance or SPM monitoring purposes. The regulatory future of this category is uncertain, but irrespective of that question the Project does not have any ARM monitors and does not foresee pursuing any in the future. Of the remaining "other" categories, this Project includes monitors only within the NCore and CSN methods. The CSN monitoring performed as part of this Project is conducted under a separate QAPP and not discussed further here.

Multipollutant NCore monitoring performed as part of this Project is conducted by FRM or FEM methods as detailed in 40 CFR 58 Appendix C Section 3.0; 40 CFR 58.13; 40 CFR 58 Appendix A; 40 CFR 58 Appendix D Sections 2(c), 3, and 4; and 40 CFR 58 Appendix E. Additionally, the EPA *AMTIC* website provides EPA guidance on the NCore monitoring methods and their operation. Table B.5. summarizes the Project's NCore monitoring methods.

Of particular significance, the noted rules and guidance require that three gases, CO, SO_2, and NO/NOy, be monitored at very low or "trace" levels. EPA's *Technical Assistance Document (TAD) for Precursor Gas Measurements in the NCore Multi-pollutant Monitoring Network* (see NCore Gas TAD) provides particular guidance on this topic. In addition, because of these unique monitoring requirements, MQOs for the NCore trace-level gas monitoring are listed in Appendix B, separate from the normal Data Validation Templates discussed in Section A.4.5 (see Appendices A).

Table B.5, NCore Monitoring Methods Summary

Parameter	Description
$PM_{2.5}$ Speciation	Organic and elemental carbon, major ions and trace metals (24-hour average; every 3rd day); IMPROVE or CSN
$PM_{2.5}$ FRM mass	24 hr. average at least every 3rd day
Continuous $PM_{2.5}$ mass	1 hour reporting interval; FEM or pre-FEM monitors
$PM_{10-2.5}$ mass	Filter-based or continuous
Ozone (O_3)	Continuous monitor
Carbon monoxide (CO)	Continuous monitor capable of trace levels (low ppm and below) where needed
Sulfur dioxide (SO_2)	Continuous monitor capable of trace levels (low ppb and below) where needed
Total reactive nitrogen (NO/NOy)	Continuous monitor capable of trace levels (low ppb and below) where needed
Surface meteorology	Wind speed and direction (reported as "Resultant"), temperature, Relative Humidity

B.2.4 Non-FEM and Sensor Methods

The Project employs several types of non-FEM monitoring methods in locations where the monitoring objectives are *only* to provide air pollution data to the general public and/or to support air pollution research studies. These methods include the following types:

1. Stationary, non-FEM Beta Attenuation Monitors (BAMs);
2. Portable, non-FEM Environmental Beta Attenuation Monitors (EBAMs);
3. Small personal sensors or low-cost monitors (Sensors);

4. Trial or experimental monitors; and
5. Equipment and samplers used to measure non-criteria pollutants (e.g., VOCs, asbestos).

B.2.4.1 Sensor Method Details

Advances in air monitoring technology have made lower cost, portable, non-regulatory-grade (FRM/FEM) equipment readily available. These devices, referred to as "sensors" in this QAPP, provide an important opportunity for providing health-based air pollution data to the public in more locations and in greater numbers than can be accomplished by FRM/FEM instrumentation. The challenge that comes with this low-cost technology is that these sensors are not as accurate or reliable as FRM/FEM instrumentation. In some cases, and under certain conditions, these sensors may exhibit undesirable biases in their measurements. Their simplicity, which is advantageous, unfortunately provides no means of calibration or accuracy adjustment. Sensors are, however, reliable enough to meet the needs of individuals, schools and organizations for citizen-level decision-making, especially when deployed in integration with the FEM/FRM network. This makes them a useful and valuable tool for public notification. To maintain a high level of data quality and confidence, the Project deploys and operates sensors under a quality system described in Sections B.4.2.4 and D.1.1.7.

Currently, the Project employs only $PM_{2.5}$ sensors, though continuing technological advances may make sensors for other air pollutants part of the network in the future.

B.2.5 Meteorological Monitoring Methods

The Project monitors several basic meteorological parameters to provide a site-specific context for its pollutant measurements. At all monitoring sites the Project monitors and records ambient temperature. At many monitoring sites the Project also measures and records wind speed, wind direction and wind direction variability (sigma theta).

In most cases (except NCore) the Project's meteorological monitoring devices do not require EPA approval and do not trigger the specific QA requirements established in EPA's *Quality Assurance Handbook on Air Pollution Measurement Systems, Volume IV: Meteorological Measurements.* However, the Project endeavors to employ applicable QA / QC practices, including siting criteria, to wind and temperature measurement instruments to ensure the data they produce are representative of actual conditions and of a dependable quality to inform data user decisions. QA/QC procedures for Project meteorological monitoring are discussed in Sections B.4.1.2.3 (Calibrations) and B.4.2.3 (Monitor Checks).

B.2.5.1 Ambient Temperature Methods

The Project employs two methods for obtaining ambient temperature. First, ambient temperature is recorded at some sites from the outdoor sensor(s) associated with PM monitoring at the site. Second, ambient temperature is monitored at some sites by means of a shielded temperature sensor, either with or without a motor-driven aspirator. These devices are deployed in addition to the PM monitor measurements, or, at stations where no PM is measured, as the unique temperature measurement system depending on the monitoring requirements and history of the station.

B.2.5.2 Wind Measurement Methods

The Project exclusively employs sonic anemometers for obtaining wind measurements. This method has been documented as an appropriate and accepted monitoring method in Tables 0-3 and 0-5 of the most recent (2008) version of Volume IV of the *EPA Quality Assurance Handbook for Air Pollution Measurement Systems*.

B.2.6 Operating Schedules

The various types of monitoring methods summarized in the previous sections are operated by the Project according to specific schedules defined by three criteria:

1. **The monitor's objective(s)**.
   Monitors established to support NAAQS compliance must be operated according to specific rule-required schedules documented in 40 CFR 58.12. Monitors established for public information only do not have a rule-required operating schedule. However, this Project is committed to providing data to the public in as near a real-time manner as possible. Monitors established for scientific studies are operated according to schedules that meet the intended purposes of the study.

2. **The monitor's function**.
   Project monitors are established to provide several distinct functions within the broad monitoring objectives. An individual monitor may be established to:

   a. Measure pollutant concentrations;
   b. Measure contextual meteorology; or
   c. Provide QC comparisons.

   Operating schedules reflect those functions as defined in 40 CFR 58.12.

3. **The monitor's operational mechanics**.
   Project monitors are of two distinct operational types:

   a. Continuous automated monitors; and
   b. Episodic manual monitors.

   The Project network design (Section B.1), measures and reports pollutant concentrations and meteorology from instruments that operate continuously and automatically except for periods of maintenance, repair, or QC/QA checks.

   Manual monitors require operator intervention (setup) before and after each sampling event and therefore operate episodically rather than continuously. In this Project manual monitors are included in the network design for two purposes:

   1. For QC purposes, providing periodic FRM data with which the output of continuous FEM PM monitors is compared as an indication of network precision and bias (see Section B.4.2.2.1); and

2. To collect samples for analysis to determine the chemical makeup (i.e., speciation) of $PM_{2.5}$ mass measurements.

As a significant reference, manual monitors are also the prescribed FRM method for measuring lead (Pb) in the ambient air. No Pb monitoring is required or conducted in the current Project network. Should Pb monitoring become necessary, approved manual method monitors will be deployed.

Project monitors are operated according to schedules established in 40 CFR Part 58 for the matrix of monitor objectives, functions, and operational mechanics in the network design. The rules are principally focused on NAAQS compliance monitoring, but the Project applies these operating schedules to all its monitoring endeavors to maintain consistency and comparability across the monitoring network. Sections B.2.6.1 and B.2.6.2 below provide excerpts from portions of those rules to provide guidance and context for this QAPP. The excerpts are not exhaustive or comprehensive, and the Project consults the CFR before establishing an appropriate operating schedule for each monitor.

B.2.6.1 Continuous Method Schedules

- "For *continuous* analyzers, consecutive hourly averages must be collected except during periods of routine maintenance, periods of instrument calibration, or periods or monitoring seasons exempted by the Regional Administrator" (§ 58.12(a)).

- "For *continuous* SO_2 analyzers, the maximum 5-minute block average concentration of the twelve 5-minute blocks in each hour must be collected except as noted in § 58.12(a)" (§ 58.12(g)).

- "Requirement for *Continuous* $PM_{2.5}$ Monitoring. The State, or where appropriate, local agencies must operate *continuous* $PM_{2.5}$ analyzers equal to at least one-half (round up) the minimum required sites listed in Table D-5 of this appendix." (§ 58.12 Appendix D Section 4.7.2).

- "Any NO_2 FRM or FEM used for making primary NAAQS decisions must be capable of providing hourly averaged concentration data" (§ 58.12 Appendix C Section 2.1.1).

B.2.6.2 Manual Method Schedules

Manual methods (including CSN monitors) operate on a nationally established annual monitoring schedule at 1-in-3 (i.e., every third day), 1-in-6, or 1-in-12-day sampling frequencies. The current annual national monitoring schedule calendar is posted on the EPA AMTIC website.

- For manual PM2.5 samplers:

  - "*Manual* $PM_{2.5}$ samplers at required SLAMS stations without a collocated continuously operating PM2.5 monitor must operate on at least a 1-in-3 day schedule unless a waiver for an alternative schedule has been approved per paragraph (d)(1)(ii) of this section" (§ 58.12(d)(1)(i)).

  - "For SLAMS $PM_{2.5}$ sites with both *manual* and *continuous* $PM_{2.5}$ monitors operating, the monitoring agency may request approval for a reduction to 1-in-6 day $PM_{2.5}$ sampling or for seasonal sampling from the EPA Regional Administrator." (§ 58.12(d)(1)(ii)).

- "Required SLAMS stations whose measurements determine the 24-hour design value for their area and whose data are within ±5 percent of the level of the 24-hour $PM_{2.5}$ NAAQS must have an FRM or FEM operate on a daily schedule if that area's design value for the annual NAAQS is less than the level of the annual $PM_{2.5}$ standard. A *continuously* operating FEM or ARM PM monitor satisfies this requirement…" (§ 58.12(d)(1)(iii)).

- "Changes in sampling frequency attributable to changes in design values shall be implemented no later than January 1 of the calendar year following the certification of such data as described in § 58.15" (§ 58.12(d)(1)(iv)).

- "*Manual* $PM_{2.5}$ samplers at NCore stations and required regional background and regional transport sites must operate on at least a 1-in-3-day sampling frequency" (§ 58.12(d)(2)).

- "For PM_{10} samplers, a 24-hour sample must be taken from midnight to midnight (local standard time) to ensure national consistency" (for both continuous and manual samplers. § 58.12(e)).

B.2.6.3 Seasonal Operating Schedules

The Project monitoring network operates according to the schedules described above all year around. However, two monitoring efforts warrant further description within that context.

B.2.6.3.1 Ozone Season

Ozone is not a pollutant that is directly emitted from industrial or natural sources but is formed by atmospheric chemistry from emitted precursors impacted by ultraviolet (UV) light. Consequently, ozone monitoring is only *required* during those seasons of the year that are conducive to its formation—that is, the sunnier (high UV) months of the year. For Montana, 40 CFR 58 Appendix D Section 4.1(i) designates the months of April through September as "ozone season", during which monitoring is required. However, the Project monitors ozone during all 12 months of the year, preferring to inform a broader understanding of ozone formation in this state including a significant representation of background concentrations, regional variations, possible impacts from long range transport, and a dynamic referred to as stratospheric intrusion.

In contrast to the above, ozone monitoring *is required* year around at NCore sites per 40 CFR 58 Appendix D Section 4.1(i).

B.2.6.3.2 Wildfire Smoke Season

Wildfire smoke from fires both within and outside the state often result in significant impacts to the citizens of Montana. These are notably more prevalent in the time period roughly equivalent to the ozone season; a time locally described as "smoke season," from April or May through September or October. During this season the Project may temporarily deploy portable, continuous, non-FEM instruments (EBAMs) to measure and report on smoke impacts to significantly impacted population areas in response to requests from local health agencies. The instruments are removed once the smoke events have ended.

B.2.6.4 Operating Schedule-- Data Completeness

For data users (see Section A.3.4) to make informed, confident decisions from Project monitoring data, it is imperative that those data be not only of the highest *quality*, but also of sufficient *quantity* to be representative of actual conditions. The minimum allowable level of data *quantity* is referred to as *completeness*.

For NAAQS compliance, monitoring minimum completeness standards are established in 40 CFR Part 50 along with the NAAQS limits and reference monitoring method for each criteria pollutant. In general, completeness is understood as the collection of valid data for at least 75% of any averaging period. That standard is applied by the Project for all monitoring objectives. Table B.6 lists the data completeness goals for this Project.

Table B.6, Project Data Completeness Goals

Averaging Period						
Pollutant	**1-hour [1]**	**3-hour**	**8-hour**	**24-hour**	**Quarterly**	**Annual**
Continuous Methods						
CO	≥ 45 minutes		≥ 6 hours			
O_3 8-hr avg[2]	≥ 45 minutes		≥ 6 hours			
SO_2	≥ 45 minutes	All 3 hours ≥ 45 minutes		≥ 18 hours		≥ 75% of hours in a year
NO_2	≥ 45 minutes				All 4 qrtrs. ≥ 75 % of days	≥ 75% of hours in a year
NO_y [3]	≥ 45 minutes					
PM_{10}	≥ 45 minutes			≥ 18 hours		≥ 75% of hours in a year
$PM_{2.5}$	≥ 45 minutes			≥ 18 hours		All 4 quarters ≥ 75%
$PM_{10\text{-}2.5}$ [3]	≥ 45 minutes					
Manual Methods						
$PM_{2.5}$				1,380 to 1,500 minutes		All 4 quarters ≥ 75%
Pb				1,380 to 1,500 minutes	Avg 3-month capture ≥ 75%	
CSN				1,380 to 1,500 minutes		

Indicates an averaging period for a NAAQS standard.
Indicates an averaging period for a MAAQS standard

[1] A complete 1-hour period is not specifically defined in rules. The Project defines it as listed by applying the general "75%" completeness expectation and the guidance of the EPA Quality Assurance Handbook Volume II, Section 6.4.1.

[2] Contrast the O_3 *daily max* 8-hour average which is the highest of the 17 consecutive 8-hour averages from 7 am to 11 pm. These must be available for at least 13 of the 17 hours, and for 90% of the days within the O_3 monitoring season on average for a 3-year period, with a minimum of 75% of the days within the O_3 season in any one year.

[3] These are not criteria pollutants but are required to be measured by the Project.

NOTE: The information listed here is for defining *monitoring* completeness. The rules in 40 CFR Part 50 include additional requirements for formatting data (often representing a 3-year period) to compare with the NAAQS. Those requirements are beyond the scope of this monitoring QAPP; consult Part 50.

Table B.7 provides an overview of the contents of 40 CFR Part 50 to aid in locating the sources of information contained in Table B.6.

Table B.7, 40 CFR Part 50 Contents Summary

Pollutant	NAAQS	Reference Method	Interpretation of NAAQS
CO	§50.8	Appendix C	Appendix C
O_3 8-hr	§50.10	Appendix D	Appendix U
SO_2 1-hr	§50.17	Appendix A-1	Appendix T
SO_2 3-hr	§50.5	Appendix A-1	Appendix T
NO_2	§50.11	Appendix F	Appendix S
PM_{10}	§50.6	Appendix J	Appendix K
$PM_{2.5}$	§50.18, §50.13	Appendix L	Appendix N
Pb	§50.16	Appendix G	Appendix R

B.3 Standard Operating Procedures

The establishment, operation, maintenance, data acquisition, data management, quality control, and assessment of the Project monitoring network are all conducted according to written and approved SOPs organized within eight categories:

1. Monitors and Samplers
2. Calibration Equipment
3. Data Collection
4. Data Processing and Management
5. Quality Assurance and Oversight
6. Data Verification and Validation
7. Validation of Standards
8. Laboratory Operations

SOPs form the essential operating foundation and direction for this Project for two reasons:

1. SOPs provide essential information and structured direction for Project staff to perform their jobs properly; and
2. SOPs establish consistency in policies and practices which elevates quality in the Project, thus improving data representativeness, accuracy, comparability, credibility, and defensibility.

SOPs are referenced throughout this QAPP and should be referred to for specific policy and operational details beyond the general scope of this document. SOPs for the Project are written by experienced senior staff and are reviewed and approved by the MTDEQ ARMS Section Supervisor and the Project QA Manager. Subsequently, SOPs are regularly reviewed and updated as needed (with document version control). The SOPs are stored on a MTDEQ network drive in edit-protected pdf format and may be accessed by users via an SOP Index System. The network drive is protected and backed up according to MTDEQ Information Technology (I.T.) system policies and procedures.

All approved Project SOPs are included in this QAPP by reference. For illustration purposes the current SOP list may be found in Appendix C. As noted above, however, the Project adds and edits SOPs as

needed to maintain a quality program, so for the most up-to-date and authoritative list and content the actual SOPs on the MTDEQ network drive should be pursued.

B.3.1 Quick Guides

Quick Guides document and direct the correct performance of many regular but critical operating tasks (for example: how to swap out a cylinder of calibration gas). These documents contain short, clear, step-by-step directions. Quick Guides provide good process reminders for new staff or for staff that may be called upon to fill in and accomplish tasks that are not part of their regular duties. While produced within a structure of document version control and QA review and oversight, Quick Guides are maintained in a format that may be easily edited by the original author as field experience or process improvements dictate. A list of the Project's current Quick Guides is contained in Appendix C.

B.4 Quality Control

Quality control (QC) refers to actions. For this Project, *QA* establishes *standards* to define what measurement quality is and is not. *QC* consists of technical *activities* to:

1. Setup and adjust measurement instruments so their outputs agree with known authoritative standards (calibrations).

2. Measure whether, and to what degree, the QA definitions are being met in each individual monitoring instrument (QC checks; see also Section A.4.4.1); and

3. Make corrections to instruments when QC checks demonstrate they are trending towards exceedances of QA limits or that have exceeded those limits.

These regular calibrations, technical quality checks, and corrective actions are described in this section. Section B.3 references the written SOPs for their consistent performance. Section C.3 discusses the SOP-prescribed processes for flagging or annotating data that were collected during periods when QC checks were being conducted or when instrument QA limits were exceeded.

