UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4

Laboratory Services & Applied Science Division
980 College Station Road
Athens, Georgia 30605-2720

Mr. Patrick Butler, Chief
Ambient Monitoring Section
Division of Air Quality (NC DAQ)
North Carolina Department of Environmental Quality
217 West Jones Street
Raleigh, North Carolina 27603

LSASD Project Number: 22-0090

Mr. Butler:

We have reviewed the following document that you submitted for approval:

Quality Assurance Project Plan (QAPP) For the North Carolina Division of Air Quality State and Local Air Monitoring Stations (SLAMS) for the Sulfur Dioxide and Nitrogen Dioxide Monitoring Program, Revision No. 0, August 1, 2022.

The quality assurance and technical elements within this QAPP were compared to EPA regulations and current guidance. The stated procedures appear to be clear, sound, and appropriate as written, to the extent they can be evaluated. EPA approval of this document is granted. Please be aware that approval of this QAPP does not constitute a waiver from any regulatory requirements. Your agency remains accountable for ensuring the SLAMS sulfur dioxide and nitrogen dioxide ambient air monitoring project adheres to all the applicable requirements detailed in 40 CFR Parts 50, 53, and 58, and that the data generated is of sufficient quality to be used for regulatory decision-making purposes. This QAPP should be reviewed internally by NC DAQ on an annual basis and revised when procedures change; at a minimum, the QAPP must be revised within five years.

If you have any questions, please contact Tony Bedel at 706-355-8552 or via email at bedel.anthony@epa.gov.

Sincerely,

KEITH HARRIS

Digitally signed by KEITH HARRIS
Date: 2022.08.03 15:16:19 -04'00'

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NORTH CAROLINA
Environmental Quality

DAQ-01-002
Quality Assurance Project Plan
For the North Carolina Division of Air Quality
State and Local Air Monitoring Stations for the
Sulfur Dioxide and Nitrogen Dioxide Monitoring Program

Prepared for:

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NORTH CAROLINA
Department of Environmental Quality

DISCLAIMER

This Quality Assurance Project Plan (QAPP) covers the State and Local Air Monitor Stations (SLAMS) sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) monitoring network for the North Carolina Department of Environmental Quality (DEQ) Division of Air Quality (DAQ).

Quality Assurance Project Plan Acronym Glossary

ADQ - Audit of data quality
AMTIC – Ambient Monitoring Technology Information Center
AQS - Air Quality System (EPA's Air database)
ARD – Air and Radiation Division
ARM – Air Resources Manager
CAA – Clean Air Act
CAPA – Corrective Action Preventative Action
CAPS – Cavity attenuated phase shift spectroscopy
CBSA – Core-Based Statistical Area
CFR – Code of Federal Regulations
Chief – Ambient Monitoring Section chief
CV – Coefficient of variation
DAQ - North Carolina Division of Air Quality
DAS – Data acquisition system
DASC – Data Assessment Statistical Calculator
° C – Degrees Celsius
DEQ – North Carolina Department of Environmental Quality
Director – Division of Air Quality Director
DIT – North Carolina Department of Information Technology
DQA - Data quality assessment
DQI - Data quality indicators
DQO - Data quality objectives
DRR – Data Requirements Rule
DV – design value
ECB – Electronics and Calibration Branch
e-log – electronic logbook
EPA – United States Environmental Protection Agency
FEM – Federal equivalent method
FEP – Fluorinated ethylene propylene
FRM – Federal reference method
HOBO - HOBO
IBEAM – Internet-Based Enterprise Application Management
IDL – Instrument detection limit
LED – Light emitting diode
LMS – North Carolina Learning Management System
LSASD – Laboratory Services and Applied Science Division
MCAQ – Mecklenburg County Air Quality
MDL – Method detection limit
MQO – Measurement quality objective

MSA – Metropolitan Statistical Area
NAAQS - National ambient air quality standards
NCore – National Core multipollutant monitoring stations
NEI – National Emissions Inventory
NIST - National Institute of Standards and Technology
NO – nitric oxide
NO_2 – nitrogen dioxide
NO_x – nitrogen oxides (NO plus NO_2)
NPAP – National Performance Audit Program
OAQPS – Office of Air Quality Planning and Standards
pdf – portable document format
PFA – Perfluoroalkoxy
PM – particulate matter
ppb – Parts per billion
PPB – Projects and Procedures Branch
ppm – Parts per million
psig – Pounds per square inch gauge
PWEI – Population-Weighted Emissions Index
PQAO – Primary quality assurance organization
PZS – Precision/zero/span
QA – Quality assurance
QA/QC - Quality assurance/quality control
QA Handbook - EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II
QAM – Quality assurance manager
QAPP - Quality assurance project plan
QC – Quality control
QMP – Quality management plan
RCO – Raleigh central office
RRO – Raleigh Regional Office
SLAMS - State and local air monitoring station
SO_2 – Sulfur dioxide
SOP - Standard operating procedure
SQL – Structured Query Language
tpy – tons per year
TSA - Technical systems audit
UV – Ultraviolet
VDEQ – Virginia Department of Environmental Quality
VIP – Valuing individual performance
ZPS – zero precision span, also known as PZS

1.0 Quality Assurance Project Plan Identification and Approval Sheet

Title: DAQ-01-002 Quality Assurance Project Plan for the North Carolina Division of Air Quality State and Local Air Monitoring Stations for the Sulfur Dioxide and Nitrogen Dioxide Monitoring Program
Revision 0

The Division of Air Quality recommends the attached Qu*ality Assurance Project Plan for the North Carolina Division of Air Quality State and Local Air Monitoring Stations for the Sulfur Dioxide and Nitrogen Dioxide Monitoring Program* for approval. This plan commits the State of North Carolina, Department of Environmental Quality, Division of Air Quality to follow the elements described within.

1) Signature: DocuSigned by: Michael Abraczinskas D5013FED0218423... _____ Date 7/27/2022
DEQ, Air Quality Division Director

2) Signature: DocuSigned by: Patrick Butler 4290A7E2D2A0429... _____ Date 7/27/2022
DAQ Quality Assurance Manager
(Ambient Monitoring Section Chief)

3) Signature: DocuSigned by: B278F8186CEC4DC... _____ Date 7/27/2022
Projects and Procedures Branch Supervisor

4) Signature: DocuSigned by: Kay Roberts BE4009EE242941D... _____ Date 7/26/2022
Primary Quality Assurance Project Plan Author,
RCO Environmental Chemist

5) Signature: KEITH HARRIS Digitally signed by KEITH HARRIS Date: 2022.08.03 15:20:44 -04'00' _____ Date _____
EPA Region 4 Designated Approving Official

2.0 Table of Contents

List of Tables and Figures

3.0 Distribution

Table 3.1 lists the primary recipients of this quality assurance project plan, or QAPP. The people on this distribution list have the responsibility to ensure and document that the regional office monitoring technicians and coordinators, Electronics and Calibration Branch, or ECB, electronics technicians, Raleigh Central Office, or RCO, chemists and statistician and any other personnel involved with this project have read and understood this QAPP. The Ambient Monitoring Section chief, or chief, will post the official QAPP after it receives approval from the United States Environmental Protection Agency, or EPA, on the Department of Environmental Quality, or DEQ, website and e-mail a link to it to everyone on this distribution list.

Table 3.1. DAQ Ambient Air Quality SLAMS SO_2 and NO_2 Monitoring Program QAPP Distribution List

Name/Position	Address	Phone/e-mail
Michael Abraczinskas, Director	DAQ 1641 Mail Service Center Raleigh, North Carolina 27699-1641	(919) 707-8447 michael.abraczinskas@ncdenr.gov
Patrick Butler, Ambient Monitoring Section Chief	Division of Air Quality Ambient Monitoring Section 1641 Mail Service Center Raleigh, North Carolina 27699-1641	(919) 707-8719 patrick.butler@ncdenr.gov
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Derrick House, Electronics and Calibration Branch Supervisor	Division of Air Quality Electronics and Calibration Branch 1730 Mail Service Center Raleigh, North Carolina 27699-1730	(919) 715-1761 derrick.house@ncdenr.gov
Joette Steger, Projects and Procedures Branch Supervisor	Division of Air Quality Projects and Procedures Branch 1641 Mail Service Center Raleigh, North Carolina 27699-1641	(919) 707-8449 joette.steger@ncdenr.gov

Table 3.1. DAQ Ambient Air Quality SLAMS SO_2 and NO_2 Monitoring Program QAPP Distribution List

Name/Position	Address	Phone/e-mail
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Caroline Freeman, EPA Region 4 Director, Air and Radiation Division (ARD)	EPA Region 4 Director ARD United States Environmental Protection Agency, Region 4 Atlanta Federal Building 61 Forsyth Street Atlanta, GA 30303-8960	(404) 562-8975 Freeman.Caroline@epa.gov
Darren Palmer, EPA Region 4 North Carolina State Contact	United States Environmental Protection Agency, Region 4 Air and Radiation Division 61 Forsyth Street SW Atlanta, Georgia 30303-8960	(404) 562-9052 Palmer.Darren@epa.gov
Keith Harris, Chief Quality Assurance Section	United States Environmental Protection Agency, Region 4 Laboratory Services and Applied Science Division 980 College Station Road Athens, Georgia 30605-2720	(706) 355-8624 Harris.Keith@epa.gov

4.0 Project/Task Organization

The EPA is responsible for developing the national ambient air quality standards or NAAQS, defining the quality of data necessary to make comparisons to the NAAQS and identifying a minimum set of quality control, or QC, measurements from which to judge the data quality. The state and local air monitoring organizations are responsible for using this information to develop and implement a quality assurance, or QA, program that will meet the data quality requirements. It is the responsibility of the EPA and the monitoring organizations to assess the quality of the data and take corrective action, when appropriate.

The State of North Carolina Division of Air Quality (DAQ) ambient air monitoring program is an independent primary quality assurance organization (PQAO) as defined in 40 Code of Federal Regulations, or CFR, Part 58, Appendix A, Section 1.2. The DAQ operates the state and local air monitoring stations, or SLAMS, SO_2 and NO_2 monitoring program as part of the DAQ PQAO. The DAQ director, or director, has organized the Ambient Monitoring Section into three main branches: The Projects and Procedures Branch, or PPB, the Laboratory Analysis Branch and the ECB. The Ambient Monitoring Section Chief or chief has responsibility for managing these branches per stated policy. The chief delegates the responsibility and authority to develop, organize, and maintain and implement quality programs to the supervisors of each branch, in accordance with the EPA-approved quality management plan (QMP). These supervisors have direct responsibility for assuring data quality. The DAQ currently does not use the services of the Laboratory Analysis Branch to implement this monitoring program. The Ambient Monitoring Section shares the monitoring responsibilities with the regional monitoring technicians and coordinators.

Figure 4.1 presents the organizational structure for the implementation of the monitoring program. The following information lists the specific responsibilities of each significant position within DAQ, North Carolina Department of Information Technology (DIT), and EPA Region 4.

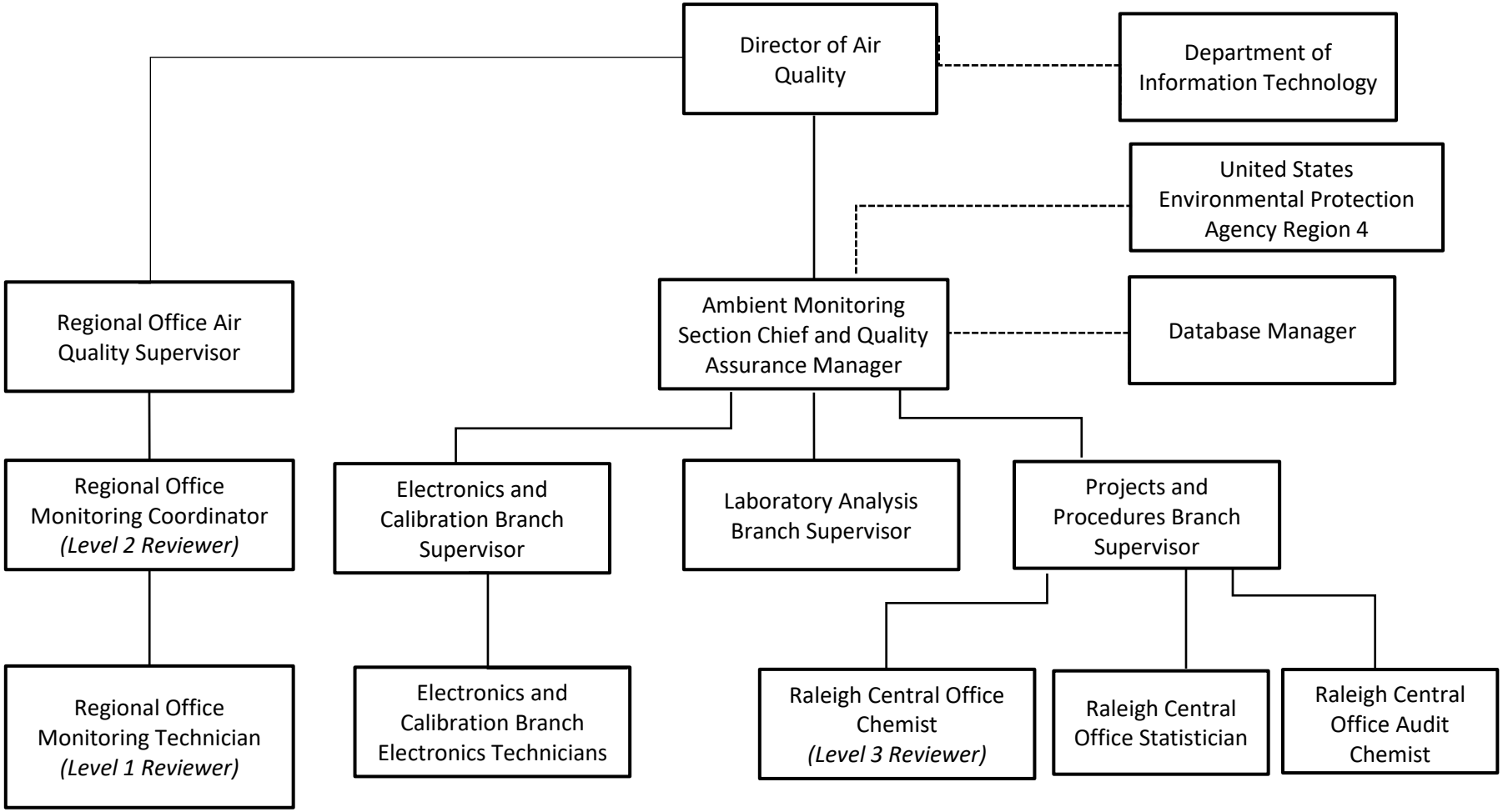
4.1 Division of Air Quality Director

The DAQ director or director, supervises the chief and regional office air quality supervisors. The director is responsible for ensuring adequate human and financial resources are available to support DAQ's SLAMS SO_2 and NO_2 monitoring program. The director has ultimate responsibility and final authority on all aspects of the monitoring program. The director has authority to stop or resume work. In the event of an emergency or inclement weather, the director implements the Continuity of Operations Plan, including the hurricane readiness procedures. The director also serves as a liaison with other divisions in DEQ, with the North Carolina General Assembly, DIT, and with other regional air-monitoring agency organizations.

4.2 DAQ Ambient Monitoring Section

The Ambient Monitoring Section contains the PPB, the Laboratory Analysis Branch (not involved in SLAMS SO_2 and NO_2 monitoring) and the ECB and is responsible for coordinating the quality assurance, or QA, data collection, and data processing aspects of this monitoring program.

Figure 4.1 Project Organizational Chart



Ambient Monitoring Section Chief: The chief serves as the QA manager, or QAM, and reports to and has direct access to the director on all matters relating to DAQ's SLAMS SO_2 and NO_2 ambient monitoring operation. The chief has ultimate authority for the program's data quality. The chief's duties include, but are not limited to the following:

- Serving as the QAM and maintaining oversight of all QA activities,
- Supervising the ambient monitoring section staff and delegating responsibilities as appropriate,
- Serving as the liaison to EPA Region 4 monitoring staff,
- Maintaining overall responsibility for the monitoring network design and review, subject to the director's approval, including oversight and approval of the annual network plan and five-year assessment,
- Authorizing the installation and discontinuation of monitors within the network,
- Approving and distributing division standard operating procedures (SOPs) and QAPPs to the personnel listed in Table 3.1,
- Serving as the tiebreaker in the event of an impasse on how to handle corrective actions or make a final judgment call on data validity,
- Collaborating with DEQ staff in developing, administering and maintaining the QMP,
- Certifying the data every year in accordance with 40 CFR Section 58.15,
- Reviewing the quarterly QA reports and the quality control, or QC, summaries to ensure the bias and precision limits are attained,
- Overseeing the management of the agency's documents and records,
- Participating in systems audits,
- Assuring that QAPPs are established and effectively implemented for each project as applicable,
- Overseeing training for the ambient monitoring staff,
- Tracking corrective actions and determining their success, and
- Reviewing budgets, contracts, grants and proposals.

If the section chief (or designee) is unavailable to perform these duties, the chief will assign someone to fulfill these duties, or if the chief is unable to make that assignment, the director will assign someone to fulfill these duties.

Database Manager: Although the database manager does not report directly to the chief, he has direct access to the chief on all matters relating to DAQ's SLAMS SO_2 and NO_2 ambient-air monitoring database management. The database manager's duties include, but are not limited, to the following:

- Maintaining the RCO data polling station (i.e., Envista Air Resources Manager, or ARM), ensuring it polls hourly and minute data for each hour of every day as well as automated check data for each day;
- Ensuring correct data is being transferred to the DAQ Internet-Based Enterprise Application Management, or IBEAM, database and DAQ real-time air quality data webpage;
- Participating in systems audits;
- Uploading environmental data to the EPA's Air Quality System, or AQS, and AirNow-Tech databases;

- Serving as the AQS administrator for DAQ;
- Maintaining and updating the RCO data polling software and AQS database when sites and monitors are established or shut down; and
- Completing other duties as assigned.

4.2.1 Projects and Procedures Branch

Projects and Procedures Branch Supervisor: The PPB supervisor reports to the chief. This supervisor's duties include the following:

- Directing and supervising the activities of the branch staff,
- Supporting and assisting the QAM in providing oversight of all QA activities,
- Communicating with the QAM to bring to the attention of the QAM QA matters needing attention,
- Verifying implementation of all Ambient Monitoring Section QAPPs and procedures,
- Assisting the chief with preparing the annual network plan and 5-year network assessment,
- Responding to public records requests and statistical consulting requests,
- Participating in systems audits,
- Ensuring training availability and utilization,
- Approving and implementing procedures, and
- Completing other duties as assigned.

Raleigh Central Office Chemists: The RCO chemists report to the PPB supervisor and are responsible for the oversight of the SLAMS SO_2 and NO_2 monitoring program. The RCO chemists' duties include the following:

- Assessing the effectiveness of the network system,
- Coordinating with the regional monitoring technicians and coordinators and ECB electronics technicians on the writing, revising and maintaining of SOP and QAPP updates, including documenting annual SOP and QAPP reviews,
- Validating data by serving as the level 3 reviewer,
- Verifying that all required quality assurance/quality control, or QA/QC, activities are performed and that measurement quality standards are met,
- Maintaining QA/QC records, flagging suspect data, and assessing and reporting on data quality,
- Conducting internal systems audits, as needed,
- Identifying data quality problems and initiating corrective actions that result in solutions,
- Providing training and certification to appropriate personnel, and
- Completing other duties as assigned.

Raleigh Central Office Audit Chemist: The RCO audit chemist reports to the PPB supervisor and is responsible for assessing, auditing and evaluating the DAQ SLAMS SO_2 and NO_2 monitoring program. The RCO audit chemist's duties include the following:

- Tracking and ensuring RCO chemists document SOP and QAPP annual reviews and updates;

- Assessing the effectiveness of the network system;
- Verifying that all required quality QA/QC activities are performed, that measurement quality standards are met, and decisions are documented;
- Maintaining QA/QC records and assessing and reporting on data quality;
- Conducting quarterly completeness evaluations and audits of data quality;
- Planning and conducting data quality assessments, or DQAs, based on interpretation of data;
- Participating in systems audits;
- Conducting internal systems audits, as needed;
- Identifying data quality problems and initiating corrective actions that result in solutions;
- Providing training and certification to appropriate personnel; and
- Other duties as assigned.

Raleigh Central Office Statistician: The RCO statistician, or statistician, reports to the PPB supervisor, provides statistical programming support to the PPB supervisor and other RCO, ECB and regional office staff including:

- Assisting the branch supervisor with responding to consulting and data requests;
- Participating in training and certification programs to keep current on technology;
- Interpreting data;
- Developing each business day and maintaining statistical reports that include tabulations of yesterday's hourly raw data;
- Preparing statistical analyses and summaries of the data, including graphs, for QA and reporting;
- Consulting on statistical analyses and approaches with the regional offices and RCO;
- Participating in systems audits;
- Preparing and delivering data and statistical interpretation of the data to the regional offices and RCO;
- Responding to public records requests and statistical consulting requests;
- Serving as a backup to the database manager;
- Uploading data to AQS; and
- Completing other duties as assigned.

4.2.2 Electronics and Calibration Branch

Electronics and Calibration Branch Supervisor: The ECB supervisor reports to and has direct access to the chief. The ECB supervisor has the responsibility and authority to:

- Identify quality problems and initiate corrective action which results in solutions;
- Schedule and document internal performance evaluations and standard certifications;
- Review and approve QAPPs and SOPs;
- Supervise the ECB electronics technicians;
- Participate in systems audits;

- Provide and document training and certification of field personnel; and
- Complete other tasks as assigned.

Electronics and Calibration Branch Electronics Technicians: The ECB electronics technicians report to the ECB supervisor and have the following responsibilities:

- Installing and replacing all field equipment and monitoring sites;
- Purchasing, maintaining and tracking an inventory of spare parts, spare equipment and consumable supplies to prevent unnecessary downtime;
- Calibrating, certifying and tracking all transfer standards or sending them to the vendor to be recertified;
- Returning "local primary standards" to the vendor or EPA for recertification and periodically checking the calibration of backup "local primary standards" to ensure quality calibrations;
- Ordering calibration gases and ensuring DAQ participation in the gas verification program operated by the EPA;
- Maintaining documentation on all transfer standard, "local primary standard" and calibration gas certifications;
- Conducting internal performance evaluations;
- Assisting in prescribing corrective actions;
- Participating in systems audits;
- Recommending changes, when needed, in the QA program;
- Performing and documenting all major maintenance and repair of field equipment as described by SOP Section 2.8.1, Revision 10, Nov. 1, 2016, and SOP DAQ-08-002.1, Revision 1.0, June 17, 2022; and
- Completing other tasks as assigned.

4.3 Regional Office

Regional Office Air Quality Supervisors: The regional office air quality supervisors report to the director and have direct access to the chief and director on all matters relating to DAQ's SLAMS SO_2 and NO_2 monitoring program. The regional air quality supervisors' duties include:

- Assuring that division policies are maintained at the regional office level,
- Acquiring needed regional monitoring resources,
- Verifying implementation of quality programs,
- Recommending changes when needed in the QA/QC program,
- Providing regional input for the design of the monitoring network,
- Reviewing and approving the network plan as far as it affects the region,
- Supervising and delineating duties for the regional monitoring coordinator and technicians, and
- Completing other tasks as assigned.

Regional Office Monitoring Coordinator: The regional office monitoring coordinator, or coordinator, reports directly to the regional office air quality supervisor. The coordinator has the overall responsibility of ensuring the implementation of the QA/QC program at the regional level. The

coordinator coordinates the activities of the regional monitoring technicians. The coordinator's responsibilities include:

- Coordinating and reviewing the collection of environmental data,
- Implementing the DAQ QA/QC program within the region,
- Acting as a conduit for information to the regional monitoring technicians,
- Training other regional monitoring coordinators and regional monitoring technicians in the requirements of the QAPP and SOPs,
- Providing a backup to the regional monitoring technicians,
- Participating in systems audits,
- Recommending changes, when needed, in the QA program,
- Providing regional input on the design and documentation of the monitoring network,
- Performing level 2 data verification activities and flagging suspect data,
- Reviewing electronic logbooks, or e-logs, other documentation and the work of the regional monitoring technicians to ensure they follow the QAPP and associated SOPs,
- Overseeing transfer standard certifications to ensure equipment is returned for recertification before expiration and that all certification documents are appropriately filed and archived,
- Documenting and assessing corrective actions to ensure they are appropriate and effective, and
- Completing other duties as assigned.

Regional Office Monitoring Technicians: The regional monitoring technicians report directly to the regional air quality supervisor and work under the direction of the regional monitoring coordinator to ensure DAQ meets all monitoring requirements. The regional monitoring technicians' duties include:

- Performing all required QC activities and ensuring that measurement quality objectives are met as prescribed in the QAPP and SOPs;
- Performing corrective actions to address any activities that do not meet the acceptance criteria as prescribed in the QAPP and SOPs;
- Ensuring that monitoring programs implement the QA/QC elements of SOPs and QAPPs;
- Participating in and providing hands-on training as needed of new regional monitoring coordinators and technicians and RCO chemists in the requirements of the QAPPs and SOPs;
- Operating and completing preventative maintenance on all monitoring equipment;
- Calibrating and verifying monitors;
- Maintaining equipment;
- Maintaining a supply of expendable monitoring items;
- Performing level 1 data verification activities and flagging suspect data;
- Participating in training and certification activities;
- Documenting deviations from established procedures and methods;
- Reporting nonconforming conditions and corrective actions to the regional monitoring coordinator and the regional air quality supervisor;
- Conducting 40 CFR Part 58, Appendix E siting criteria evaluations annually as part of the annual network review process;

- Participating in systems audits;
- Recommending changes, when needed, in the QA program;
- Preparing corrective action reports, when needed, for the Ambient Monitoring Section; and
- Completing other duties as assigned.

4.4 Department of Information Technology

The DIT provides security for the ambient monitoring computers. They manage in cooperation with the regional monitoring and ECB electronics technicians and database manager the computers located at the monitoring sites as well as the primary server that houses the Envista ARM database. Their responsibilities include ensuring the security of the computers and network, updating of the operating system and other standard software on the computer and ensuring that the regional monitoring and ECB electronics technicians maintain adequate access to the computers to perform all necessary monitoring functions.

4.5 United States Environmental Protection Agency, Region 4

The DAQ operates the SLAMS SO_2 and NO_2 monitors as SLAMS monitors following the procedures in 40 CFR Part 58. As a result, the chief includes information on these monitors in the annual network-monitoring plan and the five-year network assessment and the EPA Region 4 ARD director (or his/her designee) will review, comment on and respond to the network plan each year. Likewise, the chief will include the data from these monitors in the annual certification request. The EPA Region 4 ARD director (or his/her designee) will review and apply concurrence codes in AQS in response to DAQ's data certification request. The chief will also submit a QAPP to the EPA Region 4 Laboratory Services and Applied Science Division, or LSASD, for EPA approval. The chief will also request that the EPA Region 4 LSASD include the SLAMS SO_2 and NO_2 monitors in the National Performance Audit Program (NPAP).

5.0 Problem Definition and Background

The enactment of the Clean Air Act of 1970 resulted in a major shift in the federal government's role in air pollution control. This legislation authorized the development of comprehensive federal and state regulations to limit emissions from both stationary or industrial sources and mobile sources. It also established the NAAQS. (See 40 CFR Part 50 for additional details.) The Clean Air Act, or CAA, and its amendments provide the framework for protecting air quality. To protect air quality, active environmental data collection operations were established and operated in a manner that assures the collection of the most applicable and highest quality data.

The EPA sets primary standards at a level adequate to protect public health within an acceptable margin of safety, while it sets secondary standards at the level needed to protect public welfare. The CAA and its amendments provide the framework for the monitoring of these criteria pollutants, e.g., SO_2 and NO_2, by state, local, and tribal air monitoring organizations. Under the area designations process, the EPA and states typically use data from ambient air monitors to characterize air concentrations for identification of areas that either meet or violate the standard for a specific pollutant. Monitors used for comparisons against a NAAQS are typically designated as SLAMS monitors and must meet the requirements stipulated in 40 CFR Parts 50, 53, and 58. Pursuant to 40 CFR 58.14, any proposed addition or discontinuation of a SLAMS monitor is subject to EPA approval. For SO_2 and NO_2, three consecutive years of valid, quality-assured data are needed for comparison against the NAAQS.

5.1 Population-Weighted Emission Index SO_2 Monitoring

In 2010, the EPA changed the monitoring regulations for SO_2 and NO_2 to support the lower SO_2 and NO_2 NAAQS, provided in Table 5.1. For the SO_2 monitoring network the EPA developed the population-weighted emissions index, or PWEI. Pursuant to 40 CFR Part 58, Appendix D, Section 4.2.2, states calculate the PWEI for each core-based statistical area, or CBSA, by multiplying the population of each CBSA by the total amount of SO_2 in tons per year emitted within the CBSA. States use the most current census data or estimates for the population of each CBSA and an aggregate of the most recent county-level emissions data available in the national emissions inventory, or NEI, for each county in each CBSA for the SO_2 emissions. Dividing the resulting product by 1,000,000 provides a PWEI value with the units of million person tons per year. For any CBSA with a calculated PWEI value equal to or greater than 1,000,000, a minimum of three SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 100,000 but less than 1,000,000, a minimum of two SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 5,000, but less than 100,000, a minimum of one SO_2 monitor is required within that CBSA. For more detail on the objectives of this monitoring program, See Section 7.1 Data Quality Objectives.

Table 5.1 National Ambient Air Quality Standards for SO_2 and NO_2

Pollutant	Averaging Time	Standard Value	Standard Form	Standard Type
Sulfur Dioxide (SO_2)	1-hour average	75 ppb [a]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	Primary
	3-Hour	0.5 ppm [b]	Not to be exceeded more than once per year	Secondary

Table 5.1 National Ambient Air Quality Standards for SO_2 and NO_2

Pollutant	Averaging Time	Standard Value	Standard Form	Standard Type
Nitrogen Dioxide (NO_2)	1-hour average	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	Primary
	1-year	0.053 ppm [b] (100 $\mu g/m^3$) [c]	Annual mean of hourly values	Primary and Secondary

[a] Parts per billion [b] Parts per million [C] Micrograms per cubic meter

The SO_2 monitoring site required because of the calculated PWEI in each CBSA satisfies the minimum monitoring requirements if the monitor is sited within the boundaries of the parent CBSA and is one of the following site types as defined in section 1.1.1 of 40 CFR Part 58, Appendix D: population exposure, highest concentration, source impacts, general background or regional transport. The SO_2 monitors at National Core multipollutant monitoring (NCore) stations may satisfy minimum monitoring requirements if that monitor is located within a CBSA that is required to have one or more PWEI monitors.

In 2011, the DAQ and Mecklenburg County Air Quality (MCAQ) proposed the following monitoring sites to meet the PWEI requirements:

- Garinger as a population exposure monitor in the Charlotte-Concord-Gastonia Metropolitan Statistical Area, or MSA;
- Durham Armory as a population exposure monitor in the Durham MSA; and
- New Hanover as a population exposure/highest concentration monitor in the Wilmington MSA.

The EPA Region 4 administrator approved these locations in 2011.

The 2010 SO_2 monitoring requirements required North Carolina to add by Jan.1, 2013, three PWEI SO_2 monitors to three MSAs in North Carolina: Charlotte-Concord-Gastonia, Durham-Chapel Hill and Wilmington. The DAQ operated the monitors at the Durham-Chapel Hill and Wilmington locations while MCAQ operated the monitor at the Charlotte-Concord-Gastonia location.

In February 2020, the EPA released updated 2017 point-source emissions and non-road emissions for the 2017 NEI.[1] DAQ calculated new PWEI values for each MSA using a combination of the 2014 and 2017 NEIs and 2021 population estimates.[2] Table 5.2 presents these PWEI values. Due to lower

[1] 2017 National Emissions Inventory, February 2020 Version: The August 2019 point sources have been improved to include rail yards, offshore sources, and other minor updates. The released NEI now also includes nonroad sources (except commercial marine and rail lines), wildfires, and prescribed burning, available online at https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data. Accessed April 25, 2020.

[2] Source: Annual Estimates of the Resident Population for Metropolitan Statistical Areas in the United States and Puerto Rico: April 1, 2020 to July 1, 2021 (CBSA-MET-EST2021-POP), U.S. Census Bureau, Population Division, Released March 2022, available online at https://www.census.gov/data/tables/time-series/demo/popest/2020s-total-metro-and-micro-statistical-areas.htmlMarch 2020, available online at https://www.census.gov/newsroom/press-kits/2020/pop-estimates-county-metro.html.

Table 5.2 Population-Weighted Emission Indices Using the 2014/2017 National Emissions Inventory and 2021 Population Estimates for North Carolina Metropolitan Statistical Areas

Metropolitan Statistical Area [a]	SO_2 Emissions, tons [b]						Estimated Population, July 1, 2021 [e]	Population Weighted Emission Index	Number of SO_2 Monitors Required
	2017 Point [b]	2017 Non-Road [b]	2014 On Road [c]	2014 Non-Point [c]	2017 Fire Events [d]	Total			
Asheville	6,706.66	472,341	3,293.36	196.94	9.70	6,972.42	462,680	3,226.00	0
Burlington	12.97	173,877	10.36	27.85	0.51	59.56	169,509	10.10	0
Charlotte-Gastonia-Concord	5,097.18	2,701,046	15,650.27	340.02	62.42	5,794.15	2,636,883	15,278.51	1
Durham Chapel Hill	7,778.44	654,012	5,201.08	78.66	27.46	7,952.57	644,367	5,124.38	1
Fayetteville	104.93	524,588	181.85	48.87	140.39	346.65	526,719	182.59	0
Goldsboro	77.14	116,835	13.09	19.50	2.19	112.07	123,131	13.80	0
Greensboro-High Point	78.17	778,848	252.78	162.68	7.35	324.55	771,851	250.50	0
Greenville	59.13	172,169	16.85	21.04	0.50	97.85	180,742	17.69	0
Hickory	4,581.36	366,441	1,804.05	142.63	156.20	4,923.16	369,711	1,820.15	0
Jacksonville	239.75	206,160	103.41	183.31	59.75	501.58	197,938	99.28	0
Myrtle Beach-Conway-North Myrtle Beach	3,705.14	509,794	2,267.70	604.51	89.38	4,448.27	496,901	2,210.35	0
New Bern	744.57	122,273	125.28	165.66	100.05	1024.56	124,284	127.34	0
Raleigh	264.39	1,448,411	754.20	113.37	8.73	520.71	1,390,785	724.19	0
Rocky Mount	52.24	143,535	15.95	30.24	7.53	111.09	145,770	16.19	0
Virginia Beach-Norfolk-Newport News	2,113.58	1,803,328	8,007.10	2,123.08	34.03	4,440.18	1,768,901	7,854.25	1
Wilmington	177.13	291,833	181.47	350.96	64.73	621.84	297,533	185.7602	0
Winston-Salem	5,096.99	681,438	3,650.16	186.99	10.71	5,356.55	676,008	3,621.07	0

[a] Office of Management and Budget, OMB BULLETIN NO. 18-04: Revised Delineations of Metropolitan Statistical Areas, Micropolitan Statistical Areas and Combined Statistical Areas and Guidance on Uses of the Delineations of These Areas, Sept. 14, 2018, available on the worldwide web at https://www.whitehouse.gov/wp-content/uploads/2018/09/Bulletin-18-04.pdf, accessed April 25, 2020.

Table 5.2 Population-Weighted Emission Indices Using the 2014/2017 National Emissions Inventory and 2021 Population Estimates for North Carolina Metropolitan Statistical Areas

[b] Source: 2017 National Emission Inventory, February 2020 Version: The August 2019 point sources have been improved to include rail yards, offshore sources, and other minor updates. The released NEI now also includes nonroad sources (except commercial marine and rail lines), wildfires, and prescribed burning, available online at https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data. Accessed April 25, 2020.

[c] Source: 2014 National Emission Inventory, Version 2, available online at https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data. Accessed April 25, 2020.

[d] Source: 2017 National Emission Inventory, Additional Summary Data, Events-Fires, April 2020 Version, available online at https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data. Accessed April 26, 2020.

[e] Source: Annual Estimates of the Resident Population for Metropolitan Statistical Areas in the United States and Puerto Rico: April 1, 2020 to July 1, 2021 (CBSA-MET-EST2021-POP), U.S. Census Bureau, Population Division, Released March 2022, available online at https://www.census.gov/data/tables/time-series/demo/popest/2020s-total-metro-and-micro-statistical-areas.html.

emissions in the Wilmington area, the Wilmington PWEI monitor is no longer required so DAQ shut down the monitor at the end of 2017. Figure 5.1 shows the locations of the two required PWEI sulfur dioxide (SO_2) monitoring sites based on the 2014 and 2017 NEI and 2019 population estimates. The Garinger H.S. monitoring site is operated by MCAQ and is covered in their QAPP.

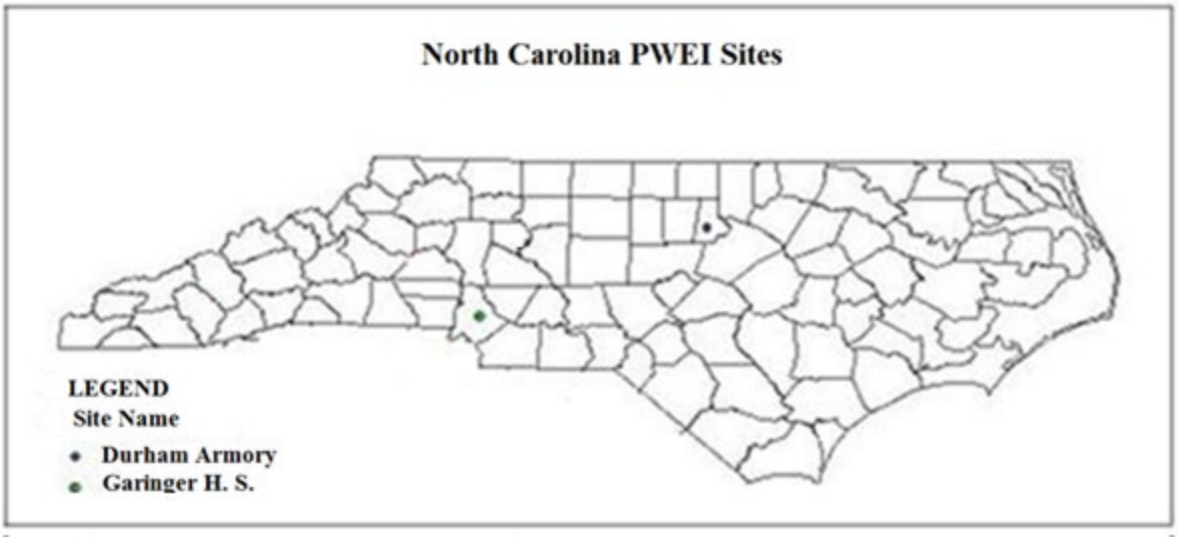


Figure 5.1. Location of North Carolina PWEI monitors

The DAQ has a written agreement with the Virginia Department of Environmental Quality, VDEQ, Office of Air Quality Monitoring. This agreement establishes the Virginia Beach-Norfolk-Newport News MSA Criteria Pollutant Air Quality Monitoring Agreement between DAQ and VDEQ to collectively meet EPA minimum monitoring requirements for criteria pollutants deemed necessary to meet the needs of the MSA. The VDEQ currently operates two SO_2 monitors in the Virginia Beach-Norfolk-New Port News MSA. Because of the written agreement and VDEQ already operating SO_2 monitors in the MSA, the DAQ does not need to add a PWEI monitor in the Virginia Beach-Norfolk-New Port News MSA.

Thus, DAQ operated two PWEI SO_2 monitors from 2013 to 2017. As of Jan. 1, 2018, DAQ operates one PWEI SO_2 monitor. Table 5.3 provides information about this monitor and monitoring station. The PWEI SO_2 monitoring project is an on-going project. The PWEI monitoring stations change as the SO_2 emissions and the population changes.

5.2. Facilities Subject to the SO_2 Data Requirements Rule, DRR

In 2010, the EPA revised the primary standards for SO_2 by replacing the previous 24-hour and annual standards with a new short-term standard. The new one-hour primary standard was set at 75 parts per billion (ppb) based upon the three year-average of the 99th percentile of the yearly distribution of one-hour daily maximum SO_2 concentrations. The secondary three-hour standard of 0.5 parts per million (ppm) was retained.

In 2015, the EPA finalized a new rule directing state and tribal air agencies to provide data for characterization of the air quality in the vicinity of large SO_2 sources in order to assist with implementation of the new one-hour primary standard. Known as the Data Requirements Rule (DRR) (40

CFR Part 51), the rule required air agencies to characterize the air quality around sources that emit 2,000 tons per year (tpy) or more of SO_2, using either modeling of actual source emissions or using appropriately sited ambient air quality monitors. Agencies could avoid the requirement to characterize the air near a source by adopting enforceable emission limits of less than 2,000 tpy of SO_2. Any ambient air monitors used to support the SO_2 DRR had to be identified in the 2016 annual network plan submittal to the EPA and had to be operational by Jan. 1, 2017.

On Jan. 15, 2016, DAQ submitted to the EPA a list identifying all facilities within North Carolina with SO_2 emissions that exceeded the 2,000 tpy threshold based on the most recent emissions data. The division's list also includes facilities for which DAQ received third-party SO_2 modeling information even though the emissions for the facilities were below the 2,000 tpy threshold. By July 15, 2016, DAQ submitted to the EPA documentation specifying the compliance path, modeling or monitoring, for each of the affected facilities. The division used ambient monitoring to characterize air quality for the following facilities:

- Duke Energy Progress, Roxboro Plant, Facility ID 7300029, EPA Approved 12/15/2016, Monitoring started 12/31/2016, Monitoring Ended 12/31/2020;
- Duke Energy Progress, Asheville Plant, Facility ID 37-021-00628 (this facility is regulated by the Asheville-Buncombe Air Quality Agency), Monitoring started 1/06/2017, EPA Approved 4/27/2017, Monitoring ended 7/01/2020;
- Blue Ridge Paper Products, Canton Mill, also known as Evergreen, Facility ID 4400159, EPA Approved 12/15/2016, Monitoring started 1/01/2017;
- PCS Phosphate Company, Inc. – Aurora, Facility ID 0700071, Monitoring started 1/28/2011, EPA Approved 12/15/2016; and
- CPI USA North Carolina – Southport Plant, Facility ID 1000067, Monitoring started 10/06/2016, EPA Approved 12/15/2016, Monitoring ended 9/28/2021.

With EPA approval, DAQ established a single SO_2 monitor at each of these facilities. Specific details for each facility were included in the appendices or an addendum to Volume 1 of the 2016-2017 North Carolina Final Network Monitoring Plan.[3]

[3] North Carolina Department of Environmental Quality 2016-2017 Final Network Monitoring Plan, Appendix D. Duke Energy Roxboro Siting Analysis and Additional Site Information, July 1, 2016, available on the worldwide web at http://xapps.ncdenr.org/aq/documents/DocsSearch.do?dispatch=download&documentId=13173; Appendix E. Evergreen Packaging Canton Siting Analysis and Additional Site Information, July 1, 2016, available on the worldwide web at http://xapps.ncdenr.org/aq/documents/DocsSearch.do?dispatch=download&documentId=13137; Appendix K. PCS Phosphate, Inc. - Aurora Siting Analysis and Additional Site Information, July 1, 2016, available on the worldwide web at http://xapps.ncdenr.org/aq/documents/DocsSearch.do?dispatch=download&documentId=13149; Appendix L. CPI Southport Siting Analysis and Additional Site Information, Sep.1, 2016, available on the worldwide web at http://xapps.ncdenr.org/aq/documents/DocsSearch.do?dispatch=download&documentId=9275; and Addendum 2 Duke Progress Energy Skyland Siting Analysis and Additional Site Information, Dec, 28, 2016, available on the worldwide web at http://xapps.ncdenr.org/aq/documents/DocsSearch.do?dispatch=download&documentId=13136.

Note that:

- Duke Energy operated the monitors at Roxboro and Asheville as part of DAQ's PQAO. Duke provided full access to all data on an hourly basis for reporting to AirNow and DAQ's real-time website; Duke QA'd the data on a daily and monthly basis. DAQ performed additional QA activities, including performance evaluations, technical system audits and annual certification of the data. The EPA granted DAQ and Duke permission to shut down these monitors in 2020.[4]
- DAQ operates the monitors at Evergreen's Canton mill, PCS Phosphate and CPI Southport. DAQ requested and received permission to shut down the monitor at CPI Southport in the 2021-2022 network plan. DAQ continues to operate the monitors at Canton (Blue Ridge/Evergreen) and Bayview Ferry (PCS Phosphate).
- DAQ reports the data to AirNow-Tech and AQS, and certifies data for these monitors.

DAQ provided modeling input and output files for siting the monitors to the EPA in 2016 outside of the network plan. A Region 4 representative visited each monitoring site except the existing site at Bayview Ferry. The EPA visited all of the sites including Bayview Ferry during the March 2019 EPA triennial technical systems audit.

5.3 Background NO_2 Monitoring

In 2010, the EPA, created a new one-hour NO_2 primary NAAQS of 100 ppb and established a new NO_2 monitoring network to support the new standard.[5] The 2010 NO_2 network, as modified in 2016, has three types of required monitoring sites: near-road sites (covered in the Near-Road QAPP), area-wide sites (covered in the NCore and PAMS QAPPs) and regional administrator required monitoring. In addition, to these types of required monitors at 14:00 on October 22, 2020, DAQ began operating a background NO_2 monitor at the Rockwell ozone SLAMS site (covered in this QAPP). DAQ decided this monitor was needed to cover a gap in coverage between the Charlotte and Winston-Salem area (see Figure 5.2) because of the interest from the general public, contractors and industry requesting information on NO_2 design values (DVs) for this area. As a result, in 2018 DAQ decided to add an NO_2 monitor at the existing Rockwell site to serve as a general background monitor for the area between Charlotte and Winston-Salem. The EPA acknowledged the startup of this monitor in the Oct. 30, 2020, EPA comments and recommendations response to the 2020-2021 network plan submittal. Even though it is not required by 40 CFR Part 58, Appendix D, DAQ is proposing to make the monitor a SLAMS monitor in the 2022-2023 network plan because the monitor will have operated for more than two years by the end of 2022 and DAQ has no plans to discontinue its operation at this time since the need for NO_2 DVs in this area continues to exist.

[4] United States Environmental Protection Agency, 2020-2021 State of North Carolina Ambient Air Monitoring Network Plan, The U. S. EPA Region 4 Comments and Recommendations, p11, available at https://xapps.ncdenr.org/aq/documents/DocsSearch.do?dispatch=download&documentId=13593

[5] Primary National Ambient Air Quality Standards for Nitrogen Dioxide, Federal Register, Vol. 75, No. 26, Feb. 9, 2010, available on the worldwide web at https://www3.epa.gov/ttn/naaqs/standards/nox/fr/20100209.pdf.

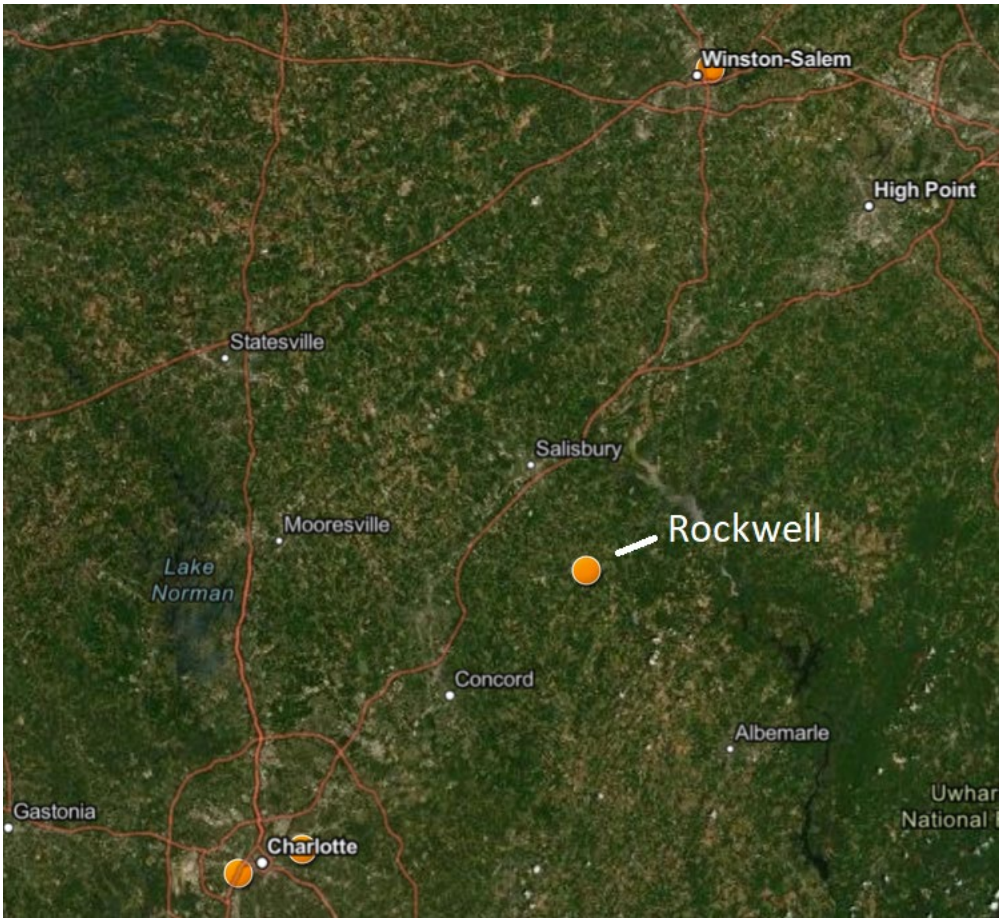


Figure 5.2. Location of Rockwell Between Charlotte and Winston-Salem

EPA policy requires that all projects involving the generation, acquisition, and use of environmental data be planned and documented and have an agency approved QAPP. The QAPP is the critical planning document for any environmental data collection operation because it documents how the DAQ will implement QA and QC activities during the project's life cycle.

The purpose of this QAPP is to prescribe requirements, procedures and guidelines for the DAQ SLAMS SO_2 and NO_2 monitoring program. The DAQ intends this QAPP to serve as a reference document for implementing and expanding the QA program and provides detailed operational procedures for measurement processes used by DAQ. The QAPP should be particularly beneficial to the regional monitoring technicians, regional coordinators and RCO chemists responsible for implementing, designing and coordinating the SLAMS SO_2 and NO_2 monitoring project. The QAPP is a compilation of QA requirements, procedures and guidelines that are applicable to air pollution measurements systems. They are designed to achieve a high percentage of valid data (>75 percent) while maintaining integrity and accuracy. This QAPP clearly and thoroughly establishes QA protocols and QC criteria required to successfully implement and maintain this monitoring program. Additional details and technical specifications are set forth in SOPs utilized by DAQ for each aspect of the SLAMS SO_2 and NO_2 monitoring program, such as instrument operations (see Table 11.2). It is the responsibility of the chief

to ensure the regional monitoring technicians and coordinator, ECB electronics technicians and RCO chemists implement and adhere to the QA programs for the field and data processing phases of the monitoring program.

The RCO chemists will review the QAPP and its associated SOPs annually and update them as needed or at least every five years. The RCO chemist will document the annual review of the QAPP by recording his or her name, signature, date and review results on the QAPP Annual Review Documentation form or the SOP annual review documentation form available in the QAPP and SOP tracking database. Grant commitments also require that annual QAPP reviews be recorded in email correspondence to EPA Region 4. The DAQ also includes information on the annual SOP reviews in that email. QAPP revisions are subject to the approval of EPA's Region 4 QA staff.

The DAQ will adhere to the principles and procedures herein, unless a special project requires more stringent requirements. If any special project requires more stringent requirements, the QAPP will be revised or, depending on the purpose and scope of the project, a separate QAPP will be developed to address the requirements of the special project.

Before DAQ implemented this QAPP, the SLAMS SO_2 and NO_2 monitoring program was included in the PWEI (Durham Armory SO_2 monitor), DRR (Bayview Ferry and Canton SO_2 monitors) and Background Monitoring (Rockwell NO_2 monitor) QAPPs. The PWEI QAPP was last conditionally approved by the EPA on 9/16/2019, the DRR QAPP was last approved by the EPA on 1/06/2017, and the background monitoring QAPP was last conditionally approved by the EPA on 12/21/2020. For information on where these QAPPs are stored see Table 9.1.

Table 5.3 North Carolina SLAMS SO_2 and NO_2 Monitoring Locations and Monitors

Site Name	AQS Identifier	Types of Monitors	Operator
Durham Armory SLAMS SO_2 Monitoring Site	37-063-0015	SO_2	Raleigh Regional Office
Rockwell SLAMS NO_2 Monitoring Site	37-159-0021	NO_2	Mooresville Regional Office
Bayview Ferry SLAMS SO_2 Monitoring Site	37-013-0151	SO_2	Washington Regional Office
Canton SLAMS SO_2 Monitoring Site	37-087-0013	SO_2	Asheville Regional Office

6.0 Project/Task Description

The chief developed this QAPP to ensure DAQ's SLAMS SO_2 and NO_2 monitoring network collects ambient data that meet or exceed EPA QA requirements. The EPA and DAQ use the criteria pollutant data collected by DAQ for regulatory decision-making purposes, i.e., determining compliance with the NAAQS. The DAQ enters all these data into the EPA AQS database.

The SLAMS SO_2 and NO_2 sites must meet the three objectives in 40 CFR Part 58, Appendix D, Section 1.1 for SLAMS:

(a) Provide air pollution data to the public in a timely manner.
(b) Support compliance with ambient air quality standards and emissions strategy development.
(c) Support for air pollution research studies.

The SLAMS SO_2 and NO_2 monitors will characterize hourly SO_2 and NO_2 concentrations as needed throughout the state of North Carolina. The DAQ will also use the data from these sites to provide the public with air pollution data in a timely manner by displaying the data on the DEQ and AirNow websites. Section 10.1 provides additional objectives for the SLAMS SO_2 and NO_2 network. The chief designed DAQ's SLAMS SO_2 and NO_2 monitoring network to support these objectives as well as to meet minimum monitoring requirements in 40 CFR Part 58 Appendix D.

Table 6.1 North Carolina SLAMS SO_2 and NO_2 Monitoring Objectives and Scales of Representativeness

Site Name / AQS Identifier	Type of Monitor	Monitoring Objective	Scale of Representativeness
Durham Armory / 37-063-0015	SO_2	Population Exposure	Urban
Rockwell / 37-159-0021	NO_2	General/Background	Urban
Bayview Ferry / 37-013-0151	SO_2	Source Oriented	Urban
Canton / 37-087-0013	SO_2	Source Oriented	Middle

The chief with input from the regional monitoring coordinators and PPB supervisor assigns the monitors operated at the SLAMS SO_2 and NO_2 sites a scale of representativeness based on the definitions in 40 CFR Part 58, Appendix D. The spatial scale of representativeness describes the physical dimensions of a parcel of air, in which pollutant concentrations are reasonably homogeneous throughout. Based on the monitoring objective and site location, the data collected at these sites will generally be representative of the middle or neighborhood scale for the source-oriented SO_2 monitors and either a neighborhood or an urban scale for the background NO_2 and PWEI SO_2 monitors. The middle scale defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometer. The neighborhood scale defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range while the urban scale defines the concentrations within an area of city-like dimensions, approximately 4 to 50 kilometers.

The work required to collect, document, and report these data includes, but is not limited to:

- Establishing a monitoring network that has:
    - Appropriate density, location, and sampling frequency; and
    - Accurate and reliable data recording equipment, procedures and software.
- Developing encompassing documentation for:
    - Data and report format, content and schedules;
    - Quality objectives and criteria; and
    - SOPs providing activities and schedules for:
        - Equipment operation and preventative maintenance; and
        - Instrument calibrations, zero, span, and precision and accuracy evaluations.
- Establishing assessment criteria and schedules.
- Verifying and validating data, according to the criteria and schedules established in this QAPP.
- Certifying data.

Towards this end, DAQ work products also include a series of assessments and reports to ensure the network and resulting data continuously meet or exceed regulatory requirements as specified in 40 CFR Parts 50 and 58. The DAQ also maintains this QAPP and the associated SOPs reviewing them every year and revising them as needed, but at least once every five years to ensure they continuously reflect the requirements of DAQ and the EPA.

6.1 Field Activities

DAQ personnel will perform those activities that support continued successful operation of the DAQ SLAMS SO_2 and NO_2 monitoring network. Personnel will perform field activities that include, but are not necessarily limited to, conducting calibrations, routine QC checks, periodic preventative maintenance and servicing equipment located at the SO_2 and NO_2 sites. Operational servicing activities may include but may not be limited to, recording pertinent field data and restocking consumables at the monitoring sites. Additional field activities could include relocating the site or locating an additional suitable monitoring site. Section 4.3 provides a more complete description of the field activities that regional monitoring technicians may perform. The ECB electronics technicians also perform internal performance evaluations on the deployed monitors.

6.2 ECB Activities

The ECB electronics technicians will perform those activities necessary to support the successful operation of the DAQ SO_2 and NO_2 monitoring network. They will perform electronic laboratory activities consistent with certifying, calibrating and testing all equipment before installing it in the field. In addition, ECB electronics technicians will perform any functions necessary to support the deployed field equipment. Section 4.2.2 Electronics and Calibration Branch provides a more complete description of the activities ECB electronics technicians may perform in support of this program.

6.2 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, "assessment" is an all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection or surveillance. Section 20.0 Assessments and Response Actions discusses the details of assessments. Table 6.2 provides information on the parties implementing assessments and their frequency.

Table 6.2 Assessment Schedule

Assessment Type	Assessment Agency	Frequency
EPA Technical Systems Audit	EPA Region 4	Every 3 years
DAQ Internal Systems Audit	State	As needed
Network Assessment	EPA Region 4 State	Every 5 years
Network Review (40 CFR Part 58, Appendix A, D and E evaluations)	EPA Region 4 State	Annually
Network Plan	EPA Region 4 State	Annually
Quarterly Data Completeness and Audit of Data Quality	State	Quarterly
Annual Data Certification	State	Annually
Quality Assurance Project Plan Review and Updates	State	Review annually Update as needed and every 5 years
Standard Operating Procedures Reviews	State	Review annually Update as needed but at least every 5 years
Data Quality Assessment	State	AMP256 and AMP600 Review Quarterly and Annually Control Chart Review Daily and Monthly
Internal Performance Evaluation	State	At least once per calendar year and every 365 days
National Performance Audit Program	EPA designated contractor	20 percent of PQAO sites per year/each PQAO site once every six years

6.3 Project Records

DAQ will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. Table 6.3 presents the categories and types of records and documents that are applicable to document control for ambient air quality information. Section 9.0 Documentation and Records explains information on key documents in each category in more detail.

Table 6.3 Critical Documents and Records

Categories	Record/Document Type
Site Information	Network Descriptions Site Files Site Maps Site Pictures
Environmental Data Operations	Quality Assurance Project Plans Standard Operating Procedures Field Notebooks and Logbooks Inspection/Maintenance Records
Raw Data	Any Original Data (routine and QC) Including Data Entry Forms
Data Reporting	Air Quality Index Reports Annual Data Certification Data/Summary Reports
Data Management	Data Algorithms Data Management Plans/Flowcharts Data Management Systems
Quality Assurance	Network Reviews and Assessments Control Charts Data Quality Assessments Quality Assurance Reports (AMP600 and AMP256) EPA Technical System Audit Reports DAQ Internal System Audit Reports Response/Corrective Action Documentation Internal Performance Evaluation Reports Certification Documentation E-mails related to QA activities and assessments

7.0 Quality Objectives and Criteria for Measurement Data

The DAQ operates under an EPA-approved QMP that describes the agency's system for communicating and implementing quality within the agency.

A quality system is a structured and documented set of management activities in which an organization applies sufficient QC practices to ensure the data produced by an operation will be of the type and quality needed and expected by the data user. Quality control defines the procedures DAQ implements to assure that the regional monitoring technicians obtain and maintain acceptability in the generated data set. Quality control procedures, when properly executed, provide data that meet or exceed the minimally acceptable quality criteria established to assist management in making confident decisions. The policy of DAQ is to implement a QA program to assure the regional monitoring technicians collect data of known and acceptable precision, bias, sensitivity, completeness, comparability and representativeness within its ambient-air-quality monitoring program.

Defined in Section 7.2 Measurement Quality Objectives, precision, bias, sensitivity, completeness, comparability and representativeness are the principal data quality indicators, or DQI, that provide qualitative and quantitative descriptions used in interpreting the degree of acceptability of data. Establishing acceptance criteria for these DQIs sets quantitative goals for the quality of data generated in the measurement process. Of the six principal DQIs, precision, sensitivity and bias are the quantitative measures, representativeness and comparability are qualitative measures and completeness is a combination of both qualitative and quantitative measures (US EPA QA/G-5, Appendix B). The DAQ establishes the specific requirements of these six DQIs before data collection starts. The goal is to locate and eliminate, or minimize, bias, so the data collected show the true conditions of the area studied. This includes consideration of siting criteria, spatial scales, monitoring objectives, climatic change, source configurations and the duration of the study.

All individuals must adhere to the written procedures and methods in the QAPP and associated SOPs (See Table 11.2) for operating air monitoring instruments and handling data to assure quality data for purposes of ensuring continued compliance with the NAAQS. EPA approved federal reference methods, or FRMs, are the designated methods and basis for operating pollutant monitoring equipment, although the EPA allows the use of federal equivalent methods, or FEMs, as well.

7.1 Data Quality Objectives

This section provides a description of the data quality objectives, or DQOs, for the SO_2 and NO_2 monitoring program for the state of North Carolina. Data quality objectives are qualitative and quantitative statements that:

- Clarify the intended use of the data,
- Define the type of data needed, and
- Specify the tolerable limits on the probability of making an erroneous decision due to uncertainty in the data.