B.4.1 QC Calibrations

Calibration is the adjustment of a measurement instrument so that its outputs agree with known values from an *authoritative standard* of *higher accuracy*. It is, therefore, the most foundational and essential QC action taken by the Project to ensure accurate scientific measurements. Two broad types of calibrations are performed by the Project, test instrument calibrations (Section B.4.1.1) and monitor calibrations (Section B.4.1.2).

B.4.1.1 Test Equipment Calibrations

The Project requires and employs a suite of test instrumentation essential to conducting monitor setup, maintenance, trouble shooting, calibration, and QC checks. These instruments include (but are not limited to) flow measurement devices, thermometers, barometers, and gas calibrators. Significantly, all QC activities and their results are defined by these instruments and the degree to which they are

correctly and regularly calibrated to known authoritative standards of higher accuracy. Therefore, the Project prioritizes and engages in continual processes to ensure the accuracy of its test instrumentation. All test instrument inspection, maintenance and calibrations are conducted according to the procedures and schedules established in manufacturer instructions and the Project SOPs referenced in Section B.3. All flow rate measurement devices are certified to a NIST-traceable standard as required by 40 CFR 58 Appendix A Section 2.6.3.

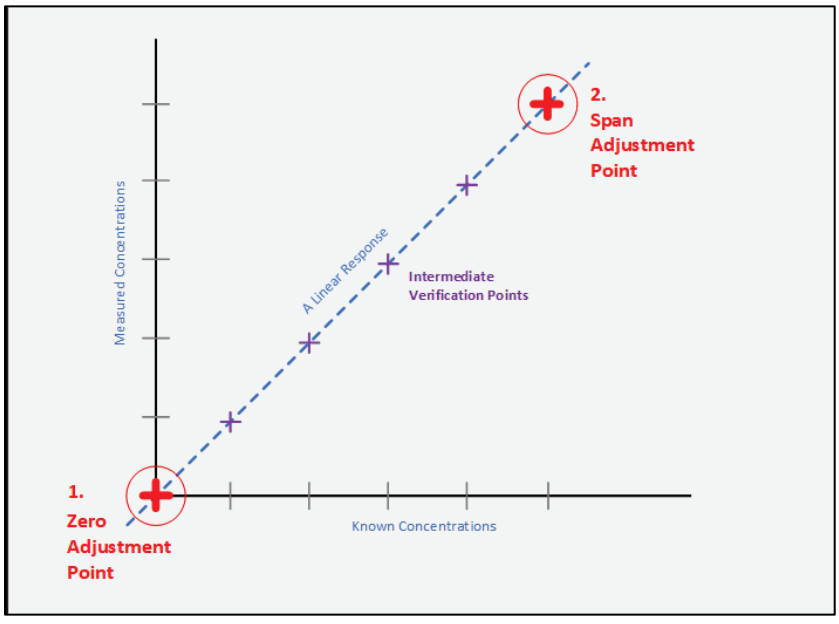
B.4.1.2 Monitor Calibrations

Calibrations are conducted on pollution monitors at initial setup, after repair or maintenance, after a failed QC check (see Section B.4.2), and as a regularly scheduled QC action. All calibrations are conducted according to method or instrument-specific SOPs as referenced in Section B.3 and per criteria and schedules documented in the method-specific *Validation Templates* discussed in Section A.4.5 and detailed in Appendices A and B. In general, the processes are divided into three groups: those associated with gas pollutant monitors, those associated with PM pollutant monitors, and those associated with meteorological monitors.

B.4.1.2.1 Gas Monitor Calibrations

Gaseous pollutant monitors produce measurements of varying *concentrations* of target pollutants in the ambient air as represented by *proportional* units such as parts per million or parts per billion (ppm or ppb). Calibrations are accomplished by injecting gas of a known zero concentration and then a known upscale (or *span)* concentration into the monitor and individually *adjusting* the monitor concentration measurements to match those two known values. In a subsequent step, four concentrations between the zero and span points are injected into the analyzer to verify accurate, linear device measurements. Figure B.4 represents this process.

Figure B.4, Gas Analyzer Calibration Process

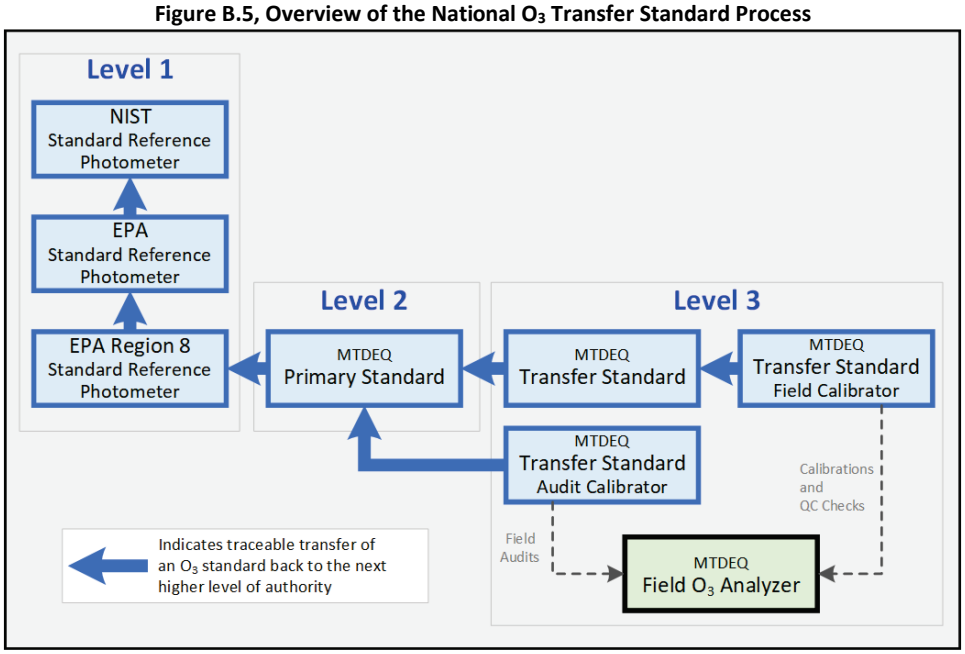


The gas calibration and QC check processes are dependent on the certainty that the injected gas concentrations are from a reliable, authoritative source. For that reason, the Project obtains and employs only gases of certified EPA Protocol concentrations per 40 CFR 58 Appendix A Section 2.6.1 and uses calibration and test equipment verified as discussed in Section B.4.1.1 and related SOPs. All gas monitor calibrations are conducted according to manufacturer instructions, method or instrument-specific SOPs as referenced in Section B.3., and the acceptance criteria and schedules documented in the method-specific *Validation Templates* discussed in Section A.4.5 and detailed in Appendices A and B.

B.4.1.2.1.1 Unique Issues with Ozone Monitors

A significant nuance to gas monitor calibrations and QC checks is associated with the measurement of ozone. Because of its reactivity and instability, ozone cannot be stored in a compressed gas cylinder in a manner that can assure an authoritative concentration. Therefore, ozone for QC purposes is produced by calibration instruments in real time, on-site. The test concentrations are assured as authoritative by a process required in 40 CFR 58 Appendix A Section 2.6.2, and nationally defined as *traceability.* Essentially, the *ozone concentration output* of each "Level" of instrument is compared and calibrated backwards to an instrument of the next higher level of ozone "authority." As illustrated in Figure B.5 a Level 3 instrument is calibrated by a Level 2 instrument, which has been calibrated by a Level 1 instrument. In this way the output of *all* ozone calibrators can be "*traced*" back to the single authoritative standard at the National Institute of Standards and Technology (NIST). As a result, the various levels of instruments are referred to as "Transfer Standards" because they each *transfer* the ozone concentration authority from the single NIST source to other instruments.

Figure B.5, Overview of the National O_3 Transfer Standard Process



Documentation and details of the transfer process are contained in the EPA Technical Assistance Document (TAD) entitled *Transfer Standards for The Calibration of Ambient Air*

Monitoring Analyzers for Ozone, EPA-454/B-22-003, January 2023. This document adds definition to the transfer process by:

1. Defining Transfer Standard Device Levels
   - **Level 1** standards are EPA devices which must only be used in a laboratory setting within controlled environmental conditions.
   - **Level 2** standards are devices that transfer ozone authority from EPA to another program, in this case to the ARMS Project.
   - **Level 3** standards are devices that transfer ozone authority from a Level 2 device to devices that are taken into the field.

2. Defining Device Types
   - **Bench standards** are transfer standards that remain stationary.
   - **Field standards** are transfer standards that are transported to field sites for use.

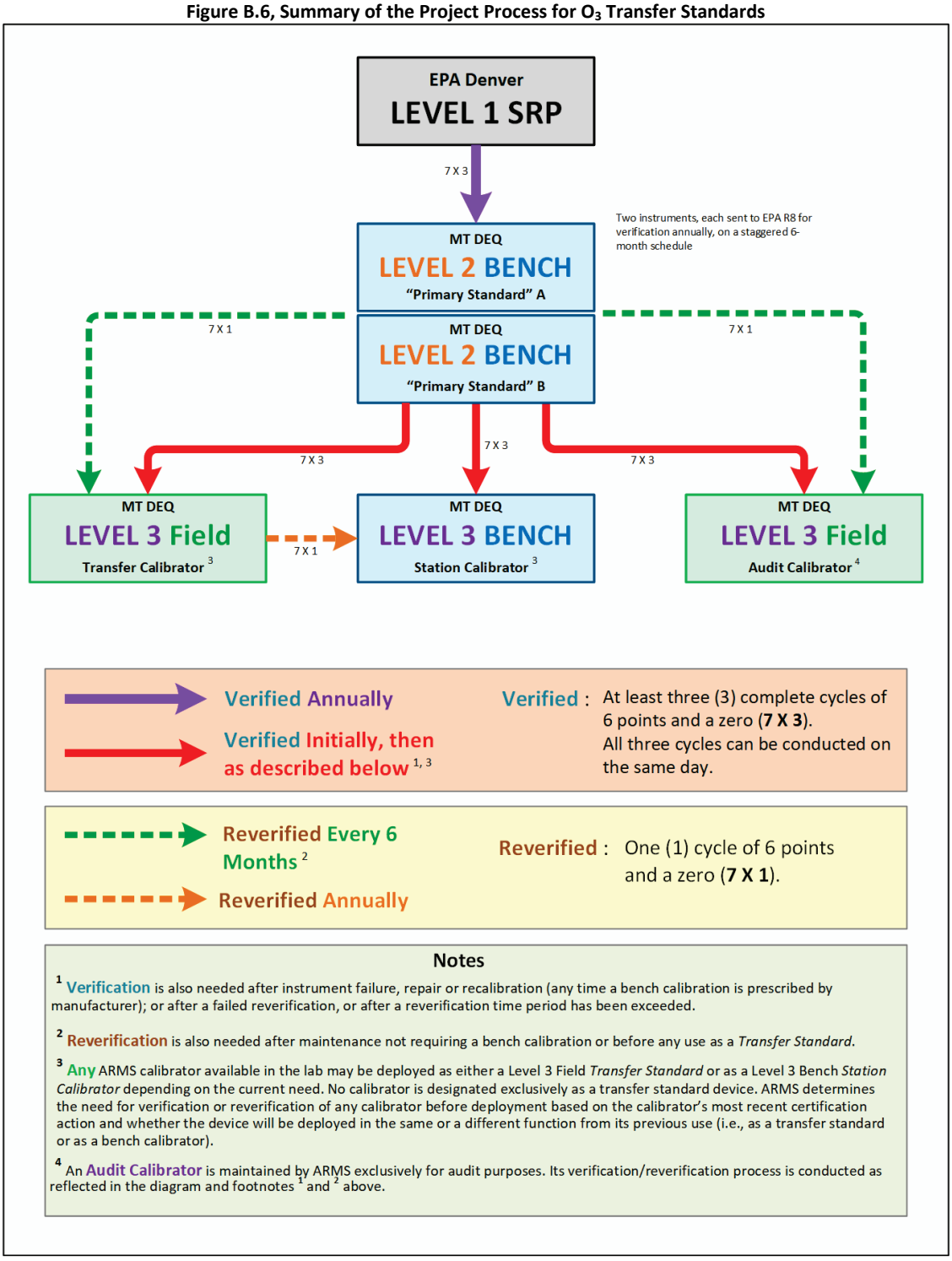
   The frequency of verification or reverification depends on this distinction. Field Standards must be verified more frequently because of the possibility of instrument drift induced by the vibrations and impacts experienced during instrument transportation.

3. Defining the Transfer Procedures
   - Each calibration/verification test cycle must consist of the generation and assay of at least six upscale concentration points and a zero point (so seven total points).

4. Defining the Transfer Requirements
   - **Verification** is the ozone authority transfer process between standards of different levels. It must be conducted annually for a level 2 instrument. It is required upon receipt of any level instrument, after adjustment or repair, or after an instrument fails a reverification. Verification must consist of three stable test cycles of seven points and is referred to as a **7 x 3** procedure.
   - **Reverification** is an ozone authority transfer check on level 3 instruments on prescribed frequencies: annually for level 3 bench instruments and every 6 months for level 3 field instruments. Reverification must consist of at least one stable test cycle of seven points and is referred to as a **7 x 1** procedure.

This Project's implementation of the transfer process is summarized in Figure B.6.

Figure B.6, Summary of the Project Process for O_3 Transfer Standards



B.4.1.2.2 PM Monitor Calibrations

PM pollutant monitors produce measurements of varying concentrations of target pollutants in the ambient air as represented in units of a *mass of the pollutant per volume of air*; specifically, micrograms per cubic meter ($\mu g/m^3$). The mass component of this concentration results either from a continuous beta attenuation process calibrated by the manufacturer, or by a filter weighing process in a certified laboratory, both of which are outside the control and direct QC

management of the Project. However, the Project does calibrate the zero-measurement level for some types of continuous PM monitors as required by the manufacturer. For all PM methods the remainder of the concentration, the *volume* component, is a critical QC calibration and QC check focus of the Project.

The measurement and control of volumes of sample air is dependent on varying local temperature and barometric pressure throughout the measurement process. Consequently, QC calibrations and checks on PM monitors are focused on setting and maintaining correct monitor measurements of temperature and barometric pressure, and the resulting measure and *control* of sample volumetric air flow. How that is accomplished is specific to the manufacturer and model of the monitor. All PM monitor calibrations are conducted according to manufacturer instructions, method or instrument-specific SOPs, and the acceptance criteria and schedules documented in the method-specific *Validation Templates* discussed in Section A.4.5 and detailed in Appendices A and B.

B.4.1.2.3 Meteorological Monitor Calibrations

See Section B.2.5 regarding Project meteorological monitoring methods and Section B.4.2.3, Meteorological Monitor Checks. Needed calibrations of this equipment are conducted according to established Project SOPs and Quick Guides (Section B.3 and Appendix C).

B.4.2 QC Checks

As defined in Section A.4.4.1, QC Checks are physical tests or measurement *evaluations* to determine if the instrument meets specified Measurement Quality Objective (MQOs) (i.e., defined *quality acceptance*) limits. Although the measurement processes are similar, QC *checks* differ from QC *calibrations* in several important ways:

1. QC checks *measure* specific operational parameters but do not (by themselves) include *adjustment* of a monitor. The *results* of the check, however, may lead to specific corrective actions as discussed in Section B.4.3.
2. QC checks are conducted more frequently than calibrations.
3. QC checks are conducted according to rule-specified frequencies and schedules as summarized in the following sections.

B.4.2.1 Gaseous Monitor Checks

The Project's regular QC checks for gaseous monitors are summarized in Table B.8.

Table B.8, Project QC Checks for Gaseous Monitors

QC Check	Assessment method	Coverage	Minimum Frequency	CFR Reference[1]
Precision Check One-Point Check	Response check at a concentration between 0.005-0.08 ppm for SO_2, NO_2, O_3, and 0.5 and 5 ppm CO. See SOP for NCore concentrations.	Each analyzer	Once every 2 weeks	3.1.1

ZSP Check Includes Zero and Span Points with *Precision Point* (see above)	Response check at zero and instrument span concentrations. See SOP for span concentrations.	Each analyzer	Once every 2 weeks	EPA *QA Handbook* recommendation
QA Audit[2] Annual Performance Evaluation	Response check at least three audit levels by a trained, experienced technician other than the routine site operator. See SOP for required concentration ranges.	Each analyzer	Once per year is required. MTDEQ goal is two per year.	3.1.2
NPAP Audit[2] National Performance Audit Program	Independent Audit by EPA or contractor	20% of sites each year, 100% every six years	Annually	3.1.3

[1] The section of 40 CFR Part 58 Appendix A.

[2] Audits are discussed in Section D, *Assessment and Oversight*

All of the Project's gas monitor QC checks are conducted according to manufacturer instructions, method or instrument-specific SOPs as referenced in Section B.3., and the acceptance criteria documented in the method-specific *Validation Templates* discussed in Section A.4.5 and detailed in Appendices A and B.

B.4.2.2 PM Monitor Checks

The Project's regular QC checks for PM monitors are summarized in Table B.9.

All of the Project's PM monitor QC checks are conducted according to manufacturer instructions, method or instrument-specific SOPs as referenced in Section B.3, and the acceptance criteria documented in the method-specific *Validation Templates* discussed in Section A.4.5 and detailed in Appendices A and B.

Table B.9, Project QC Checks for PM Monitors

QC Check	Assessment method	Coverage	Minimum Frequency	CFR Reference[1]
Precision Continuous $PM_{2.5}$	Collocate[2] with same FEM and/or with FRM. See CFR for required numbers of each and Section B.4.2.2.1.	15% of monitors from each method	Continuously: FEM, 1-in-12-day schedule: FRM	3.2.3
Flow Rate Checks Continuous $PM_{2.5}$ and PM_{10}; manual $PM_{2.5}$; $PM_{10-2.5}$, and CSN	Verify flow rate	Each monitor	At least once every month; separated by 14 days	3.2.1
Flow Rate Audits[3] Continuous $PM_{2.5}$ and PM_{10}; manual $PM_{2.5}$; $PM_{10-2.5}$, and CSN	Verify flow rate	Each analyzer	Twice per year spaced 5 to 7 months apart	3.2.2 and 2.6
PEP $PM_{2.5}$ Audit[3] Performance Evaluation Program	Independent Audit by EPA or contractor	8 audits each year, 100% every six years	Annually	3.2.4, 2.4, and 4.2.5

[1] The section of 40 CFR Part 58 Appendix A.

[2] See Section B.3.2.2.1.