The goal of this monitoring program is threefold: to determine the highest one-hour SO_2 concentrations in the ambient air in the vicinity of facilities that emit large amounts of SO_2, comply with 40 CFR Part 58, Appendix D for PWEI monitoring and measure background concentrations of NO_2 concentrations in the corridor between Charlotte and Winston-Salem to ensure these areas meet and continue to meet the NAAQS.

The data necessary to meet the goals of this monitoring program are:

- Continuous hourly averaged SO_2 and NO_2 concentration data, with each hour considered valid if the monitor reports at least 45 valid one-minute concentration values for the hour;
- Continuous shelter temperature measurements for ensuring conformity to environmental requirements of the SO_2 and NO_2 monitors;
- Precision measurements;
- Bias measurements;
- Site and monitoring metadata for AQS;
- Locational measurements (geographical, topographical, etc.); and
- Minute data for SO_2 and NO_2 and hourly five-minute maximum data for SO_2.

The DAQ SLAMS SO_2 and NO_2 monitoring network will operate and collect data in accordance with the schedules codified in 40 CFR 58.12. The ambient SO_2 and NO_2 concentration data will be collected by monitors that have been designated as FRM or FEM, in accordance with 40 CFR Part 58, Appendix C, Section 2.1. The appendices to 40 CFR Part 50 explain the data reporting and handling conventions for the individual pollutant parameters. 40 CFR Part 50, Appendix S explains the data reporting and handling conventions for NO_2 while 50.5 and Appendix T explains the data reporting and handling conventions for SO_2. DAQ will adhere to those reporting conventions.

The following bullet lists provide more detail regarding the specifications on the types of SO_2 and NO_2 data needed for this project. This information summarizes the data needed to compare DAQ DVs to the SO_2 and NO_2 NAAQS.

Sulfur Dioxide

- Keep each hourly data point (at least 45 valid minutes of the hourly data are needed) with at least one decimal place in units of ppb, with additional digits to the right truncated with no further rounding.
- Calculate 24 hourly average values for each day and determine the maximum. Daily maximum 1-hour values (and therefore the 99th percentile of those daily values) are not rounded.
- The 1-hour DV, which is the mean of 3 consecutive annual 99th percentile daily maximum values, rounded to the nearest whole number, is used to compare to the primary standard.
- The level of the 3-hour secondary standard is 0.5 ppm, not to be exceeded more than once per calendar year. The 3-hour averages shall be determined from successive, non-overlapping 3-hour blocks starting at midnight each calendar day and shall be rounded to one decimal place.
- To demonstrate attainment, the second-highest 3-hour average must be based upon hourly data that are at least 75 percent complete in each calendar quarter. A 3-hour block average shall

be considered valid only if all 3 hourly averages for the 3-hour period are available. If only 1 or 2 hourly averages are available, but the 3-hour average would exceed the level of the standard when zeros are substituted for the missing values, subject to the rounding rule of 40 CFR 50.5(a), then this shall be considered a valid 3-hour average. In all cases, the 3-hour block average shall be computed as the sum of the hourly averages divided by 3.

Specific information on SO_2 NAAQS calculations is found in 40 CFR Part 50, Appendix T and 40 CFR 50.5.

Nitrogen Dioxide

- ·Keep each hourly data point (at least 45 valid minutes of the hourly data are needed) with at least one decimal place in units of ppb, with additional digits to the right truncated with no further rounding.
- Calculate 24 hourly average values for a day and determine the maximum. Daily maximum 1-hour values are not rounded.
- The 1-hour DV is the mean of the 3 consecutive annual 98^{th}-percentile daily maximum values, rounded to the nearest whole number.
- The annual DV is simply the arithmetic average of all of the reported 1-hour values, rounded to the nearest whole number.

Specific information on NO_2 NAAQS calculations is found in 40 CFR Part 50, Appendix S.

Section 10.0 Network Description presents specific information on the sampling design, including how to identify the monitoring location. The DAQ and EPA will use these data to evaluate compliance with the NAAQS, determine trends over time and provide real-time data to the public.

The DQO process defines tolerable limits on the probability of making a wrong decision because of uncertainty in the data (i.e., limits on the probability of coming up with a false positive or a false negative error). A decision maker encounters a false positive error when the data indicate a monitor exceeded the NAAQS when in fact, due to random deviations in the data, the monitor did not exceed it. Alternately, a decision maker encounters a false negative error when the data indicate the monitor did not exceed the NAAQS when in fact, due to random deviations in the data, the monitor did exceed it. Using the formal DQO process, EPA determined the objectives to control precision and bias to reduce the probability of decision errors. The regulations at 40 CFR Part 58, Appendix A, Section 2.3.1 provide the DQOs. The SLAMS SO_2 and NO_2 monitoring programs have adopted the acceptable precision, as measured by coefficient of variation (CV), and acceptable bias for each pollutant as listed in Table 7.1.

Table 7.1. Acceptable Precision as Measured by Coefficient of Variation (CV) and Bias

Pollutant	Acceptable Precision	Acceptable Bias
SO_2	upper 90 percent confidence limit for the CV of ≤10 percent	Upper 95 percent confidence limit for the absolute bias of ≤10 percent
NO_2	upper 90 percent confidence limit for the CV of ≤15 percent	Upper 95 percent confidence limit for the absolute bias of ≤15 percent

The DAQ calculates coefficient of variation and absolute bias using the procedures in 40 CFR Part 58, Appendix A, Section 4.

7.2 Measurement Quality Objectives

As air pollution measurement systems increase in both cost and complexity, it becomes essential to have a methodology that will, in a cost-effective manner, increase the completeness and precision and decrease the bias of the data produced by the air-pollution measurement systems.

Once a DQO is established, the DAQ evaluates and controls the quality of the data to ensure DAQ maintains data quality within the established acceptance criteria. Measurement quality objectives evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure total measurement uncertainty is within the range prescribed by the DQOs. The DAQ defines the MQOs for North Carolina's SLAMS SO_2 and NO_2 monitoring program in terms of the following DQIs:

- **Precision -** "Precision is a measure of agreement between two replicate measurements of the same property, under prescribed similar conditions. (US EPA QA/G-5, Appendix B)." This is the random component of error. The DAQ calculates this value using percent difference as described in 40 CFR Part 58, Appendix A, Section 4.
- **Bias -** "Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction (US EPA QA/G-5, Appendix B)." Bias is determined by estimating the positive and negative deviation from the true value as a percentage of the true value.
- **Comparability -** "Comparability is the qualitative term that expresses the confidence that two data sets can contribute to a common analysis and interpolation. Comparability must be carefully evaluated to establish whether two data sets can be considered equivalent regarding the measurement of a specific variable or groups of variables (US EPA QA/G-5, Appendix B)."
- **Representativeness -** "Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point or for a process condition or environmental condition(US EPA QA/G-5, Appendix B)." Representativeness is a qualitative term that DAQ should evaluate to determine whether in situ or other measurements are made in such a manner that the resulting data appropriately reflect the media and phenomenon measured or studied
- **Sensitivity** – "Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest (US EPA QA/G-5, Appendix B)." The DAQ determines sensitivity by using the Single Point Precision and Bias Report on EPA's outdoor air quality site. Currently the DAQ does not perform annual method detection limit, or MDL, studies but relies on manufacturer's specifications for instrument detection limit, or IDL, or something similar.
- **Completeness -** Completeness is a metric quantifying the amount of valid data obtained from a measurement system compared to the expected amount obtained under correct, normal conditions. The DAQ expresses completeness as a percentage. Data completeness requirements are included in 40 CFR Part 50, Appendix T for SO_2 and 40 CFR Part 50, Appendix S for NO_2.

For each of these attributes, DAQ developed acceptance criteria using various parts of 40 CFR Parts 50, 53 and 58 and EPA-supplied guidance documents. Tables 7.2 and 7.3 list the MQOs for the SLAMS SO_2 and NO_2 monitoring program. The DAQ based these tables on the validation templates in the EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, referred to as the QA Handbook. As described in the QA Handbook and implemented here, for SO_2 and NO_2, Tables 7.2 and 7.3 list three validation criteria: critical, operational and systematic. The tables discriminate between:

- Criteria that must be met to ensure the quality of the data, i.e., critical criteria;
- Criteria that indicate there may be issues with the quality of the data and further investigation is warranted before determining the validity of the data, i.e., operational criteria; and
- Criteria that indicate a potentially systematic problem with the environmental data collection activity that may affect the ability to make decisions with the data, i.e., systematic criteria.

For each criterion, the tables include: (1) the requirement, (2) the frequency with which compliance is to be evaluated, (3) the acceptance criteria, and (4) information where the requirement can be found or additional guidance on the requirement.

North Carolina has adopted and implemented EPA Region 4's LSASD recommended warning limits or an even stricter warning limit for SO_2 and NO_2 monitoring. The DAQ defines warning limits as the level of allowable imprecision before the regional monitoring technician must calibrate an analyzer or take other corrective action. The DAQ sets the warning limits lower than the MQOs or control limits to reduce imprecision and bias and enhance data recovery.

The DAQ defines control limits as the level of allowable imprecision before data invalidation is required (corrective action is required at the warning limit). The DAQ cannot set control limits higher than the MQOs. The DAQ uses these limits when validating ambient air measurements against single point precision checks. The use of both warning and control limits strengthens the precision of these measurements and improves the data validation practices to meet regulatory requirements. Tables 7.2 and 7.3 include both the EPA-established control limits and DAQ-established warning limits.

Other elements, as well as the SOPs associated with this QAPP that are specific to the SO_2 and NO_2 monitors provide more detailed descriptions of these MQOs and how they will be used to control and assess measurement uncertainty.

Table 7.2 Sulfur Dioxide Measurement Quality Objectives Parameter – Sulfur Dioxide (SO_2) (Ultraviolet Fluorescence).			
1) Requirement (SO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
CRITICAL CRITERIA- SO_2			
Sampler/Monitor	Not applicable	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58, Appendix C, Section 2.1 2) Not applicable 3) 40 CFR Part 53 and FRM/FEM method list
1-Point-QC Check Single analyzer	***1/14 days is required (The DAQ goal is daily checks)***	DAQ Warning Limit: ≤ 7.0 percent (percent difference) EPA Control Limit: < ± 10.1 percent (percent difference) or < ± 1.5 ppb difference, whichever is greater	1 and 2) 40 CFR Part 58, Appendix A, Section 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58, Appendix A Section 2.3.1.5 (see DAQ SO_2 SOP DAQ-12-001.2 for details) QC Check Concentration range 5 – 80 ppb relative to mean or median monitor concentration.
Zero/span check	***1/14 days is required (The DAQ goal is daily checks)***	Zero drift < ± 3.1 ppb (24 hours) < ± 5.1 ppb (>24hours-14 day) (The DAQ Warning limit is <± 1.5 ppb (24 hour) and <± 2.5 ppb (>24 hour – 14 days) Span drift < ± 10.1 percent (The DAQ Warning limit is < ±5 percent)	1 and 2) QA Handbook Volume 2 Section 12.3 3) Recommendation and related to DQO (see DAQ SO_2 SOP for details)
Shelter Temperature Range	**Daily** (hourly values)	20.0 to 30.0° C. (Hourly average)	1, 2 and 3) QA Handbook Volume 2 Section 7.2.2 and FRM/FEM method list
OPERATIONAL CRITERIA- SO_2			
Shelter Temperature Control	Daily (hourly values)	< ± 2.1° C Standard deviation over 24 hours	1, 2 and 3) QA Handbook Volume 2 Section 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 Section 7.2.2
Internal Performance Evaluation Single Analyzer	***Every site 1/365 days and 1/calendar year***	Percent difference of audit levels 3-10 ≤ ±15.0 percent; audit levels 1 and 2 <± 1.5 ppb difference or <±15.1 percent, whichever is greater	1 and 2) 40 CFR Part 58, Appendix A, Section 3.1.2 3) Recommendation - 3 audit concentrations not including zero. AMTIC Technical Memo
Federal Audits (NPAP)	100 percent of sites every 6 years; 20 percent of sites audited each year	Audit levels 1 and 2 <± 1.5 ppb difference; all other levels percent difference <± 15.1 percent	1 and 2) 40 CFR Part 58, Appendix A, Section 3.1.3 3) NPAP QAPP/SOP
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving; When 1-point-QC check is > 7.0 percent difference; 1/365 days and 1/calendar year	Span/Span2 within ± 5.0 percent of expected 1-point-QC check ≤ 7.0 percent difference Zero within ± 1.0 ppb of expected Slope of best fit line = 1 ±0.05 and each point within 2 percent of best fit line or ± 1.5 ppb, whichever is greater	1) 40 CFR Part 50, Appendix A-1, Section 4 2 and 3) Recommendation: See SO_2 Operator SOP Multi-point calibration (0 and 3 upscale points)
Gaseous Standards	***All gas cylinders***	***NIST Traceable (e.g., EPA Protocol Gas)***	1) 40 CFR Part 50, Appendix A-1, Section 4.1.6.1 2) Not applicable Green Book 3) 40 CFR Part 50, Appendix A-1, Sections 2.2 and 4.1.6.1 Producers must participate in Ambient Air Protocol Gas Verification Program 40 CFR Part 58, Appendix A, Section 2.6.1

Table 7.2 Sulfur Dioxide Measurement Quality Objectives Parameter – Sulfur Dioxide (SO_2) (Ultraviolet Fluorescence).			
1) Requirement (SO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Zero Air/ Zero Air Check	Chemicals changed 1/365 days and 1/calendar year	Concentrations below LDL < 0.1 ppm aromatic hydrocarbons	1) 40 CFR Part 50, Appendix A-1, Section 4.1.6.2 2) Recommendation: See SO_2 ECB SOP 2.8.1 3) Recommendation and 40 CFR Part 50, Appendix A-1, Section 4.1.6.2
Gas Dilution Systems	Certified 1/365 days and 1/calendar year or after failure of 1-point-QC check or performance evaluation	***Accuracy <± 2.1 percent***	1) 40 CFR Part 50, Appendix A-1, section 4.1.2 2) Recommendation: See DAQ ECB SO_2 SOP 2.8.1 3) 40 CFR Part 50, Appendix A-1, section 4.1.2
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements			
Noise	Verified by manufacturer at purchase	***≤ 0.001 ppm (standard range)*** ***≤ 0.0005 ppm (lower range)***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) See DAQ ECB SO_2 SOP 2.8.1 3) 40 CFR Part 53.20 Table B-1
Lower detectable level	Verified by manufacturer at purchase	***≤ 0.002 ppm (standard range)*** ***≤ 0.001 ppm (lower range)***	1) 40 CFR Part 53.23 (c) (definition & procedure) 2) Recommendation: See DAQ ECB SO_2 SOP 2.8.1 3) 40 CFR Part 53, Table B-1
SYSTEMATIC CRITERIA- SO_2			
Standard Reporting Units	***All data***	***ppb (final units in AQS)***	1, 2 and 3) 40 CFR Part 50, Appendix T, Section 2 (c)
Rounding convention for design value (DV) calculation	***All routine concentration data***	***1 place after decimal with digits to right truncated***	1, 2 and 3) 40 CFR Part 50, Appendix T, Section 2 (c) The rounding convention is for averaging values for comparison to the NAAQS and not for reporting individual hourly values to AQS.
Completeness	***1-hour standard***	***Hour – ≥ 75 percent of hour*** ***Day- ≥ 75 percent of hourly concentrations*** ***Quarter- ≥ 75 percent complete days*** ***Years-4 complete quarters*** ***5-minute values - ≥ 75 percent of minutes*** ***5-minute maximum value reported only for valid hours***	1, 2 and 3) 40 CFR Part 50, Appendix T, Section 3 (b), (c) More details in CFR on acceptable completeness.
Sample Residence Time Verification	At installation, 1/365 days and 1/calendar year **(The DAQ goals is every 30 days)**	***< 20 seconds***	1) 40 CFR Part 58, Appendix E, section 9 (c) 2) See DAQ SO_2 SOPs 2.8.1 and DAQ-12-001.2 3) 40 CFR Part 58, Appendix E, section 9 (c)
Sample Probe, Inlet, Sampling train	***All sites***	***Borosilicate glass (e.g., Pyrex®) or Teflon®*** (The EPA has accepted FEP and PFA as equivalent material to Teflon.)	1, 2 and 3) 40 CFR Part 58, Appendix E, section 9 (a) Replace at least every 2 years; more frequently if pollutant load or contamination dictate
Siting	1/365 days and 1/calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58, Appendix E, sections 2-6 2) See DAQ Network Review SOP 2.43 3) 40 CFR Part 58, Appendix E, sections 2-6

Table 7.2 Sulfur Dioxide Measurement Quality Objectives Parameter – Sulfur Dioxide (SO_2) (Ultraviolet Fluorescence).			
1) Requirement (SO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Precision (using 1-point-QC checks)	***Calculated annually and as appropriate for DV estimates***	***90 percent confidence limit CV ≤ 10 percent***	1) 40 CFR Part 58, Appendix A, section 2.3.1.5 and 3.1.1 2) 40 CFR Part 58, Appendix A, section 4 (b) 3) 40 CFR Part 58, Appendix A, section 4.1.2
Bias (using 1-point-QC checks)	***Calculated annually and as appropriate for DV estimates***	***95 percent confidence limit ≤ ± 10 percent***	1) 40 CFR Part 58, Appendix A, section 2.3.1.5 and 3.1.1 2) 40 CFR Part 58, Appendix A, section 4 (b) 3) 40 CFR Part 58, Appendix A, section 4.1.3

Table 7.3. Measurement Quality Objective Parameter: Nitrogen Dioxide (NO_2) (Cavity Attenuated Phase Shift Spectroscopy).			
1) Requirement (NO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
CRITICAL CRITERIA- NO_2			
Sampler/Monitor	***Not applicable***	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58, Appendix C, Section 2.1 2) Not applicable 3) 40 CFR Part 53 and FRM/FEM method list
1-Point-QC Check Single analyzer	***1/ 14 days***	Warning limit ≤ ± 10.0 percent (percent difference) Control limit ≤ ±15.0 percent (percent difference) or <±1.5 ppb difference, whichever is greater	1 and 2) 40 CFR Part 58, Appendix B, Section 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58, Appendix B, Section 2.3.1.4 (see DAQ NO2 CAPS SOP for details.) QC check concentration range 0.005 - 0.080 ppm and 05/05/2016 Technical Note on AMTIC. Relative to routine concentrations
Zero/span check	1/ 14 days	Zero drift ≤ ± 1.0 ppb (24 hour) ≤ ± 5.0 ppb (>24 hour-14 day) Span drift < ± 10.1 percent	1 and 2) QA Handbook Volume 2 Section 12.3 3) Recommendation and related to DQO (see DAQ NO2 CAPS SOP for details.)
Shelter Temperature Range	Daily (hourly values)	5 to 40.0 ° C. (hourly average) (DAQ goal is 20.0 to 30.0 ° C. (hourly average) to remain compatible with collocated instruments with more restrictive temperature ranges)	1, 2 and 3) QA Handbook Volume 2, Section 7.2.2
OPERATIONAL CRITERIA- NO_2			
Shelter Temperature Control	Daily (hourly values)	≤ ± 2.0 ° C Standard Deviation over 24 hours	1, 2 and 3) QA Handbook Volume 2, Section 7.2.2
Shelter Temperature Device Check	1/182 days and 2/calendar year	± 2.0 ° C of standard	1, 2 and 3) QA Handbook Volume 2, Section 7.2.2
Internal Performance Evaluation Single Analyzer	***Every site 1/365 days and 1/calendar year***	Percent difference of audit levels 3-10 ≤ ±15.0 percent Audit levels 1 and 2 ± 1.5 ppb difference or < ±15.1 percent	1) 40 CFR Part 58, Appendix B, section 3.1.2 2) 40 CFR Part 58, Appendix B, section 3.1.2 3) Recommendation - 3 audit concentrations not including zero. AMTIC guidance 5/3/2016
Federal Audits (NPAP)	100 percent of sites every 6 years; 20 percent of sites audited each year	Audit levels 1 and 2 < ± 1.5 ppb difference; all other levels percent difference < ± 15.1 percent	1) 40 CFR Part 58, Appendix B, section 3.1.3 2) NPAP adequacy requirements on AMTIC 3) NPAP QAPP/SOP
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving/failure of zero/span or 1-point-QC check 1/365 days / *Verification during Calibration and within 182 days of most recent calibration*	*All points < ± 2.1% or ≤ ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± 0.05)*	1) 40 CFR Part 50, Appendix F 2 and 3) Recommendation based on instrument manual and experience (see DAQ NO_2 CAPS SOP for details.) Multi-point calibration (0 and 4 upscale points) *Slope criteria is a recommendation)*

Table 7.3. Measurement Quality Objective Parameter: Nitrogen Dioxide (NO_2) (Cavity Attenuated Phase Shift Spectroscopy) – Continued			
1) Requirement (NO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Gaseous Standards	All gas cylinders	**NIST Traceable** (e.g., EPA Protocol Gas) 10-25 ppm [b] of NO in Nitrogen with < 1 ppm NO_2	1) 40 CFR Part 50, Appendix F, Section 1.3.1 and 01/30/2018 EPA Technical Note 2) Not applicable Green book 3) 40 CFR Part 50, Appendix F, Section 1.3.1 requires 50 - 100 ppm but to successfully calibrate the CAPS monitor DAQ found using 10 to 25 ppm works better (see Guidance Document). Gas producer used must participate in EPA Ambient Air Protocol Gas Verification Program 40 CFR Part 58, Appendix A, section 2.6.1
Zero Air/ Zero Air Check	1/365 days and 1/ calendar year	Concentrations below lower detectable level [c]	1) 40 CFR Part 50, Appendix F, Section 1.3.2 2 and 3) Recommendation
Gas Dilution Systems	1/365 days or after failure of 1-point-QC check or performance evaluation; 1/calendar year	Accuracy < ± 2.1 percent	1,2 and 3) Recommendation based on SO_2 requirement in 40 CFR Part 50, Appendix A-1, Section 4.1.2
Detection (FEM/FRMs) Noise and lower detectable limits are part of the FEM/FRM requirements.			
Noise	Determined by manufacturer at purchase	***≤ 0.005 ppm***	1) 40 CFR Part 53.23 (b) (definition and procedure) 2) Not applicable 3) 40 CFR Part 53.20, Table B-1
Lower detectable level	Determined by manufacturer at purchase	***≤ 0.01 ppm***	1) 40 CFR Part 53.23 (c) (definition and procedure) 2) Recommendation 3) 40 CFR Part 53.20, Table B-1
SYSTEMATIC CRITERIA- NO_2			
Standard Reporting Units	***All data***	***ppb [d] (final units in AQS)***	1,2 and 3) 40 CFR Part 50, Appendix S, Section 2 (c)
Rounding convention for data reported to AQ S	***All data***	***1 place after decimal with digits to right truncated***	1, 2 and 3) 40 CFR Part 50, Appendix S, Section 4.2 (a)
Completeness	***Annual Standard***	***≥ 75 percent hours in year***	1) 40 CFR Part 50, Appendix S, section 3.1(b) 2) 40 CFR Part 50, Appendix S, section 3.1(a) 3) 40 CFR Part 50, Appendix S, section 3.1(b)
	1-hour standard	***1) 3consecutive calendar years of complete data 2) 4 quarters complete in each year 3) ≥75 percent sampling days in quarter 4) ≥ 75 percent of hours in a day***	1) 40 CFR Part 50, Appendix S, section 3.2(b) 2) 40 CFR Part 50, Appendix S, section 3.2(a) 3) 40 CFR Part 50, Appendix S, section 3.2(b) More details in 40 CFR Part 50, Appendix S

Table 7.3. Measurement Quality Objective Parameter: Nitrogen Dioxide (NO_2) (Cavity Attenuated Phase Shift Spectroscopy) – Continued

1) Requirement (NO_2)	2) Frequency	3) Acceptance Criteria	Information /Action
Sample Residence Time Verification	At installation, 1/365 days and 1/calendar year **(The DAQ goals is every 30 days)**	***< 20 seconds***	1) 40 CFR Part 58, Appendix E, section 9 (c) 2) Recommendation (See DAQ-08-002.1 and DAQ-08-001.2 SOPs for details.) 3) 40 CFR Part 58, Appendix E, section 9 (c)
Sample Probe, Inlet, Sampling train	***All sites***	***Borosilicate glass (e.g., Pyrex®) or Teflon™***	1, 2 and 3) 40 CFR Part 58, Appendix E, section 9 (a) The EPA accepts FEP and PFA as equivalent material to Teflon™. Replacement every two years and more frequent if pollutant load or contamination dictate
[a]-National Institute of Standards and Technology [b]-parts per million [c]-Lower Detection Limit [d]-parts per billion			
Siting	1/365 days and 1/calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58, Appendix E, sections 2-6 2) Recommendation (See DAQ Annual Network Review SOP) 3) 40 CFR Part 58, Appendix E, sections 2-6
Precision (using 1-point-QC checks)	***Calculated annually and as appropriate for DV estimates***	***90 percent confidence limit CV <15.1 percent***	1) 40 CFR Part 58, Appendix B, section 2.3.1.4 and 3.1.1 2) 40 CFR Part 58, Appendix A, section 4 (b) 3) 40 CFR Part 58, Appendix B, section 4.1.2
Bias (using 1-point-QC checks)	***Calculated annually and as appropriate for DV estimates***	***95 percent confidence limit < ± 15.1 percent***	1) 40 CFR Part 58, Appendix B, section 2.3.1.4 and 3.1.1 2) 40 CFR Part 58, Appendix A, section 4 (b) 3) 40 CFR Part 58, Appendix B, section 4.1.3

AMTIC – Ambient Monitoring Technology Information Center
FEP – Fluorinated ethylene propylene
PFA – perfluoroalkoxy
DV – design value

7.3 Type of Data Needed

The DAQ collects SO_2 and NO_2 pollutant data using hourly concentration data (with each hour considered valid if the monitor has reported at least 45 valid 1-minute readings). For each of these pollutants, the EPA requires quarterly data capture of greater than or equal to 75 percent completeness. The collection of maximum five-minute SO_2 concentration data and precision and bias data is also required. In addition to these requirements, the data needed for the DAQ SLAMS SO_2 and NO_2 monitoring program will meet the following quality objectives:

- All data should be traceable to a National Institute of Standards and Technology, or NIST, primary standard.
- All data shall be of a known and documented quality. Two major measurements used to define quality are precision and bias. Refer to Section 7.2 Measurement Quality Objectives for definitions of the metrics precision and bias.
- All data shall be comparable. This means the DAQ shall produce all data in a similar and scientific manner. The use of the standard methodologies for sampling, calibration, auditing, etc. referenced in the QAPP and associated SOPs should achieve this goal.
- All data shall be representative of the parameters measured with respect to time, location, and the conditions at which DAQ obtains the data. The use of approved standard methodologies should ensure that the data generated are representative. Support in achieving representativeness is also provided through adhering to the requirements prescribed in 40 CFR Part 58, Appendices D and E.
- All data shall be as complete as possible and DAQ will supplement the data, as needed, using either a collocated data logger for shelter temperature or data stored in the SO_2 and NO_2 monitors; and
- The QAPP and its associated SOPs must be dynamic to continue to achieve its stated goals as techniques, systems, concepts and project goals change.

8.0 Training Requirements

Adequate education and training are integral to any monitoring program that strives for reliable and comparable data. DAQ personnel will meet the educational requirements, accountability standards and training requirements for their positions. Section 4 of the QMP describes the DEQ training program. DAQ requires all staff to take specific, mandatory governmental training courses, such as safety training, defensive driving and harassment awareness courses, among others. The DAQ maintains records on personnel qualifications and training in several locations, dependent upon the applicability of the information. For example, staff may maintain copies of certificates received from classes or workshops, whereas human resources will keep records of personnel qualifications. The DAQ uses the North Carolina Learning Management System, or LMS, to track training by DIT and the Office of State Human Resources.

The DAQ aims ambient air monitoring training at increasing the effectiveness of employees as well as the effectiveness of DAQ. In general, training for the ambient-air monitoring program consists of a combination of required reading, ambient monitoring monthly meetings, active cross training amongst staff, completion of EPA-led training classes and attendance at DAQ and EPA workshops and conferences. Currently, no recurring annual training is required for SO_2 and NO_2 monitoring staff other than attendance at the annual ambient monitoring workshop. Observations made during internal systems audits or EPA technical systems audits, or TSAs, may result in the need for specific refresher training provided by DAQ staff. Completion of additional training – such as self-instructional air monitoring courses and EPA provided webinars – is encouraged by all staff.

Specific air monitoring personnel training consists of required reading before implementing the requirements of this QAPP. Documents monitoring personnel must read shall include this QAPP, and the SOPs and instrument manuals specific to the equipment personnel will be working with or servicing. Employee supervisors or trainers typically document required reading on a form indicating the employee has read and understood the QAPP or SOP. These forms are archived in IBEAM. Specific training requirements are provided in SOP DAQ-15-003 *(in draft and under review at this time.)* DAQ continually revises the training program and updates the training forms used to document training as needed.

All positions have a training guide that provides suggested training for employees to complete to achieve competency in that position. Staff are encouraged to also read applicable parts of the CFR (e.g.,40 CFR, Parts 50 and 58), the QA Handbook, Vol. II, and EPA's data validation guidance documents and policy memoranda. See Table 11.2 for relevant SOPs to review.

The DAQ makes efforts to ensure the staff receives timely training and periodic refreshers in accordance with the established training guide. Experienced staff members provide on-the-job training. As the Raleigh Regional Office (RRO) has the largest ambient monitoring staff with the most diversified monitoring equipment, the chief often calls upon the RRO to provide hands-on training when needed. The chief, PPB supervisor, or equivalent, typically arranges for this training. In some cases, the chief calls upon other regional offices, the ECB electronics technicians and RCO chemists to provide hands-on

training. The employee documents this training on the provided training forms (obtained from IBEAM), which are archived in IBEAM as well as in the employee's valuing individual performance (VIP). Before 2021, the employee may have archived training records in the LMS.

The DAQ supervisors actively encourage all employees to pursue training opportunities whenever possible and as needed, because the chief continually evaluates DAQ's SLAMS SO_2 and NO_2 monitoring network to ensure it continues to meet its objectives. Because of these evaluations, the chief could add new equipment, procedures, or new personnel to the project. DAQ provides vendor-based training for its personnel when DAQ obtains new equipment. The employees document this training on the provided training form and archive it in IBEAM. The employee may also archive the training records in the LMS, if he or she chooses to do so. Additionally, personnel are encouraged to periodically identify, request, and attend pertinent courses and seminars. The DAQ may provide these courses and seminars as videotapes, web based real-time interactive formats, closed circuit transmissions, live instruction or a combination of one or more. Organizations that provide these training opportunities include local and regional universities, the Air and Waste Management Association, the Mid Atlantic Regional Air Management Association, and EPA. The employees document this training on the appropriate training form and archive it in IBEAM. The air quality supervisors ensure the air monitoring personnel have sufficient training to currently perform necessary functions at an acceptable level.

The DAQ supervisors also evaluate employee proficiency based on performance and feedback from peers and other coworkers. During the VIP review, the supervisors recommend any refresher training that the employee might need and develop a plan for the employee to receive the needed training. The LMS provides and archives certificates of completion for any course work taken through the LMS.

Prior to the start of the on-site work, DAQ provides all field personnel instruction specific to the project, covering the following areas:

- Organization and lines of communication and authority,
- Overview of the QAPP, including monitor maintenance, calibration, and QC activities,
- Quality assurance / quality control, or QA/QC, requirements,
- Documentation requirements and
- Health and safety requirements.

Monitoring staff provide new monitoring personnel and regional monitoring technicians the necessary on the job training for their individual monitoring tasks. These include data review, verification and validation. Upon completion of training, the trainee will be performance tested on knowledge, skills and abilities in the field and at the office. Upon successful demonstration of initial competency, the trainer will complete Form DAQ-16-022 DAQ Initial Demonstration of Competency. Continuing demonstration of competency is noted during VIP reviews and internal TSAs and documented using Form DAQ-16-019 DAQ Continuing Demonstration of Competency. The employee documents all on-the-job training on the appropriate form and archives it in IBEAM. Ongoing proficiency is reviewed on an as needed basis. No certificates are provided to the trainee and trainee proficiency is documented as part of the on-the-job training process and documentation.

The chief invites the regional monitoring coordinators and technicians to the DAQ ambient monitoring workshop held each year. This workshop provides an opportunity to discuss and train on monitoring and the QC and QA processes, including data review and verification, to ensure the collection of valid data. A senior staff member provides hands on instruction with the analyzers as on the job training when new employees are hired. The vendor provides training when DAQ purchases new monitors and other equipment. The DAQ and EPA staff provides training annually during the monitoring workshop. All available presentations and materials generated at the workshop are maintained on the RCO group drive or in SharePoint for archival purposes. No formal evaluation forms are collected during or after the workshop.

DEQ - DAQ Training Links

Air Monitoring:	Conferences and Training | US EPA
Professional Skills:	http://oshr.nc.gov/state-employee-resources/training

9.0 Documentation and Records

The following information describes DAQ's management of documents and records, including this QAPP, for the SLAMS SO_2 and NO_2 monitoring program. Currently, DAQ does not have a single designated position responsible for policing documents and/or records for the entire Ambient Monitoring Section. A dedicated document and records custodian would be a tremendous asset; however, such a position is unlikely to be created anytime in the foreseeable future due to lack of funding. Also, this huge responsibility cannot be assigned to a single position within the already overburdened monitoring staff. Therefore, the Ambient Monitoring Section has established that the individual staff members who generate the original document and/or record are responsible for the placement, maintenance and archival of their respective documents and records. DAQ-14-003 will provide additional details on document retention procedures once it is finalized.

DIT maintains a shared group drive for use by Ambient Monitoring personnel in the RCO and regional offices. Access to this drive is restricted to DAQ personnel and assigned DIT personnel. Although it is commonly referred to as the "P" drive, the group drive may have a different letter designation in the regional offices. To reduce confusion, the group drive will be referred to as the "RCO group drive" in this QAPP.

Microsoft SharePoint is utilized as an access-restricted document and records storage repository by the seven regional offices. The regional ambient monitoring coordinator is responsible for all ambient monitoring documents and/or records stored on their specific SharePoint site. Access to each SharePoint page is restricted to its respective regional office personnel. Regional records and/or documents are stored on the regional SharePoint sites and the regions retain their records and documents according to the retention schedule. RCO chemists do not have access to the regional SharePoint sites. Therefore, any document and/or record requiring RCO review is placed on the RCO group drive for the RCO chemist to review and approve. The RCO chemists are assigned specific program areas for which they are responsible. For instance, each chemist is responsible for a specific criteria pollutant, such as ozone, particulate matter (PM), SO_2, nitrous oxides, and carbon monoxide. Also, a specific RCO chemist is assigned to meteorology data and a specific RCO chemist is assigned to air toxics data. These chemists are responsible for the final approved records that are stored on the RCO group drive.

Documents and records are also archived in the internal access restricted IBEAM. The RCO staff also utilize SharePoint to share information such as reference materials, meeting notes, draft copies of documents, news articles, workshop materials, presentations, and other miscellaneous information. The RCO SharePoint page is for internal division usage by the Ambient Monitoring Section and access is restricted to specific North Carolina air quality and DAQ staff, but it is not the official location of the approved QMP, QAPPs and SOPs. The approved QMP, QAPPs and SOPs are posted to the DEQ/DAQ website for the ease of access for all State, Local and Tribal staff at any location where internet access can be utilized, such as the monitoring sites. All approved documents are posted to the website under strict approval processes and protocols.

DIT routinely creates backups of all data stored on the RCO group drive and IBEAM. Files stored in the "General Documents" module of IBEAM are protected from deletion; any file a user attempts to delete remains in the database but is hidden from view. A supervisor can restore that file to its previous location via a request to the IBEAM administration staff. As a cloud-based file storage location, SharePoint file backups are facilitated by Microsoft, Inc.; all files are backed up twice daily and Microsoft provides a 90-day window for recovery of documents from inadvertent editing or deletion.

The DAQ secures all electronic documents by utilizing encrypted laptops or password protected computers and by storing paper documents in limited access areas. Additionally, SOPs must not conflict with any part of this QAPP or with any other relevant local, state, or federal regulation.

Table 9.1 lists the documents and records pertaining to all data the EPA requires DAQ to collect and all other data deemed important by DAQ's policies and records management procedures, including documents and records required to support the concentration data reported to EPA.

Table 9.1 Documentation and Records Information

Categories	Record / Document Type	File Location
Management and Organization	State Implementation Plan Reporting agency information EPA directives Grant allocations Support contracts	Raleigh, North Carolina – Raleigh Central Office (RCO)
	Quality Management Plan	DEQ Website
	Organizational structure	Ambient Monitoring Administration Page on SharePoint
	Personnel qualifications and training	DEQ Human Resources and DAQ Training page on SharePoint
	Training records and certification	Learning Management System, IBEAM General Documents Module and Valuing Individual Performance
Site Information	Network descriptions Site files Site maps Site pictures	RCO group drive, Regional Office SharePoint page, IBEAM General Documents Module
Environmental Data Operations	Quality Assurance Project Plans	DEQ Website for official repository. Other file locations may include IBEAM General Documents Module for archived versions, North Carolina Ambient Monitoring Section QAPP page on SharePoint or RCO group drive (see below)
	Standard Operating Procedures QA bulletins and technical notes	DEQ Website, IBEAM General Documents Module (see below)

Table 9.1 Documentation and Records Information

Categories	Record / Document Type	File Location
	Field and site notebooks	RCO group drive, Regional Office SharePoint page, monitoring site
	Inspection, Equipment and Maintenance Records	RCO group drive, Regional Office SharePoint page, ECB
Raw Data	Any original data (routine and QC) Including data entry forms	Raleigh, North Carolina – RCO, Regional Offices, ECB
Data Reporting	Air Quality Index Reports	DAQ Website, IBEAM General Documents Module
	Annual Certification Report	IBEAM General Documents Module
	Data Summary Reports	DAQ Website, IBEAM General Documents Module
	Journals/ articles/ papers/ presentations	RCO group drive, IBEAM General Documents Module
Data Management	Data Algorithms Data Management Plans/ Flow Charts Data Management Systems	Raleigh, NC – RCO
	Pollutant Data Minute Data	Envista ARM database
	Meteorological Data (from State Climate Office) Traffic Data (from North Carolina Department of Transportation)	RCO group drive Regional Office SharePoint Pages
Quality Assurance	Network Reviews and Assessments Control Charts Certification Documentation Data Quality Assessments Quality Assurance Reports Response/ Corrective Action reports Site Audits Internal / EPA Technical Systems Audit reports Emails relating to QA activities and assessments	Raleigh, NC – RCO and ECB Regional Offices IBEAM General Documents Module

The state of North Carolina considers all emails official records and the state of North Carolina retains all email correspondence for a minimum of 10 years. In addition, DAQ archives emails that are critical in documenting official decisions regarding network decisions and data quality decisions in IBEAM.

Most documentation and records produced by DAQ's SLAMS SO_2 and NO_2 monitoring program consist of data and information gathered to support the data collection activities. Documentation and records include:

- QAPPs;
- SOPs;
- Logbooks and data collection records in electronic and written format;
- Instrument and equipment calibration information;
- QA documentation in electronic and written format; and
- Documentation that supports data review, validation and certification activities.

Upon assuming a new role working with DAQ documents and/or records, personnel are trained on the appropriate specific locations for each of the document and record types listed in Table 9.1, how to access the various locations, and proper procedures for maintaining those documents and/or records for which they are responsible. If DAQ personnel require access to documents or records outside of their sphere of responsibility, they may contact the appropriate RCO branch supervisor or regional monitoring coordinator for more information.

Section 19.0 Data Management contains detailed information regarding how DAQ will manage data from the SLAMS SO_2 and NO_2 network, including information on data recording, transmittal, storage and retrieval.

9.1 Statewide Policy and Procedure Documentation

DAQ maintains records of program policy and procedure documentation. Documents in this category include:

- QAPPs,
- SOPs,
- Electronic QA/QC data forms that technicians must use to document their work, and
- QA and technical notes, which provide air monitoring policy interpretations or best practices.

The DAQ ensures that document numbers and revision numbers and dates are clearly discernible, generally in the header and on the cover page. The DAQ generates document numbers for these documents using the DAQ Document ID Builder, which can be found on the RCO SharePoint page. Detailed instructions for drafting SOPs can be found in DAQ-14-001 - Standard Operating Procedure (SOP) for Preparing SOPs for the North Carolina Division of Air Quality (NCDAQ).

As of this QAPP revision, DAQ is in the process of implementing a new document and record storage database, which may result in changes to these procedures and locations. When these changes are made, this QAPP and relevant SOPs will be revised to reflect new procedures and document and record locations.

The DAQ currently uses IBEAM for a controlled internal locale for archiving all QA/QC forms, SOPs and QAPPs. PPB chemists are responsible for the blank QA/QC forms and final records concerning their assigned pollutant(s). Intermediate records are the responsibility of the regional ambient monitoring coordinator. In IBEAM, documents that are archived are marked as *OBSOLETE* in the title so that staff know not to use them for current procedures. The QAM or his designee is responsible for changing the title to *OBSOLETE* when a new version is approved. QA/Tech Notes are also stored in IBEAM. The DEQ website is the official DAQ repository for controlled QMPs, QAPPs and SOPs, i.e., current approved versions. All other QMPs, QAPPs and SOPs not on the website or in IBEAM are uncontrolled and therefore not considered official. Personnel are responsible for obtaining and utilizing current versions of documents.

Also, at the time of this QAPP revision, RCO uses the RCO group drive and SharePoint as repositories for working documents. Regional offices use SharePoint as a repository for working documents, and

transfer completed documents to the RCO group drive. Draft documents will be watermarked as *DRAFT* so that no confusion arises as to the finality of the document. The QAM or designee receives final versions for review and approval. Once all approvers sign the QAPPs and SOPs, the QAM or designee will upload or assign someone to upload the document to the website and IBEAM. The QAM will notify staff of the issuance of the new document via email and on the next ambient monitoring work group call. The chief and RCO chemists may change these procedures when the new document and record storage database is implemented and will revise the QAPP if changes are made at that time.

9.2 Data Collection Records and Logbooks

Table 9.1 lists the documents and records DAQ must retain. The appropriate sections of this QAPP will discuss the details of these various documents and records. The DAQ will collect all raw data required for calculations, the submissions to the AQS database and QA/QC data electronically, in e-logs, spreadsheets or on data forms recorded in the field; see Section 11.0 Sampling Methods Requirements for additional information.

All regional monitoring technicians, coordinators, ECB electronics technicians, RCO chemists and other DAQ personnel shall fill out information in the site visit logbook in indelible ink. In addition, the ECB electronics technicians will fill out instrument maintenance logs and Air Quality Section Maintenance Order or AQ-109 and Continuous Monitor Performance Audit Report or AQ-121 forms in indelible ink. They shall make corrections by inserting one line through the incorrect entry, initialing and dating this correction and placing the correct entry alongside the incorrect entry, if they can accomplish this legibly, or by providing the information on a new line if the above is not possible.

9.2.1 Logbooks

Each regional monitoring technician will be responsible for obtaining, maintaining and documenting the appropriate logbooks or associated QA/QC data forms. Each SLAMS SO_2 and NO_2 monitor type has an e-log created for that specific monitor type. The e-log contains all data entry forms required by a regional monitoring technician to document all routine operations. After each use, the regional monitoring technician uniquely numbers these e-logs by giving them a specific file name before saving them to a storage device such as a laptop computer. From the laptop computer, the regional monitoring technician will transfer the e-log to the regional SharePoint page for the regional monitoring coordinator to review. The regional monitoring technician will use these e-logs to record information about the site operations, as well as document routine operations. The e-logs are editable, but the original e-logs remain on the access-restricted regional SharePoint page, which tracks changes and edits and are recoverable in the event of inadvertent deletion. Once the regional monitoring coordinator has reviewed and approved an e-log, they upload it to the RCO group drive, which is the official repository of these records. The ECB electronics technicians will fill out instrument maintenance logs, Air Quality Section Maintenance Order or AQ-109 forms, and Continuous Monitor Performance Audit Report or AQ-121 forms. The original AQ-109 forms are retained at the ECB facility. The AQ-121 forms are scanned and stored in IBEAM; hard-copies are stored in a filing cabinet at RCO.

The regional monitoring and ECB electronics technicians must complete e-logs, instrument maintenance logbooks and Air Quality Section Maintenance Order or AQ-109 forms associated with all routine environmental data operations, even when the site logbooks contain all appropriate and associated information required for the routine operation performed.

Field Logbooks – The DAQ uses a combination of bound paper logbooks and e-logs for recordkeeping for each sampling site, sampling instrument, specific program or individual. Each paper logbook should be hardbound and paginated. The regional monitoring and ECB electronics technicians use the paper site logbooks to document site visits and other activities, including who is at a site, when and why. Every visitor must sign the site logbook. The logbooks generated and maintained by regional office staff are filed and archived at the appropriate regional office once completed. Logbooks generated and maintained by ECB staff are filed and archived at the ECB once completed. The e-logs capture monitor maintenance and QA/QC activities, including calibrations.

9.2.2 Electronic Data Collection

All instrument types currently used in the DAQ SLAMS SO_2 and NO_2 network can provide an automated means for collecting information that DAQ would otherwise record on data entry forms. Section 19.0 Data Management provides detailed information on these systems. To reduce the potential for data entry errors, the DAQ will use automated systems where appropriate and will record the same information the regional monitoring technician would record on data entry forms. To provide a backup, the PPB staff will store electronic copies of the automated data collection information (daily poll) for an appropriate period on the RCO group drive. Electronic backup copies of automated data collection information will also be stored on the site computers.

9.3 QA/ QC Records

The DAQ achieves QA/QC through the performance of periodic activities such as:

- Internal / EPA technical systems audits,
- One-point QC checks,
- Zero and span checks,
- Verification/calibration procedures,
- Maintenance activities,
- Performance evaluations,
- EPA performance audits such as the National Performance Audit Program, or NPAP, and Ambient Air Protocol Gas Verification Program,
- Traceability certifications and calibrations and
- Corrective actions.

The EPA and DAQ document TSAs and internal systems audits in the form of a written report. The DAQ typically documents and maintains most of the other QA/QC activities using a variety of activities, including emails, Excel spreadsheets, fillable PDF data forms, worksheets and data management systems such as Envidas Ultimate and Envista ARM, both developed by the software developer, Envitech. The associated SOPs describe the use of these methods to create air monitoring QA/QC records. The DAQ

retains and archives these records according to the procedures identified in Section 9.5 Data Archiving and Retrieval.

However, for some of the QA/QC activities described above – such as the traceability certifications – the ECB retains many of those records at the ECB. Currently, the vendors typically provide the certificates of analyses that accompany gas cylinders in paper format, which the ECB stores in a file in the office. If DAQ personnel require information related to these documents, they may contact the ECB for assistance. Paper records of these documents are stored at the ECB in a file cabinet. Any electronic records of these documents are stored on the RCO group drive and additionally on local computer hard drives in the certification rooms. Records for calibrators used in the field and for audits are stored electronically on the RCO group drive. The division is in the process of implementing a database for generating and archiving these types of records. When the database is fully implemented, the chief and RCO chemists will review the new record generating and retention processes and will revise the QAPP.

9.4 Reference Materials

Because of the technical nature of ambient air monitoring, DAQ requires numerous reference materials to administer the SLAMS SO_2 and NO_2 monitoring program effectively. This category includes publications such as instrument operation manuals, troubleshooting guides, EPA guidance documentation, EPA technical memoranda and various other reports. DAQ maintains access to applicable reference materials if DAQ has an administrative need for them. DAQ retains these documents at the RCO, in the IBEAM general documents module, or on the RCO group drive.

9.5 Data Archiving and Retrieval

The DAQ classifies documentation according to its intended use, future applicability and regulatory requirement for retention. DAQ follows the state of North Carolina's functional schedules for files. Files used and created by DAQ will be kept for a minimum amount of time set by these functional schedules. To meet DAQ's contractual obligation to the EPA, DAQ will retain all the information listed in Table 9.1 for a minimum of four complete calendar years from the date of collection in accordance with 2 CFR Part 200.334. However, if any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the four-year period, DAQ will retain the records until completion of the action and resolution of all issues that arise from it, until the end of the regular four-year period, or until the minimum time required by the state of North Carolina functional schedules, whichever is later. The records custodians are responsible for ensuring these retention times are met and disposing of records after their retention period has elapsed.

DAQ stores electronic records within the data management systems located at the SLAMS SO_2 and NO_2 sites, or Envidas Ultimate, the RCO, or Envista ARM, and on network servers in the region and RCO. The DIT backs up records stored on the RCO group drive nightly and stores these backups off site. The database manager regularly backs up the Envista ARM database following the procedures in Section 5.7 of DAQ-05-001.5 Ambient Monitoring Section Database Manager Standard Operating Procedure.

10.0 Network Description

The primary function of the SLAMS SO_2 and NO_2 monitoring program is to measure the one-hour averaged concentrations of SO_2 and NO_2 in several areas of North Carolina to verify compliance with the NAAQS. The program also provides real-time data to the public and the EPA and DAQ may use the data to determine trends over time.

The SLAMS SO_2 and NO_2 sampling network design and monitoring site selection comply with 40 CFR Part 58, Appendices D and E. Appendix A to Part 58 prescribes requirements for collocating regulatory PM monitors, which are covered under separate DAQ QAPPs. Appendix A does not require gaseous pollutant monitors to be collocated.

In addition, for the two source-oriented monitors, the chief also complied with the following:

- 40 CFR Part 51, Subpart BB – Data Requirements for Characterizing Air Quality for the Primary SO_2 NAAQS, and
- SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document.

10.1 Network Objectives

The SLAMS SO_2 and NO_2 monitors are intended to address specific air quality management interests. The three basic monitoring objectives of the DAQ SLAMS SO_2 and NO_2 ambient air quality monitoring network are listed in Section 6.0 of this QAPP. Tables 6.1 and 10.2 include monitoring objective, spatial scale of representativeness, and operating schedule information for each SLAMS SO_2 and NO_2 monitor.

For the source-oriented SO_2 monitors, the chief designed the monitoring network to determine the highest concentrations of SO_2 expected to occur in the area near the source. For the other monitors in the network, the chief chose existing monitoring sites that best met the monitoring objectives. The SLAMS SO_2 and NO_2 monitoring network uses the design criteria specified in 40 CFR Part 58, Appendices D and E, to establish the appropriate network configuration necessary to meet these objectives.

The DAQ has assigned the SLAMS monitors within the SO_2 and NO_2 monitoring network one or more of the following monitoring objective designations: General Background, Population Exposure, or Source Oriented.

Data collected within the network must be representative of the spatial area under study. The goal in siting a monitoring station is to match the spatial scale represented by the data obtained with the spatial scale most appropriate for the monitoring objective of the station. For a discussion of the representative measurement scale for the SLAMS SO_2 and NO_2 monitoring sites, see Section 6.0 Project/Task Description.

10.2 Site Selection

Table 5.3 lists the SLAMS SO_2 and NO_2 monitoring sites covered by this QAPP. Currently, DAQ is only required to operate one PWEI SO_2 site. This site is located at the Durham Armory, AQS ID 37-063-0015,

located at latitude 36.032955 and longitude -78.904037 and is for the monitoring of the Durham MSA. The Durham site also monitors for ozone and particles. The monitoring probe is located 41 meters south of Stadium Drive and 3.87 meters above the ground. The closest permitted source of SO_2 to the Armory site is Carolina Sunrock, located 3.25 kilometers southeast of the site. DAQ operates two source-oriented SO_2 sites at Canton, AQS ID 37-087-0013, and Bayview Ferry, AQS ID 37-013-0151, and one general background NO_2 site at Rockwell, AQS ID 37-159-0021. Figures 10.1 through 10.4 display aerial views of the sites. The annual network monitoring plan contains additional information on the sites.

Figure 10.1 Aerial View of the Durham Armory PWEI SO_2 site (purple marker) at latitude 36.032955 and longitude -78.904037

Figure 10.2 Aerial View of the Rockwell NO_2 site (pink marker) at latitude 35.551868 and longitude -80.395039

Figure 10.3 Aerial View of the Canton (former DRR) SO_2 site (yellow star) at latitude 35.535 and longitude -82.850

Figure 10.4 Aerial View of the Bayview Ferry SO_2 site ("B" marker) at latitude 35.428 and longitude -76.7399

When selecting a site, the DAQ adheres to the site selection criteria specified in 40 CFR Part 58, Appendix D. The selection of a specific monitoring site includes the following activities:

- Developing and understanding the monitoring objective and appropriate DQOs,
- Identifying the spatial scale most appropriate for the monitoring objective of the site,
- Identifying potential locations where the monitoring site could be placed, and
- Identifying the specific monitoring site.

The regional monitoring technician evaluates each monitoring site every year to assure it adheres to the site selection criteria specified in 40 CFR Part 58, Appendix E.

10.2.1 Site Location

The DAQ considered four criteria when evaluating potential SLAMS SO_2 and NO_2 monitoring sites:

- Location of potential pollution sources,
- Topography of the area,
- Predominant wind direction in relation to any potential pollution sources, and
- Potential population exposure.

Selection per these criteria requires detailed information concerning the types and location of pollutant sources, geographic variability of ambient pollutant concentrations in the background environment, meteorological conditions and population density. The calculated PWEI index for each CBSA determines the number, geographic locations and types of PWEI SO_2 stations. The sampling site selection process for SLAMS SO_2 and NO_2 monitors also involves consideration of the following factors:

- **Economics -** The quantity of resources required to accomplish all data collection activities, including instrumentation, installation, maintenance, data retrieval, data analysis, QA and data interpretation, must be established
- **Security -** In some cases, a preferred location may have associated problems that compromise the security of monitoring equipment (i.e., high risk of theft, vandalism, etc.). If the ECB staff cannot remedy such problems using standard measures such as additional lighting, fencing, etc., then the regional staff shall attempt to locate the site as near to the preferred location as possible.
- **Logistics -** This process includes procurement, maintenance and transportation of material and personnel for the monitoring operation. The logistics process requires full knowledge of all aspects of the data collection operation: planning, reconnaissance, training, scheduling, safety, staffing, procuring goods and services, communications and inventory management.
- **Atmospheric Considerations -** These considerations may include spatial and temporal variability of pollutants and their transport. Effects of buildings, terrain, and heat sources or sinks on air trajectories can produce localized anomalies of pollutant concentrations. The DAQ considers meteorology in determining the geographic location of SLAMS SO_2 and NO_2 sites as well as the height, direction and extension of sampling probes. Evaluation of a local wind rose is essential to locate SLAMS SO_2 and NO_2 monitoring sites properly.

- **Topography –** The DAQ evaluated the local topography based upon land use maps, U.S. Geological Survey topographic maps, and other available resources. The DAQ also identified and evaluated minor and major topological features that affect both the transport and diffusion of SO_2 and NO_2. Minor features may include an adjacent tree lined stream or tall structures upwind or downwind of a point source, each of which may exert small influences on pollutant dispersion patterns. Major features include river canyons or deep valleys, mountain ranges, and large lakes. Major features significantly affect the prevailing wind patterns or create their own local weather such as katabatic or anabatic winds.
- **Pollutant Considerations** – The monitoring site location for a specific pollutant may or may not be appropriate for another pollutant. The DAQ evaluated the changes that SO_2 and NO_2 undergo temporally and spatially to determine the applicability of each potential site.

An interdependence exists between all the factors listed above. Consequently, the DAQ employed an iterative procedure to select appropriate sites that can provide the data necessary to accomplish the stated objectives. In situations where the sites do not specifically meet the requirements necessary to obtain the project objectives, reevaluation of the project priorities may be necessary before the final monitoring site selection. Experience in the operation of air quality measurement systems; estimates of air quality, field, and theoretical studies of air diffusion; and considerations of atmospheric chemistry and air pollution effects make up the required expertise needed to select the optimum sampling site for obtaining data necessary to fulfill the monitoring objectives. The Ambient Monitoring Section shares these responsibilities with staff throughout DAQ.

10.2.2. Monitor Placement

General inlet siting criteria for monitors at SLAMS SO_2 and NO_2 monitoring sites shall adhere to the requirements in 40 CFR Part 58, Appendix E. Final placement of a monitor at a selected site is dependent on physical obstructions and activities in the immediate area. The ECB electronics technicians must place monitors away from obstructions such as trees and fences to avoid their effects on airflow. To prevent sampling bias, airflow around monitor sampling probes must be representative of the general airflow in the area. In addition, the availability of utilities (i.e., electricity and telephone services) is critical.

10.3. Sampling Frequency

As prescribed in 40 CFR 58.12, the EPA establishes the minimum sampling frequencies of the monitors. The DAQ follows the EPA's requirements for the sampling frequencies of monitors. The monitors used in the SLAMS SO_2 and NO_2 monitoring project collect data continuously. The data acquisition system, or DAS, aggregates the minute averages into five-minute (SO_2) and hourly averages. The DAQ ensures each monitor collects at least the minimum amount of data required to calculate the appropriate summary statistics. At least 75 percent of the total possible observations must be present before summary statistics are calculated. The exact requirements appear in 40 CFR Part 50, Appendices S and T and in Table 10.1. Table 10.2 provides the sampling schedule and frequency.

Table 10.1 Requirements for Calculating Summary Statistics.

Pollutant	Completeness Requirement	Time Frame
SO_2	75 percent	Per 5-minutes, hour, day, quarter and year
NO_2	75 percent	Per hour, day, days per quarter and hours per year and quarter

Table 10.2. Monitoring Sampling Schedule and Frequency

Pollutant	Time Frame	Frequency	Monitor Type
SO_2	Hourly (60 minutes/hour) and 5-minute averages	24 hours a day / 7 days a week	Continuous
NO_2	Hourly (60 minutes / hour)	24 hours a day / 7 days a week	Continuous
Shelter Temperature	Hourly (60 minutes / hour	24 hours a day / 7 days a week	continuous

10.4. Rationale for DAQ's SLAMS Sulfur Dioxide and Nitrogen Dioxide Monitoring Network

The primary rationale for the operation of the SLAMS SO_2 and NO_2 monitoring network is to measure hourly concentrations of SO_2 and NO_2 to determine compliance with the NAAQS and provide the public with information on current air quality. The DAQ also operates the PWEI monitor at the Durham Armory to meet 40 CFR Part 58, Appendix D requirements for PWEI monitoring.

11.0 Sampling Methods Requirements

11.1 Analyzer or Sensor Methodology

In accordance with 40 CFR Part 58, Appendix C, Section 2.1, a criteria pollutant monitoring method used for making NAAQS decisions at a SLAMS site must be a reference or equivalent method. Towards that end, the DAQ uses only EPA-approved FRM or FEM instrumentation to measure SO_2 and NO_2 at the SLAMS SO_2 and NO_2 monitoring sites currently in operation. Criteria pollutant analyzer methods that have received FRM or FEM status have been rigorously tested, in accordance with 40 CFR Part 53 requirements, and found to meet or be comparable to the EPA reference methods codified in 40 CFR Part 50, Appendices A-1 and F. For the detailed specifications upon which a specific monitoring method has received its FRM or FEM status, see the List of Designated Reference and Equivalent Methods, issued by the EPA Office of Research and Development and available on the Ambient Monitoring Technology Information Center, or AMTIC, website. The DAQ will operate the SO_2 and NO_2 analyzers in accordance with these designation specifications. To ensure the monitor meets these specifications DAQ uses the criteria in the validation templates in Section 7.0 and will follow procedures set forth in associated SOPs (see Table 11.2 of this QAPP). These data collection methods use real-time or near real-time (continuous) analysis of the ambient air. As a result, the DAQ does not collect physical samples. The analyzer performs "in situ" analysis of the composition of the ambient air within the analyzer itself using a specific method. The following subsections describe the data collection methods used in the SLAMS SO_2 and NO_2 monitoring network. DAQ maintains copies of the Thermo and API Teledyne instrument manuals at the sites, at the regional offices and at the ECB facility.

Table 11.1 lists the specific analyzers and methods used. The SO_2 and NO_2 monitors are designated as FEMs. When the current monitors used in the network become obsolete, the ECB supervisor and electronics technicians in consultation with the chief, RCO chemists and regional monitoring staff will select a new monitor type to replace the existing monitor type used throughout the network. Rollout of the new monitor type will be coordinated by the chief with input from the ECB, RCO and regional monitoring staff.

Table 11.1. DAQ SLAMS SO_2 and NO_2 Monitoring Network Analyzers

Pollutant	Analyzer	AQS Method Code	EPA Reference/Equivalence
Sulfur dioxide	Thermo Environmental Instruments, Inc. Model 43i	060	EQSA-0486-060
Nitrogen Dioxide	Teledyne-Advanced Pollution Instruments, Model T500U	212	EQNA-0514-212
Indoor Shelter Temperature	Comet temperature transmitter, Model T0310 primary, HOBO as backup	013	No FRM or FEM

11.1.1 Sulfur Dioxide (Ultraviolet Fluorescence)

The SLAMS SO_2 monitoring network uses Thermo 43i SO_2 analyzers. These analyzers use ultraviolet, or UV, fluorescence. The physical principle used in SO_2 measurement relies on exciting an electron shell of a SO_2 molecule, which occurs in the presence of a specific wavelength (214 nanometers) of UV radiation, and the subsequent relaxation, which produces a photon of light. A photo multiplier tube measures the light emissions as the SO_2 molecule returns to the ground state. The intensity of this light is proportional to the quantity of SO_2 present in the ambient air. A reference detector continuously monitors the intensity of the UV lamp, used to excite the SO_2, and allows use of a ratio metric measurement technique that compensates for lamp degradation. A hydrocarbon scrubbing system, containing no consumable material, removes interfering hydrocarbons prior to the ambient air entering the measurement chamber.