[3] Audits are discussed in Section D, *Assessment and Oversight*

The rules in 40 CFR 58 Appendix A contain QC check requirements for additional types of PM monitors not currently employed or planned for operation in this Project, including manual PM_{10} lo-vol and hi-vol, Pb-TSP and Pb-PM_{10}. Should any of these monitors be added to this Project, the QC check procedures specified in 40 CFR 58 Appendix A will be employed.

B.4.2.2.1 Unique Issue with PM Monitors: Collocation

As discussed in Section A.4.4.2.1, *precision* is a primary indicator of data quality. In that section precision is defined as "the degree of agreement among repeated measurements of the same property under identical, or substantially similar conditions." For gas analyzers precision is measured by regularly challenging an analyzer with a known concentration of the pollutant gas. A similar process is not possible with PM monitors, because a known, sampleable concentration of PM cannot be provided with which to challenge these instruments. As a result, a different process is needed to provide PM precision checks. That process is accomplished by installing and operating two PM monitors side-by-side at a site and comparing their measured results. In this process, the principal monitor that is operated to provide hourly PM pollutant measurements is referred to as the *primary monitor*. The second monitor is referred to as the *quality control* (or *collocated*) *monitor*. Measurements from both devices are reported to the EPA AQS database as the means for calculating precision.

In distinction from gas analyzers, which all undergo required *individual* precision checks, federal rules prescribe precision assessment for PM monitors based on the PQAO's *network* of monitors. To that end, federal rules specify a statistical proportion of monitors of each distinct *method* (Section B.2) in a network that must be collocated in order to calculate precision for the network (i.e., not all primary PM monitors must have a collocated quality control monitor—just a representative portion).

This Project follows the rules contained in Sections 3.2.3 and 4.2 of Appendix A to 40 CFR Part 58 for correct collocation of PM monitors. At present, PM precision collocation is only required for continuous methods of $PM_{2.5}$ monitoring in the Project network. In the event that the network PM methods change, the Project will revise its numbers and locations of collocated monitors according to 40 CFR Part 58 Appendix A direction.

B.4.2.3 Meteorological Monitor Checks

See Section B.2.5 regarding Project meteorological monitoring methods. Needed QC checks of this equipment are conducted according to established Project SOPs (Section B.3 and Appendix C).

B.4.2.3.1 Ambient Temperature Checks

Ambient temperature sensors at PM monitoring sites are checked and verified during monthly PM flow checks and twice more per year during semiannual flow rate audits. These checks compare readings from at least two to as many as four separate temperature sensors (PM_{10} temperature, $PM_{2.5}$ temperature, 2-meter temperature, and the check/audit device depending on the site configuration). Recalibrations are conducted when needed according to the instrument manual and Project SOP associated with the out-of-spec sensor.

B.4.2.3.2 Wind Measurement Checks

Volume IV of the *EPA Quality Assurance Handbook for Air Pollution Measurement Systems* documents the use of sonic anemometers as an appropriate and accepted monitoring method for SLAMS, SPM, and NCore monitoring stations. In the Project, QC procedures are conducted on sonic anemometers based on two different categories of installations:

1. Primary sites where wind measurements are required (NCore) or critical; and

2. Secondary sites where wind measurements are conducted for information and background purposes.

For both types of sites, the initial installation and correct directional orientation of the sonic sensors is conducted via the process established in Project SOPs. Subsequent to that step the QC procedures differ depending on the wind measurement site type. At primary sites the sonic devices are changed out once per year with devices that have recently been evaluated and certified by the manufacturer. The removed devices are then shipped to the manufacturer for recertification. This process is documented in the Project *Quick Guide* number G1 and has received approval from EPA.

At secondary sites QC procedures for sonic devices are limited to routine data review for correct function and reasonability. No ongoing certification or renewal is performed on these devices.

B.4.2.4 Non-FEM and Sensor Monitor Checks

B.4.2.4.1 Stationary, Non-FEM BAMs

The Project follows the same QC check and QA audit procedures and frequencies for non-FEM BAMS as for FEM BAMs.

B.4.2.4.2 Portable, Non-FEM EBAMs

QC checks for EBAMs are conducted at the time of installation at a monitoring site. Subsequently, QC checks are conducted each time new filter tape is loaded or when instrument troubleshooting is necessary or desirable.

B.4.2.4.3 Other Non-FEM Sensors and Monitors

QC checks for sensors, trial/experimental instrumentation, and devices used by the Project to measure non-criteria pollutants are method- and application-specific. However, the collection of accurate and representative data from these instruments remains essential. Therefore, the Project follows manufacturer-recommended or method-required procedures for correct QC of these types of monitors. Section D.1.1.7 contains a description of the Project's quality assessment system for sensors.

B.4.3 QC Check, Monitor Corrections

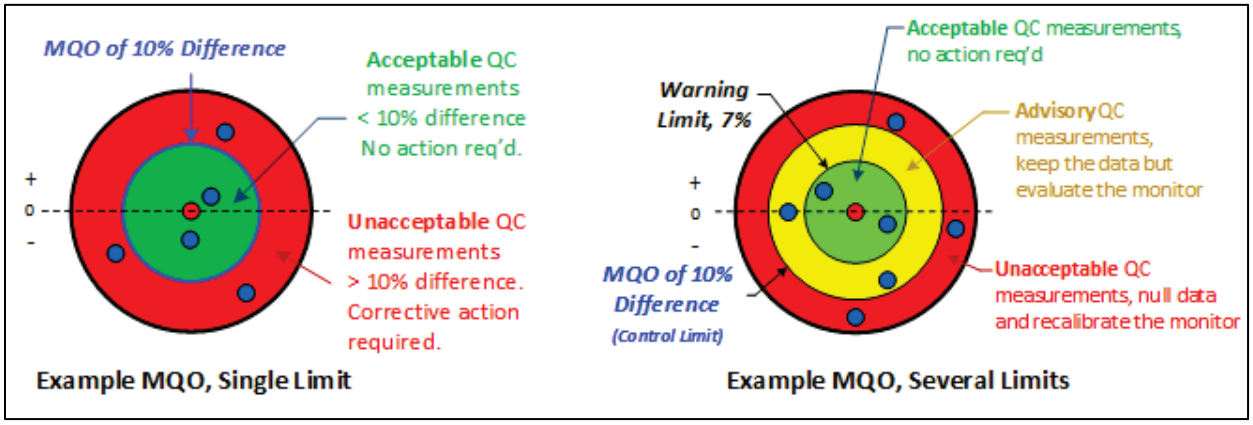
Measurements resulting from each of the QC checks are compared to the QA numeric limits established as MQOs (see Section A.4.4.3) and documented in the Project *Validation Templates* (Section A.4.5 and

Appendices A and B) for each monitoring method. The results of those comparisons define the acceptability of monitor performance since the last QC check, determining:

1. The need for data flagging or annotation since the last QC check (see Sections C.3 and D); and
2. The need for correction to the monitor in the form of maintenance, repair or calibration.

The Project's approved procedures for conducting monitor corrections are contained in SOP documents referenced in Section B.3 and Appendix C. For gas monitors, the SOPs may establish a secondary QC limit set lower than the MQO that provides an advisory or "warning" indication so that corrective actions may be performed before data loss or invalidation occurs if the MQO is exceeded. In such cases the MQO is referred to as a "*Control Limit*," and the advisory value as a "*Warning Limit*." Figure B.6 illustrates this relationship.

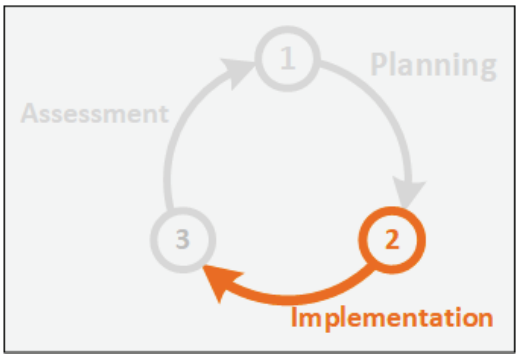
Figure B.6, Example MQOs and Resulting Corrective Actions



B.4.4 QC of Non-Direct Measurements

The implementation and operation of the Project requires the acquisition, evaluation and use of data that it does not directly measure, and as a result, for which it has no quality control, but that particularly influences the network design process. Such factors include the population of designated regions, the emission rates of air pollution sources, and the GIS coordinates of the locations of sources and geographic features and boundaries. For necessary non-directly measured data, the Project always seeks the most authoritative source and the most appropriate date range for those data. For example, the Project obtains population data only from the United States Census Bureau.

C. Data Acquisition, Management, and Usability



The objective of this Project is to "***…provide high quality [ambient air quality] data that informs data users and their decisions***". Section C of this QAPP focuses on Project data processes and products. It complements Section B as the second of two Project *implementation* process flow steps.

As introduced in Section A.5, the Project collects and stores three essential types of data:

1. **Monitor Data**: the measurements made by pollutant monitors and meteorological sensors;

2. **QA/QC Data**: data collected to document the validity of the *monitor data* and the activities performed to assess and demonstrate its quality; and

3. **Network Support Data**: information such as continuously reported site or instrument conditions, instrument inventory, instrument logs, and test device calibrations.

The following sections describe how each type of data is acquired, stored, and reported.

C.1 Data Acquisition

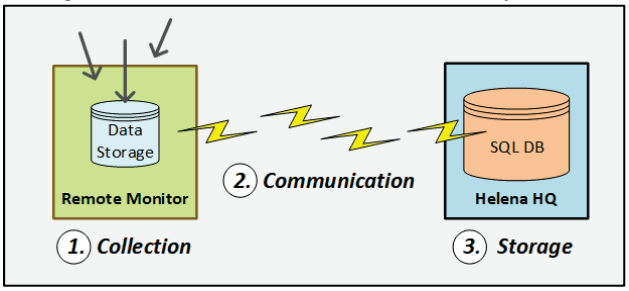
C.1.1 Monitor Data Acquisition

Monitor data acquisition is the process by which the measurement values from pollutant analyzers and meteorological sensors are collected and made available for review, validation, reporting, and use. The Project's processes for acquisition of these data differ between continuous automated monitors and episodic manual monitors (see Section B.2.6 bullet 3) as described in the following two sections.

C.1.1.1 Continuous Method Data Acquisition

Data acquisition from continuous monitors and meteorological sensors is normally a fully automated, computer-controlled process. In its most basic form this process is comprised of three components as illustrated in Figure C.1.

Figure C.1, Basic Continuous Monitor Data Acquisition



① **Collection** is accomplished by a monitor or sensor measuring an ambient air parameter and storing the resulting data on site through an automated process.

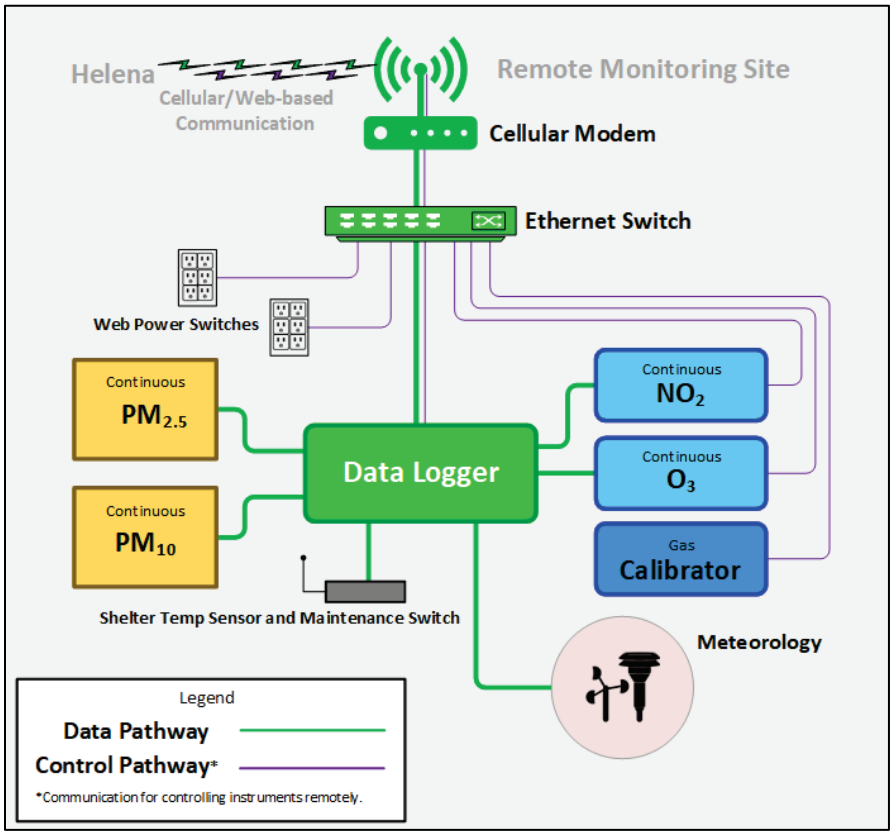
② **Communication** is accomplished by hardware and software that electronically transmits the collected data by the cellular network from the remotely located monitor to a central data storage in Helena.

③ **Storage** is accomplished by an enterprise SQL database maintained by the State of Montana I.T. services.

C.1.1.1.1 Continuous Method Site Setup

In practice the Project performs continuous method data acquisition in three different formats depending on the type or types of monitors operating at a monitoring site. The first format centers around a computerized site *data logger* that communicates with, stores data from, and controls functions in analyzers or meteorological sensors at a site. In current configurations this type of site may operate from one to ten or more different analyzers and meteorological sensors. Figure C.2 provides a schematic example of data acquisition at this site format.

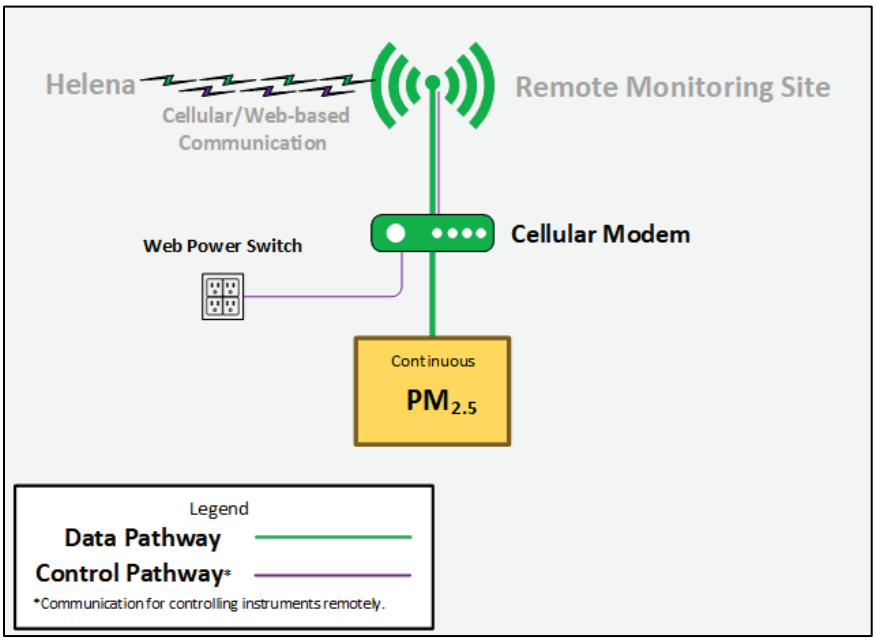
Figure C.2, Continuous Method Data Acquisition, Example Configuration with a Data Logger



The second format used by the Project for continuous method data acquisition is associated with the operation of a portable or semi-portable $PM_{2.5}$ monitor. Typically, the monitor in this scenario is an FEM stand-alone monitor installed for long term measurements or a non-FEM EBAM installed temporarily for measuring wildfire smoke impacts. In both cases the monitor operates

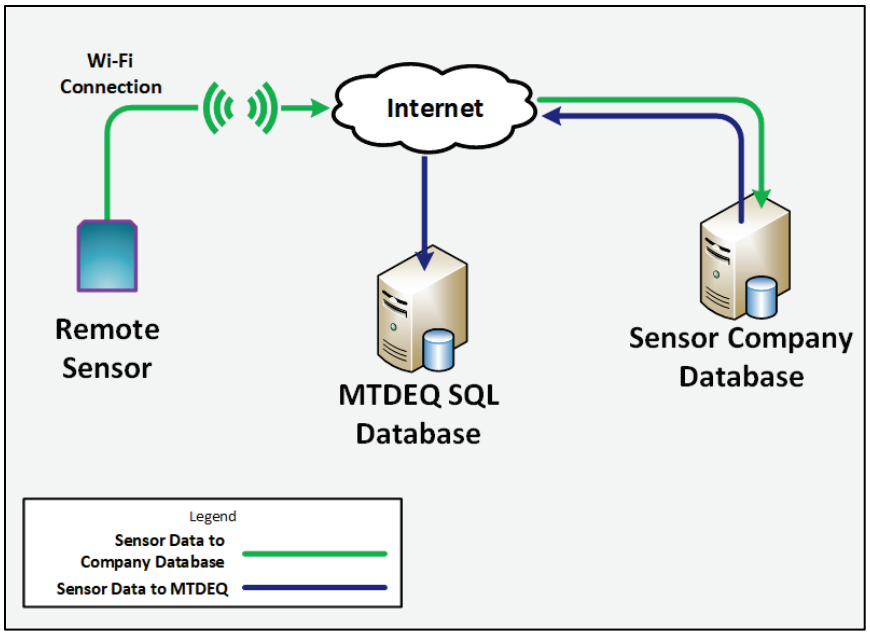
with internal data storage, so no data logger is required, and the communication system interacts directly with the monitor. Figure C.3 provides a schematic example of this data acquisition format.

Figure C.3, Continuous Method Data Acquisition, Example Stand-alone Monitor



The third format used by the Project for continuous method data acquisition is associated with the operation of non-FEM pollutant sensors. The process particulars are unique to each device manufacturer, but the general *Collection -Communication – Storage* process for continuous methods applies to this monitoring format as well. Figure C.4 provides a schematic example of Project retrieval and storage of continuous $PM_{2.5}$ sensor data.

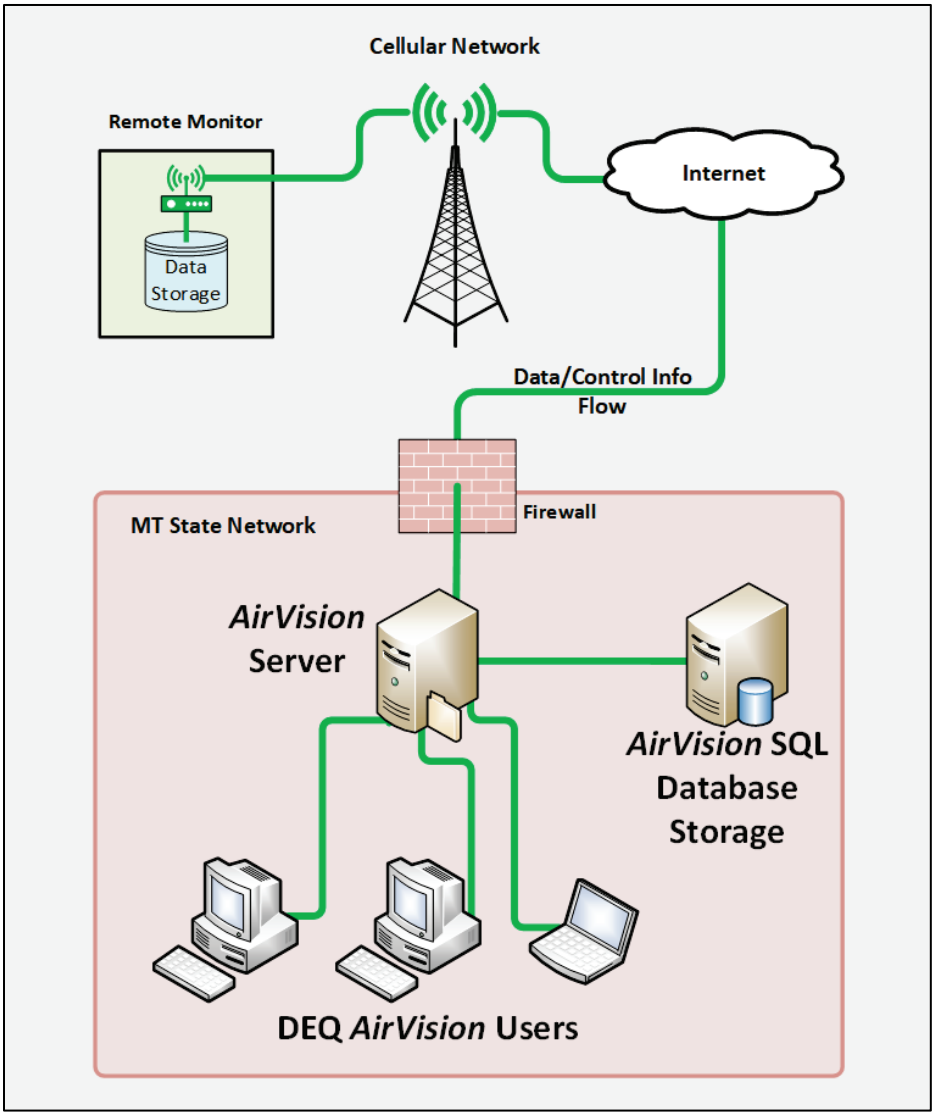
Figure C.4, Example Sensor PM Data Retrieval and Storage Schematic



C.1.1.1.2 Continuous Method Data Retrieval and Storage

For all continuous methods except non-FEM pollutant sensors, the Project employs software and a related SQL database developed by Agilaire LLC, known as *AirVision*. This software system resides in Helena within the State/MTDEQ computer network and communicates with each remote monitoring site via the cellular communication network and the internet. Shortly after the beginning of each hour the *AirVision* application automatically connects with or "polls" the data storage equipment at every Project site and electronically retrieves the stored measurement data from the previous hour. Retrieved data are electronically reviewed by the software to identify issues or errors through an Automatic Data Validation Processor (ADVP) module. The reviewed data are then stored in the Helena SQL database. Once in storage the data are available for monitoring staff to review and validate as discussed in Section C.3. *AirVision* also facilitates data uploads to Montana *Today's Air*, EPA *AirNow*, and the EPA AQS database as discussed in Section C.4. Figure C.5 provides a schematic example of Project retrieval and storage of continuous data.

Figure C.5, Continuous Method Data Retrieval and Storage Schematic



C.1.1.1.3 Continuous Sensor Data Retrieval and Storage

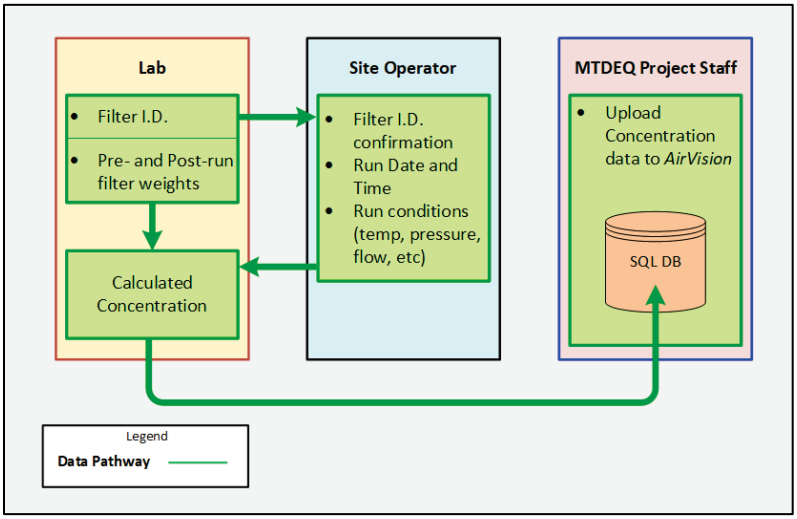
The Project's process of retrieving and storing data from non-FEM pollutant sensors takes place in a system entirely separate from AirVision system described in the previous section. Again, the process particulars are unique to each device manufacturer, but the Project has developed and employs a process flow in which the data is downloaded and stored in a state-owned database, and then custom-built software is used to assess sensor performance and to run an initial round of QA/QC checks on the data. Figure C.4 provides a schematic example of Project retrieval and storage of continuous $PM_{2.5}$ sensor data.

C.1.1.2 Manual Method Data Acquisition

As introduced in Section B.2.6 bullet 3, manual monitors require operator intervention before and after each sampling event and therefore operate episodically rather than continuously. In the current Project network design, manual methods are only employed for $PM_{2.5}$ pollutant concentration QC purposes (see Section B.4.2.2.1). These measurements are accomplished by drawing an air sample of known volume through a pre-weighed filter for 24 hours. Once the sample run is complete the filter is removed and returned to the originating lab to obtain a post-run weight.

Manual method sample data is assembled from two sources. Site operators collect pre- and post-run sample data to document the date the sample was run, the length of time the air sample was drawn through the filter, the measured rate of air flow, and temperature and pressure information to determine the volume of air that was drawn through the filter. The operators submit those data to the lab along with the sampled filter. The laboratory provides pre- and post-run filter weights (and the net difference between the two), then correlates the operators' sample run data with the weight of material on the filter to provide resultant pollutant data in the form of mass per volume or µg/m^3. The laboratory sends this information to Project monitoring staff who review it and manually upload it to the *AirVision* database. Figure C.6 summarizes this process.

Figure C.6, Manual Method Data Acquisition Process



The described method for manual data acquisition is essentially the same for the $PM_{2.5}$ chemical speciation monitors operated by the Project. See the CSN QAPP and related SOPs for a description of this process.

C.1.2 QA/QC Data Acquisition

C.1.2.1 QA/QC Data Acquired by Project Staff

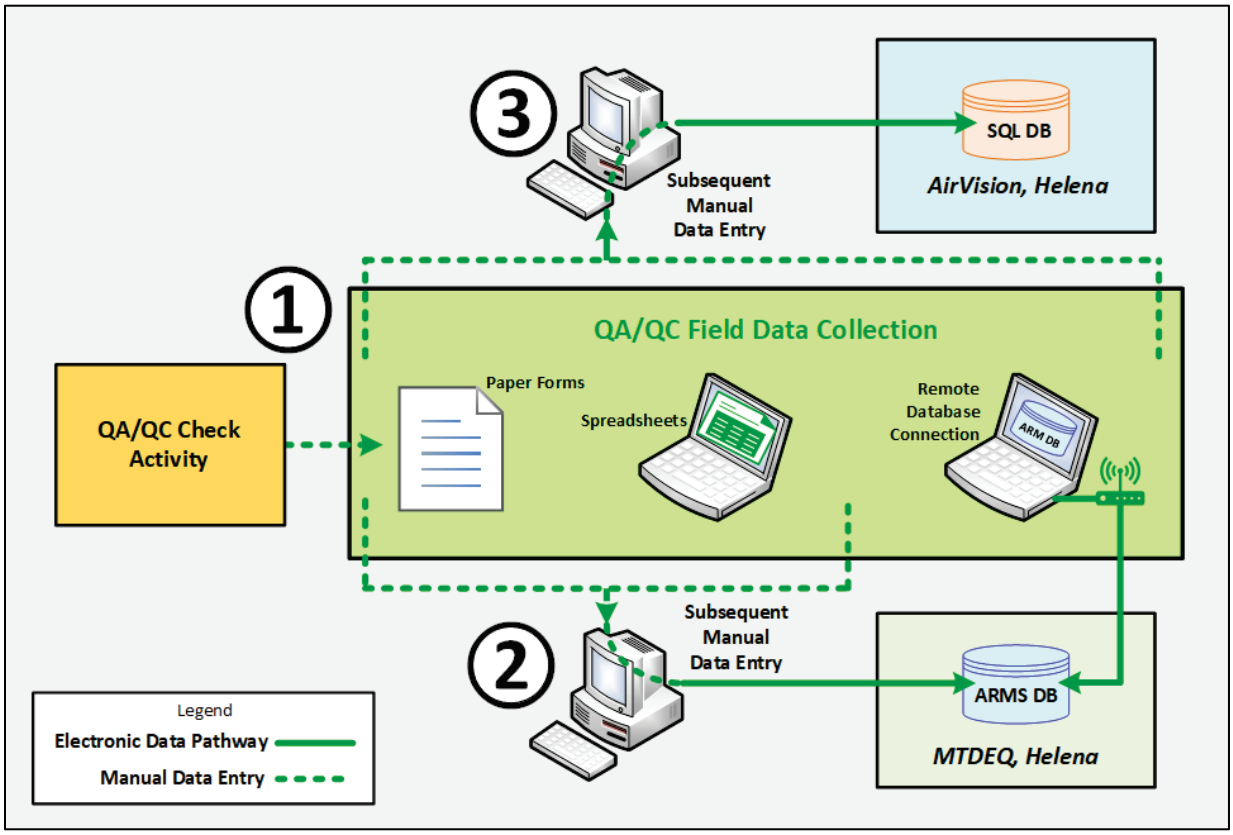
QA/QC data is the purpose and essential product of the QA/QC checks performed by Project staff as described in Sections B.4 and D.1.1.1. Those data are acquired and stored via a three-step process as illustrated in **Figure C.7**

① The QA or QC Check is performed, and the results are recorded in one of three ways:
- On paper forms, or
- In spreadsheets on a laptop computer, or
- Directly into the Air Research and Monitoring Section (ARMS) database, an additional SQL database distinct from *AirVision*, that serves various data storage functions for the Project.

② Data collected in the field via paper forms or spreadsheets are manually entered into the ARMS database, typically when staff return to the Helena office.

③ Data collected in the field by any/all of the three means are *also* manually entered into the *AirVision* SQL database, typically when staff return to the Helena office.

Figure C.7, QA/QC Data Acquisition



C.1.2.2 QA/QC Data Acquired by EPA

EPA or consultants employed by EPA perform annual NPAP and PEP audits on Project monitors as introduced in Section B.4.2 and discussed in Section D.1.2. EPA acquires and stores data from those

audits independent of Project staff or data management processes. Data collected by EPA during Technical Systems Audits of the Project conducted in accordance with 40 CFR 58 Appendix A Section 2.5 (see Section D.1.2.3) are acquired and stored by EPA, then shared with the Project in findings reports. The reports and correspondence from all these EPA efforts are stored on an MTDEQ network drive.

C.1.3 Network Support Data Acquisition

Three broad types of data are collected and stored in the support of appropriate, accurate and efficient Project network operation:

C.1.3.1 Continuous Monitor Operating Parameters

Along with continuous monitored pollutant data (including meteorological parameters) the Project continuously measures and records various data streams that indicate safe operating environments or monitor conditions that help Project staff ensure or evaluate each monitor's correct operation. Examples of these parameters include such things as shelter temperature, monitor pressure, and various instrument channel voltages. The processes for collection, communication and storage of these data are the same as those for the continuous pollutant data discussed in Section C.1.1.1.

C.1.3.2 Network Equipment Inventory

The Project requires a significant inventory of monitors, support and test equipment, spare parts, and gas calibration sources. Continuous, accurate knowledge of the type, age, location, availability and operating status of equipment and supplies is essential to proper, ongoing network operation. Data reflecting these materials is manually entered by operating staff into the ARMS database at the time of initial receipt, and then regularly updated as the status of equipment changes.

C.1.3.3 Instrument Logs

Logs of equipment maintenance, calibration, certification, and other pertinent actions or information are manually entered by operating staff into the ARMS database throughout the lifespan of each instrument.

C.1.3.4 Station Logs

Records of site visits and summaries of actions taken during the site visits are manually recorded in a site notebook kept in each monitoring shelter.

C.2 Data Management, Retention, and Security

The Project follows the direction of Section 10 of the MTDEQ Quality Management Plan (QMP), and the agency policies and federal and state rules referenced within it regarding the definition, collection, use, retention, availability and management of records associated with its operations. The Project maintains and follows approved SOPs for these purposes.

Electronic records acquired and stored by the Project in AirVision, AQS, and the ARMS Database are accessible only to individuals who have obtained password access through a management approval process. The password access process includes levels of permissions for read-only and editing rights to those data stores depending on approved Project roles.

C.3 Data Review and Validation

Data review and validation is the point where all Project principles, processes and procedures intersect to fulfill the Project purpose. As a result, data review and validation are significant, deliberate, and continuous investments by Project staff.

Validation, as defined in Volume II of the EPA *Quality Assurance Handbook,* is "*confirmation, through provision of objective evidence, that the particular requirements for a specific intended use are fulfilled.*" Three essential components are required in that definition: (1). The Project's "*particular requirements*" are the DQIs and MQOs discussed in Section A.4.4 and detailed in the Validation Templates in Section A.4.5 and Appendices A and B. (2). The Project's "*objective evidence*" is the verified performance and results of the QC checks listed in Section B.4.2 and the QA assessments discussed in Section D1.1. (3). The Project's "*specific, intended use[s]*" are defined in Section A of this QAPP.

Data Review is the active *process* in which the three defined components are pulled together and compared; that is, the Project's acquired monitor and sensor data are evaluated within the context of defined requirements and objective evidence reflecting data quality. Monitor or sensor data that meet the requirements and objective quality evidence are maintained, and those that do not are either flagged or isolated from inclusion in the measurement results database. The end product of data review is a representative dataset that conclusively and defendably fulfills the Project uses established in Section A and reiterated throughout this QAPP.

C.3.1 Data Review Processes

The data review process includes both automated and manual components.

C.3.1.1 Automated Data Review—ADVP

As noted in Section C.1.1.1.2 the *AirVision* software system provides a toolset which enables automated initial data review of the continuous monitoring and operating data retrieved each hour. The Automatic Data Validation Processor (ADVP) evaluates incoming data according to user-assigned criteria based on established Project DQIs and MQOs. Users with the highest level of *AirVision* software security permissions establish specific evaluation *rules* consisting of a *trigger* and an *action* and assign them to select monitored parameters. The *trigger* is a conditional test of each data point in the parameter data stream, and the *action* is the response the software will take if the trigger is true. Actions are limited to the following:

- Assign a Fixed Value
- Apply a Flag
- Clear a Flag
- Apply a Null Cole
- Clear a Null Code
- Add Annotation Text
- Assign a Data Grade (1 - 10)
- Send an Email

Actions can be applied to any parameter, not just the one that triggered the rule. For example, ADVP can be set up to assign a notification flag to hourly values of *ozone* collected when the corresponding *shelter temperature* value is above or below a designated level. Note that the ADVP cannot *delete* data.

The Project uses the ADVP principally to inform and assist staff in their manual data review by flagging questionable data for further investigation. It is also used to automatically assign null codes to $PM_{2.5}$ data that are excessively negative before passing those data to Montana's *Today's Air* and EPA's *AirNow* web maps so that the web display process functions appropriately (see Section C.4.2).

Further information about the ADVP process may be found in related SOPs and the *AirVision* manual.

C.3.1.2 Manual Data Review

The greater and more substantial process of Project data review is conducted by MTDEQ Air Research and Monitoring Section (ARMS) staff. The process is of high priority, is finely detailed, is constantly ongoing, and is directed by specific SOPs which should be consulted for more information and direction. However, several summary descriptions are valuable for baseline direction and understanding.

C.3.1.2.1 Manual Data Review: Frequency and Schedule

Project staff review data on both an informal and a formal schedule. Informally staff frequently review data, often on a daily basis or multiple times per day during work hours via *AirVision* or direct electronic interrogation of site data loggers and monitors. This process often occurs when data is discovered to be missing or when analyzers or entire monitoring sites demonstrate an error condition.

Formally, each staff person performs a data review of all sites and parameters assigned to them per SOP direction on a monthly basis. The Project requires all data to be staff-reviewed by the end of the month for data collected in the previous month. This schedule is maintained to ensure all Project data is completely submitted to EPA's AQS database within 90 days after the end of any reporting calendar quarter (per 40 CFR 58.16(b); see Section C.4). In addition, formal data review is conducted on laboratory reports of manual method monitoring results as they are received.

C.3.1.2.2 Manual Data Review: Process and Content

Formal data review is conducted within *AirVision* by using the report and review tools provided in that software. Staff follow an SOP-prescribed process for examining and asking questions of the data and then responding consistently to what is discovered.

Examples of what staff look for in their data review include but are not limited to the following:

- Data that is either negative or of high values indicating malfunction or out of control conditions.
- Data that do not change over a period of time, indicating an impaired or "stuck" monitor.
- Data that are flagged by the monitor, the data logger, or ADVP.
- Data that are impacted by a QC check.