11.1.2 Nitrogen Dioxide (Cavity Attenuated Phase Shift Spectroscopy)

The SLAMS NO_2 monitoring network uses the Teledyne Model T500U NO_2 analyzers utilizing cavity attenuated phase shift spectroscopy (CAPS) technology. This technology results in a direct measurement of NO_2 using an optical absorption spectrometer. The basic components of the analytical system include an optical cell, a pair of highly reflective mirrors centered at 450 nm (a strong NO_2 absorbance band), a light emitting diode (LED), and a vacuum photodiode detector. The LED is located behind one of the mirrors and the detector is positioned at the end of the cell behind the other mirror. The LED produces UV light into the cell which is reflected between the mirrors. While the sample flows through the cell, precisely timed data acquisition in combination with an algorithm translated the absorbance into a phase shift. The phase shift in turn is used to calculate the NO_2 concentration. There is an inverse relationship between the phase shift and the NO_2 concentration – as the phase shift decreases the NO_2 signal increases.

11.1.3 Indoor Shelter Temperature

The DAQ measures shelter temperature using a Comet temperature transmitter. The sensor measures temperature in the range of - 30 to + 80 degrees Celsius (° C) with an accuracy of ± 0.4 ° C and resolution of 0.1 ° C. The DAQ collects shelter temperature measurements every minute. The DAQ collects backup temperature measurements using a HOBO data logger and temperature sensor. The regional monitoring technician downloads data from the HOBO at least once a month and archives the data. The data verifiers and validators only use the HOBO data when the Comet data are unavailable.

11.2 Data Collection Methodology

Table 11.2 lists the specific SOP titles used in the network.

Table 11.2. List of SOPs Associated with this Quality Assurance Project Plan

Section 2.3.3 Certification and Accuracy Check of Field Barometers and Thermometers, Revision 7, Nov. 1, 2011

Table 11.2. List of SOPs Associated with this Quality Assurance Project Plan

Section 2.3.4 Thermo Environmental Model 146C Calibrator Certification, Revision 12.2, Sept. 17, 2014
Section 2.3.6 Protocol Gas Verification for Compressed Gas Cylinders Containing Either SO_2, NO or CO, Revision 0, Nov. 30, 2009
Section 2.8.1 Sulfur Dioxide SOP for the Electronics and Calibration Branch, Revision 10, Nov. 1, 2016*
DAQ-12-001.1 Sulfur Dioxide SOP for the Electronics and Calibration Branch, Revision 11***
DAQ-12-001.2 Operator Responsibilities Sulfur Dioxide SOP, Revision 14.1, May 27, 2022
DAQ-08-002.1 Model T500U Nitrogen Dioxide (NO2) Monitoring System Electronics and Calibration Branch Responsibilities, Revision 1.0, June 24, 2022
DAQ-08-001.2 Model T500U Nitrogen Dioxide (NO2) Monitoring System – 200 ppb Operator Responsibilities, Revision 2.0, June 24, 2022
Section 2.39.4 SOP for Quarterly Completeness Data Review, Revision 1.0, June 12, 2020
Section 2.43.2 SOP for Completing the Annual Network Review for the DAQ, Revision 2, Sep. 29, 2017*
DAQ-05-001.5 Ambient Monitoring Section Database Manager Standard Operating Procedure, Revision 0, March 5, 2021
DAQ-13-002.1 Standard Operating Procedure (SOP) for the DryWell 3101 Temperature Generator, ECB RESPONSIBILITIES, Revision 0, May 5, 2021
DAQ-13-007.1 Standard Operating Procedure (SOP) Teledyne-API Model T700U Calibrator Certification / Verification, Revision 2, June 3,2022
DAQ-14-001 SOP for Preparing SOPs for the DAQ, Revision 2.0, May 21, 2021
DAQ-14-003 Document Retention Procedure, Revision 0, April 1, 2021 **
DAQ 14-002.5 QAPP and SOP Tracking Database Procedures, Revision 0, Dec. 1, 2020
DAQ-15-001.1 Verification of Ambient Monitoring Thermometers Version 0.0, November 13, 2020
DAQ-15-001.5 Ambient Monitoring Section Database Manager Standard Operating Procedure, Revision 0, March 5, 2021
DAQ-15-002 Corrective Action, Revision 0.0, Dec 1, 2021
DAQ-15-005.5 Data Verification and Validation for Continuous Gaseous Monitors, Revision 2.0, May 1, 2022
** SOP is in the process of being revised*
*** SOP has been withdrawn from use and is currently being revised*
***SOP-12-001.1 is drafted and will be implemented to replace 2.8.1 after the QAPPs are updated

Electronic data collection is possible for the continuous monitors through the network's DAS, which is currently Envidas Ultimate, and wireless modems. This equipment is in a shelter where the DAS records the data history, and the modem provides a path to download the data for analysis. The database manager configures the computers in the state's RCO, managed by DIT, to connect automatically to the station at least hourly to retrieve these data for analysis. Monitoring personnel can contact the station manually to retrieve data or determine the status of the systems. The Envista ARM data software sends all data automatically to AirNow-Tech and the IBEAM database for real-time reporting of ambient concentrations and the Air Quality Index to the public via EPA's AirNow website and the DEQ real-time web page.

11.3 Support Facilities

This subsection describes the monitoring shelters used in the SLAMS SO_2 and NO_2 monitoring network.

11.3.1 Monitoring Station Design

The monitoring station design must encompass the operational needs of the equipment, provide an environment that supports data collection integrity and allow the regional monitoring technicians, who operate the site, to safely and easily service and maintain the equipment. The DAQ considers winter and hurricane weather conditions during site selection to meet the station safety and serviceability requirements.

11.3.2 Shelter Criteria

The ECB electronics technicians house the SLAMS SO_2 and NO_2 analyzers in shelters capable of fulfilling the following requirements:

- The regional monitoring technicians must maintain the shelter temperature at a temperature that meets the reference or equivalency method requirements for all instrumentation that it contains.
- The shelter power supply should not vary more than ±10 percent from 117 alternating current voltage. The ECB electronics technicians should provide some type of voltage regulation to accomplish this, if needed.
- The shelter must protect the instrumentation from precipitation, excessive dust and dirt; provide third wire grounding as in modern electrical codes and meet federal Occupational Safety and Health Administration regulations.
- The regional monitoring technician must clean the shelter regularly to prevent a buildup of dust.
- The shelter must protect the instrumentation from any environmental stress such as vibration, corrosive chemicals, intense light or radiation.

The DAQ uses either wooden shelters or Ecotech shelters. The ECB electronics technicians use a single probe line to provide ambient air to the monitor. They insulate and wrap the probe lines in heat tape to reduce condensation. In addition, the ECB electronics technicians attach the probe lines to a PM filter to prevent contaminants from entering the analyzer. Typically, the ECB electronics technicians locate the filter within the protected shelter, between the probe inlet and the analyzer. The analyzers are calibrated through the PM filter. The 1-point-QC checks also enter the analyzers via the PM filter. The internal performance evaluations for the NO_2 analyzer also pass through the PM filter. The analyzer draws ambient air from the probe inlet. The internal performance evaluations for the SO_2 analyzers are also conducted through the probe inlet. The probe material and probe line must be either borosilicate glass or an acceptable inert plastic, such as polytetrafluoroethylene, perfluoroalkoxy, or PFA, or other Teflon™-type materials.

The ECB electronics technicians use Teflon™ probe lines to ensure the probe material is non-reactive with SO_2 and NO_2. The probe, intake vent and interconnecting tubing design must provide a

minimum number of bends to avoid particles hitting and adhering to the surfaces. Impacted particles may provide surfaces to which SO_2 or NO_2 may adsorb, or, if the impacted particle is metallic, catalyze to a non-criteria species. Additionally, the ECB electronics technicians use part of a Teflon™ filter holder on the end of the probe to prevent rainwater from entering the analyzer. Any liquid water will absorb pollutants, affecting the SO_2 and NO_2 concentration by removing it from the ambient air, and consequently, yielding inaccurate environmental data.

Residence time is defined as the amount of time it takes for a sample of air to travel from the opening of the probe inlet to the inlet of the instrument. The residence time in the probe must be less than 20 seconds. The regional monitoring technician evaluates the residence time at every site visit and documents it in the e-log. If the physical configuration of the probe restricts the flow such that the probe configuration cannot meet the residence time, then the ECB electronics technicians will modify the physical configuration to fix this deficiency. They may accomplish this by reducing the length of interconnecting tubing, using tubing with a smaller inner diameter, and/or decreasing the bends in the tubing between the probe and analyzer, or other alterations that allow the system to meet the residence time requirements.

The ECB electronics technicians replace all probes and probe lines at least once every two years or as needed when something damages or contaminates the line. Based on years of monitoring experience and evaluation of the data, DAQ has not observed any problems with probe lines between one and two years except in situations where other problems occurred. Situations that may cause probe problems include the monitor pulling rain or other precipitation into the probe, insects getting into the probe or a cold spot developing along the probe that causes condensate to form in the probe.

12.0 Sample Handling and Custody

The SLAMS SO_2 and NO_2 monitoring program does not require the regional monitoring technicians to collect any samples that would warrant a sample custody procedure. The instrumentation located at the monitoring sites directly analyzes the ambient air and reports the SO_2 and NO_2 concentrations.

13.0 Analytical Methods

The SLAMS SO_2 and NO_2 monitoring program does not use any laboratory analytical methodologies to complete the analysis of any SO_2 and NO_2 samples. The respective operation manuals provide specifics on the SO_2 and NO_2 monitor's analytics. Section 11.1 Analyzer or Sensor Methodology provides a summary of the operation principles used for each monitor.

14.0 Quality Control Requirements and Procedures

The DAQ must perform two distinct and important interrelated functions to assure the quality of data from air monitoring measurements. One function is the control of the measurement process through broad QA activities, such as establishing policies and procedures, developing DQOs, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific QC procedures, such as audits, calibrations, checks, replicates, routine self-assessments, etc.

Quality control is the overall system of technical activities that measure the attributes and performance of a process, item or service against defined standards to verify they meet the stated requirements established by the end user. For the SLAMS SO_2 and NO_2 monitoring network, the DAQ uses QC activities to ensure DAQ maintains measurement uncertainty, as discussed in Section 7.0 Quality Objectives and Criteria for Measurement Data, within acceptance criteria for the attainment of the DQOs. The SOPs (see Table 11.2) and the specific instruments' operation manuals provide lists of pertinent QC checks.

The DAQ achieves QC through:

- Daily automated calibration checks, consisting of a zero, span and 1-point-QC check;
- Daily review of instrument measurements;
- Annual, or as needed, multipoint calibrations;
- Verifications following calibration;
- Verifications within 182 days of the most recent calibration for NO_2 monitors;
- Monthly operational checks by the regional monitoring technician;
- Performance evaluations;
- Periodic maintenance;
- Acceptance test procedures;
- Accuracy, bias, precision checks;
- Control charts; and
- Other verification techniques.

Zero, span and 1-point QC-checks are required once every fourteen days for SO_2 and NO_2 monitors. The DAQ chooses to use a goal of daily checks for the SO_2 monitors. Data analyzed from monitors in the SLAMS SO_2 and NO_2 network do not undergo routine post-processing to correct for zero and span drift. The RCO chemists embedded the calculations for the following QC procedures in e-logs. Regional monitoring and ECB electronics technicians do not compute any calculations by hand. The RCO chemists derived the formulas from relevant sections of 40 CFR Part 58 and the appendices to 40 CFR Part 50. Tables 7.2 and 7.3 provides specific QC procedures and associated acceptance criteria.

14.1 Calibrations

Adjusted calibration, which DAQ calls calibration, is the process used to verify and rectify an instrument's measurements to minimize deviation from a standard. This multiphase process begins with certifying a calibration or transfer standard against a NIST-traceable authoritative standard. The regional monitoring technician compares the analytical instrument's measurements to this calibration or transfer standard. If significant deviations, as described in Tables 7.2 and 7.3, exist between the instrument's

measurements and the calibration or transfer standard's measurements, the regional monitoring technician adjusts the instrument's response to rectify the analytical instrument's measurements.

The instruments' operations manuals and SOPs DAQ-12-001.2 and DAQ 08-001.2 provide calibration requirements for the critical field equipment. To calibrate the SO_2 and NO_2 analyzers the DAQ uses a gas dilution system to generate specific upscale calibration points. The ECB electronics technicians established the calibration scales for the SO_2 and NO_2 monitor based on the highest average minute concentrations expected to occur at the site. In Tables 14.1 and 14.2 below, the zero and span represent the calibration scale of the monitor. The regional monitoring technicians generally follow the calibration frequencies in the QA Handbook to calibrate the SO_2 and NO_2 monitors. The selected schedule requires calibration of the SO_2 and NO_2 monitor at installation, when the 1-point-QC check fails, when the monitor is without power for 72-hours, after major maintenance and once every 365 days and calendar year. Manual performance checks are used as a bracketing point before calibrations and extended planned monitor inactivity (such as shutting a site down due to a hurricane). While running a manual performance check is not required in these situations, any data that are outside two valid precision/zero/span checks (PZSs) (no matter if automated or manual) before a monitor is altered, will be considered unverifiable and voided.

The regional monitoring technician adjusts the zero and span points during a calibration. These points have tight acceptance ranges, between which the analyzers' measured values must fall. After the regional monitoring technician calibrates the monitor by adjusting the zero and span, he or she verifies the calibration by repeating the zero and span points and running three additional points and performing a linearity check. The regional monitoring technician then performs zero and span checks, ideally automated checks each night, but at least every 14-days to demonstrate the monitor remains calibrated within the specified criteria. The instrument's operations manual and SOPs DAQ-12-001.2 and DAQ-08-001.2 provide specific calibration requirements for the SO_2 and NO_2 analyzers. Tables 14.1 and 14.2 provide a summary of the control limits for these requirements. The zero and span levels in Tables 14.1 and 14.2 represent the range over which the DAQ calibrates.

Table 14.1 Acceptance Criteria for SO_2

Criteria for SO_2 Calibrations and Multi-Point Verifications				
	Zero	Span	Span 2	Span 3
Concentration [A] (ppb)	0	400	100	20
Acceptance (±)	1 ppb	5 percent difference	5 percent difference	7 percent difference
Linearity test – slope must be 1 ± 0.05; each point must be within 2.0 percent of the best fit line or ± 1.5 ppb whichever is greater				
Criteria for Daily SO_2 Auto-Calibration Checks				
SO_2	Zero	Span	1-point QC (Span 1)	
Concentration [A] (ppb)	0	400	20 [B]	
Acceptance (±)	<3.1 ppb	<10.1 percent (percent difference)	<10.1 percent (percent difference) [C]	

[A] Concentrations are nominal values
[B] Value must be between 5 and 80 ppb per 40 CFR Part 58 Appendix A Section 3.1.1
[C] This is the control limit; the warning limit is > 7.0 percent

Table 14.2 Acceptance Criteria for NO_2

Criteria for NO_2 Calibrations and Multi-Point Verifications					
	Zero	Span	Span 5	Span 2	Span 4
Concentration [A] (ppb)	0	180	135	90	45
Acceptance (±)	1.5 ppb	< ± 2.1% **or** 1.5 ppb	< ± 2.1% **or** 1.5 ppb	< ± 2.1% **or** 1.5 ppb	< ± 2.1% **or** 1.5 ppb
Linearity test – slope mut be 1 ± 0.05; each point must be < ± 2.1% **or** 1.5 ppb of the best fit line, whichever is greater					
Criteria for Daily NO_2 Auto-Calibration Checks and 14-day (or less) Manual Checks					
NO_2	Zero	Span	1-point QC (Span 1)		
Concentration [A] (ppb)	0	180	20 [B]		
Acceptance (±)	<1.0 ppb	<10.1 percent (percent difference)	<15.1 percent (percent difference) [C]		
[A] Concentrations are nominal values [B] Value must be between 5 and 80 ppb per 40 CFR Part 58 Appendix A Section 3.1.1 [C] This is the control limit; the warning limit is > 10.0 percent					

Currently, the DAQ SO_2 calibration procedure does not use four upscale points for the linearity verification as recommended by the EPA. For SO_2, the DAQ uses zero and three upscale points. The DAQ will retain the use of three upscale points but revised its procedures in 2020 to include linear regression analysis.

14.2 Precision Checks

The EPA defines precision as the measure of agreement among individual measurements of the same property, usually under prescribed similar conditions. To meet the DQOs for precision, DAQ will ensure the entire measurement process is within statistical control. The DAQ will employ various tools in evaluating and monitoring precision measurements. For the gaseous monitors and pursuant to 40 CFR Part 58, Appendix A, Section 3.1.1, a one-point QC check or auto precision/zero/span or PZS must be performed at least once every 2 weeks on each continuous analyzer used to measure gaseous pollutants. The 1-point-QC check will provide evidence of deviations from the required precision measurement as described in 40 CFR Part 58, Appendix A, Section 3. The ECB electronics technicians set up equipment at the site to challenge the analyzer with a NIST-traceable, QC check gas of a known concentration that is between the prescribed range of 5 and 80 ppb and is representative of the mean or median concentrations within the DAQ network of monitors. SOPs DAQ-12-001.2 and DAQ-08-001.2, the specific instrument operations manuals and Tables 14.1 and 14.2 provide the 1-point QC check and precision requirements for SO_2 and NO_2 monitors.

When the daily auto PZS falls outside the DAQ warning limits two days in a row, the regional monitoring technicians must investigate to determine if the check is a valid check. A check may be invalid due to a problem with the calibrator or zero air system, a bad solenoid, or a power failure. If a valid check falls outside the DAQ warning limits twice or when some type of anomaly occurs, the regional monitoring technicians are required to at a minimum complete a manual calibration check, consisting of a zero,

span and an intermediate concentration level. The SOPs and instrument operations manual provides 1-point QC check and precision requirements for the SO_2 and NO_2 monitors.

For SO_2 monitors, the DAQ uses only automated checks. The equipment at the site typically performs an auto PZS check daily. The regional monitoring technicians typically refer to the automated check as either an "auto PZS" or "PZS", or a 1-point QC. The RCO chemists use all of these terms in the statewide instrument SOPs. Automated checks must include a precision measurement, but also include the span and zero. For each check, the DAS calculates a percent difference and compares it to the acceptance criteria established in Table 7.2 and as specified in the SOP. Table 14.1 summarizes this information. When automated checks are outside the DAQ warning limits, the regional monitoring technicians may, at their discretion, perform a manual check.

For NO_2 monitors, DAQ performs a nightly "diagnostic auto-ZPS" or "PZS." For these PZS checks, Envista calculates the percent difference for each point; each point must be within the specifications in Table 7.3 for the check to pass. Due to the limitations of the current version of software being used to collect PZS data for the NO2 monitors, the DAQ considers these checks diagnostic and does not report them to AQS. DAQ is working with the software provider to resolve the issues at which time the automated nightly PZS may be reported to AQS. Until such time, manual QC checks are performed at least every 14 days by the regional monitoring technician. The manual checks include a zero, precision and span point and are reported to AQS.

The regulations at 40 CFR Part 58, Appendix A, Section 4.1.1 provide the calculation for the precision measurement (i.e., percent difference) and the RCO chemists also embed this calculation in the e-logs used by the regional monitoring technicians. Precision checks (1-point QC and PZS) verify or confirm the analyzer is in good working order and therefore support the defensibility of the data.

The regional monitoring technician must perform a calibration if the 1-point QC check or PZS fails and the calibration and analytical equipment are working properly. Normally, if either of these checks fails, a problem exists within the monitoring system that needs addressing, i.e., the equipment needs maintenance or repair. If the zero check or span check exceeds the specifications in Tables 14.1 and 14.2, then the regional monitoring technician will perform a calibration after diagnosing the equipment failure, getting it repaired, and ensuring the instrument operates properly.

However, if a typical slow drift causes the check to fail, no routine maintenance may be necessary. The drift may simply indicate it is time to recalibrate the analyzer. The DAQ staff do not adjust ambient concentration data to correct for zero drift. A failure at the zero or span points will require investigation and if deemed appropriate, based on a weight of evidence approach, the regional monitoring technician will invalidate the data based on the failed check.

14.3 Accuracy or Bias Checks

The EPA defines accuracy as the degree of agreement between an observed value and an accepted reference value. Accuracy is a combination of random error or precision and systematic error, or bias. The PZS checks can also provide data capable of identifying bias for gaseous monitors. The DAQ will also monitor data integrity with control charts to provide evidence of deviations from the required precision

measurement. Accuracy and bias requirements for the applicable instrumentation are found in the SOPs and DAQ 08-001.2 and in the specific instruments' operations manual. Bias calculations follow the procedures described in 40 CFR Part 58, Appendix A, Section 4.1.3.

14.3.1 Internal Performance Evaluations

ECB electronics technicians will perform an internal performance evaluation at least every 365 days and once per calendar year and whenever requested by the chief. The ECB electronics technicians perform these evaluations by comparing the analyzer measurements to independent standards or references. The ECB electronics technicians determine the audit concentrations following requirements in 40 CFR Part 58, Appendix A, Section 3.1.2.1. The audit concentrations selected for evaluation include a value at or near the detection limit of the monitor, a value near the level of the primary NAAQS, and a value that is less than the 99th percentile of the data within the network. The ECB electronics technicians use a different gas cylinder and calibrator to complete the audit than the gas cylinder and calibrator used to calibrate the monitor and complete the daily 1-point-QC checks. However, the ECB may reference both the calibration standard and the audit standard to the same primary standard. The DAQ designates the ECB electronics technicians, who are not normally involved in the routine operational activities of the monitors, to do the internal performance evaluations using dedicated QA equipment. The instrument's operations manual and SOPs 2.8.1 and DAQ-08-002.1 provide details for implementing internal performance evaluations. The EPA has designed these checks to access the accuracy and measure the bias.

14.3.2 External Agency Audits

The DAQ participates in the EPA Ambient Air Protocol Gas Verification Program and the NPAP. Information regarding the frequencies and acceptance criteria for the NPAP audits is available in Tables 6.2, 7.2 and 7.3. Information on the NPAP is available at https://www.epa.gov/amtic/national-performance-audit-program-npap-gaseous-monitoring. Information on the EPA's Ambient Air Protocol Gas Verification Program is available at https://www.epa.gov/amtic/ambient-air-protocol-gas-verification-program.

14.4 Corrective Actions

All DAQ personnel take corrective action measures as necessary to ensure the DAQ attains the MQOs. Given the diversity of monitoring activities and the complexity of the instruments, a potential exists that issues may arise with the sampling and measurement systems. In the SLAMS SO_2 and NO_2 monitoring network, the DAQ has anticipated many of the issues in advance, and prepared and equipped its staff to address these issues as they arise.

However, the staff will encounter unexpected or unforeseen circumstances, such as a failed QA/QC check, so they will also need to implement corrective actions on an "as-necessary" basis. The DAQ SOPs in Table 11.2 contain examples of corrective actions that the staff may need to complete under certain circumstances. The regional monitoring technician should consult SOP DAQ-12-001.2 and DAQ-08-001.2 for technique-specific checks, required frequency of checks, acceptance criteria and additional

corrective action guidance. Table 14.3 is an abridged list for typical problems that require corrective action.

According to DAQ policy, the regional monitoring and ECB electronics technicians and RCO chemists must report the need for corrective action to the regional monitoring coordinator or appropriate supervisor within two business days and address the issue as soon as possible, ideally within five business days. The regional monitoring technicians, ECB electronics technicians and RCO chemists can resolve most problems within one or two business days, but occasionally it takes longer to identify what caused the problem and find a solution. When equipment is down, staff must work to repair the problem as quickly as possible to limit the amount of data loss.

Table 14.3 Corrective Actions

Activity	Problem	Likely Actions
QA/ QC Check	Zero/Span/1-point-QC check exceeds acceptance criteria; Monitor/ Program fails to meet operational or critical criteria	1) Verify / reproduce performance check findings (e.g., Zero, Span and Precision). Use an alternate transfer standard to confirm failures. 2) Perform alternate performance checks to determine cause (for example – filter change and leak tests). 3) Replace solenoid and send old solenoid to ECB for testing. 4) Recalibrate the monitor using SOPs listed in Table 11.2. 5) Identify any required procedural changes to prevent reoccurrence. 6) Document actions on audit worksheet, data sheet or site logbook as appropriate. 7) Notify the chief of performance audit failures as soon as practical.
Probe Line Integrity Check	Probe wet or contaminated	1) Verify probe inlet is intact and protectors from rain, insects and dirt are in place. 2) Check line for cold spots and bends or low points where water could accumulate. 3) Blow line out with zero air and dry for several hours if needed. 4) Document cause and any actions in the e-log or site logbook as appropriate.
Power	Loss or interruptions	1) Verify power supply integrity. 2) Verify circuit breaker and fuse integrity. 3) Document cause and actions taken in e-log or site logbook as appropriate.
Data Review	Data missing from data acquisition system (DAS)	1) Verify DAS operation. 2) Ensure monitor polling is current. 3) Isolate telecommunications problem by connecting to the monitor using alternate processes. 4) Verify monitor operations remotely. 5) Notify the database manager or ECB, as appropriate. 6) Perform site visit to resolve monitor or telecommunication issues.

Table 14.3 Corrective Actions

Activity	Problem	Likely Actions
Internal Performance Evaluation	Out of specification	1) Verify integrity of the audit equipment. 2) If a problem exists with the audit equipment, repair the equipment and repeat the audit. 3) If the audit equipment is good, verify the monitor is operating correctly and if problems exist, fix them. 4) If no problems exist with the audit equipment or monitor, notify the operator so the operator can recalibrate the monitor. 5) Document cause and actions taken on the audit datasheet or site logbook as appropriate.

14.5 Documentation

The regional monitoring technicians will document all events including routine site visits, calibrations, analyzer maintenance and calibration equipment maintenance in e-logs or site logbooks. The ECB electronics technicians will document all activities including site visits, internal performance evaluations, and equipment installs and removals and monitoring and calibration equipment maintenance on 109 forms and in site logbooks. The ECB electronics technicians will also record in indelible ink, field maintenance activities associated with equipment used by the regional monitoring technicians in dedicated instrument logbooks as well, which are stored at the ECB. The records generated by the regional monitoring technicians or at the monitoring sites will normally be controlled by the regional ambient monitoring coordinators and located in the field sites when in use or at the regional offices when being reviewed or used for data verification. The regional coordinators transfer these records to the RCO group drive for the RCO chemists to use to validate the data.

15.0 Equipment Testing, Inspection, and Maintenance Requirements

15.1 Purpose/Background

Preventative maintenance is a foundational element to an effective QA program. The ECB in the Maywood facility operates the maintenance and repair shop, referred to as the "shop," for off-site repair, maintenance and field readiness certification of equipment. This section discusses the procedures regional monitoring and ECB electronics technicians use to maintain all instruments and equipment, including spare analyzers, in sound operating condition and verify they can operate at acceptable performance levels. Refer to the instrument specific SOPs, listed in Table 11.2, for more details on the specific preventative maintenance and repair activities. The regional monitoring and ECB electronics technicians must document and file all instrument inspection and maintenance activities. See Section 9.0 Documentation and Records for details.

15.2 Testing

For all monitors used in the SLAMS SO_2 and NO_2 monitoring network the DAQ shall purchase equipment listed on the EPA's List of Reference or Equivalent Methods. Therefore, the DAQ assumes the monitors and procedures used to be of sufficient quality for the data collection operation. Table 11.1 identifies the model designations. For indoor shelter temperature, where EPA equivalent or reference methods do not exist, DAQ will follow EPA guidance. Currently when the DAQ purchases new monitors, the DAQ makes every effort to evaluate the monitor as soon as possible after receipt to ensure the monitor is working so DAQ can address any problems while the monitor is still under warranty. The ECB electronics technicians will create a new maintenance logbook for each new piece of equipment.

Before the ECB electronics technicians install the monitors at the SLAMS SO_2 and NO_2 site, the ECB electronics technicians assemble and operate newly purchased or repaired monitors at the ECB. The analyzer shall successfully undergo zero/span and multi-point calibrations as described in SOPs 2.8.1 and DAQ-08-002.1. If the monitor meets the acceptance criteria, the ECB electronics technician allows it to operate in the shop until he can confirm functionality. Functionality is determined by the analyzers undergoing at least one zero, span and multi-point calibration using the criteria found in Tables 14.1 and 14.2. If any of these checks are out of specification, the ECB electronics technician will contact the vendor for initial corrective action. Often these contacts are documented via email. The ECB electronics technician will not deploy an analyzer to the field until it has successfully passed all required checks. SOP 2.8.1 and DAQ-08-002.1 provides further information on the instrument specific testing those new and recently repaired SO_2 and NO_2 monitors must undergo. Following site installation, the ECB electronics technicians will initiate, observe and document the successful completion of a zero/span cycle. If the analyzers meet the zero/span acceptance criteria in Tables 7.2 and 7.3, the ECB electronics technicians will assume the monitors are operating properly and ready for calibration by the regional monitoring technician. The ECB electronics technicians will properly document and file these tests in the instrument maintenance logbooks stored at the ECB.

15.3 Inspection

Several items periodically require field inspection. The operations manual and SOPs 2.8.1, DAQ-12-001.2, DAQ-08-002.1 and DAQ-08-001.2 (see Table 11.2 for SOP titles) and equipment operations manuals present detail on these items and procedures. In general, the following inspection activities are used:

- The regional monitoring technicians inspect monitoring shelters, probe inlets and other enclosures during each site visit and at least once a month to ensure conditions do not adversely affect monitor operation or data integrity. The ECB electronics technicians inspect monitoring shelters, probe inlets and other enclosures during internal performance evaluations to ensure conditions do not adversely affect monitor operation or data integrity.
- A zero-air system is a vital piece of support equipment maintained at any SLAMS SO_2 and NO_2 monitoring site. The calibrator blends zero air with calibration gases to dilute them to the necessary concentrations for conducting routine calibrations, precision checks, including 1-point-QC checks and zero-span-precision checks, and performance evaluations or audits. Zero air systems used by DAQ for conducting these QA/QC checks and audits should be able to deliver 10 liters per minute of air that is free of ozone, NO, NO_2, SO_2, carbon monoxide and non-methane hydrocarbons to below the instruments' method detection limits. Zero air supplies do not have to be NIST traceable but will be inspected and serviced annually by the ECB electronics technicians to ensure they remain free of contaminants.
- The regional monitoring technicians and coordinator and RCO chemists and statistician review data collection and data quality each business day. They inspect the data for trends and signs of problems. Data trends that signal a need for further inspection would include issues such as frozen numbers for multiple hours in a row or erratic spikes or valleys in concentrations obtained.
- Inspections on equipment also occur during site visits to verify the entire system is in good working order. Site visit checklists are available to the regional monitoring and ECB electronics technicians, who document equipment-operating parameters on the zero-span-precision, calibration and maintenance tracking forms within the e-logs, as well as on performance-evaluation audit forms. During each site visit the regional monitoring technician also does a probe- line integrity check to ensure the probe line remains attached to the monitor, is intact, dry and clear of debris and insects.
- The regional monitoring technician reviews the site and monitor annually to ensure continuing compliance with 40 CFR Part 58, Appendices D and E. The regional monitoring technician documents the review on the site review form.
- The ECB electronics technicians test and inspect spare equipment at the time of purchase or after major repairs and before deployment to the field. When the equipment passes the tests and inspections, the ECB electronics technicians certify it as field ready and store it on a shelf or monitoring bench until deployment.

All monitors also undergo routine maintenance as part of the monthly site visit. If necessary, the regional monitoring technicians may contact the ECB electronics technicians for specific non-routine maintenance.

15.4 Routine Maintenance

The following are general routine maintenance protocols:

- The ECB electronics technicians maintain a limited supply of critical spare parts in the ECB maintenance / repair shop to aid in rapid response to issues. For example, pump rebuild kits, spare pumps, filters, and other expendable supplies are routinely on hand.
- The regional monitoring and ECB electronics technicians schedule preventative maintenance ahead of time so they have all parts and tools easily available to complete the tasks and thereby minimize data loss.
- The regional monitoring technicians typically perform preventative maintenance activities in the field, although the ECB electronics technicians may complete some activities in the shop.
- The regional monitoring technicians maintain the grounds within the secured area for each SO_2 and NO_2 site as needed.

The specific equipment SOPs 2.8.1, DAQ-12-001.2, DAQ-08-002.1 and DAQ-08-001.2 (see Table 11.2 for SOP titles) detail the routine preventive activities and schedules and the equipment user manuals supplement these procedures. The regional monitoring technicians perform diagnostic checks and document them before and after preventive maintenance. They document these diagnostic checks in the e-log. The regional monitoring technicians replace all SO_2 instrument PM filters at least monthly. The NO_2 instrument filters are replaced annually by ECB electronics technicians during annual maintenance of the monitor.

16.0 Instrument Calibration and Frequency

The EPA defines “calibration” as the comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustment. Use of the term "calibration" indicates that an adjustment, in either the instrument or the software, occurred. The EPA recommends that regional monitoring technicians minimize adjustments to prevent introducing measurement uncertainty and verifications, "i.e., checks without correction (adjustment)," be used to confirm whether an instrument is operating within its acceptance range. Thus, the purpose of calibration is to minimize bias. Section 14.0 Quality Control Requirements and Procedures discusses calibrations in more detail. SOPs DAQ-12-001.2 and DAQ-08-001.2 (see Table 11.2) describe calibration procedures for the SO_2 and NO_2 monitors.

The regulations at 40 CFR Part 58, Appendix A, Section 2.6 require that gaseous standards (i.e., gas cylinders) and flow rate standards used in the ambient-air monitoring network be traceable to NIST. The ECB electronics technicians procure and maintain dedicated NIST-traceable standards for the certification of the ambient air quality monitoring systems. These standards provide a direct link to established national standards, (i.e., NIST) and are the foundation for the collection of the highest quality ambient air pollution data possible in accordance with current procedures and existing federal regulations and guidelines. Traceable is defined in 40 CFR Parts 50 and 58 as meaning that a local standard, i.e., one maintained by a monitoring organization, has been compared and certified, either directly or via not more than one intermediate standard, to a primary standard such as a NIST Standard. Similarly, traceability is the property of a measurement result whereby DAQ or an auditor can relate the result to a stated reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty. Standard traceability, therefore, is the process of transferring the accuracy or authority of a primary standard to a field-usable standard, resulting in a documented unbroken chain of calibrations/certifications. The applicable SOPs (See Table 11.2) or operation manuals provide specific calibration procedures and timeframes for certifications of field equipment. See Tables 7.2 and 7.3 for applicable equipment certification frequencies and acceptance criteria

To achieve and ensure traceability, DAQ adheres to the following principles:

- Devices are re-certified at least annually. The DAQ keeps records of these certifications at the ECB and in the regional office.
- Where applicable, in-house certification procedures (i.e., certifying a transfer standard against a certified primary standard - i.e., one of higher authority) are performed using SOPs 2.3.3, 2.3.5 and 2.3.6. The ECB maintains documentation of these procedures in the ECB shop on appropriate forms.
- The regional monitoring coordinator maintains records of all instrument calibrations, using the traceable standards (with instrument identification numbers clearly documented), on the appropriate group network drives in the regional offices and RCO.

In this manner, documentation exists that provides a documentation trail that links all DAQ calibrations back to NIST.

The following subsections summarize the standards used in the DAQ network and their recertification process. The regional monitoring coordinators and ECB electronics technicians monitor all certification periods to ensure the regional monitoring technicians do not use equipment beyond the documented certification expiration dates. The regional monitoring technicians are responsible for verifying the equipment they use is within certification and contacting ECB at least 30 days prior to being out of certification.

16.1 Calibration of Local Primary Standards

A primary standard has sufficient accuracy such that it does not require calibration by and is not subordinate to other standards. The DAQ uses primary standards to calibrate other standards referred to as working standards. The DAQ uses "local primary standards" or standards certified against NIST-traceable standards and kept in the ECB shop for the sole purpose of certifying transfer standards used in the field to calibrate equipment and verify equipment calibrations. The DAQ owns two "local primary standards" for each type of device. The ECB sends each "local primary standard" to the vendor for recertification in alternate years ensuring that one local primary standard is always available for use and has been certified within 365 days. The vendor provides the DAQ with a certificate of authentication. DAQ staggers the rotation of standards such that one device always remains in certification. The ECB electronics technicians compare the "local primary standard" that did not return to the vendor to the one that did return to the vendor to certify it and use it to certify equipment for the next year. Procedures for doing these comparisons are provided in SOP 2.3.3. The ECB is responsible for procuring and maintaining dedicated traceable standards and gases for the calibration of the ambient air quality monitoring systems. These standards provide a direct link to established national standards (NIST) and are the foundation for the collection of the highest quality ambient air pollution data possible in accordance with current procedures and existing Federal Regulations and Guidelines.

16.1.1 "Local Primary Temperature Standard"

The ECB uses an Omega Digital Thermometer DP-41 (with resistance temperature detectors) RTD-805-Lab Standard (LS) as a "local primary temperature standard" to verify the accuracy of the shelter temperature sensors. An ECB electronics technician sends the "local primary standard" to the vendor for recertification against a NIST primary standard every 365 days.

16.1.2 "Local Primary Flow Rate Standard"

The ECB uses dedicated Alicat mass flow meters as a "local primary flow standard" used to certify the accuracy of the calibrator mass flow meters. This "local primary flow rate standard" is a dedicated unit, and as such, the ECB electronics technicians use it only to certify the accuracy of mass flow meters used in the field. An ECB electronics technician sends them to the vendor for recertification against a NIST-traceable standard every 365 days.

16.1.3 "Local Primary Time Standard"

The ECB and regional monitoring technicians use the WWV NIST atomic clock in Boulder, Colorado, (telephone number: 1-303-499-7111) as a primary time standard. They can also obtain the correct time via the website http://nist.time.gov. Regional monitoring technicians can also call the ECB electronics technicians to request the NIST Time. The DIT configures all state network resources and devices, including the site computers at the SLAMS SO_2 and NO_2 monitoring sites, to receive time settings from the web clock at Nist.gov (primary) and the Internet Time Service at bldroc.gov (backup). The DIT also configures the site computer at the SLAMS SO_2 and NO_2 monitoring sites to remain on Eastern Standard Time throughout the year, which is the local standard time throughout North Carolina.

16.2 Calibration of Transfer Standards

The ECB electronics technicians or device vendor certify all transfer standards against either a primary standard or the "local primary standard." This establishes the traceability of the calibration.

16.2.1 Temperature Transfer Standards

The field-temperature transfer standards used for auditing the shelter temperature sensors will be mineral thermometers or Tetra-Cals that have their own certification by the vendor. ECB electronics technicians are responsible for returning the Tetra-Cals to the vendor for annual certification. The mineral thermometers will be re-verified/recertified at least annually, by ECB electronics technicians, against the "local primary temperature standard," or auditor's transfer standard, to within 1 ° C, over the expected range of ambient temperatures at which the regional monitoring and ECB electronics technicians expect to use the temperature standard. The ECB electronics technicians audit the shelter temperatures during each internal performance evaluation. They record the results of their audits on the AQ-121 forms.

16.2.2 Calibrators

The field calibrators are transfer standards that will have their own certification against "local primary standards." The ECB electronics technicians use Thermo 146i calibrators or Teledyne (Model T700U) calibrators as the field calibration device and as the audit device for SO_2 and NO_2 monitoring. The ECB electronics technicians certify the mass flow controllers within field calibrators and audit calibrators every 12 months using Alicat flow measurement units. SOP 2.3.4 Thermo Environmental Model 146C Calibrator Certification and DAQ-13-007.1 contains further details on the certification procedures.

16.3 Calibration Gases

All SO_2 and NO_2 calibration gases must be EPA Protocol (NIST-traceable) and include the following information:

- Cylinder serial number,
- SO_2 or NO concentration,
- Recertification status,
- Gas type,

- Cylinder pressure (double checked upon receipt),
- Impurity concentration, and
- Expiration date.

The ECB electronics technicians service the zero air generators, used at the SLAMS SO_2 and NO_2 monitoring sites, annually, or more frequently if needed. The ECB electronics technicians use a separate zero air generator when conducting performance evaluations. These zero air generators are serviced annually by ECB electronics technicians. The ECB electronics technicians maintain independent gas standards purchased from the same vendor, which they designate for independent SO_2 and NO_2 performance audits. The vender will reverify or recertify the SO_2 standards every four years. The vender will reverify or recertify the NO calibration gas after three years.

16.4 Documentation

See the appropriate SOPs for field QC checks that include frequency and acceptance criteria and references for calibration and verification tests of analyzer concentration responses. The analyzer verification checks include 1-point-QC checks at least every 14 days (DAQ does daily checks for SO_2 monitors) and multipoint calibrations at least annually, as documented by tracking on control charts.

The regional monitoring technicians will document all these events, as well as analyzer and calibration equipment maintenance, in field data records and logbooks and annotate these events with appropriate flags. The regional monitoring technicians will also keep field activities associated with the equipment they use in record logbooks as well. The regional monitoring coordinator will normally control the records, which are located in the field site when in use or at the regional office when being reviewed or used for data validation.

The ECB electronics technicians will retain calibrator certification and gas cylinder documentation at the ECB facility in Raleigh, North Carolina. Please reference Table 9.1 for the storage location of all documentation.

17.0 Inspection and Acceptance of Supplies and Consumables

DAQ SOPs (listed in Table 11.2) itemize the apparatus, equipment, materials, and supplies required for various monitoring equipment. In general, the ECB electronics technicians procure supplies and consumables directly from the vendor manufacturing the monitors used by DAQ. Most manufacturers' operating manuals itemize parts lists, including recommended replacement schedules. DAQ uses this information to determine the appropriate procurement schedule and volume of consumables required to support continuing operations.

The regional monitoring technicians track supplies and consumables (e.g., in-line PM filters); when the regional monitoring technicians need replacements, they notify the ECB. The ECB then supplies the needed items out of its inventory or purchases what the regional monitoring technician needs. The ECB electronics technicians maintain an inventory of supplies in the ECB shop for later distribution. The ECB electronics technicians inspect received materials to ensure they received the proper part number as ordered. They also perform a general inspection to identify any damaged products. They do not retain products deemed unsuitable. The ECB electronics technicians date parts received so they can easily determine storage duration. The ECB uses a revolving inventory system (first in, first out) to ensure storage times do not affect the material's integrity. If a manufacturer or EPA requirement indicates a specific expiration period for supplies, the ECB discards those supplies exceeding expiration dates if not used within the acceptable period.

Probe lines and fittings are important supplies. If used in the sampling train of a reactive gaseous analyzer, they must be fluorinated ethylene propylene (FEP) Teflon™ or equivalent. A consumable that is critical to the successful operation of the gaseous monitors are the gas cylinders used for calibration and QC checks of SO_2 and NO_2 analyzers, as well as gas cylinders used to conduct internal performance audits. Gas cylinders ordered by DAQ are EPA Protocol Cylinders. The ECB electronics technicians review certificates of analyses upon receipt of new gas cylinders to ensure the cylinder meets purchase specifications. The certificates indicate the expiration date of the gases contained within the cylinders. DAQ abides by these expiration dates; the ECB electronics technicians track dates and usage, replacing cylinders when the regional monitoring technicians notify them that less than 500 pounds per square inch gauge (psig) remains in the cylinder or before they expire. Additionally, DAQ participates in the EPA Ambient Air Protocol Gas Verification program (https://www.epa.gov/amtic/ambient-air-protocol-gas-verification-program). This program allows the independent assessment of gas cylinders to ensure their integrity and that of the supplier.

18.0 Non-Direct Measurements

This section addresses data not obtained by direct measurement from the SLAMS SO_2 and NO_2 monitoring program. This includes data provided by outside sources and historical monitoring data. These types of data and information include:

- CBSA boundaries (e.g., determining minimum monitoring requirements in each area of the State);
- Census data (e.g., determining minimum monitoring requirements in each area of the State);
- SO_2 emissions from latest NEI (e.g., determining in which CBSAs SO2 PWEI monitors are required);

In addition to the above types of data, DAQ may also need the following types of data to support the SLAMS SO_2 and NO_2 monitoring program:

- Chemical and physical properties data
- Sampler manufacturers' operational literature
- Geographic location data (e.g., site metadata for AQS)
- Historical monitoring information
- External monitoring databases
- National Weather Service and North Carolina State Climate Office data and
- Traffic count data from the North Carolina Department of Transportation (e.g., to assist in identifying the minimum separation distance between the Rockwell NO2 monitor inlet and the nearest roadway)

Any use of outside data will be quality controlled and documented to the extent possible following QA procedures outlined in this document and in applicable EPA guidance documents.

19.0 Data Management

19.1 Purpose/Background

The primary work product of the SLAMS SO_2 and NO_2 monitoring program is data. Thus, the DAQ established formalized procedures to ensure successful data management. Data management describes an inter-related set of standardized processes used to acquire, transmit, transform, reduce, analyze, store, and retrieve data. When documented and followed, a data management system helps maintain the integrity and validity of the data throughout its entire life cycle. DAQ's air monitoring data follows a documented flow path. The data life cycle starts before data collection begins and ends with use of the data. The following subsections identify the processes and procedures the DAQ follows to acquire, transmit, transform, reduce, analyze, store, and retrieve data. These processes and procedures maintain the data integrity and validity through application of the identified data custody protocols.

Figure 19.1 displays the generalized flow path of the DAQ ambient air monitoring data, as well as the QA/QC data collected within the network. The DAQ follows procedures in DAQ-05-001.5. The SLAMS SO_2 and NO_2 regional monitoring technicians and coordinators, ECB electronics technicians, RCO chemists and statistician and database manager acquire and process the SLAMS SO_2 and NO_2 monitoring data. Section 4.0 Project/Task Organization describes staff responsibilities.

19.2 Data Collection and Recording

DAQ will use ambient air monitoring analyzers, which the EPA has designated as FRMs or FEMs to collect data in the SLAMS SO_2 and NO_2 network. Upon installation and at regular intervals as specified, the regional monitoring technicians calibrate the ambient air monitoring instrumentation in accordance with the SOPs identified in Table 11.2 of this QAPP. Note: When DAQ establishes a new site, the regional monitoring coordinator and ECB electronics technicians manually collect metadata for the site (GPS coordinates, etc.). The database manager maintains the metadata and uploads it into AQS, as appropriate. The regional monitoring technicians and coordinators review the metadata annually during the network review and update it as needed.

For the DAQ SLAMS SO_2 and NO_2 network, DAQ records all raw data electronically. The site computer is equipped with a DAS, called Envidas Ultimate, and a wireless modem used to transmit data to the master polling system, i.e., the Envista ARM data storage database, which is a separate software package located on a state server. The DAS and site computer have the capability to record the output of the monitors at the site, perform any required data transformation and format the resulting data in preparation for downloading to the Envista ARM database or a Microsoft Excel spreadsheet. The Envidas Ultimate and Envista ARM databases do not allow the deletion of raw (i.e., original) data. The DAQ uses the Envista ARM database for data verification, validation and reporting and it is capable of producing a plot of the minute data. The database uses replicate versions of the raw data to avoid violating the integrity of the original dataset. The Envidas Ultimate and Envista ARM databases do not allow the deletion of data and track all changes made to the data. The regional monitoring technicians and coordinators, RCO chemists and database manager can modify, flag or void data stored in the Envista

Figure 19.1 Data Flow Path for Raw Data and Performance Evaluation Data

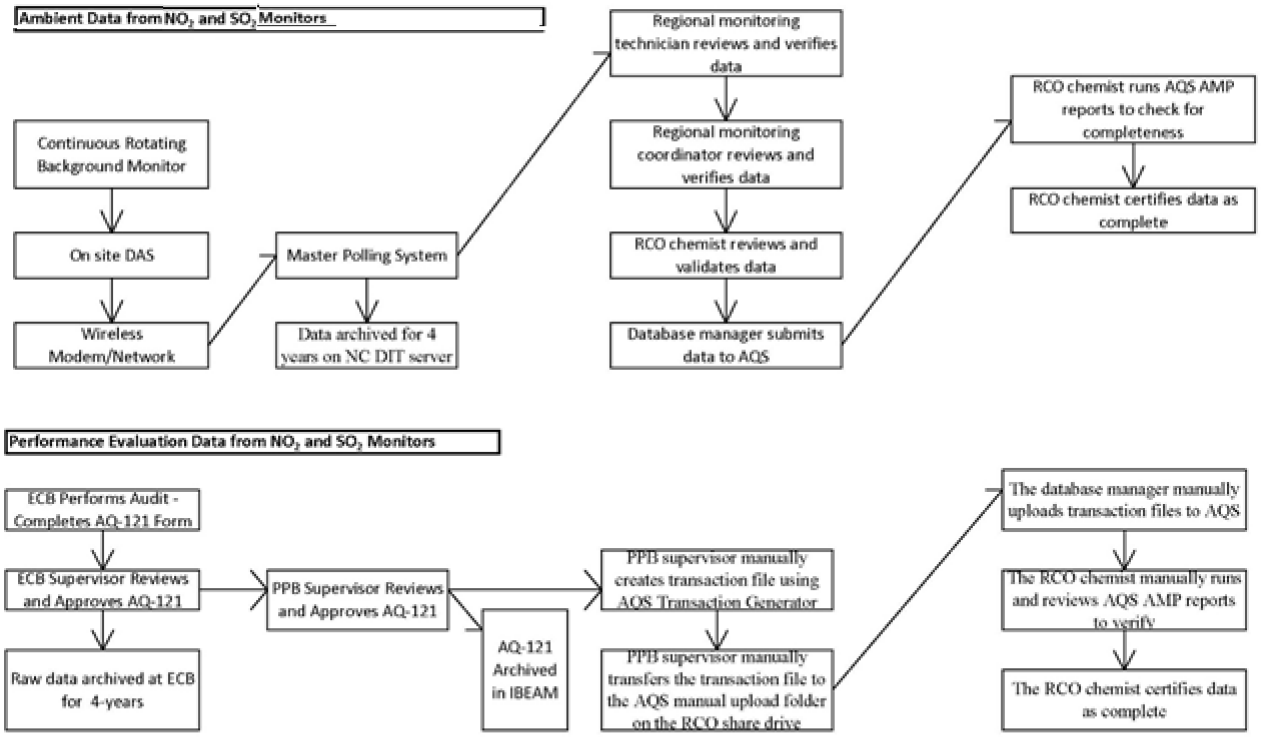
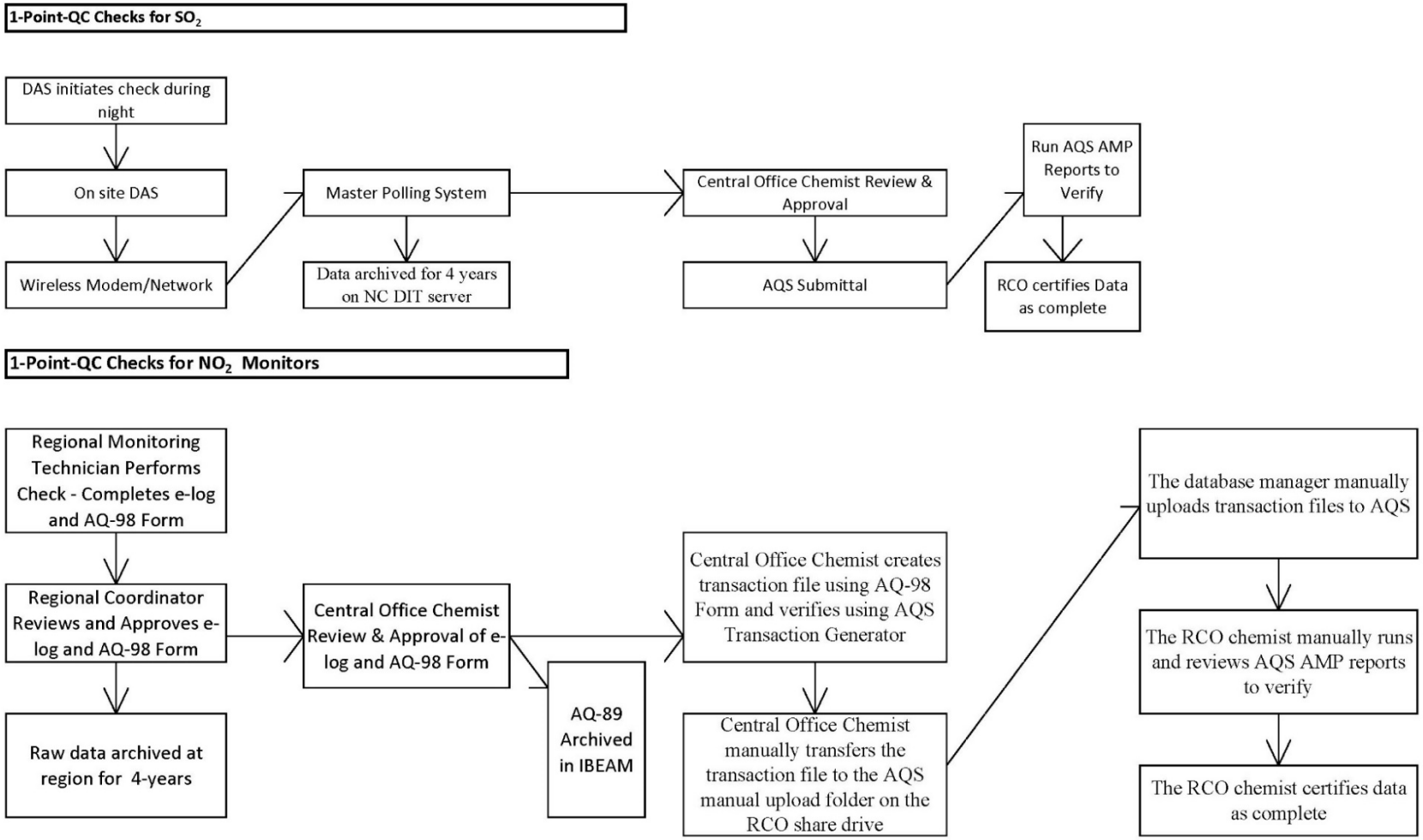


Figure 19.2 Data Flow Path for 1-Point -QC Check Data



ARM "edit" database as needed. The DAS records and makes available an edit history to track changes made to the data. The procedure(s) to test/audit the acceptability of the hardware and software used for SO2 and NO2 data management are delineated in SOP DAQ-05-005.5.

For all paper documents, the PPB supervisor, or a designee, creates a transaction file manually, which the database manager uses to electronically transfer the data to AQS. The PPB supervisor or designee also archives a scanned copy of the paper document in IBEAM. IBEAM is a Java-based web application system used by DAQ as a primary repository and tracking system for many of the division's business processes including facility tracking, permits, mobile sources, emission source inventories, ambient monitoring data, forecast data, compliance and enforcement actions, source tests, and facility and DAQ business documents. The DAQ modeled the design architecture of IBEAM after the standard n-tier architecture supported by Tomcat Application Server running on a Windows Server. The system uses a thin client interface for presenting information, via HTML and Java Server Pages, or JSP's, in Internet Explorer. The DAQ designed the system in a modular format with each module containing sub-categories as appropriate. The DAQ defined security at the module level with a range of security options appropriate to staff requirements. Although IBEAM displays systems in a modular format, it stores the data in the background in an integrated data structure managed by the Oracle Relational Database Management System, or RDBMS. This means no duplication of data or data entry and a single point source for reporting and information dissemination.

For the AQ-121 reports from the performance evaluations, which are paper documents, the PPB supervisor manually creates the records to upload to AQS as described in DAQ-15-005.5, archives a scanned copy of the paper document in IBEAM and files the paper copy in a secured file cabinet in the RCO. The PPB supervisor manually or the database manager electronically uploads the data to the AQS as described in DAQ-15-005.5.

For 1-Point-QC checks for SO_2, every night, a Precision, Zero, Span runs to determine if the SO_2 Analyzer is running within specifications. Each month, the RCO statistician generates an excel file that contains the PZS checks for each site for the previous month. The RCO chemist will then use this file to validate the PZS checks, use Envista ARM to add any missing PZS checks, add null codes where appropriate, and add comments where appropriate. Once the RCO chemist finishes validating the PZS checks, he or she creates transaction files from the excel spreadsheet using macros and transfers the transaction files to the database manager to electronically upload to AQS. See DAQ-15-005.5 for additional details.

For 1-Point-QC checks for NO_2, every 14-days or less, the regional monitoring technician manually runs a PZS point. The regional monitoring technician records the PZS results in the e-log and the precision point results on an AQ-98 form. At the end of the quarter, the regional monitoring coordinator reviews the e-logs and AQ-98 forms and transfers the documents to the RCO. The RCO chemist reviews the documents and submits the transactions created by the AQ-98 form to the database manager to electronically upload to AQS. The RCO chemist archives the AQ-98 forms in IBEAM.

19.3 Data Transmittal and Transformation

Data transmittal is accomplished using wireless communication to access a site modem. Downloading collected data does not delete data from the DAS. The Envidas Ultimate software removes data from the site computer by overwriting data on a first-in, first-out basis. This configuration requires the Envista ARM software to extract data from the site computer on a regular basis to prevent any data loss (hourly for minute and hourly data and the hour after it is collected for nightly checks). If communications problems arise, the Envista ARM software retrieves the data from the Envidas Ultimate system when it can once again communicate with the site. Regional monitoring technicians must make a site visit if the database manager or ECB electronics technician informs them that he cannot correct the communications problems in a timely fashion.

The DAS reads instantaneous SO_2 and NO_2 values from the monitor and averages each 60-second interval to create a one-minute average. The DAS stores each minute average, and this average acts as the base unit for all measurements taken by the SO_2 and NO_2 monitors within this monitoring network. The monitors, themselves, as well as the Envidas Ultimate system averages the stored 1-minute averages to form averaged hourly values, as well as 5-minute block averages, which are used to determine the hourly 5-minute maximum values. The Envidas Ultimate system transmits all these values to the Envista ARM for retention. The data are reviewed daily by RCO chemists as well as regional monitoring technicians. There exists a dynamic ongoing open communication with the monitoring staff to discuss anomalies, missed data, or observed errant issues with respect to the daily data. In addition, at least once a month, the statistician downloads the instantaneous data for at least one hour for three different days from at least one NO_2 or SO_2 site and compares these values to the data captured in Envista to verify the data for accuracy. The database manager submits the 1-hour blocks of ambient SO_2 and NO_2 measured concentrations as well as the hourly 5-minute maximum SO_2 concentrations to the EPA. Envidas Ultimate transmits all these values to Envista ARM for retention.

19.4 Data Verification and Validation

Data verification and validation is an important routine process that involves several steps to ensure the regional monitoring technicians, coordinators and RCO chemists have carried out the field and data processing operations correctly. The verification and validation process will identify data with errors, biases and physically unrealistic values before DAQ or the EPA uses them for the identification of exceedances, for further analysis or for modeling. Once the regional monitoring technicians, coordinators or RCO chemists have identified these problems, the RCO chemists, regional monitoring technicians and coordinators and RCO chemists can correct, flag or invalidate the data. If necessary, the regional monitoring and ECB electronics technicians can take corrective actions. Section 23 contains additional information on data verification and validation.

Each of the network's analytical instruments employed to measure the ambient concentrations of the criteria pollutants undergoes periodic audits, 1-point-QC checks and calibrations. SOPs 2.8.1, DAQ-12-001.2, DAQ-08-002.1 and DAQ-08-001.2 outline these procedures. Audits and checks ascertain the accuracy, precision and repeatability of each instrument in performing its required function.

The instrument-generated data are stored on site in the DAS. When Envista ARM accesses the data through the wireless modems, it downloads the data into its database, where the data undergo verification, reduction and analysis (Level 0). The regional monitoring technician using Envista ARM performs data verification electronically by searching the data for status flags and comparing reported values to acceptable range criteria (Level 1). After the regional monitoring technician flags data as questionable, level 2 (preliminary) and 3 (final) reviewers evaluate the flagged data to identify underlying causes and decide whether the data are valid. If the data are invalid, DAQ and the EPA do not use them in calculations. If the data are valid, but flagged due to some extenuating circumstance, then DAQ and the EPA may use the data in calculations, accompanied by a comment documenting the situation. SOP DAQ-15-005.5 contains further details on the data verification and validation procedures.

19.5 Data Reduction and Analysis

As described in the subsections above, data reduction activities take place throughout the entire data management process. The on-site DAS gathers data from the monitors at the site each hour and transmits them to the Envista ARM database. The data are gathered and transmitted in response to a poll via the wireless modem. The SO_2 and NO_2 data do not require special aggregation. The EPA compares submitted results to the NAAQS for SO_2 and NO_2. The regulations at 40 CFR Part 50 define the quantity of valid data points required within a data set. For most pollutants, the EPA requires a minimum data capture of 75 percent of the interval – hour, day, quarter – for the EPA to consider the interval valid for use in NAAQS comparisons. Tables 7.2 and 7.3 summarize the completeness requirements, as well as provide specific references to the CFR. For information on how SO_2 and NO_2 data is used to calculate DVs, please see section 7.1.

The DAQ analyzes data periodically throughout the data collection and validation process. For example, the regional monitoring technicians and coordinators, RCO chemists, audit chemist and statistician can download data from Envidas Ultimate directly into Microsoft Excel spreadsheets. The regional monitoring technicians, coordinators, RCO chemists and statistician use Microsoft Excel spreadsheets solely for data analysis and in-depth study of the data. For example, each business day the statistician prepares a tabulation of the raw hourly data from the previous day, evaluating it for missing data, trends, and data higher or lower than Tukey's fences for that day, as well as to ensure it is within specifications. The RCO chemist and statistician also review all validated data looking for trends, data outside of three times the interquartile range, etc. to establish the reasonableness of the data sets. The RCO chemist and the statistician accomplish these tasks by retrieving several reports, such as the AMP256, AMP430, AMP450 and AMP600, from the AQS database and analyzing the results.

19.6 Data Submission

After the regional monitoring technician, coordinator and RCO chemist complete all three levels of verification and validation for a month of data, as described in Section 23.0 Verification and Validation Methods, the database manager uploads the data to the AQS database. In addition to hourly data, the database manager also uploads to AQS hourly 5-minute maximum SO_2 data, internal performance

evaluations, and one-point-QC checks. This submittal must occur no later than 90 days following the close of each calendar quarter, as specified in 40 CFR Section 58.16.

At the end of each quarter, an RCO chemist runs the AMP251, AMP256, AMP350, AMP430, AMP501 and AMP600 reports in AQS and verifies that the database manager and statistician successfully entered all hourly, internal performance evaluation, and 1-point-QC check data. The DAQ will notify the EPA if a monitor does not meet the completeness requirements summarized in Tables 7.2 and 7.3.