Examples of staff responses to what they find in their data review include but are not limited to the following:

- Annotate data with a flag indicating a unique detail about a data point or points.
- Insert a null code to the data indicating it is missing or of unacceptable quality, and why that determination was made. Note that no data is deleted. Following a QC check that does not meet MQOs, the hourly data from the time of the check back to a previous valid QC check or calibration is nulled-out.
- Annotate data with a comment or explanation.
- Re-poll a data logger or instrument to obtain missing data if it is available but was not adequately transmitted or stored.
- Accept data as found in the *AirVision* database.
- Verify that data from QC checks was completely and accurately entered into *AirVision*.

When individual staff complete their review for a month of data they record their completion date in the Project's *Review Tracker* spreadsheet maintained on a Project network drive.

C.3.1.2.3 Manual Data Review: Comprehensive Depth

Several additional components and activities enhance the depth and quality of the Project's data review process:

1. After staff complete their review of data from their assigned sites, the staff person responsible for uploading the data to EPA's AQS database (Section C.4.1) performs an additional review of all monitored data and QA/QC results before performing the upload. Questions or concerns that are discovered are discussed with the assigned staff to determine appropriate data review actions. The MTDEQ ARMS supervisor is often involved in these review and correction discussions.

2. EPA's AQS system includes integrated, automated data validation within its software that reviews incoming data as it is uploaded in comparison with defined system acceptance values (i.e., "validation" as defined in the introduction to Section C.3). If errors or inconsistencies are found the software produces an error message and prevents the data from entering AQS. The generated error messages are sent back to the individual attempting the upload. Project staff then research and correct any errors discovered in this process before re-trying an upload. The EPA *AQS Data Coding Manual* provides additional information on this process and its use. See Section C.4.1 and related SOPs for more information on AQS uploads.

3. Summary reports of hourly data and QC actions drawn from the AQS system by Project QA staff during production of the Project's Annual Data Certification (Sections C.5 and D.1.1.6) and the Annual Network Plan (Sections B.1.2.1 and D.1.1.5) provide two additional levels of data review oversight. These reports can demonstrate missing or mis-entered information that can be researched and corrected as warranted.

C.3.2 Data from Exceptional Events

At the highest level, the nature and intent of the Montana and Federal Clean Air Acts have two purposes:

1. To identify and clean up areas in which the air quality is worse than scientifically established standards that protect human health and welfare; and

2. To prevent the degradation of air quality that meets the established standards so that it does not become worse than (i.e., violates or does not comply with) the standards.

The underlying understanding of both of these purposes is that the causes of poor air quality (i.e., the emission of harmful pollutants or their precursors) are within the realm of human ability to prevent or reduce. In many cases this is clearly true-- and great progress has been made in improving the air quality in Montana and the nation. However, in some cases emission of air pollutants are not humanly controllable, such as those from volcanoes or wildfires or extreme wind events, or from the intrusion of high atmosphere (stratospheric) pollutants into the breathable atmosphere (troposphere). Beyond those natural events, air pollutant emissions that are "not reasonably controllable or preventable" can also result from human activities such as structure fires or fourth of July fireworks or prescribed burns for forest management or chemical spills. Uncontrollable emissions of pollutants, both natural and human-caused, that result in high ambient air concentrations are referred to as *exceptional events* as defined in 40 CFR Part 50.

This Project's technical process of measuring the concentrations of select pollutants in ambient air, by itself, cannot discern if pollutant concentrations result from either controllable or exceptional events. Therefore, Project data review includes specific processes for identifying and documenting exceptional air pollution events, and annotating (i.e. "flagging") monitored data in *AirVision* that shows exceedances or violations of NAAQS that have been collected during those events. These activities are conducted according to an established and approved SOP and the requirements of 40 CFR 50.14 and associated EPA guidance.

MTDEQ may request the EPA Administrator, per 40 CFR 50.14, to exclude monitored data showing NAAQS exceedances or violations from EPA determinations of compliance with those standards. Exclusion requests are significant and detailed activities beyond the scope of this monitoring QAPP.

C.4 Data Reporting

The monitoring objective being pursued with each monitor and monitoring site (Section A.2.1.2 and B.1.1.1.1) defines the ultimate destinations to which the Project reports its produced data. Sites and monitors operated for multiple objectives have multiple destinations as summarized in Table C.1.

Table C.1, Project Data Reporting and Availability

Monitoring Objective		Data Reporting Destination
1	Provide air pollution data to the general public	1. MTDEQ *Today's Air* 2. EPA *AirNow* 3. EPA AQS
2	Support compliance with NAAQS and emissions strategy development	EPA AQS
3	Support for air pollution research studies	MTDEQ *AirVision*

C.4.1 AQS Reporting

Most of the data produced by the Project from both SLAMS and SPM monitors (Section B.1.1.1.3) are reported to EPA by a manually initiated electronic upload from *AirVision* to the national AQS (Air Quality System) database. The Project reports data to AQS in compliance with the requirements of 40 CFR 58.16. This rule contains specific direction for reporting contained in subparts (a) through (g) which may be summarized as follows:

(a) All collected ambient air quality data of listed pollutants and related QA data must be electronically submitted to the AQS database by specified schedules.
(b) The data specified in (a) must all be submitted within 90 days after the end of each calendar quarter.
(c) The data specified in (a) must all be edited, validated, and entered into AQS according to prescribed procedures described in the EPA *AQS Data Coding Manual* and this QAPP.
(d) Section (d) contains requirements for pollutants not currently monitored by the Project.
(e) Data must also be submitted to the Regional EPA Administrator upon request.
(f) The Project must retain the filters used in manual PM methods for a minimum of 5 years and kept for the first year in cold storage.
(g) From sites monitoring SO_2, the Project must report the maximum 5-minute SO_2 average for each hour in addition to the hourly SO_2 average.

Requirements in 40 CFR Part 50 also direct AQS reporting by prescribing numeric formats required for submitting measured pollutant data. These requirements are summarized in Appendix D.

The AQS reporting process is detailed and complex, requiring each station and monitor to be correctly and identically defined via user inputs in both *AirVision* and AQS. The EPA *AQS Coding Manual*, the EPA *AQS User Guide*, appropriate Project SOPs, and the MTDEQ ARMS *Site and Monitor Form Instruction Manual* should be consulted for more information and direction in this process.

C.4.1.1 Corrections to AQS Data

Though unusual it is possible that information may come to light that dictates a modification to Project data that has already been successfully uploaded to AQS. The discovery during data certification review (Sections C.3.1.2.3 bullet 3, C5, and D.1.1.6) of unrecorded failed or misinterpreted audit results, for example, could produce such a scenario. In such cases, the Project requires completion of a *Corrective Action Request Form* (CARF, see Section D.3) that justifies the change, and that has been approved by

both the ARMS Supervisor and the ARMS Quality Assurance Manager before the data will be modified in AQS.

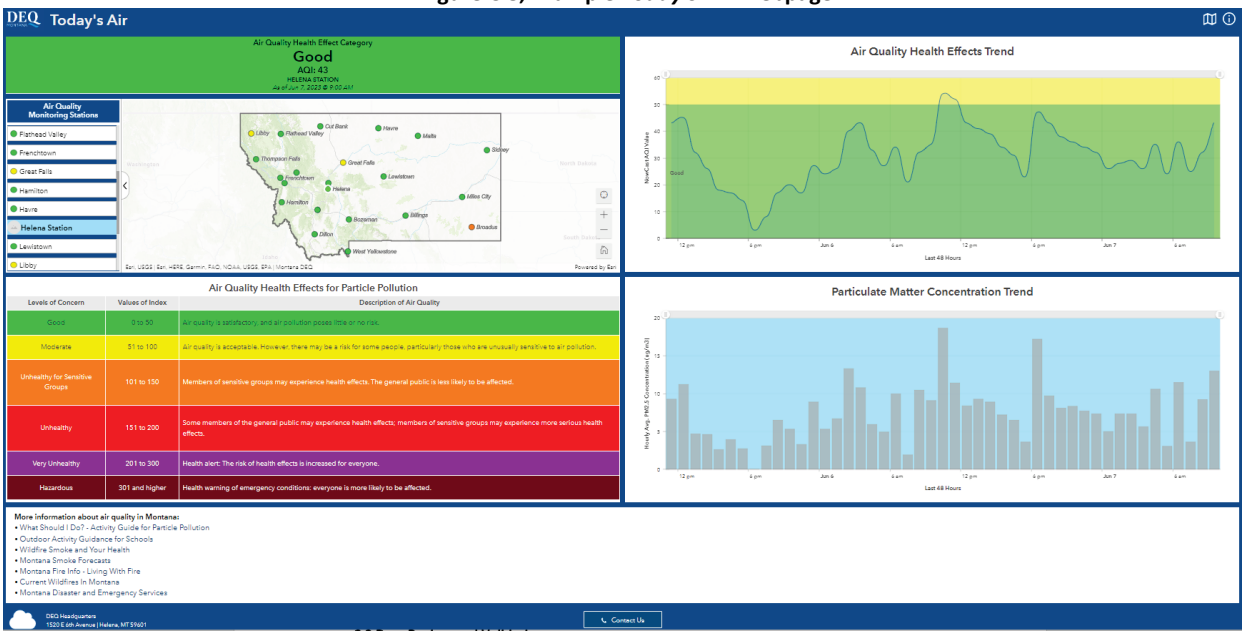
C.4.2 Air Pollution Reporting to the General Public

The Project employs three methods to make monitored ambient air pollution data directly available to the general public. All three make use of Geographic Information System (GIS) tools to provide graphic and tabular representations of data available via the internet. In the first 18 minutes of each hour the Project's AirVision software polls each monitoring station's previous hour's data, passes it through ADVP review (Section C.2.1.1), and then pushes it to each of the three tools. A brief description of each tool follows.

1. *Today's Air*—This tool reports $PM_{2.5}$ data and related health impact information in a Montana-focused manner. Each of the Project's monitoring sites is indicated by a color-coded symbol representing the past hour's $PM_{2.5}$ air quality health impact as calculated by national *NowCast* Air Quality Index (AQI) algorithms. In addition, graphs of both the AQI and the measured concentration for each site are presented to provide users with a perspective of their local 24- or 48-hour $PM_{2.5}$ exposure trend. Links to health-protective information provided by Montana's Department of Public Health and Human Services are provided to assist users in making decisions about behaviors and activities that can limit $PM_{2.5}$ exposures and impacts. Figure C.8 provides an example of a *Today's Air* site data presentation.

   MTDEQ intends to continually improve and develop the *Today's Air* website. Plans include the future inclusion of $PM_{2.5}$ measurements from personal sensors, and the addition of other pollutants monitored by the Project.

Figure C.8, Example *Today's Air* Webpage

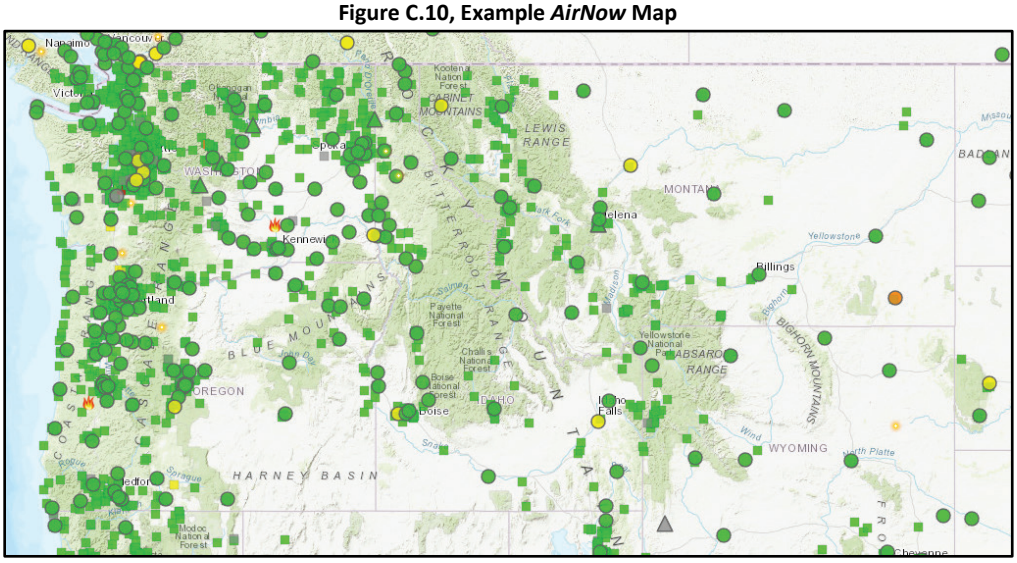


2. *MTDEQ Data Portal*—This tool is related to the *Today's Air* data process but has a broader content and is focused on providing numeric data. The portal provides direct public-user access to data from all the pollutants and meteorological parameters measured by the project. Data may be viewed on-site or downloaded for the user to examine or analyze according to their needs.

3. *EPA's AirNow Website*—This tool is similar to Montana's Today's Air, but with a national perspective. It includes a focus on measured $PM_{2.5}$ and O_3 concentrations, and reports measurements from personal $PM_{2.5}$ sensors in addition those made by FEM instruments (sensor data is communicated directly from the sensor company database to EPA). Information regarding wildfires and related smoke impacts is also made available to the public via this tool. Figures C.9 and C10 provide examples of *AirNow* data presentations.

Figure C.9, Example *AirNow* Data Presentation

Figure C.10, Example *AirNow* Map



Beyond the three tools, the public can also access the Project's monitoring data that has been uploaded to the AQS database via links on the EPA website. The data is not available by this means as quickly as it is via the three tools because of the 90-day window for the project to complete its review and validation processes (Section C.1.3.1 and C.4.1). The tradeoff is that the review and validation process is already complete on data from this source so changes to the data are much less likely, making them more authoritative for decision making purposes. In addition, data in AQS that is older than one year and that has been certified as discussed in Section C.5 embodies an increased degree of data certainty because of the additional data review associated with certification and the reality the EPA locks down the dataset, preventing data changes once the certification is complete.

C.4.3 Data Availability

The web-based tools summarized in Section C.4.2 make much of the Project's ambient air monitoring data available directly to the public via the internet. In cases where the internet is unavailable or uncomfortable to use, or where specific data or data formats are needed by users, the Project provides custom-generated data reports upon request.

C.5 Data Certification

Each spring the Project produces a certification of the fully QA'd data collected from FRM and FEM monitors at its SLAMS and SPM sites. The certification is required by 40 CFR 58.15, and must:

1. Be submitted to the EPA Regional Administrator by May 1;

2. Be submitted under the authority and signature of the head official of the monitoring agency or their designee;

3. Certify that "*the previous year of ambient concentration and quality assurance data are completely submitted to AQS and that the ambient concentration data are accurate to the best of her or his knowledge, taking into consideration the quality assurance findings*;*"*

4. Contain a summary report of data collected from FRM and FEM monitors at SLAMS and SPM sites during the previous calendar year; and

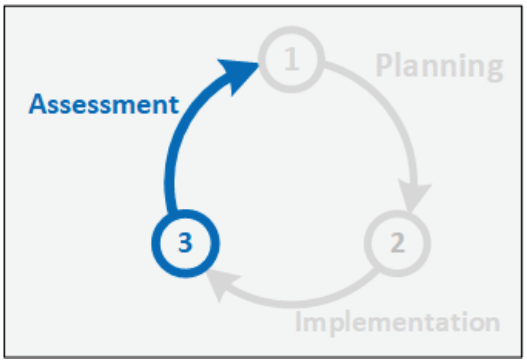
5. Contain a summary of the precision and accuracy data for all ambient air quality data collected by FRM, FEM, and ARM monitors at SLAMS and SPM sites during the previous calendar year.

Each year the EPA produces guidance regarding the form, content, and/or process of the certification for that year's certification. Data and QA summary reports are normally required to be generated in specific formats established within the AQS Reports and Forms database interface. The Project contacts its EPA Region 8 contact prior to submission to facilitate this reporting effort.

Section D.1.1.4 provides additional information on the Project's data certification.

D. Monitoring Assessment and Oversight

Section A of this QAPP establishes the overall *plan* of the Project. Sections B and C detail how the Project *implements* the plan through operation of monitoring equipment and collection of the data it produces. Section D details a final evaluation step in the process flow of the Project, consisting of three components:



1. **Ask**
    a. Does the *implementation* match and fulfill the *plan*, and to what degree?

    b. Does the plan and its implementation meet the Project's *purpose*, that is, …"***to provide high quality ambient air data that informs data users and their decisions***," and to what degree?

    c. What should the Project's response be if the answers to questions a. and b. are, or are not, satisfactory?

2. **Answer**

    The answers to questions a. and b. will be one of two types:

    - Positive, or *affirming*, that is, "yes, we're fulfilling the objective," or "yes, this monitor is demonstrably meeting its DQIs."

    - Negative, or *deviating*, that is, "no, we're not fulfilling the objective," or "no, this monitor is demonstrably *not* meeting its DQIs."

3. **Action**

    Question c. must result in *action* corresponding to the answers to questions a. and b. as summarized in the following table:

Table D.1, Actions from Assessment Answers

ANSWER	ACTION
Affirming	***Continue*** the present process and ***build*** on it for the future.
Deviating	***Correct*** the error or appropriately ***change*** the process.

This *Ask-Answer-Action* process is known as *assessment*. The term "assessment" as used in this QAPP is a broad process by which the Project is evaluated to determine its performance, effectiveness, and how well it is meeting its goals and objectives. Assessment looks back in time to evaluate and validate actions that were conducted and data that has been collected, and then looks forward to define how the Project can grow, adapt, adjust, and improve. The outputs of assessment feed back into the iterative Project process flow to inform continuous improvements to planning and implementation.

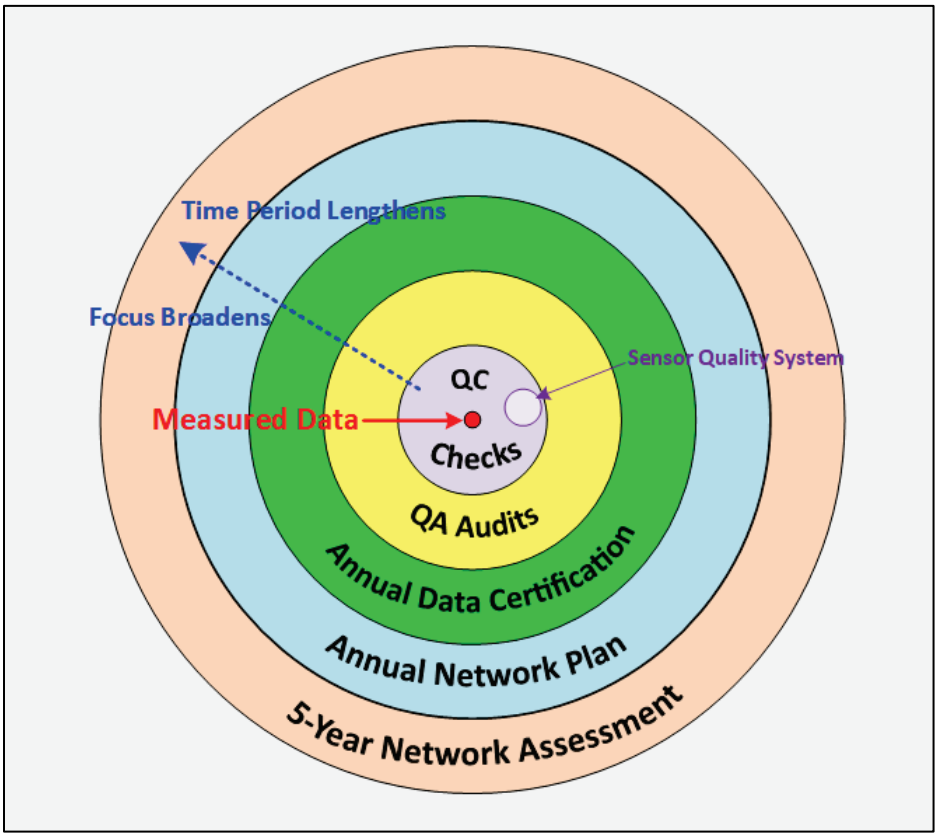
Assessment is both qualitative and quantitative in process and outcomes. The *quantitative* processes are generally referred to as "audits." As used in this QAPP the term "audit" refers to specific activities, usually systematic examinations of monitors or processes conducted by personnel and/or equipment that are different from, and independent of, those involved in normal monitoring network operations. Audit results are compared to *quantitative* limits or *data quality indicators* (DQIs) as discussed in Sections A.4.4.1, and A.4.4.2, and listed in the Validation Templates in Appendices A and B.

D.1 Assessment Types

D.1.1 Internal Assessments

The Project performs five types of assessments on its monitoring network equipment and processes. Figure D.1 graphically represents the types, focuses, and relationships of these assessments. As illustrated there, working from the center out, each successive assessment type evaluates everything within the steps before it. In that continuum, the *focus* of each successive assessment type broadens, beginning with a focus on individual monitors and expanding incrementally to a review of the entire monitoring network. Similarly, with each successive assessment type, the time frame covered by the assessment broadens, beginning with a two-week period for QC checks and stepping out to a period covering five years and a projection into the future.

Figure D.1, Types of Internal Project Assessments



The following Sections summarize each of the internal assessment types.

D.1.1.1 QC Checks

As discussed in Section B.4.2, QC checks are performed on individual gas monitors every two weeks and on individual PM monitors each month. The results of these checks are reported to the EPA AQS database (Section C.4.1). By comparing their results to related DQIs, QC Checks define the near-term validity of monitored data (see Section B.4.3). Aggregated over a year, these assessments also help quantify the performance of the network as a whole (Sections D.1.1.3 and D.1.1.4).

D.1.1.2 Semi-Annual Flow Rate Audits for PM_{10} and $PM_{2.5}$

The flow rate for each PM monitor in the Project's network is audited at least twice per year as directed in 40 CFR 58 Appendix A. PM flow audits are conducted according to Project SOPs and the requirements of Section 3.2.2 of 40 CFR 58 Appendix A for $PM_{2.5}$ audits, and Section 3.3.3 of 40 CFR 58 Appendix A for PM_{10} audits. Results of each audit are shared with Project staff and management and are reported to the EPA AQS database (Section C.4.1). These audits help define the validity of regular QC checks (Section D.1.1.1) as well as the intermediate-term validity of monitored data. The Correction or Corrective Action processes described in Section D.3. are employed in the event that results of any audit do not meet DQIs.

D.1.1.3 Gas Monitor Annual Performance Evaluations

Each gas monitor in the Project's network is audited at least once per year as directed in 40 CFR 58 Appendix A Section 3.1.2. The audits consist of challenging each monitor (per SOP processes) with known (reference) gas concentrations of at least three levels. The audit levels are selected per direction in the referenced CFR and are listed in the Project's SOP Reference Documents. An additional assessment is incorporated within the audit procedures by recording analyzer response information from the station Data Acquisition System (DAS or Data Logger, see Section C.1.1.1.1) and comparing it with the direct analyzer output, thereby auditing the DAS at the same time as the gas analyzer. Results of each audit are shared with Project staff and management and are reported to the EPA AQS database (Section C.4.1). These audits help define the validity of regular QC checks (Section D.1.1.1) as well as the intermediate-term validity of monitored data. The Correction or Corrective Action processes described in Section D.3. are employed in the event that results of any audit do not meet DQIs.

D.1.1.4 Annual Data Certification Process

The Annual Data Certification process summarized in Section C.5 facilitates Project assessment through additional review of the entirety of the previous year's hourly measurement and QC/QA data. The resulting document contains a certification by the head of the MTDEQ monitoring effort of the truth, accuracy, and completeness of the Project's submitted data. Data certification assessments uniquely complement the annual and semi-annual audit assessments described in the previous two sections and the regular QC checks discussed in Section B.4.2. While the audits and checks focus on individual monitors and DAS systems at specific points in time, data certification summarizes those efforts in a greater breadth that represents the monitoring network as a whole for an entire year. Each monitor's contribution to the performance of the entire Project network for each measured pollutant is assessed in the context of the whole network. DQIs assessed within the certification, particularly bias, relate to annual and network-wide monitor performance. Additionally, data certification reports include representations of both the internally conducted QC checks and QA assessments, as well as the externally conducted assessments described in Section D.1.2. Results of the Annual Data Certification

are shared with Project staff and MTDEQ management, and are reported to EPA. EPA reviews the certification and documents its concurrence or disagreement with the submitted materials, as described in Section D.2.1.1.

D.1.1.5 Annual Network Plan

The Annual Network Plan described in Section B.1.2.1 documents a significant annual review of the Project's monitoring network. This effort summarizes the monitored pollutant data from all FEM and FRM monitors for a calendar year. It also assesses the network's compliance with the requirements of 40 CFR Part 58 Appendices A through E, including conformity with QA requirements and the prescribed numbers and locations of pollutant monitors. Following the review and assessment, the Plan contains proposed needed or desired changes to the network. Each Annual Network Plan document is shared with ARMS staff and management. In addition, it is shared with the public with a request for input and comments for at least 30 days before it is submitted to EPA. EPA reviews the Network Plan and communicates its approval or disagreement with the submitted materials as described in Section D.2.1.2.

D.1.1.6 Five-year Periodic Assessment

As described in Section B.1.2.2 and illustrated in Figure D.1, the Periodic Network Assessment forms the broadest and most long-term internal analysis of the Project and its monitoring network. This assessment focuses particularly on whether the network is comprised of the correct types, numbers and locations of monitors as defined by 40 CFR 58 Appendix D. Based on that review, the five-year assessment proposes plans for measuring long term pollutant trends with correct numbers and types of monitors. The assessment plan document is submitted to EPA. EPA reviews the five-year Network Assessment and communicates its approval or disagreement with the submitted materials as described in see Section D.2.1.2.

D.1.1.7 Assessments of Sensors

As introduced in Section B.2.4.1, non-FEM pollutant sensors may, in some cases and under certain conditions, exhibit undesirable biases in their measurements; and their simplicity provides no means of calibration or accuracy adjustment. However, these devices are reliable enough to meet the needs of individuals, schools and organizations for citizen-level decision-making, especially when deployed in integration with the FEM/FRM network. To achieve a high level of data quality/confidence from its sensors, the Project deploys and operates them under a quality system described in the following paragraphs.

D.1.1.7.1 Sensor Network Spatial Quality Assessment

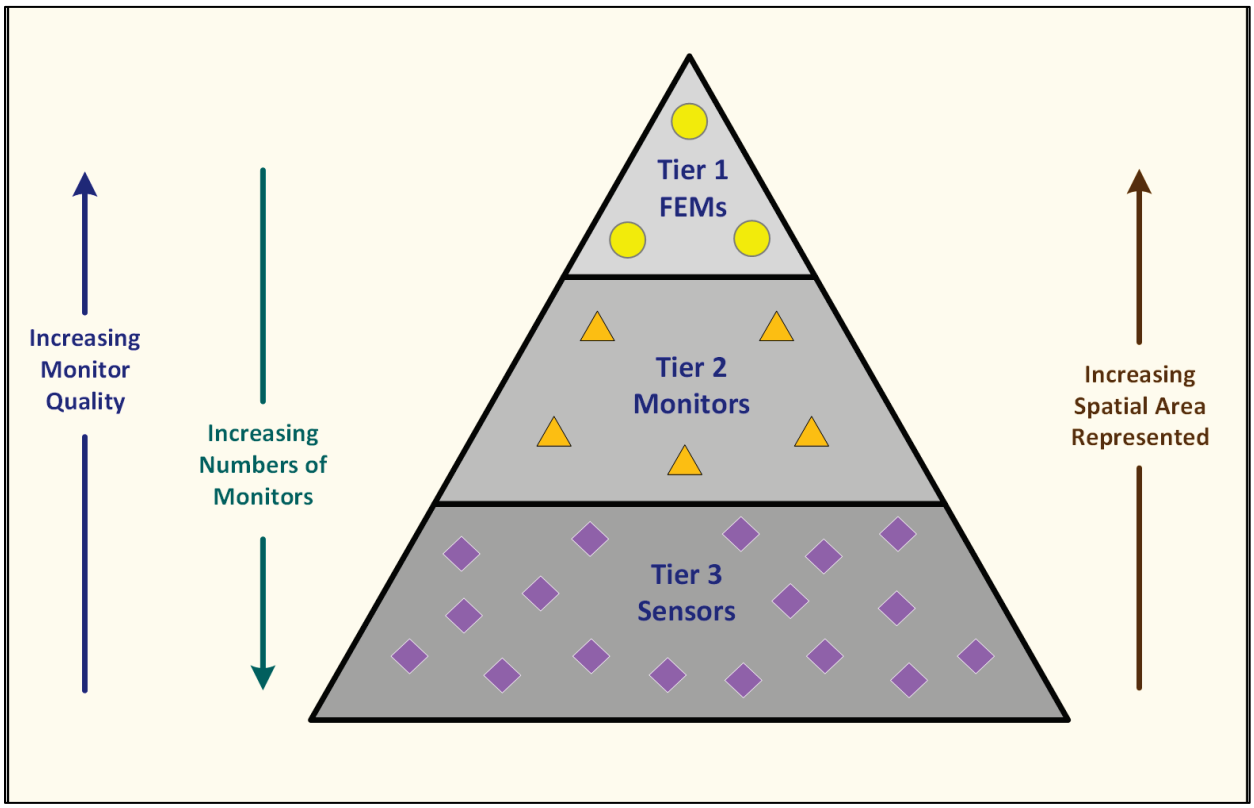
The Project promotes and evaluates the quality of sensor performance through comparison with instrumentation of known quality (as determined by the processes described throughout this QAPP). Two forms of comparison are used:

1. **Collocation with existing monitors**. The Project collocates sensors with higher quality monitors (typically FEM instruments) at sites across the monitoring network. Measurement data from the sensors are then compared with corresponding data from the confirmed higher-quality stationary monitors to determine if, and to what degree, sensor bias is occurring.

2. **Tiered network quality hierarchy.** Within the Network Design process described in Section B.1., the monitor and sensor networks are planned to provide overlapping

geographic (spatial) areas of QA oversight. The highest quality instruments are fewest in number and individually represent the air quality in a broad geographic area. Each FRM/FEM monitor provides a measurement quality standard to a group of more numerous mid-quality monitors, each of which represents the air quality in a smaller geographic area. The mid quality monitors, in turn, each provide a measurement quality standard to an even more numerous group of sensors, each of which represents the air quality in a smaller, more localized geographic area. The Project aspires to have a tiered monitoring network QA system where no sensor is more than 50 miles from a higher tier monitor. Figure D-2 provides a graphic illustration of the tiered quality hierarchy for $PM_{2.5}$ sensor monitoring in Montana.

Figure D.2, $PM_{2.5}$ Sensor Network Tiered Quality Hierarchy



D.1.1.7.2 Sensor Network Data Acquisition Validation

The Project processes by which data is acquired from its network sensors (see Section C.1.1.1) is designed to collect instrument operating parameters in addition to measured pollutant concentrations. Automated comparisons between appropriate parameters and measurements provide an indication of sensor performance and resulting data quality. This process undergoes continual review and enhancement as operating experience with the sensor network is gained.

D.1.2 External Assessments

EPA performs three types of assessments of the Project monitoring network equipment and processes. These assessments are completely independent of the Project, its personnel, and its activities. This adds

a significant verification of the Project's quality and produces documentation of the Project's compliance with National Performance Evaluation Program (NPEP) standards.

D.1.2.1 EPA National Performance Audit Program (NPAP)

The NPAP is an independent audit program designed to assess the performance of monitoring networks for gaseous pollutants. The program is established in 40 CFR 58 Appendix A, Sections 2.4 and 3.1.3. Under these requirements, a Primary Quality Assurance Organization (PQAO, see QAPP Section A.3.2.4.1) must perform audits of the primary monitors at 20 percent of its gaseous monitoring sites each year, and 100 percent of the sites every 6 years (see also Table B.8). While a PQAO may perform these audits, the Project elects to utilize the federally implemented NPAP program as established in 40 CFR 58 Appendix A, Section 3.1.3.4, in which EPA or its contractor conducts the assessments. NPAP audits add a degree of independent QA to the Project. Results of NPAP audits are reported and evaluated in the Annual Data Certification process discussed in Sections C.5 and D.1.1.4.

D.1.2.2 EPA $PM_{2.5}$ Performance Evaluation Program (PEP)

The PEP is an independent assessment program performed to estimate total measurement system bias for the Project's $PM_{2.5}$ monitoring network. The program is established in 40 CFR 58 Appendix A, Sections 2.4 and 3.2.4. Under these requirements a PQAO must annually evaluate approximately 15 percent of their $PM_{2.5}$ monitors and have all monitors in the network evaluated at least once every six years (see 40 CFR 58 Appendix A Section 3.2.4.2). In the Project, at least eight valid PEP audits must be conducted each year (see 40 CFR 58 Appendix A Section 3.2.4. See also QAPP Table B.9) to meet these conditions. The Project elects to utilize the federally implemented independent PEP program to conduct PEP audits. The bias calculations resulting from the PEP audits are reported and evaluated in the Annual Data Certification process discussed in Sections C.5 and D.1.1.4.

D.1.2.3 EPA Technical Systems Audits (TSA)

The rules in 40 CFR 58 Appendix A, Section 2.5 require each EPA Regional Office to conduct a comprehensive, system-wide audit of each PQAO at least every 3 years. For this Project, TSAs are conducted by EPA Region 8, whose office is in Denver, Colorado. TSAs must be performed according to the *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program*. EPA-454/B-17-001, particularly Section 15.3 of that document. As referenced there, a TSA is "an on-site review and inspection of a monitoring organization's ambient air monitoring program to assess its compliance with established regulations governing the collection, analysis, validation, and reporting of ambient air quality data." EPA provides a report of the results of the TSA findings to the Project. The Project may discuss any deviating "findings" with EPA, and takes actions to change or correct them as appropriate.

D.2 Project Oversight

Section A.3.2 of this QAPP introduces and discusses the multi-tiered quality planning and *oversight* system under which this Project operates. This QA structure exists to limit measurement uncertainty and ensure the Project meets its intended purpose and objectives. Specific to the topic of *monitoring assessment*, several EPA review and approval oversight roles warrant further discussion here.

D.2.1 EPA Monitoring Assessment Oversight

D.2.1.1 EPA Data Certification Evaluation and Confirmation

As discussed in Sections C.5 and D.1.1.4, the Project's Annual Data Certification documents a review of the entirety of the previous year's hourly measurement and QC/QA data. The certification process involves an EPA AQS automated assessment of the Project's data, then EPA's final manual review of the Project's certification submission. This final review requires EPA to assess the Project's comments and qualifiers and then document EPA's confirmation or rejection of the Project's certification package. This response from EPA not only completes the certification process, but also informs the Project on components that are working well or that need assessment or change for future monitoring.

D.2.1.2 EPA Annual Network Plan Approval

The Annual Network Plans discussed in Sections B.1.2.1 and D.1.1.5, and the 5-year Periodic Assessments discussed in Sections B.1.2.2 and D.1.1.6, both include evaluations of the Project network's performance and adequacy, as well as proposals for future changes to the network. The rules in 40 CFR 58.10(a)(2) specify that proposed network changes to SLAMS sites must be approved by the EPA Regional Administrator. The approval or disapproval must be completed within 120 days of a complete plan submission to the EPA.

D.2.1.3 EPA Grant Approvals

EPA's grant funding for the Project is normally subject to conditions requiring performance of monitoring according to an approved QAPP and other related direction and reporting requirements. Therefore, EPA's oversight and approval are critical for the continued funding of the Project.

D.2.1.4 EPA Ambient Air Protocol Gas Verification Program (PGVP)

EPA established the PGVP to improve the quality of commercially prepared calibration gases by establishing their traceability to NIST Standard Reference Materials (SRMs), and then verifying their accuracy and traceability (see the use of certified EPA Protocol gases by the Project in Section B.4.1.2.1). As established in 40 CFR 58 Appendix A Section 2.6, the Project must:

- Provide information to EPA on the gas producers used on an annual basis; and
- Participate in the PGVP, at the request of the EPA, at least once every 5 years by sending a new, unused gas standard to a designated verification laboratory.

(Note that 40 CFR 58 Appendix A Section 2.6 includes two other Project-pertinent requirements as discussed in Sections B. 4.1.1 and B.4.1.2.1.1).

D.3 Corrective Action

D.3.1 Corrective Action Background

As established in the introduction to Section D, the ultimate value or goal of Project assessment processes is the intentional action that flows from the answers in an *Ask-Answer-Action* process. As summarized in Table D.1, when the answers to the questions show a deviation or error, the appropriate action is to ***correct*** the error or ***change*** the process. Discrimination between these two actions is significant. For example, if an instrument fails a flow check or a precision check, the appropriate action is to immediately ***correct*** (that is "fix") the instrument, but NOT to change the assessment process. If,

however, all the instruments in the network, or those of a given manufacturer, consistently fail flow or precision checks, then a very different action is warranted. The action in that case involves a system-wide analysis to determine the root causes and origins of errors in the instruments, the QC check process, peoples' techniques, manufacturers' parts (or part unavailability), and so on. Based on that analysis, discussions and decisions of further actions and deployment plans are necessary.