The RCO chemist assigned to this task shall certify to the chief that the data are complete to the best of his or her knowledge. The quarterly data submittal shall contain the following summary data:

- The AQS site code, monitoring method code and parameter occurrence code,
- The results of all valid precision, bias and accuracy tests performed during the quarter for SO_2 and NO_2, and
- The ambient air quality data obtained for SO_2 and NO_2.

Every year before the annual data certification due date, the chief reviews the data from the EPA AQS summary reports, along with internal performance evaluation and audit reports to confirm the data meet the required criteria. The RCO chemists address any concerns with the data.

DAQ shall submit to the EPA an annual AMP600 summary report of all the SLAMS SO_2 and NO_2 monitoring data, in accordance with 40 CFR Section 58.15. DAQ will also submit a signed certification letter on DAQ agency letterhead signed by the chief. The chief will submit the report by May 1 of each year for the data collected from Jan. 1 through Dec. 31 of the previous year. The chief, or designee, must certify the report as accurate to the best of his or her knowledge. The chief will base the certification on the various assessments and reports performed by DAQ, including the AMP600 report

19.7 Data Storage and Retrieval

Once collected, data are stored in a variety of ways and for varying periods. Initially, data are stored in the monitor and/or the station-specific DAS. The monitors keep an unalterable record of instrument measurements for a period of days to weeks, depending on the amount of information stored. The on-site DAS also keeps an unalterable record of instrument measurements for a period of months to years depending on the number of monitors operated at the site. The RCO Envista ARM database system automatically accesses data stored in the on-site Envidas Ultimate system.

The archiving system used by DAQ makes possible the storage and retrieval of the air quality monitoring data. Backup and recovery procedures exist to ensure the regional monitoring and ECB electronics technicians and database manager can recover data in the event of a catastrophic failure. The database manager manually executes a backup of the full database every Friday. Due to the lack of a second structured query language (SQL) database in which to import the backup files, the database manager has not routinely tested procedures for using the backup files; however, he has used backup files to import data into the virtual server's database. The DAQ has recently established a backup computer with SQL software installed to continue data polling operation in the event of a catastrophic failure of the server. When storage space limits the amount of data that DAQ can keep in the database,

procedures exist for moving the data into an archive database. Presently, the database manager backs up data weekly using a Zip File. The database manager keeps the most recent copy available on SharePoint. Envidas Ultimate polls data older than one week old directly from the site computer. DAQ keeps all data in real time.

Note: The monitoring technicians also download backup site temperature data and store it on the regional group drive for archival purposes.

The DAQ retains all supporting electronic and written information, such as logbooks, maintenance logs, certifications, and diagnostic information worksheets for a minimum period of four years, unless any litigation, claim, negotiation, audit, or other action involving the records started before the expiration of the four-year period. When this type of situation occurs, DAQ will retain the records until completion of the action and resolution of all issues that arise from it, or until the end of the regular four-year period, whichever occurs later. The DAQ shall store the data on electronic media or in hard copy, whichever format proves most advantageous. Envitech Ultimate software updates have no impact on data accessibility. After the storage period has passed, the database manager may dispose of the storage media or recycle it. However, the database manager uploads the validated dataset to the EPA AQS for long-term storage.

20.0 Assessments and Response Actions

An assessment is the process used to measure the performance or effectiveness of the quality system, the SLAMS SO_2 and NO_2 monitoring network and its sites, the pertinent QAPP and various measurement phases of the data operation. The DAQ also uses assessments to determine whether the monitoring staff has implemented the ambient air-quality monitoring program in accordance with the approved QAPP. Although not all of these assessments are required the DAQ follows 40 CFR Part 58, which calls for network plans as well as some of the other assessments listed here. DAQ also evaluates these monitors according to the requirements in Appendix A to 40 CFR Part 58. To ensure the adequate performance of the quality system, DAQ will perform the following assessments:

- Network reviews and assessments,
- DAQ internal and EPA external TSAs,
- External performance evaluations,
- Internal performance evaluations,
- Quarterly completeness assessments,
- Annual data certification,
- Data quality audits, and
- Data quality assessments.

Table 6.2 provides information on the parties implementing assessments and their frequency.

20.1 Network Reviews and Assessments

Conformance with network requirements of the SLAMS SO_2 and NO_2 monitoring network as set forth in 40 CFR Part 58, Appendices A, C, D and E are determined through annual network reviews of the ambient air quality monitoring systems, as required by 40 CFR Section 58.10(a). The chief uses the network review to determine if the SLAMS SO_2 and NO_2 monitoring network collects adequate, representative and useful data in pursuit of its air monitoring objectives. Additionally, the annual network review may identify possible network modifications to enhance the system or correct deficiencies in attaining network objectives.

Before implementing an annual network review, the regional monitoring technician compiles and evaluates significant data and information pertaining to the network and SLAMS SO_2 and NO_2 site. Such information might include:

- Network files (including metadata, updated site information and site photographs);
- AQS reports, especially the AMP380 and AMP390 reports;
- Network monitors' five-year air quality summaries;
- Latest National Emission Inventory, or NEI, SO_2 emissions for MSAs;
- Traffic data; and
- National Weather Service or State Climate Office meteorological summaries or wind roses for the monitoring network area.

Upon receiving the information, the regional monitoring technician will check it to ensure it is current. The regional monitoring technician will note discrepancies and resolve them during the review. The regional monitoring technician will also identify and update files and photographs that need updating during the review. The DAQ emphasizes several categories of information during network reviews, such as the monitor location, nearby pollution sources, potential changes to nearby pollution sources, population density, changes in nearby land use and other pertinent information.

During the annual network review, the regional monitoring technician will reconfirm the stated objective for the monitoring site and re-verify the location's spatial scale. If the site location does not support the stated objectives or the designated spatial scale, the regional monitoring technician will propose changes to rectify the discrepancy. The regional monitoring and RCO monitoring staff will then act to correct the information in AQS, relocate the monitors or site, or move the site to a more suitable location, if needed.

In addition to the items included in the checklists, other subjects for discussion as part of the network review and overall adequacy of the monitoring program will include:

- Installation of new monitors,
- Relocation of existing monitors,
- Siting criteria problems and suggested solutions,
- Problems with data submittals and data completeness,
- Maintenance and replacement of existing monitors and related equipment,
- QA problems,
- Air quality studies and special monitoring programs, and
- Other issues such as proposed regulations and funding.

20.1.1 SLAMS SO_2 and NO_2 Network Reviews

The regional monitoring technicians complete a network review of the SLAMS SO_2 and NO_2 sites and submit a network review form to the RCO every year. EPA regions are also required to perform these reviews. The regional monitoring technicians consider the following criteria:

- Date of last review;
- Areas where attainment/non-attainment re-designations are likely to take place, or did take place;
- Results of special studies, saturation sampling, point source oriented ambient monitoring, etc.; and
- Proposed network modifications since the last network review.

The regulations at 40 CFR Part 58 Appendix D discuss the number of SLAMS SO_2 and NO_2 monitors required, depending upon the measurement objectives.

Once the annual network plan is updated based on the annual network review, latest census and traffic data and other pertinent information, the network plan is posted on the DAQ website for a 30-day public comment period. The plan is prepared by DAQ and submitted to EPA Region 4 by July 1 each year.

20.1.2 Five-Year Network Assessment

The five-year network assessment is a more extensive evaluation of the air-monitoring network. This assessment is prepared by the chief with assistance by the PPB supervisor or his/her designee(s). The assessment determines at a minimum:

- If the SLAMS SO_2 and NO_2 network meets the monitoring objectives defined in 40 CFR Part 58 Appendix D,
- Whether DAQ must add another SLAMS SO_2 or NO_2 site,
- Whether any of the existing SLAMS SO_2 and NO_2 sites are no longer needed and can be terminated, and
- Whether new technologies are appropriate for incorporation into the ambient-air monitoring network.

During the five-year network assessment, the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals, for example, children with asthma, as well as the potential impact any sites proposed for discontinuance may have on other data users is considered. As part of the 5-year network assessment, DAQ requests renewals and provides additional information related to applicable waivers for the DAQ SLAMS SO_2 and NO_2 monitoring network sites in the network plan submitted with the 5-year network assessment. The DAQ submits a copy of the five-year network assessment, along with a revised annual network plan, to the EPA Region 4. These assessments began in 2010 for the SLAMS SO_2 and NO_2 network and are due to EPA every five years on July 1.

For more information regarding 5-year network assessments, please see 40 CFR 58.10(d).

For more information about the SLAMS SO_2 and NO_2 monitoring location, please see the annual network plan at https://deq.nc.gov/about/divisions/air-quality/air-quality-data/annual-network-plan.

20.2 External Performance Evaluations

DAQ addresses performance evaluation activities by participating in the EPA's NPAP. In general, the NPAP is a performance evaluation where quantitative data are collected independently to evaluate the accuracy of the monitoring equipment. In Region 4, a mobile laboratory arrives at a DAQ SLAMS SO_2 or NO_2 monitoring site and generates known concentrations of audit gases, used to challenge the on-site SO_2 or NO_2 analyzer. Only qualified and authorized personnel execute performance audits. The NPAP program audits 20 percent of an agency's gaseous pollutant sites per year and each site every six years. Since DAQ has 32 sites, including the SLAMS SO_2 and NO_2 sites, the EPA may only audit the SLAMS SO_2 and NO_2 sites once every six years. EPA contractors typically provide the results of NPAP audits immediately following the NPAP audit. The NPAP audit results are also reported to AQS by EPA or its support contractor(s). Acceptance criteria applicable to NPAP audits may be found in Tables 7.2-7.3. If the monitor does not pass the evaluation the regional monitoring and ECB electronics technicians will take appropriate action to identify why the monitor failed the evaluation and to implement corrective action to resolve the situation. For more information on the NPAP audits, please see 40 CFR Part 58, Appendix A sections 2.4 and 3.1.3

20.3 Internal Performance Evaluations

The ECB electronics technicians, who do not operate the monitors, conduct performance evaluations at least once each calendar year and every 365 days on the SO_2 and NO_2 monitors by challenging the monitor with known concentrations of gas using an independent NIST-traceable calibrator and gas standard. The ECB electronics technicians certify the audit system and the monitor's calibration system using the same primary standard for both. Likewise, the ECB purchases the gas standards for the audit system and monitor's calibration system from the same vendor at the same time, so both come from the same lot of gas. The ECB electronics technicians follow the audit procedures in SOP 2.8.1 and DAQ-08-002.1. They document the results of these audits on the AQ-121 form. Acceptance criteria applicable to the performance evaluations may be found in Tables 7.2-7.3. If a monitor does not pass the evaluation, the regional monitoring and ECB electronics technicians will take appropriate action to identify why the monitor failed the evaluation and to correct the situation. See 40 CFR Part 58, Appendix A, Sec. 3.1.2 for more information regarding required performance audits.

20.4 Quarterly Completeness Assessment

After the database manager uploads to AQS the data for a quarter, an RCO audit chemist assesses the data to ensure all data made it through the upload process and into AQS. The RCO chemist accomplishes the quarterly completeness assessment by running the AMP430 Completeness Report, the AMP350 Raw Data Report, the AMP501 Report and the AMP251 QA Data Report. The RCO chemist compares the data in AQS with the data that should be in AQS based on the monitoring schedule. When the RCO chemist identifies missing data or some other problem, he or she informs the Level 3 reviewer and database manager who act to resolve the issue. The RCO chemist archives the AMP251, AMP350 and AMP430 reports used for the quarterly completeness review in IBEAM. If the monitor does not meet 75 percent completeness requirements, the chief contacts EPA Region 4, providing information on what occurred and what actions DAQ plans to take to keep the event from reoccurring.

20.5 Annual Data Certifications

In accordance with 40 CFR Section 58.15, an annual air monitoring data certification letter is required to certify that the data from Jan. 1 to Dec. 31 of the previous year, collected by the FRM/FEM monitors at the SLAMS SO_2 and NO2 sites, meet criteria in 40 CFR Part 58, Appendix A. Along with the certification letter, the chief must submit to EPA an annual summary report of all the ambient air quality data collected by the monitors, as well as a summary of the precision and accuracy data, for the previous year.

Data certification is the final process of assessing the SLAMS SO_2 and NO_2 data for the previous calendar year. The DAQ verifies and validates data monthly, as discussed in Section 23.0 Verification and Validation Methods. Additionally, the chief or designee assesses data on a quarterly basis when an RCO audit chemist generates specific AQS reports to assess the DQIs as discussed in Section 20.7 Data Quality Assessments. With these assessments ongoing throughout the year, annual data certification, then, serves as the last assessment of the data – looking at it from an all-inclusive, annual perspective – to see if any unidentified anomalies or trends exist in the data that the RCO audit chemist or statistician had

not previously identified. The annual data certification process starts with running and reviewing AMP reports contained in AQS. The reports typically queried include the following:

- AMP350 Raw Data
- AMP251 QA Data
- AMP430 Data Completeness
- AMP600 Certification Evaluation
- AMP256 Data Quality Indicator
- AMP501 Extract Raw Data
- AMP504 Extract QA Data
- AMP450 Quicklook Criteria Parameters
- AMP450NC Quicklook All Parameters
- AMP480 Design Value

The AMP480 Design Value Report, may be reviewed, but is not necessary for annual data certification.

The RCO chemist and the PPB supervisor review these reports and confirm everything is complete and accurate. The RCO chemist and PPB supervisor also review the reports to ensure the statistical results indicate the monitoring data were in control over the course of the entire year and met the DQOs. If they identify problems, the RCO audit chemist investigates them in accordance with Section 24.0 Reconciliation with Data Quality Objectives.

Ultimately, this process verifies that the monitoring data submitted to AQS are correct and complete. Once the RCO chemists, statistician and database manager complete any necessary corrections, additions or deletions in AQS and the RCO audit chemist and PPB supervisor finalize the dataset, the chief officially recommends the data for certification to EPA Region 4. The data certification package provided to EPA includes a signed copy of the AMP600 report, along with a letter signed by the chief, certifying that the ambient concentration and QA data in AQS are complete and accurate, taking into consideration the QA findings, to the best of his or her knowledge.

The annual data certification package is due to EPA Region 4 by May 1 of each year.

20.6 Audit of Data Quality

The RCO audit chemist who does not validate the data conducts the audit of data quality, or ADQ, which reveals how the level 1 to 3 reviewers handled data, what judgments they made and whether they made uncorrected mistakes and records exist to support the decisions made. An ADQ can often identify the means to correct systematic data reduction errors. Sufficient time and effort will be devoted to this activity so that the RCO audit chemist has a clear understanding and complete documentation of data flow. The RCO audit chemist shall perform this assessment quarterly in accordance with the quarterly data review as described in SOP 2.39. The DAQ ensures the level 1 to 3 reviewers maintain data collection and handling integrity via the quarterly data review. If the RCO audit chemist finds a problem during the ADQ, the RCO audit chemist will work with the level 1 to 3 reviewers to correct the situation

and modify the procedures to ensure the problem does not reoccur. See Section 23.0 of this document for more information related to the data review process that occurs monthly and quarterly.

20.7 Data Quality Assessments

A DQA is the statistical analysis of environmental data to determine whether the data meet the assumptions under which the DQOs and data collection design were developed and whether the total error in the data is tolerable. Calculations for DQA activities shall follow the requirements and equations identified in 40 CFR Part 58, Appendix A, Section 4. *Data Quality Assessment - A Reviewer's Guide* (EPA QA/G-9R) describes in detail the DQA process. The regulations at 40 CFR Part 58, Appendix A provide terminology associated with measurement uncertainty.

An RCO chemist will calculate estimates of the data quality on a quarterly basis using the AQS AMP256 and AMP600 reports. A report listing any sites or specific monitors which fail to meet, or which are in danger of failing to meeting, the DQOs will be sent to the QAM for information and to allow corrective action to be taken. Since the SLAMS SO_2 network has multiple sites, the DAQ calculates the estimates of the data quality using all the network monitors. Since the SLAMS NO_2 network has only one site, the DAQ bases the estimates of the data quality on a single monitor. For the annual data certification, the SLAMS SO_2 and NO_2 sites are combined with monitors from other DAQ-supported networks to determine an estimate of data quality for the agency or PQAO overall. The chief reports the individual results of these tests for each method or analyzer to the EPA annually as part of the AQS AMP600 report.

The RCO chemists review control charts of the daily auto zero, span and 1-point-QC check for SO_2 and NO_2 every business day. When the control chart indicates the zero, span, or 1-point-QC check drifted out of range, the RCO chemists contact the regional monitoring technicians and ask them to take corrective action as specified in each monitor's SOP. (Table 11.2 lists associated SOPs.) In addition, box and whisker plots are viewed at least twice a year for the 1-point-QC checks.

20.8 Internal Technical Systems Audits

The DAQ is implementing internal technical systems audits on the SLAMS SO_2 and NO_2 network. These internal technical system audits will be performed by RCO chemists. These audit procedures, complete with audit checklists, are detailed in SOP DAQ-15-004.5, currently under development.

20.9 EPA Technical Systems Audits

An EPA TSA is a thorough, independent and systematic on-site qualitative assessment, where EPA auditors examine facilities, equipment, personnel, training procedures, protocols and record keeping for conformance with the regulatory requirements and this QAPP. EPA Region 4 QA staff conducts a TSA of DAQ every three years, in accordance with 40 CFR Part 58, Appendix A, Section 2.5. The EPA reports its findings to the DAQ director and chief. The chief regularly monitors progress on corrective actions required because of TSA findings and communicates progress to the director and EPA Region 4.

An EPA TSA team or an individual TSA auditor may segregate TSA activities into categories. The auditor may audit the categories independently or together. Possible categories include:

- Field activities – Monitor installation, calibration and sampling.
- Data management activities – Collecting, flagging, editing, and uploading data and providing data security.

During the audit, the auditors will interview key personnel with responsibilities for planning, field operations, equipment certification, maintenance shop operations, QA/QC, data and document management and reporting.

Upon completion of the audit, EPA verbally alerts the DAQ director and chief of any deficiencies or findings during an on-site TSA exit briefing. This briefing allows DAQ staff to begin formulating or implementing corrective actions. The EPA typically distributes a draft TSA report within 30 days of the completion of the audit. EPA Region 4 allows a brief comment period of the draft report for factual accuracy. After EPA receives comments from DAQ, EPA finalizes the TSA report and resubmits the report to the director and chief. The director and chief must complete and submit to EPA Region 4 within 30 days a formal response to address the TSA findings. The chief will communicate with EPA routinely after submitting the corrective action plan to provide progress updates on a periodic basis until DAQ has completed the corrective actions.

EPA shall conduct TSAs once during every three-year period that the SLAMS SO_2 and NO_2 monitoring program collects data verifying compliance with the NAAQS.

20.10 Reporting and Resolution of Issues

The communication process regarding necessary corrective actions within DAQ's SO_2 and NO_2 monitoring program as a result of the previously mentioned assessments is detailed in SOP DAQ-15-002. The NC DAQ Ambient Monitoring Section - Hurricane Readiness Task List provides emergency/contingency plans that should be implemented when a hurricane or tropical storm is approaching North Carolina.

21.0 Reports to Management

This section describes the quality-related reports and communications to management necessary to support the SLAMS SO_2 and NO_2 network operations and the associated data acquisition, validation, assessment, and reporting. Besides the reports discussed in this section, staff meetings occur regularly on a weekly, biweekly or monthly schedule depending on the part of the organization involved. In addition, DAQ holds as needed meetings with the affected parties to address any additional issues that may arise. See Section 20.0 of this document for additional information regarding the types of reports generated from AQS used to inform management of QA issues. Unless otherwise noted all reports will contain monitoring data for the list of pollutants provided in Table 5.1. Raw data reports may also contain data for shelter temperature.

The reports to management required for the SLAMS SO_2 and NO_2 monitoring program are the same as those for the SLAMS program which are discussed in various sections of 40 CFR Parts 50, 53 and 58. The EPA's Air Quality Assessment Division within the Office of Air Quality Planning and Standards (OAQPS) provides guidance for management report format and content. The subsections below describe the reports to management used by DAQ.

21.1 Quarterly Data Submittal Reports

The DAQ monitoring staff will edit, validate and upload air quality data submitted for each reporting period to AQS using the procedures described in the EPA's AQS User Guide, EPA's *AQS Data Coding Manual*[6] and DAQ's data handling and validation SOP DAQ-15-005.5. The level 1 to 3 reviewers review and validate the concentration data in the Envista ARM database. When a monitor's data capture falls below 75 percent for the quarter, an RCO chemist prepares for the chief a memo explaining why and the corrective action taken.

Each quarter, DAQ uploads to AQS the results of all valid precision, bias and accuracy tests it carried out during the previous quarter. The database manager submits data to AQS consistent with the data reporting requirements specified for air quality data as set forth in 40 CFR Part 58, Appendix A, Section 5. DAQ reports the required QA data on the same schedule as quarterly monitoring data submittals. The chief is responsible for ensuring that the level 1 to 3 reviewers use the results of QA data to validate concentration data.

In accordance with 40 CFR Section 58.16(b), DAQ submits data to the AQS database no later than 90 days following the end of the quarter in which DAQ collected the data. Table 21.1 provides the dates by which the DAQ uploads the previous quarter's data. After the database manager uploads all data for the quarter to AQS, an RCO chemist retrieves and reviews the following quarterly reports from AQS: the AMP251, AMP256, AMP350, AMP350MX, AMP430, AMP501 and AMP600. After reviewing the reports,

[6] Available at https://www3.epa.gov/ttnairs1/airsaqsORIG/manuals/AQS_Data_Coding_Manual.pdf

the RCO chemist archives the reports in the IBEAM general documents module and sends an email to the Level 3 reviewer summarizing the review and any corrective action needed.

Table 21.1 Required AQS Data Reporting Periods

Quarter	Reporting Period	Last Day to Upload Data to AQS
Q1	Jan. 1 to March 31	June 29
Q2	April 1 to June 30	Sept. 28
Q3	July 1 to Sept. 30	Dec. 29
Q4	Oct. 1 to Dec. 31	March 30 or 31 (of following year)

21.2 Performance Evaluations

The ECB electronics technicians conduct performance evaluations, sometimes referred to as audits, of the SO_2 and NO_2 monitors at least once each calendar year, using specially designated audit equipment. All gaseous transfer standards used in the air-monitoring network must be traceable to a primary standard such as a NIST standard reference material or an EPA/NIST-approved certified reference material.

The ECB electronics technicians document the results of each performance evaluation on the AQ-121 form. After the ECB supervisor reviews and approves the form, he routes the form to the PPB supervisor for review and approval. After the PPB supervisor reviews and approves the form, the PPB supervisor distributes the form to the regional supervisor, coordinator and RCO chemists.

21.3 Annual Network Review

By Oct. 31 each year, the regional monitoring technicians conduct an annual network review of the sites documenting the information requested on the annual site review forms, which is part of DAQ's overall annual network review. SOP 2.43.2 describes this process. The network review determines if the monitoring site and probe locations meet the siting requirements and monitoring objectives defined in 40 CFR Part 58, Appendices D and E. The review identifies needed modifications to the site and network including termination or relocation of unnecessary stations or monitors or establishment of new stations or monitors. The regional monitoring technician completes the annual network review form described in SOP 2.43.2; then the coordinator reviews the form and submits it to the RCO by Dec. 31. The PPB supervisor archives the network review forms in the IBEAM general documents module and provides them to the public and the EPA as appendices to the annual network-monitoring plan.

21.4 Annual Data Certification

The chief will prepare a data certification package for his signature by May 1 of each year, which is submitted to the Director, ARD, US EPA Region 4. The report will consist of a letter, for signature, along with AQS generated summaries of SLAMS SO_2 and NO_2 concentration data collected during the previous

year, and all applicable QA data. The OAQPS and EPA Region 4 specify the exact AQS reports for the chief to submit. Generally, the chief submits an AMP600 and AMP450NC report.

21.5 Annual Network Monitoring Plan

Following the requirements in 40 CFR Section 58.10(a) the DAQ prepares and submits to the EPA Region 4 regional administrator an annual monitoring network plan by July 1 of each year. This plan is reviewed and submitted by the chief. It is composed by the regional air quality supervisors and coordinators, RCO chemists, the Ambient Monitoring Section supervisors and the chief. The plan provides for the establishment and maintenance of an air-quality surveillance system consisting of a network of SLAMS monitoring stations. The plan includes: (1) a statement of purpose for each monitor and (2) evidence that siting and operation of each monitor meets the requirements of appendices A, B, C, D and E of 40 CFR Part 58, where applicable. Before submission to the EPA, the DAQ makes the annual monitoring network plan available for public inspection for at least 30 days.

As required by 40 CFR Part 58, Appendix A, Section 5.1, DAQ provides a list of all monitoring sites and their AQS site identification codes to EPA Region 4 each year in the network plan. DAQ keeps AQS up to date by creating site data records with the date DAQ established a site and other pertinent info. DAQ also sends any appropriate data to AirNow-Tech. Whenever there is a change in this list of monitoring sites or in a reporting organization between network plans, DAQ reports this change to EPA Region 4 via e-mail and to AQS and AirNow-Tech by updating the appropriate site records.

21.6 Five-Year Network Assessment

The DAQ conducts and submits to the EPA regional administrator an assessment of the air-quality surveillance system every 5 years on July 1. At a minimum, this assessment determines if the network meets the monitoring objectives defined in 40 CFR Part 58, Appendix D, whether DAQ needs to add new sites, whether DAQ no longer needs existing sites and can terminate them, and whether new technologies are appropriate for incorporation into the ambient-air monitoring network. In the network assessment, DAQ considers the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma). For any sites that DAQ proposes for discontinuance, DAQ also considers the effect on users of the data, other than the agency itself, such as nearby states and tribes or health effects studies. The chief submits a copy of this 5-year assessment, along with a revised annual network plan, to the EPA regional administrator.

21.7 Internal Systems Audit Reports

SOP DAQ-15-004.5, currently under development, describes DAQ's internal systems audit program. An RCO auditor or audit team will perform an internal systems audit to verify that the SLAMS SO_2 and NO_2 program meets the data measurement quality objectives outlined in Section 7.2 Measurement Quality Objectives. When completed, the RCO auditor or audit team will distribute copies of the annual systems audit report to the regional supervisors, RCO chemists, the ECB and PPB supervisors and the chief.

21.8 Response/Corrective Action Report

Currently, regional monitoring technicians document any corrective action taken at the site in an e-log. The regional monitoring technicians do not send these e-logs to management but the regional monitoring coordinator and RCO chemists review them. When the corrective action needed is beyond what the regional monitoring technician can handle at the site, the regional monitoring technician contacts the regional monitoring coordinator and ECB electronics technician. The ECB electronics technicians document all corrective actions taken on a 109 Form, which the supervisors of the ECB and PPB review. When the level 1, 2 or 3 reviewers need to correct data reported to AQS, they document the changes on a data correction form (see DAQ-15-005.5 Appendix A). If the corrective action affects several days or a month or more of data, involves systemic issues, or endangers meeting completeness, an RCO chemist documents the corrective action in a memo to the chief and carbon copies the DAQ regional office air quality supervisor. SOP DAQ-15-002, describes when a need exists for a formal corrective action preventative action (CAPA) process that documents the root cause analysis, investigates solutions, and confirms that the solution was effective.

22.0 Data Validation and Usability

Data review is the in-house examination to ensure that the RCO chemist, regional monitoring technicians and coordinators have recorded, transmitted and processed the data correctly. It includes completeness checks to determine if there are any deficiencies such as missing data or lost integrity. The Level 1 to 3 reviewers should compare the data under evaluation to actual events, as per guidance (Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8)). In addition, DAQ expects that some of the QC checks will indicate that the data fail to meet the acceptance criteria. The Level 1 to 3 reviewers shall flag or void data identified as suspect, or that does not meet the acceptance criteria, with AQS codes prior to upload to AQS.

Data verification is the process for evaluating the completeness, correctness, and conformance or compliance of the data set against method, procedural and contractual specifications. The EPA further defines verification as confirmation, through provision of objective evidence, that the dataset has fulfilled specified requirements for that type of data.

Data validation is a routine process designed to ensure that reported values meet the quality goals of the environmental data operations. The EPA further defines data validation as examination and provision of objective evidence that the reported data fulfill particular requirements for a specific intended use. The primary intended use for the SLAMS SO_2 and NO_2 data set is to provide SO_2 and NO_2 data for comparison to the NAAQS. The DAQ must use a progressive, systematic approach to data validation to ensure and assess the quality of data. Data validation includes the review of the DAQ SLAMS SO_2 and NO_2 data sets against the individual pollutant MQOs listed in Tables 7.2 – 7.3. Reviewing data over a monthly or quarterly period provides information about the structure of the data and may identify patterns, relationships or potential anomalies. If the RCO chemists find a problem or discrepancy, they will conduct further investigations to find the source of the error and then correct it. Deviations from operational procedures or QA requirements that do not result in data invalidation may require that data be qualified with QA qualifier flags prior to upload to AQS.

22.1 Sampling Design

The EPA must approve sampling network and monitoring site selection for SLAMS monitors. Sampling network and monitoring site selection must comply with the following:

- 40 CFR Part 51, Subpart BB – Data Requirements for Characterizing Air Quality for the Primary SO_2 NAAQS (for source-oriented monitors)
- 40 CFR Part 58, Appendix D - Network Design Criteria for Ambient Air Quality Monitoring
- 40 CFR Part 58, Appendix E - Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring
- SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document (for source-oriented monitors)

The location of each DAQ SLAMS SO2 and NO2 monitoring site has received EPA approval; thus, data from each SLAMS SO2 and NO2 monitor will be considered spatially representative as long as these sites

continue to meet the requirements set forth in 40 CFR Part 58, Appendix E and in this QAPP. *Guidance for Choosing a Sampling Design for Environmental Data Collection* (EPA QA/G-5S)[7] provides additional guidance.

The regional monitoring technician shall thoroughly document any deviations from the minimum siting criteria (e.g., shelter location, probe placement and/or monitor sight path requirements) in the site's QC documentation. Examples of deviations include, but are not limited to, insufficient distance from roadways (i.e., marginal terrain criteria) and insufficient distance from influencing objects (e.g., dripline of an adjacent tree or a cell phone tower installed after establishment of the monitoring site).

22.2 Data Collection Procedures

Section 11.0 Sampling Collection Method Requirements outlines data collection procedures. The SLAMS SO2 and NO2 monitors used by DAQ are designated as FRM/FEM; thus, the methodologies/technologies are considered acceptable for regulatory use. The Envidas Ultimate DAS routinely identifies potentially unacceptable data points in the database through electronic application of Envidas Ultimate applied status flags. The database manager has associated each instrument-specific flag with a unique error. The level 1 to 3 reviewers routinely review these Envidas Ultimate-applied status flags as part of the data validation process. This activity assists in identifying suspect (potentially bad) data points that could invalidate the resulting averaging periods. Table 22.1 presents a compilation of the AQS error flags and null codes (as of September 15, 2021). A current list of AQS error flags and null codes can be found at EPA's AQS webpage. The monitoring technician must document any deviation from the established data collection plan in the e-log or site logbook. Accurate and complete documentation of any data collection deviations will assist in any subsequent investigations or evaluations.