These two examples illustrate the difference between the concepts of ***correction***, as in the first example, and ***corrective action*** in the second example. *Correction* is immediate, direct, limited in scope, SOP-directed, informal, and requires minimal or no documentation. *Corrective action*, as in the second example, is longer-term, more formal, broader in scope, and requires documentation and follow-up. *Correction* largely addresses immediate, individual errors, while *corrective action* often addresses broader root causes and systemic challenges to Project monitoring and/or its larger quality system.

D.3.2 Corrective Action Process

The Project employs a formal *corrective action* process in response to a problem or error whenever large amounts of data are impacted, when data in AQS must be edited, when procedural inadequacies are revealed, when systemic instrument or monitoring site impacts are discovered, when instrument audits demonstrate deviations, and when other complex or large-scale problems or errors in the Project network are encountered.

Every corrective action process in this Project includes the following mandatory components:

1. **Discussion**. The discoverer must bring the matter to the ARMS for awareness and discussion. At minimum, the participants in the discussion must include the discoverer, the ARMS Section Supervisor, and the ARMS Quality Assurance Manager. Depending on the situation, input and participation from additional ARMS staff may be required or encouraged.

2. **Documentation**. If required by the QA Manager, the discoverer must complete and file a *Corrective Action Request Form* (CARF) according to the instructions on the most recent version of the form stored on the MTDEQ network drive (see Corrective Actions Folder).

3. **Resolution**. As directed by the ARMS Section Supervisor or QA Manager, staff must take specific action(s) to correct the problem or issue. In cases involving broader, systematic problems, SOPs may need to be written or modified.

4. **Follow-up**. The ARMS must conduct a follow-up discussion to communicate the problem, the resolution process, and the outcome of its resolution. All staff must be educated and directed to adopt corrected operating practices. The CARF must then be appropriately signed, filed, and closed per the instructions on the form.

Appendix A

Montana DEQ Ambient Air Monitoring

Data Validation Templates

Montana Department of Environmental Quality, Air Quality Bureau
Air Research and Monitoring Section

Data Validation Templates

Table of Contents

Click any of the following pollutants to navigate to the corresponding template.

Template Legend		
Color	**Criteria Category**	**Definition**
	Critical	Criteria deemed critical to maintaining the integrity of a sample or group of samples. Invalidate data if criteria are not met.
	Operational	Criteria important for maintaining and evaluating the quality of the data collection system. *May* be cause for data invalidation if other QC info indicates.
	Systematic	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

CARBON MONOXIDE CRITICAL[1] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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. 2.3.1.2. per OAQPS Technical Note dated 05/05/2016. QC Check Conc. range must be between 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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[1] Criteria deemed **critical** to maintaining the integrity of a sample or group of samples.
Observations that do not meet every ***critical*** criterion should be **invalidated** unless there are compelling reasons and justification for not doing so.

CARBON MONOXIDE OPERATIONAL[2] CRITERIA - Page 1 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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 daily***	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 CO_2 sensitive instruments. 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 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

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operational*** criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

CARBON MONOXIDE OPERATIONAL[2] CRITERIA - Page 2 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

CARBON MONOXIDE SYSTEMATIC [3] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	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 a equivalent material to Teflon. Replacement/cleaning is suggested as 1/year and more frequent if pollutant load dictates.
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. 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 < ± 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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

NO_2 – NO – NO_X CRITICAL[1] Criteria

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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. 2.3.1.4. per OAQPS Technical Note dated 05/05/2016. QC Check Conc range must be between 0.005 - 0.08 ppm.
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 (for GPT) or 2.4.10 (for permeation devices) 2) Recommendation 3) 40 CFR Part 50 App F Sec. 1.5.10 or 2.4.10 Regulation states > 96%, 96 – 104.1% is a recommendation.

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[1] Criteria deemed **critical** to maintaining the integrity of a sample or group of samples.
Observations that do not meet every ***critical*** criterion should be **invalidated** unless there are compelling reasons and justification for not doing so.

NO_2 – NO – NO_X Operational[2] CRITERIA - Page 1 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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
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

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

NO_2 – NO – NO_X Operational[2] CRITERIA - Page 2of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

NO_2 – NO – NO_X Systematic[3] CRITERIA - Page 1 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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 AQS	***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
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

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

NO_2 – NO – NO_X Systematic[3] CRITERIA - Page 2 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

OZONE CRITICAL[1] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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. 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.2. per OAQPS Technical Note dated 05/05/2016. QC Check Conc range must be between 0.005 - 0.08 ppm.
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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[1] Criteria deemed **critical** to maintaining the integrity of a sample or group of samples.
Observations that do not meet every ***critical*** criterion should be **invalidated** unless there are compelling reasons and justification for not doing so.

OZONE OPERATIONAL[2] CRITERIA - Page 1 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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 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 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
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

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operational*** criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

OZONE OPERATIONAL[2] CRITERIA - Page 2 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
Ozone Level 2 Standard			
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-10-001
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-10-001
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-10-001 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-10- 001 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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

OZONE SYSTEMATIC [3] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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 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-10-001 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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

SO_2 CRITICAL[1] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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. per OAQPS Technical Note dated 05/05/2016. QC Check Conc range must be between 0.005 - 0.08 ppm.
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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[1] Criteria deemed **critical** to maintaining the integrity of a sample or group of samples.
Observations that do not meet every ***critical*** criterion should be **invalidated** unless there are compelling reasons and justification for not doing so.

SO_2 OPERATIONAL[2] CRITERIA Page 1 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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 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 < ± 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 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 ± .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
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 Verification Program 40 CFR Part 58 App A Sec. 2.6.1

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

SO_2 OPERATIONAL[2] CRITERIA Page 2 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operational*** criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

SO_2 SYSTEMATIC [3] Criteria

SO_2 SYSTEMATIC [3] Criteria **1) Requirement (DQI)**	**2) Frequency**	**3) Acceptance Criteria (MQO)**	**Information / Action**
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
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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

PM_{10} CONTINUOUS at STP, - CRITICAL[1] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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
Average Flow Rate	Every 24 hours of operation	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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[1] Criteria deemed **critical** to maintaining the integrity of a sample or group of samples.
Observations that do not meet every ***critical*** criterion should be **invalidated** unless there are compelling reasons and justification for not doing so.

PM_{10} CONTINUOUS at STP, - OPERATIONAL[2] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
Verification/Calibration			
System Leak Check	During pre-calibration 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 5 to 7 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' Manual or SOP	

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

PM_{10} CONTINUOUS at STP, - SYSTEMATIC[3] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	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	***24-hour, quarterly***	***≥ 75%***	1), 2) and 3) 40 CFR Part 50 App. K, Sec. 2.3 b & c
Reporting Units	All filters	µg/m^3 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/m^3 (≥ 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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

$PM_{2.5}$ Continuous, Local Conditions - CRITICAL[1] CRITERIA – Page 1 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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 [4].***	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)
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

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[1] Criteria deemed critical to maintaining the integrity of a sample or group of samples.

Observations that do not meet every ***Critical*** criterion should be **invalidated** unless there are compelling reasons and justification for not doing so.

[4] 24-hour average value must be flagged if not meeting criteria

$PM_{2.5}$ Continuous, Local Conditions - CRITICAL[1] CRITERIA – Page 2 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
Sampling Instrument continued…			
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 operator 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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[1] Criteria deemed **critical** to maintaining the integrity of a sample or group of samples.
Observations that do not meet every ***critical*** criterion should be **invalidated** unless there are compelling reasons and justification for not doing so.

$PM_{2.5}$ Continuous, Local Conditions - OPERATIONAL[2] CRITERIA - Page 1 of 3

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
Annual Multi-point Verifications/Calibrations			
Leak Check	Every 30 days	< 1.0 lpm BAM (Met One BAMS only) < 0.42 lpm difference with and without adapter for Thermo BAMs	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) Recommendation 3) BAM SOP Sec. 10.1.2 ***Thermo BAM leak check REQUIRES the use of an adapter--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
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/m³	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

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operational*** criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

$PM_{2.5}$ Continuous, Local Conditions - OPERATIONAL[2] CRITERIA - Page 2 of 3

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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	

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

$PM_{2.5}$ Continuous, Local Conditions - OPERATIONAL[2] CRITERIA - Page 3 of 3

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
Met One BAM Specific Operational Criteria			
BAM check of membrane span foil	Daily	Avg. < ± 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
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	≤ 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	
Internal/External Data Logger Data (BAM)	Every 30 days 10 randomly selected values	Agree exactly (digital) and ± 1 µg/m3 (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		

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

$PM_{2.5}$ Continuous, Local Conditions – SYSTEMATIC[3] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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			
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*** [5]	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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

[5] Need to ensure data system stamps appropriate time period with reported sample value

$PM_{2.5}$ Filter Based Local Conditions, *Field Activities* – CRITICAL[1] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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 [4] 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 operation***	***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 operation***	**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[4]**	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[4]**	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 [5]**	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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[1] Criteria deemed **critical** to maintaining the integrity of a sample or group of samples.
Observations that do not meet every ***critical*** criterion should be **invalidated** unless there are compelling reasons and justification for not doing so.

[4] Value must be flagged.

[5] 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.

$PM_{2.5}$ Filter Based Local Conditions, *Field Activities* - OPERATIONAL[2] CRITERIA – Page 1 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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
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/m³***	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

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operational*** criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

$PM_{2.5}$ Filter Based Local Conditions, *Field Activities* - OPERATIONAL[2] CRITERIA – Page 2 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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	

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

$PM_{2.5}$ Filter Based Local Conditions, *Field Activities* – SYSTEMATIC[3] CRITERIA –- Page 1 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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 (PM2.5)***	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.
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

Continued next page…

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

$PM_{2.5}$ Filter Based Local Conditions, *Field Activities* - SYSTEMATIC[3] CRITERIA – Page 2 of 2

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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, ± 0.5o 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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

$PM_{2.5}$ Filter Based Local Conditions, *Laboratory Activities* - CRITICAL[1] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
Post-sampling Weighing	***All filters***	***Protected from exposure to temperatures above 25° C 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***	Manufacturers' 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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[1] Criteria deemed **critical** to maintaining the integrity of a sample or group of samples.
Observations that do not meet every ***critical*** criterion should be **invalidated** unless there are compelling reasons and justification for not doing so.

$PM_{2.5}$ Filter Based Local Conditions, *Laboratory Activities* – OPERATIONAL[2] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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			
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 ompared to primary	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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[2] Criteria that are important for maintaining and evaluating the quality of the data collection system. Violation of an ***operationa***l criterion or a number of criteria ***may*** be cause for data invalidation *after consideration of other QC information*.

$PM_{2.5}$ Filter Based Local Conditions, *Laboratory Activities* – SYSTEMATIC[3] CRITERIA

1) Requirement (DQI)	2) Frequency	3) Acceptance Criteria (MQO)	Information / Action
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

DQIs listed in ***RED, bold, italic*** font are **REQUIRED** in the CFR. The corresponding Frequency and acceptance criteria (MQOs) are then listed in ***bold italic*** font. **REQUIRED** criteria can be used for data invalidation depending on the infraction. Other DQIs are recommended and will normally be applied by MTDEQ for all FEM instruments, and other informational instruments as appropriate.

[3] 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.

Appendix B

Montana DEQ Ambient Air Monitoring

NCore Station Trace Level Gas Instruments Measurement Quality Objectives

NCore Station *Trace Level* Gas Instruments* - Measurement Quality Objectives - Page 1 of 2

QC Parameter or Check		CO	SO2	NO, NOy	ADDITIONAL INFORMATION	Source
Analyzer Range		5000 ppb	100 ppb	200 ppb	For a typical urban NCore station	EPA[1]
One-Point Quality Control (QC) Check with ZSP	**Frequency**	Once Every Two Weeks (every 14 days)				40 CFR Part 58, Appendix A, Sec 3.1.1
	Zero	< ±40 ppb	< ±0.100 ppb	< ±0.050 ppb		EPA[1] Action Limit
		< ±75 ppb	*< ±0.750 ppb*	*< ±0.750 ppb*	MT DEQ guidance as of July 08, 2011	DEQ Action Limit
	Precision	250 – 500 ppb	5 - 10 ppb	20 -40 ppb	Concentration Range	
		±10 %Δ	±10 %Δ	±10 %Δ		EPA[1] Action Limit
	Span	4500 ppb	90 ppb	180 ppb	Concentration Range	
		±15 %Δ	±10.0 %Δ	±15.0 %Δ		EPA[2] Action Limit
	NOy Converter Efficiency	--	--	≥ 96 %		40 CFR Part 50 App F Sec. 1.5.10 or 2.4.10. Regulation states > 96%, 96 – 104.1% is a recommendation.
Measurement Uncertainty Goal	**Precision**	15%	10%	10%	Upper 90% confidence limit (CL) for the Coefficient of Variation (CV)	40 CFR Part 58 App A Sec. 2.3.1.5 & 3.1.1
	Bias	10%	10%	10%	Upper 95% CL for the Absolute Bias CV	

Continued next page…

[1] EPA NCore Training Workshop National Air Monitoring Conference (2009). <https://www3.epa.gov/ttn/amtic/ncoreguidance.html>

[2] EPA TEI MODEL 48C TLE CO Analyzer SOP (Version 2.0; May 6, 2009); EPA TEI MODEL 43C TLE SO2 Analyzer SOP (Version 2.0; May 6, 2009); EPA TELEDYNE API NOy SOP (Version 1.0; May 6, 2008). <https://www3.epa.gov/ttn/amtic/ncoreguidance.html>

%Δ = Percent Difference

*** O_3 must also be monitored at NCore but not at trace levels. See the regular Validation Templates for MQOs on measuring O_3.**

NCore Station *Trace Level* Gas Instruments* - Measurement Quality Objectives - Page 2 of 2

QC Parameter or Check		CO	SO2	NO, NOy	ADDITIONAL INFORMATION	Source
Calibration	**Frequency**	Once Every 90 days and Following Maintenance / Repairs				EPA[2]
	Number of Test Concentrations	At least 4 including zero				EPA[2]
	Span and Mid-Scale Concentrations	< ±5.0 %Δ	< ±5.0 %Δ	< ±5.0 %Δ		EPA[2]
	Zero	< ±40 ppb	< ±0.100 ppb	< ±0.050 ppb	DEQ Goal	DEQ Goal
	Span	±2.0 %Δ	±2.0 %Δ	±2.0 %Δ	DEQ Goal	DEQ Goal
	Slope	0.98 - 1.02	0.98 - 1.02	0.98 - 1.02	Sum of Least squares Linear Regression (SSR) of known test concentration (X) versus DAS response (Y)	EPA[2]
	Intercept	±40 ppb	±1.0 ppb	±1.0 ppb		
	Correlation Coefficient	≥ 0.9950	≥ 0.9950	≥ 0.9950		
	NOy Converter Efficiency	--	--	≥ 96 %	Slope from SSR of known NO_{DIF} test concentration (X) versus NO_{DIF} Converted (Y)	EPA[2]

[1] EPA NCore Training Workshop National Air Monitoring Conference (2009). <https://www3.epa.gov/ttn/amtic/ncoreguidance.html>

[2] EPA TEI MODEL 48C TLE CO Analyzer SOP (Version 2.0; May 6, 2009); EPA TEI MODEL 43C TLE SO2 Analyzer SOP (Version 2.0; May 6, 2009); EPA TELEDYNE API NOy SOP (Version 1.0; May 6, 2008). <https://www3.epa.gov/ttn/amtic/ncoreguidance.html>

%Δ = Percent Difference

*** O_3 must also be monitored at NCore but not at trace levels. See the regular Validation Templates for MQOs on measuring O_3.**

Appendix C

Montana DEQ Ambient Air Monitoring

List of Active Standard Operating Procedures and Quick Guides

Quick Guides					
Guide Number	**Parameter**	**Instrument or Process**	**Revision**	**Issue Date**	**Revision Date**
G1	WS/WD	Sonic Anemometer	**0**	02/26/24	
G2	PM Filters	NCore Filter Changes	**1**	06/25/24	08/05/24
G3	PurpleAir Sensors	Configuring PurpleAir Wi-Fi	**0**	06/25/24	
G4	Gas Monitors	Perform ZSPs	**0**	06/25/24	
G5	Gas Monitors	Gas Monitor Remote Communication	**0**	06/25/24	
G6	PM Monitors	Exceptional Events Flagging for PM	**0**	11/25/24	
G7	Gas Calibrators	Gas Calibrator Swap Out	**0**	8/20/2024	
G8	Gas Cylinders	Gas Bottle Swap Out	**0**	8/20/2024	
G9	PM FRM Filter Data	Filter Based FRM Data Import and QC	**0**	11/25/2024	

SOP Number	**Parameter or Process**	**Equipment Manufacturer**	**SOP Title**	**Revision Number**	**Issue Date**	**Revision Date**
Monitors and Samplers						
SOP-001	SO2	API	T100U SO2 Analyzer	3	3/31/2006	12/19/2019
SOP-003	O3	Thermo	49i UV Photometric O3 Analyzer	3	3/31/2006	12/19/2019
SOP-005	NOX	API	200E Chemiluminescence NOx Analyzer	2	3/31/2006	10/19/2019
SOP-006	PM	Met One	BAM 1020 Particulate Monitor Software ver. < 3.2.4	4	7/15/2008	4/10/2018
SOP-009	PM	BGI	PQ 200 Low Volume Particulate Sampler	1	7/15/2008	8/15/2015
SOP-011	WS/WD	Climatronics	Sonic Anemometer	1	9/30/2008	2/18/2016
SOP-012	Ambient Temp	--	Ambient Thermometer in a Motor Aspirated Radiation Shield	0	9/30/2008	
SOP-014	PM	Met One	BAM 1020 Particulate Monitor Software ver. 3.2.4 and above	3	8/29/2008	9/1/2017
SOP-015	NOX	Thermo	42i-Trace Level Chemiluminescence NO-NO2-NOx Analyzer	2	3/15/2016	12/19/2019
SOP-016	CO	Thermo	48i Trace Level – Enhanced CO Analyzer	0	6/26/2017	
SOP-017	NOy	Thermo	42i-NOy Chemiluminescence NO-DIF-NOy Analyzer	0	6/26/2017	
SOP-019	PM	Thermo	Thermo 5014i Beta Continuous Ambient Particulate Monitor	1	11/1/2015	4/12/2018
SOP-020	Gas QC	--	Gaseous Analyzer Remote QC and Status Check	1	12/15/2016	12/19/2019

SOP-021	PM Coarse	Met One	BAM 1020 PM2.5 FEM and PM Coarse Configuration	3	8/29/2008	9/1/2017
SOP-022	PM	Met One	BAM 1022	0	7/31/24	
SOP-025	PM	Met One	Met One EBAM	0	7/31/24	
SOP-026	PM2.5	PurpleAir	PurpleAir $PM_{2.5}$ Sensors	0	7/31/24	
SOP-028	WS/WD	R.M. Young	Sonic Anemometer	0	2/26/24	
Calibration Equipment						
SOP-106	Thermo	Thermo	49C PS UV Photometric O3 Primary Standard Calibrator	0	9/30/2008	
SOP-107	Zero Air	API	701 Zero Air Generator	1	12/30/2005	10/20/2020
SOP-118	WD		Verification of Wind Direction Instrument Orientation Using NFC-6 Forester Compass	0	9/30/2006	
SOP-120	Gas Calibration	API	T700 Dynamic Dilution Calibrator	1	11/1/2015	12/26/2019
Data Collection						
SOP-202	Data Collection	ESC	ESC 8816 Data Logger	1	3/31/2006	6/30/2009
SOP-203	Data Collection	ESC	ESC 8832 Data Logger	1	6/30/2009	10/1/2014
SOP-204	Data Collection	ESC	Honeywell Minitrend Recorder	0	7/19/2017	
Data Processing and Management						
SOP-301	Data Processing	--	Continuous Instrument and Integrated Sampling Data Processing	2	7/10/2008	1/5/2018
SOP-302	Data Processing	--	Industrial Continuous and Integrated Data Processing	0	9/30/2008	
SOP-304	Data Processing	--	Data Certification	1	9/30/2008	3/15/2017
SOP-306	Data Processing	--	AQS QA Transactions	1	9/30/2008	1/11/2018
SOP-307	Data Processing	--	Exceptional Events / Smoke Impacted Data	0	5/15/2009	
SOP-309	Data Processing	--	Records Management	0	3/1/2016	
Quality Assurance and Management						
SOP-401	Gasses	--	Continuous Gas Analyzer Performance Audit	2	6/30/2006	12/19/2019
SOP-402	PM	Met One	BAM-1020 Performance Audit Standard Operating Procedure	1	1/1/2007	8/29/2008
SOP-403	PM	BGI	PQ200 Performance Audit	0	1/1/2007	

SOP-405	All	EPA	Technical Systems Audit Standard Operating Procedure	0	9/30/2008	
SOP-406	PM	--	Analytical Laboratory Audit Standard Operating Procedure	0	9/30/2008	
SOP-408	PM	Thermo	5014i Beta Continuous Ambient Particulate Monitor Performance Audit	0	7/20/2017	
Data Verification and Validation						
SOP-501	Data Verification and Validation	--	Continuous Gaseous and Meteorological Data Review, Verification, and Validation	3	9/30/2006	12/23/2019
SOP-502	Data Verification and Validation	--	Continuous Particulate Data Review, Verification, and Validation	1	9/30/2008	1/5/2018
SOP-504	Data Verification and Validation	--	Integrated Low Volume Particulate Data Review, Verification, and Validation	1	9/30/2008	8/1/2015
SOP-505	Data Verification and Validation	--	Industrial Monitoring Data Review, Verification, and Validation	0	9/30/2008	
Validation of Standards						
SOP-604	Mass Flow Meter	--	Certification	0	9/30/2006	
SOP-605	Ozone Transfer Standard and Photometer	--	Certification	2	6/30/2006	11/15/2013
SOP-606	Thermometer	--	Certification	1	9/30/2008	7/26/2017
SOP-607	Barometer	--	Certification	1	9/30/2008	6/30/2020
Laboratory						
SOP-702	IML Air Science	--	Quality Assurance Project Plan for Laboratory and Data Management Support of the Determination of Fine Particulate as PM2.5 in the Atmosphere	1	12/31/2005 (Revision 9)	1/31/2013 (Revision 13)

Appendix D

Montana DEQ Ambient Air Monitoring

Monitor Parameter and Method Codes

MTDEQ ARMS Monitor Parameter and Method Codes

as of 06-20-2023

See online EPA AQS Reference Table: AQS Code List

Parameter	ARMS Instrument	Parameter Code	Method Code	Recording Mode	Collection Description	Analysis Description	Method Type	Reference or Equivalent Method ID	Federal MDL	Min Value	Max Value	Units	Digits	Round / Truncate Indicator
Carbon monoxide	Thermo 48i TLE	42101	554	Continuous	Instrumental	Gas Filter Correlation Thermo Electron 48i-TLE	**FRM**	**RFCA-0981-054**	0.04	-0.4	50	ppm	3	R
Sulfur dioxide	API T100 U	42401	600	Continuous	Instrumental	Ultraviolet Fluorescence API 100 EU	FEM	EQSA-0495-100	0.2	-4.0	1500	ppb	1	T
Ozone	Thermo 49i	44201	47	Continuous	Instrumental	Ultraviolet	FEM	EQOA-0880-047	0.005	-0.004	0.5	ppm	3	T
Ozone	API T400	44201	87	Continuous	Instrumental	Ultraviolet Absorption	FEM	EQOA-0992-087	0.005	-0.004	0.5	ppm	3	T
Nitrogen dioxide (NO2)	Thermo 42i TL	42602	574	Continuous	Instrumental	Chemiluminescence Thermo Electron 42C-TL, 42i-TL	**FRM**	**RFNA-1289-074**	0.05	-5.0	1000	ppb	1	T
Nitrogen dioxide (NO2)	API T200U	42602	599	Continuous	Instrumental	Chemiluminescence Teledyne API 200 EU/501	**FRM**	**RFNA-1194-099**	0.05	-5.0	200	ppb	1	T
Nitrogen dioxide (NO2)	API N500	42602	256	Continuous	Instrumental	Cavity-Attenuated Phase-Shift (CAPS) spectroscopy	FEM	EQNA-0320-256	0.1	-5.0	500.0	ppb	1	T
Reactive oxides of nitrogen (NOy)	Thermo 42i-Y	42600	674	Continuous	Instrumental	Chemiluminescence Thermo Electron 42C-Y, 42i-Y			0.05	-5.0	1000	ppb	1	T
PM2.5 - Local Conditions	BGI PQ200 VSCC	88101	116	Intermittent	BGI Model PQ200 PM2.5 Sampler w/WINS*	Gravimetric	**FRM**	**RFPS-0498-116**	2	0	5000	µg/m3 (LC)	1	T
PM2.5 - Local Conditions	Met One BAM-1020 VSCC	88101	170	Continuous	Met One BAM-1020 Mass Monitor w/VSCC	Beta Attenuation	FEM	EQPM-0308-170	5	-10	975	µg/m3 (LC)	1	T
PM2.5 - Local Conditions	Thermo 5014i VSCC	88101	183	Continuous	Thermo Scientific 5014i or FH62C14-DHS w/VSCC	Beta Attenuation	FEM	EQPM-0609-183	2	-10	5000	µg/m3 (LC)	1	T
PM2.5 - Local Conditions	Met One BAM-1022 VSCC	88101	209	Continuous	Met One BAM-1022 Mass Monitor w/ VSCC or TE-PM2.5C	Beta Attenuation	FEM	EQPM-1013-209	5	-10	975	µg/m3 (LC)	1	T
Acceptable PM2.5 AQI & Speciation Mass	Met One Bam-1020 SCC	88502	731	Continuous	Met-One BAM-1020 W/PM2.5 SCC	Beta Attenuation			5	-10	5000	µg/m3 (LC)	1	T
PM10 Total 0-10um STP	Met One BAM-1020	81102	122	Continuous	INSTRUMENT MET ONE 4 MODELS	Beta Attenuation	FEM	EQPM-0798-122	4	-5	5000	µg/m3 (25 °C)	0	T
PM10 Total 0-10um STP	Thermo Scientific 5014i	81102	150	Continuous	Thermo Scientific Model 5014i	Beta Attenuation	FEM	EQPM-1102-150	4	-50	5000	µg/m3 (25 °C)	0	T
PM10-2.5 - Local Conditions	Met One BAM-1020, 10-2.5 Syst.	86101	185	Continuous	Met One BAM-1020 System	Paired Beta Difference	FEM	EQPM-0709-185	3	-10	5000	µg/m3 (LC)	1	T

* BGI Monitors are operated with a VSCC (Very Sharp Cut Cyclone), not a WINS. However, the Method Code of 116 for BGIs designated as FRMs under RFPS-0498-116 is maintined per EPA direction.

$PM_{2.5}$ Speciation Parameters are listed speparately.

See online EPA AQS Reference Table: https://aqs.epa.gov/aqsweb/documents/codetables/methods_criteria.html

See online EPA FRM / FEM Designations: https://www.epa.gov/system/files/documents/2023-06/List_of_FRM_FEM_%20June%202023_Final.pdf

Appendix E

Montana DEQ Ambient Air Monitoring

NAAQS Rounding Conventions

NAAQS Decimal Place Rounding Conventions

Pollutant	Units	Decimal[1]	CFR Reference	40 CFR Part 50 Minimum Reporting Requirement
CO	ppm	1	40 CFR Part 50.8 (a), (d)	Averages shall be stated to one decimal place. Comparison of the data with the levels of the standards in parts per million shall be made in terms of integers with fractional parts of 0.5 or greater rounding up
SO_2	ppb	0	40 CFR Part 50, Appendix T, Section 4(a)	Report to AQS in units of parts per billion (ppb), to at most one place after the decimal, with additional digits to the right being truncated with no further rounding
O_3	ppm	3	40 CFR Part 50, Appendix U, Section 3(b)	Report in parts per million (ppm) to the third decimal place, with additional digits to the right of the third decimal place truncated
NO_2, (NO, Nox)	ppb	0	40 CFR Part 50, Appendix S, Section 4	Report to AQS in units of parts per billion (ppb), to at most one place after the decimal, with additional digits to the right being truncated with no further rounding
Pb (both TSP and PM_{10})	µg/m^3@ LC [8]	3	40 CFR Part 50, Appendix R, Section 3(b)	Report to AQS in units of micrograms per cubic meter (µg/m3) at local conditions (local temperature and pressure, LC) to three decimal places; any additional digits to the right of the third decimal place are truncated
$PM_{2.5}$	µg/m3@ LC [8]	1	40 CFR Part 50, Appendix N, Section 3(b)	Report to AQS in micrograms per cubic meter (µg/m^3) to one decimal place, with additional digits to the right being truncated[6]
PM_{10}	µg/m3@ SC [8]	0	40 CFR Part 50, Appendix K, Section 1(b)	See footnote[7]. CFR Part 50 does not provide a reporting requirement.
CO Trace (NCore)	ppb	0	EPA NCore Training Workshop; 2009 National Air Monitoring Conference.	See additional guidance on NCore monitoring
SO_2 (NCore)	ppb	1[3]		See additional guidance on NCore monitoring
NO, NOy (NCore)	ppb	1[3,4]		See additional guidance on NCore monitoring
$PM_{10-2.5}$	µg/m^3@ LC	1	40 CFR Part 50, Appendix O	See additional guidance on NCore monitoring

[1] NOTE: CFR requirements for AQS reporting and for Design Values may have different rounding and decimal specifications.

[2] EPA NCore Training Workshop; 2009 National Air Monitoring Conference.

[3] NCore SO_2, NO, NOy performance evaluation (field audit) record zeros reported to 3 decimals.

[4] NO, NOy are not criteria pollutants, inferences developed using 40 CFR Part 50, Appendix S, Section 4

[5] Automated PM_{10} and $PM_{10-2.5}$ sampler inference developed using $PM_{2.5}$ automated (continuous) 1-hour samplers from 40 CFR Part 50, Appendix N – Interpretation of the NAAQS for PM2.5.

[6] In situations where suitable PM2.5 data are available to EPA but not reported to AQS, the same truncation protocol shall be applied to that data. In situations where PM2.5 mass data are submitted to AQS, or are otherwise available, with less precision than specified above, these data shall nevertheless still be deemed appropriate for NAAQS usage.

[7] The EPA QA Handbook Table 14-1 lists one decimal place. However, 40 CFR 50 App. K defines an exceedance as a 24-hour value rounded up to the nearest 10 µg/m^3

[8] SC – Standard 'reference' conditions (temperature: 25 ˚C, pressure: 760 mm Hg). LC – Local conditions (temperature and pressure).

Appendix F

Montana DEQ Ambient Air Monitoring

Glossary of Acronyms and Abbreviations

Glossary of Acronyms and Abbreviations

AAGVP	Ambient Air Gas Validation Program
ADQ	Audit of Data Quality
ADVP	Automatic Data Validation Processor, a component of the AirVision software system
AEMD	Air Energy and Mining Division (at Montana DEQ), within which AQB is a Bureau
AMTIC	EPA's web based Ambient Monitoring Technology Information Center
AQI	Air Quality Index
AQS	Air Quality System (EPA Ambient Air Database)
ARM	Administrative Rules of Montana
ARMS	Air Research and Monitoring Section (within MTDEQ Air Quality Bureau)
ASQ	American Society for Quality
ASTM	American Society for Testing and Materials
BAM	Beta Attention Monitor
CAA	Clean Air Act
CAAAC	Clean Air Act Advisory Committee (Montana)
CARF	Corrective Action Request Form
CASTNET	Clean Air Status and Trends Network
CBSA	Core Based Statistical Area
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CSN	National Chemical Speciation Network
DASC	Data Assessment Statistical Calculator
DEQ	Montana Department of Environmental Quality (See also MTDEQ)
DQA	Data Quality Assessment
DQI	Data Quality Indicator
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
GPT	Gas Phase Titration
H_2S	Hydrogen Sulfide
Hi-Vol	High-Volume (typically refers to a PM measurement method)
IDL	Instrument Detection Limit
IML	Inter-Mountain Laboratories, Inc. (typically refers to the IML Air Science Laboratory)
IMPROVE	Interagency Monitoring of Protected Visual Environments

LC	Local Actual Conditions
LDL	Lower Detection Limit
Lo-Vol	Low-Volume (typically refers to a PM measurement method)
m^3	Cubic Meter
MAAQS	Montana Ambient Air Quality Standards
MCA	Montana Code Annotated
MDL	Method Detection Limit
MFC	Mass Flow Controller
µm	Micrometer
MQO	Measurement Quality Objective
MSA	Metropolitan Statistical Area
MST	Mountain Standard Time
MTDEQ	Montana Department of Environmental Quality (See also DEQ)
NAAQS	National Ambient Air Quality Standards
NACAA	National Association of Clean Air Agencies
NATTS	National Air Toxics Trends Stations
NCore	National Core multipollutant monitoring station
NIST	National Institute of Standards and Technology
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_X	Oxides Of Nitrogen; the sum of the concentrations of NO and NO_2
NO_y	Sum of all total reactive nitrogen oxides ($NO + NO_2 + NO_Z = NO_y$)
NO_Z	Reactive and other oxides of nitrogen (e.g., nitrogen acids, organic nitrates, PAN, PPN, and PM nitrates)
NPAP	National Performance Audit Program
O_3	Ozone
OAQPS	EPA Office of Air Quality Planning and Standards
OEI	EPA Office of Environmental Information
ORD	EPA Office Of Research and Development
PAMS	Photochemical Assessment Monitoring Stations
Pb	Lead
Pb-PM_{10}	Lead as PM_{10}
Pb-TSP	Lead as Total Suspended Particulate Matter
PEP	Performance Evaluation Program
PGVP	Protocol Gas Validation Program
PM	Particulate Matter

PM_{10}	Particles with an average aerodynamic diameter of 10 µm or less
$PM_{2.5}$	Particles with an average aerodynamic diameter of 2.5 µm or less
$PM_{10-2.5}$	Particles with an average aerodynamic diameter ≤ 10 µm and > 2.5 µm
PPB	Parts Per Billion
PPM	Parts Per Million
PPT	Parts Per Trillion
PQAO	Primary Quality Assurance Organization
PSD	Prevention Of Significant Deterioration
psig	Pounds-per-square-inch, gauge
QA	Quality Assurance
QA Handbook	EPA Quality Assurance Handbook for Air Pollution Measurement Systems
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RadNet	EPA Nationwide Radiation Monitoring System
SC	Standard Reference Conditions (25 °C and 760 mm Hg)
SIP	State Implementation Plan
SLAMS	State or Local Air Monitoring Stations
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedure
SPM	Special Purpose Monitor
SRP	Standard Reference Photometer
STN	National Speciation Trends Network
TS	Transfer Standard
TSA	Technical Systems Audit
TSP	Total Suspended Particulate Matter
WESTAR	Western States Air Resources Council
WRAP	Western Regional Air Partnership
ZSP	Zero, Span, and Precision Check (technically, Precision with Zero and Span)

Appendix G

Montana DEQ Ambient Air Monitoring

QAPP Revision History

QAPP Revision History

Revision Number	Date	Author	Section Modified	Description of Revisions
0	06/15/2023	Hoby Rash	New Version	2023 version approved and adopted.
1	10/15/23	Hoby Rash	A.2.3	Modified Table A.1 by adding rows for Network Assessment and QAPP Revision (both every 5 years) inadvertently deleted during Version 0 editing.
1	12/11/2024	Hoby Rash	B.2.5, B.4.1.2.3, and B.4.2.3	Detail added to sections discussing meteorological monitoring methods and QA/QC procedures. This update reflects the results of the EPA TSA audit conducted in October 2023.
1	12/11/2024	Hoby Rash	B.3.1	Inserted a description of Quick Guides. Added the term “Quick Guides” to sections throughout the document as a supplement to SOPs.
1	12/11/2024	Hoby Rash	B.4.1.2.1.1	Revised the entire section on the ozone transfer process to align with EPA Ozone TAD dated Jan 2023.
1	12/11/2024	Hoby Rash	Appendix C	Updated the list of active SOPs and added a list of new “Quick Guides.”
1	12/11/2024	Hoby Rash	Appendix D	Inserted new Appendix D, Monitor Parameter and Method Codes Table
1	12/11/2024	Hoby Rash	Appendix F (was Appendix E)	Updated the list of Acronyms and Abbreviations