Table 22.1. AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
IA	African Dust	Informational Only	To provide information on events that influenced the measured values.
IB	Asian Dust	Informational Only	
IC	Chem. Spills and Industrial Accidents	Informational Only	
ID	Cleanup After a Major Disaster	Informational Only	
IE	Demolition	Informational Only	
IF	Fire - Canadian	Informational Only	
IG	Fire - Mexico/Central America	Informational Only	
IH	Fireworks	Informational Only	
II	High Pollen Count	Informational Only	
IJ	High Winds	Informational Only	
IK	Infrequent Large Gatherings	Informational Only	
IL	Other	Informational Only	
IM	Prescribed Fire	Informational Only	

[7] Available at: EPA QA/G-5S

Table 22.1. AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
IN	Seismic Activity	Informational Only	
IO	Stratospheric Ozone Intrusion	Informational Only	
IP	Structural Fire	Informational Only	
IQ	Terrorist Act	Informational Only	
IR	Unique Traffic Disruption	Informational Only	
IS	Volcanic Eruptions	Informational Only	
IT	Wildfire-U. S.	Informational Only	
J	Construction	Informational Only	
1C	A 1-Point-QC check exceeds acceptance criteria but there is compelling evidence that the analyzer data is valid	Missing QA/QC Audit	Codes to account for completeness of 1-Point QC checks where the results are not reportable
1F	No 1 Point-QC but need to count for completeness	Missing QA/QC Audit	
AA	Sample Pressure out of Limits	Null Data Qualifier	Void the data and submit the code in its place.
AB	Technician Unavailable	Null Data Qualifier	
AC	Construction/Repairs in Area	Null Data Qualifier	
AD	Shelter Storm Damage	Null Data Qualifier	
AE	Shelter Temperature Outside Limits	Null Data Qualifier	
AF	Scheduled but not Collected	Null Data Qualifier	
AG	Sample Time out of Limits	Null Data Qualifier	
AH	Sample Flow Rate or CV out of Limits	Null Data Qualifier	
AI	Insufficient Data (cannot calculate)	Null Data Qualifier	
AJ	Filter Damage	Null Data Qualifier	
AK	Filter Leak	Null Data Qualifier	
AL	Voided by Operator	Null Data Qualifier	
AM	Miscellaneous Void	Null Data Qualifier	
AN	Machine Malfunction	Null Data Qualifier	
AO	Bad Weather	Null Data Qualifier	
AP	Vandalism	Null Data Qualifier	
AQ	Collection Error	Null Data Qualifier	
AR	Lab Error	Null Data Qualifier	
AS	Poor Quality Assurance Results	Null Data Qualifier	
AT	Calibration	Null Data Qualifier	
AU	Monitoring Waived	Null Data Qualifier	
AV	Power Failure	Null Data Qualifier	
AW	Wildlife Damage	Null Data Qualifier	

Table 22.1. AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
AX	Precision Check	Null Data Qualifier	Void the data and submit the code in its place.
AY	QC Control Points (zero/span)	Null Data Qualifier	
AZ	QC Audit	Null Data Qualifier	
BA	Maintenance/Routine Repairs	Null Data Qualifier	
BB	Unable to Reach Site	Null Data Qualifier	
BC	Multi-point Calibration	Null Data Qualifier	
BD	Auto Calibration	Null Data Qualifier	
BE	Building/Site Repair	Null Data Qualifier	
BF	Precision/Zero/Span	Null Data Qualifier	
BG	Missing ozone data not likely to exceed level of standard	Null Data Qualifier	
BH	Interference/co-elution/misidentification	Null Data Qualifier	
BI	Lost or damaged in transit	Null Data Qualifier	
BJ	Operator Error	Null Data Qualifier	
BK	Site computer/data logger down	Null Data Qualifier	
BL	QA Audit	Null Data Qualifier	
BM	Accuracy check	Null Data Qualifier	
BN	Sample Value Exceeds Media Limit	Null Data Qualifier	
BR	Sample Value Below Acceptable Range	Null Data Qualifier	
CS	Laboratory Calibration Standard	Null Data Qualifier	
DA	Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Shifts)	Null Data Qualifier	
DL	Detection Limit Analyses	Null Data Qualifier	
EC	Exceeds Critical Criteria	Null Data Qualifier	
FI	Filter Inspection Flag	Null Data Qualifier	
MB	Method Blank (Analytical)	Null Data Qualifier	
MC	Module End Cap Missing	Null Data Qualifier	
QV	Quality Control Multi-Point Verification	Null Data Qualifier	
SA	Storm Approaching	Null Data Qualifier	
SC	Sampler Contamination	Null Data Qualifier	
ST	Calibration Verification Standard	Null Data Qualifier	
SV	Sample Volume out of limits	Null Data Qualifier	
TC	Component Check and Retention Time Standard	Null Data Qualifier	
TS	Holding Time or Transport Temperature Is Out of Specs.	Null Data Qualifier	
XX	Experimental Data	Null Data Qualifier	

Table 22.1. AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
1	Deviation from a CFR/Critical Criteria Requirement	Quality Assurance Qualifier	Flag indicating the quality of the data
1V	Data Reviewed and Validated	Quality Assurance Qualifier	
2	Operational Deviation	Quality Assurance Qualifier	
3	Field Issue	Quality Assurance Qualifier	
4	Lab Issue	Quality Assurance Qualifier	
5	Outlier	Quality Assurance Qualifier	
6	QAPP Issue	Quality Assurance Qualifier	
7	Below Lowest Calibration Level	Quality Assurance Qualifier	Flag indicating the quality of the data. In some cases, the data may not meet all the criteria but is still valid.
9	Negative value detected - zero reported	Quality Assurance Qualifier	
CB	Values have been Blank Corrected	Quality Assurance Qualifier	
CL	Surrogate Recoveries Outside Control Limits	Quality Assurance Qualifier	
DI	Sample was diluted for analysis	Quality Assurance Qualifier	
EH	Estimated; Exceeds Upper Range	Quality Assurance Qualifier	
FB	Field Blank Value Above Acceptable Limit	Quality Assurance Qualifier	
FX	Filter Integrity Issue	Quality Assurance Qualifier	
HT	Sample pick-up hold time exceeded	Quality Assurance Qualifier	
LB	Lab blank value above acceptable limit	Quality Assurance Qualifier	
LJ	Identification of Analyte is Acceptable; Reported Value Is an Estimate	Quality Assurance Qualifier	
LK	Analyte Identified; Reported Value May Be Biased High	Quality Assurance Qualifier	
LL	Analyte Identified; Reported Value May Be Biased Low	Quality Assurance Qualifier	
MD	Value less than MDL	Quality Assurance Qualifier	
MS	Value reported is 1/2 MDL substituted.	Quality Assurance Qualifier	
MX	Matrix Effect	Quality Assurance Qualifier	
ND	No Value Detected, Zero Reported	Quality Assurance Qualifier	
NS	Influenced by nearby source	Quality Assurance Qualifier	
QX	Does not meet QC criteria	Quality Assurance Qualifier	
SQ	Values Between SQL and MDL	Quality Assurance Qualifier	
SS	Value substituted from secondary monitor	Quality Assurance Qualifier	
SX	Does Not Meet Siting Criteria	Quality Assurance Qualifier	
TB	Trip Blank Value Above Acceptable Limit	Quality Assurance Qualifier	
TT	Transport Temperature is Out of Specs.	Quality Assurance Qualifier	
V	Validated Value	Quality Assurance Qualifier	

Table 22.1. AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
VB	Value below normal; no reason to invalidate	Quality Assurance Qualifier	
W	Flow Rate Average out of Spec.	Quality Assurance Qualifier	
X	Filter Temperature Difference or Average out of Spec.	Quality Assurance Qualifier	
Y	Elapsed Sample Time out of Spec.	Quality Assurance Qualifier	
RA	African Dust	Request Exclusion	Flags data influenced by an exceptional event for which the agency plans to submit a data exclusion request.
RB	Asian Dust	Request Exclusion	
RC	Chemical Spills and Industry Accidents	Request Exclusion	
RD	Cleanup After a Major Disaster	Request Exclusion	
RE	Demolition	Request Exclusion	
RF	Fire - Canadian	Request Exclusion	
RG	Fire - Mexico/Central America	Request Exclusion	
RH	Fireworks	Request Exclusion	
RI	High Pollen Count	Request Exclusion	
RJ	High Winds	Request Exclusion	
RK	Infrequent Large Gatherings	Request Exclusion	
RL	Other	Request Exclusion	
RM	Prescribed Fire	Request Exclusion	
RN	Seismic Activity	Request Exclusion	
RO	Stratospheric Ozone Intrusion	Request Exclusion	
RP	Structural Fire	Request Exclusion	
RQ	Terrorist Act	Request Exclusion	
RR	Unique Traffic Disruption	Request Exclusion	
RS	Volcanic Eruptions	Request Exclusion	
RT	Wildfire-U. S.	Request Exclusion	

Data collection procedures must adhere to those procedures documented in the SOPs listed in Table 11.2. EPA and internal auditors verify adherence to data collection procedures and the associated SOPs during EPA TSAs and internal systems audits. Any time the regional monitoring technicians or coordinators use a code to void or flag data, they should document the reasons for using the code in the appropriate logbook and must document any deviation from the established data collection plan in the appropriate logbook. Accurate and complete documentation of any flagged or voided data will assist in any subsequent investigations or evaluations.

22.3 Quality Control

Section 14.0 Quality Control Requirements and Procedures specifies the QC checks that the regional monitoring technician must perform when initially setting up a monitor and periodically throughout the period while the monitor is operating, during data collection and analysis. These include the analysis of daily one-point QC checks, which provide indications of the quality of data produced by specified components of the measurement process. SOPs DAQ-12-001.2 and DAQ-08-001.2 (See Table 11.2 for SOP titles) specify the procedure, acceptance criteria, and corrective action (and changes) for each QC check. Data validation should document the corrective actions taken, affected sampling days or hours, and the potential effect of the actions on the validity of the data. The level 1, 2 and 3 data reviewers will:

- Code missing SO_2 and NO_2 data with appropriate AQS null codes,
- Invalidate hourly SO_2 and NO_2 data (and maximum 5-minute SO_2 data) if less than 45 minutes of valid data are collected within the hour,
- Invalidate SO_2 and NO_2 data when the FRM or FEM shelter temperature requirements are not met,
- Bracket valid SO_2 and NO_2 data with valid, 1-point QC checks that meet the MQOs and control limits,
- Invalidate SO_2 and NO_2 data back to the most recent valid, passing 1-point QC check and also forward to the completion of appropriate corrective actions and calibration when a valid 1-point QC check exceeds critical criteria, and
- Report all valid QA/QC data to AQS, with valid 1-point QC checks that exceed acceptance criteria reported with the "1F" null code and invalid 1-point QC checks reported with the "1C" null code.

Tables 7.2 and 7.3, along with SOPS DAQ-12-001.2 and DAQ-08-001.2 provide further information about 1-point-QC checks.

22.4 Calibration

Section 14.0 Quality Control Requirements and Procedures addresses the calibration of the monitors and the information the regional monitoring technicians should present to demonstrate they performed the calibrations correctly and the results are acceptable. When a level 1 to 3 reviewer identifies calibration problems, a level 1 to 3 data reviewer should flag or void any data produced between the suspect calibration event and any subsequent recalibration to alert data users. SOPs DAQ-12-001.2 and DAQ-08-001.2 provide further information about calibrations.

22.5 Data Reduction and Processing

As mentioned in the above sections, the EPA will perform external TSAs and the DAQ will perform ADQs, to ensure the level 1 to 3 data reviewers follow the data reduction and processing activities required in the QAPP. The level 1 to 3 data reviewers will review data monthly to ensure that associated flags or any other data qualifiers have been appropriately associated with the data. An RCO audit chemist, not involved in data collection and processing, will review the data quarterly to ensure that the regional

monitoring and ECB electronics technicians, coordinators and the RCO chemists doing the level 3 review took appropriate corrective actions.

22.6 Exceptional Events

The regulations at 40 CFR Section 50.14 allow the EPA Administrator to exclude certain data from use for determinations of exceedances and violations of a NAAQS, so long as a state or local agency demonstrates to the Administrator's satisfaction that an "exceptional event" caused the exceedance or violation. The regulations at 40 CFR Section 50.1 define an "Exceptional Event" as an event or events, in which:

- The resulting emissions affect air quality in such a way that there exists a clear causal relationship between the specific event(s) and the monitored exceedance(s) or violation(s);
- The event(s) is not reasonably controllable or preventable; and
- The event(s) is caused by a human activity that is unlikely to recur at that location or is a natural event(s).

An exceptional event does not include:

- Air pollution relating to source noncompliance;
- Stagnation of air masses or meteorological inversions; and
- Meteorological events involving high temperatures or lack of precipitation.

Conditions involving high temperatures, or a lack of precipitation may promote occurrences of some types of exceptional events, such as wildfires or high wind events, which do directly cause emissions. Natural events such as a volcanic eruption or an unlikely to recur human activity such as a train derailment may also lead to exceedances which satisfy 40 CFR Section 50.1 and for which the administrator could grant an exception.

The EPA does not consider data impacted by an exceptional event "representative" of air quality for NAAQS comparison purposes, or calculation of certain summary statistics. The RCO chemist should flag all concentration data impacted by an exceptional event with an AQS information code linked within AQS to an event description. The RCO chemist should add exceptional event codes and descriptions to AQS during the monthly data review, or as soon thereafter as possible, but no later than the schedule established by federal rulemaking.

It is the responsibility of the RCO chemist with the assistance of the regional office staff and air quality forecasters to analyze the data for potential exceptional events and to add the necessary flags and descriptions into AQS by the applicable regulatory due dates.

To obtain concurrence with an exceptional event the RCO must notify and cooperate with the EPA Region 4 Regional Office to prepare a demonstration package for the EPA administrator. When the chief submits a demonstration package, the RCO chemist working with the database manager will change the informational flags in AQS to request exclusion flags. Exceptional event data in AQS must receive concurrence from the EPA administrator. Data that does not receive a concurrence is still eligible for NAAQS comparisons, regardless of the application of request exclusion flags.

23.0 Verification and Validation Methods

Data verification is the process of evaluating the completeness, correctness, and conformance of a specific data set against the method, procedural, or contractual requirements, as specified in both the SOPs and 40 CFR Part 58. Data validation is a routine process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to ensure that reported values meet the quality goals of the environmental data operations and that the data can be used for its intended purpose.

The DAQ uses the validation templates provided in Tables 7.2 and 7.3 for the weight of evidence approach afforded to PQAOs within 40 CFR Part 58, Appendix A. The DAQ follows the guidance in the QA Handbook regarding the use of these templates and handles the criteria as follows:

- Critical criteria are criteria deemed critical to maintaining the integrity of a datum, ambient air concentration value or group of values. The level 1 to 3 reviewers should invalidate observations that do not meet each criterion on the critical table unless there are compelling reasons and justification for not doing so. The datum or data that do not meet one or more of these criteria is invalid until proven otherwise. In most cases, the CFR dictates the requirement, the implementation frequency of the criteria and the acceptance criteria so these criteria are therefore regulatory in nature.
- Operational criteria are situations where violations of a criterion or criteria might be cause for invalidation of the data. The level 1 to 3 reviewers should consider other QC information that may or may not indicate the data are acceptable for the parameter they want to control. Therefore, the data, which do not meet one or more of these criteria, are suspect unless other QC information demonstrates otherwise, and the reviewers have adequate documentation of that information. The level 1 to 3 reviewers should investigate, mitigate or justify the reason for not meeting the criteria.
- Systematic criteria include those criteria which are important for the correct interpretation of the data, but do not usually change the validity of a datum or the data. An example criterion is that at least 75 percent of the days for each quarter should successfully collect 18 or more hours of valid concentration data. The DQOs are also included in this table. If the data do not meet the DQOs, this does not invalidate any of the data measurements, but it may reduce the confidence in the attainment or non-attainment decision.
- The designation of QC checks as operational or systematic does not imply that the regional monitoring and ECB electronics technicians do not need to perform these QC checks. Not performing an operational or systematic QC check required by regulation can be a basis for invalidation of all associated data. The DAQ applies the validation templates only to small datasets of single values or a few weeks of information and does not allow a criterion to be in non-conformance simply because it is operational or systematic.

23.1 Validating and Verifying Data

The validation and verification procedures that DAQ will employ for this operation shall conform to the validation SOP DAQ-15-005.5 listed in Table 11.2. *Guidance on Environmental Data Verification and Data Validation,* (EPA QA/G-8) also discusses verification and validation issues at length. The regional monitoring technicians and coordinators shall perform all verification activities. The RCO chemists shall provide additional support through a final review of all data reconciling any anomalies through discussions with the regional monitoring technicians and coordinators. Following the final review, the RCO chemists will provide a final validation of all data. The RCO chemists will also provide QA/QC support.

The level 1 to 3 data reviewers should compare data under evaluation to actual events as specified in applicable SOPs. However, significant or unusual field events may occur, and field activities may negatively affect the integrity of the data. In addition, the DAQ expects that some of the QC checks will indicate the data fail to meet the acceptance criteria in Tables 7.2 and 7.3. The level 1 to 3 reviewers shall void, or flag data identified as suspect, or does not meet the acceptance criteria using the null codes and flags in Table 22.1.

The DAQ verifies and validates the routine and the associated QC data monthly. Presently, monthly review is the most efficient period for these verification and validation activities. The DAQ finds that if DAQ can control the measurement uncertainty each month, then the DAQ will maintain the overall measurement uncertainty for the one-year and three-year periods within the precision and bias DQOs.

23.2 Verification

After the previous month of data is available, the level 1 and 2 reviewers conduct a thorough review of the data for completeness and accuracy. Once the database manager enters the data into the Envista ARM database, the regional monitoring technician will review the data for routine data outliers and conformance to acceptance criteria. The regional monitoring technician will void or flag appropriately unacceptable or questionable data. The regional monitoring coordinators will verify all voided and flagged data again to ensure that the regional monitoring technician entered the null codes and flags correctly and that the remaining data are acceptable for use. The level 1 and 2 reviewers document their review in Envista ARM along with their data review decisions.

23.3 Validation

Validation of continuously obtained data requires two stages, one at the measurement value level and another after the previous month of data becomes available. The Envista ARM database retains records of all invalid data. Information shall include a summary of why the level 1 to 3 reviewers invalidated the measurement along with the associated null codes. Logbook notes shall have more detailed information regarding the reason a reviewer voided or flagged a measurement.

The DAQ brackets all SO_2 and NO_2 data by 1-point-QC checks or manual calibration checks before and after any invalidated period. This requirement helps to ensure that the SO_2 monitors were in proper operating condition before and after the incident. When a monitor fails, the level 1, 2 and 3 reviewers

invalidate any data after the last passing 1-point-QC check. For the NO_2, the DAQ generally brackets all data by 1-point QC checks, but since the 1-point QC checks are performed every 14-days, in cases where weight of evidence exists that the data are valid, the DAQ may choose to invalidate data back to the last passing overnight diagnostic check instead of the last 1-point QC check. The requirement to bracket the data helps to ensure that the NO_2 monitors were in proper operating condition before and after the incident.

Data validation occurs monthly. DAQ does not use EPA's Data Assessment Statistical Calculator (DASC) tool to evaluate SLAMS SO_2 or NO_2 data. The discussion below outlines the review, verification and validation processes. The organizational chart in Figure 4.1 labels the specific roles for review level 1 through 3 within the organization.

Level 0 Review – The Envidas Ultimate DAS does the level 0 review.

- Acquire minute averages from instantaneous averages, 5-minute and hourly averages from minute averages.
- Flag missing and irregular data with pre-programmed, user-defined status flags.

Level 1 Review – The regional monitoring technicians do the level 1 review.

- Review daily for anomalies and completeness and acquire missing data if available.
- Verify that all daily and 14-day precision checks fall within acceptable ranges.
- Invalidate data collected during an hour where the shelter temperature was not within the acceptable range.
- Evaluate automated nightly and 14-day PZS checks and take appropriate corrective action if necessary.
- Review minute data.
- Verify maximum daily values for validity and take appropriate action if necessary.
- Assess data for values or outliers outside of the acceptable ranges.
- Review the hourly values for any exceedances and take appropriate action if necessary.
- Review minute data as needed when completing the level 1 review procedures.
- Flag data as necessary for further investigation.
- Apply necessary validation codes from Table 22.1 for hours in which maintenance or calibrations were occurring.

Level 2 Review (Verification) – The regional monitoring coordinators do the level 2 review.

- Review site records (regional monitoring technician logbook, site data sheets).
- Review regional monitoring technician checks (leak checks, filter changes, and maintenance).
- Assess data for values or outliers outside of the acceptable ranges.
- Review minute data as needed when completing the level 2 review procedures.
- Determine if source specific emissions caused any irregularities.
- Flag data as necessary for further investigation.

- Ensure level 1 reviewers used consistent reasons for data invalidation throughout the monitoring period to indicate calibrations, audits, etc.
- Resolve any inconsistencies, anomalies or systemic issues.
- Verify that all daily and 14-day precision checks fall within acceptable ranges.

Level 3 Review (Validation) – The RCO chemist does the level 3 review.

- Ensure the use of proper null codes by the regional monitoring technicians and coordinators.
- Ensure that level 1 and 2 reviewers bracketed all valid data with the appropriate null codes indicating valid checks of analyzer accuracy.
- Ensure only valid 5-minute hourly maximum SO_2 data are reported.
- Ensure all data falls within the acceptable ranges as stated in the MQOs in Tables 7.2 and 7.3.
- Ensure all data is acceptable and can be used for its intended purpose.
- Review minute data as needed to confirm that 45 minutes of data are available within an hour.
- Add informational AQS flags (from Table 22.1) to describe data that are out of the ordinary but may be considered "valid."
- Provide final validation signature.

The DAQ uses a weight of evidence approach in validating data. After level 1 and 2 verifications, the independent level 3 reviewer determines the validity of the data by reviewing:

- The one minute and hourly values;
- Daily automatic QC checks, any manual checks and the 14-day checks;
- Leak checks after in-line PM filter and probe changes;
- e-logs and the information documented therein;
- Correspondence with the regional monitoring technicians, coordinators and ECB electronics technicians;
- SO_2 concentrations from nearby monitors; and
- The results of DAQ and EPA performance evaluations.

The level 3 reviewer compares all the available information to the specifications in Tables 7.2 and 7.3. The weight the reviewer should give to the available evidence depends on factors such as the quality of the data, consistency of results, nature and severity of effects, and relevance of the information. The weight of evidence approach requires use of scientific judgment and, therefore, it is essential to provide adequate and reliable documentation.

As a general principle, the more information the regional monitoring technicians provide, the stronger the weight of evidence. The RCO chemists, regional monitoring technicians and coordinators should present the information in a structured and organized way and consider the robustness and reliability of the different data sources to support any justification for validating or invalidating data.

The Envidas Ultimate software completes the level 0 review daily. The regional monitoring technicians and coordinators will complete the level 1 and 2 reviews within 20 calendar days from the end of the monitoring month. (Example: The month ends on February 28. The level 1 and 2 reviews must be complete by the 20th day of March). The RCO chemist will complete the level 3 review 20 calendar days

after the level 2 review is completed. (Using the prior example, the level 3 review must be completed by April 9.) When the level 3 reviewers sign off on the data in Envista ARM, their signature indicates the files are accurate and ready for the database manager to upload to AQS. Within 40 calendar days after the level 3 review is completed for the quarter, an independent RCO chemist will complete a review of the validated data once the database manager has uploaded it to AQS.

As discussed earlier, the EPA and DAQ have developed certain criteria based upon federal requirements and regional monitoring technicians' judgment that the level 1 to 3 reviewers will use to invalidate a datum or measurement. The level 1 to 3 reviewers shall use the null data codes listed in Table 22.1 to indicate they have invalidated individual measurements, or groups of measurements from an instrument.

24.0 Reconciliation with Data Quality Objectives

Section 6.0 Project/Task Description describes the objectives of the SLAMS SO_2 and NO_2 monitoring program. Section 7.0 Quality Objectives and Criteria for Measurement Data describes the DQOs for this monitoring program.

The AQS AMP256 and AMP600 reports are automated reports based on data uploaded to AQS. These reports provide summary statistics for the data collected. Because the DAQ uses warning limits that are more stringent than EPA's control limits for its data and implements EPA's critical criteria for all monitoring, DAQ should not have to directly calculate confidence intervals annually because all data should statistically meet the DQOs.

An RCO chemist will analyze the results of both the AQS AMP256 and AMP600 reports on a quarterly (Section 20.7 Data Quality Assessment) and annual basis (Section 20.5 Annual Data Certifications) to ensure that all monitoring stations meet the required DQOs. This chemist documents this review by archiving the AMP256 and AMP600 reports in the IBEAM General Documents module. If the data from any of the monitors violate the DQO bias and/or precision limits, then the RCO chemist will investigate to uncover the cause of the violation. Depending on the severity of the violation and weight of evidence, the level 3 reviewer will either void or flag the data in AQS. If all the monitors in the network of a similar type or pollutant violate the DQO, the cause may be at the agency level (regional monitoring technician training) or higher (problems with method designation). If only one monitor or site violates the DQO, the cause is more likely specific to the site (regional monitoring technician, problem with the site). Tools for determining the cause include reviewing:

- Data from a collocated network (local or tribal program or nearby reporting organizations)
- Data from performance audits (DAQ or NPAP)
- QC trends.

Once DAQ has identified a cause, DAQ will implement an appropriate corrective action. Some courses of action include:

- Determining the level of aggregation at which DAQ violated the DQOs: Results of the DQA process tell which monitors have problems, since the EPA developed the DQOs at the monitor level. To determine the level at which to take corrective action, DAQ must determine whether the violations of the DQOs are unique to one site, multiple sites or a network of similar monitors, or caused by a broader problem. The AQS generates QA reports summarizing bias and precision statistics at the national and reporting organization levels by method designation. Examination of these reports may assist in determining the level at which the DQOs are being violated.
- Communicating with EPA Region 4: If DAQ finds a violation of the bias and precision DQOs, the chief will remain in close contact with EPA for both assistance and for communication.
- Extensively reviewing quarterly data until DAQ achieves the DQOs: The chief will continue to review extensively the quarterly QA reports and the QC summaries until DAQ attains the bias and precision limits.

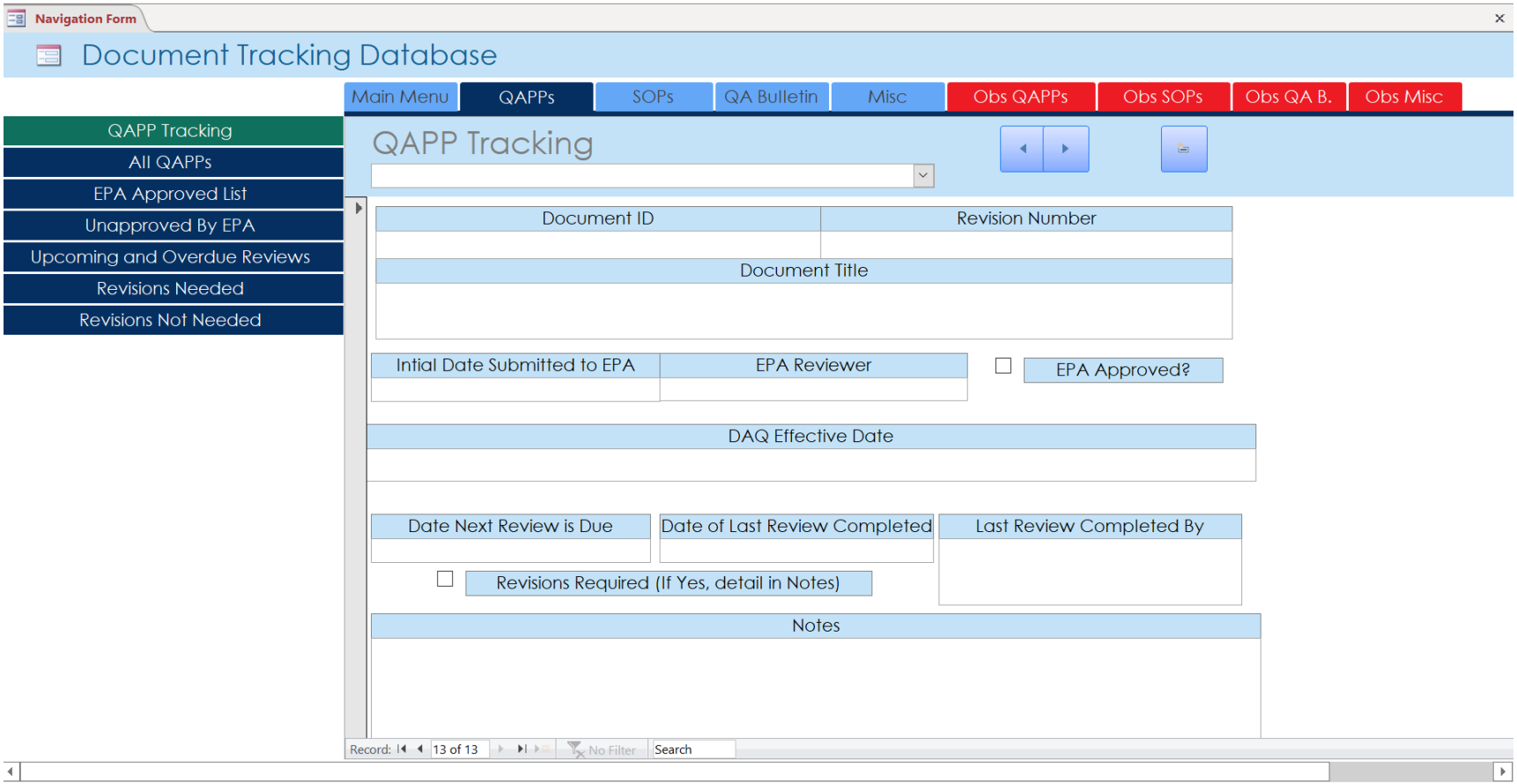
- Updating MQOs and quality assurance documents: If the cause indicates that the MQOs, SOPs associated with this QAPP, or this QAPP need to be updated, the RCO chemists will inform the chief and PPB supervisor of the needed changes and either the chief or PPB supervisor will assign staff to make the necessary updates. Should staff not be readily available to make these updates in a timely fashion, the chief or PPB supervisor will assign staff to make a QA Bulletin addressing the change until such time that the documents associated with this QAPP can be updated.

Ultimately, specifying tolerable error limits reduces the probability of making an error in a decision due to uncertainty in the data. Decision makers, such as the director and the EPA administrator, need to determine if the data collected within the DAQ monitoring network are adequate for meeting the monitoring objectives listed earlier in Section 6.0 Project/Task Description. The annual data certification process and reports generated as part of the certification provide a quantitative assessment of the measurement uncertainty within the DAQ criteria pollutant data set. By controlling uncertainty in the data to the extent prescribed by the DQOs, decision makers can use DAQ's ambient air monitoring data with confidence.

Revision History

The SLAMS SO_2 and NO_2 monitoring program is a combination of the PWEI, Background Monitoring and DRR QAPPs.

QAPP Annual Review Documentation



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