Quality Assurance Project Plan
for the
South Carolina Ethylene Oxide Community Scale Grant

Category III

Environmental Affairs
Bureau of Environmental Health Services
Division of Air Quality Analysis

February 15, 2022
Revision 0

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Acronyms and Abbreviations

ABC	Assistant Bureau Chief
A&C	Audit and Calibration
ACTS	Audit, Calibration, and Technical Support
ADQ	Audit Data Quality
ANP	Annual Network Plan
ALS	Analytical Laboratory Section
ALSM	Analytical Laboratory Section Manager
ANSI	American National Standards Institute
APTI	Air Pollution Training Institute
AQI	Air Quality Index
AQS	Air Quality System
ASTM	American Society for Testing and Materials
AWMA	Air and Waste Management Association
BAQ	Bureau of Air Quality
BEHS	Bureau of Environmental Health Services
CAA	Clean Air Act
CAR	Corrective Action Report
CFR	Code of Federal Regulations
COC	Chain of Custody
DAS	Data Acquisition System
DAQA	Division of Air Quality Analysis
DMS	Data Management Section
DQA	Data Quality Assessment
DQOs	Data Quality Objectives
EA	Environmental Affairs
EPA	Environmental Protection Agency
ERG	Eastern Research Group
ETO	Ethylene Oxide
FEMA	Federal Emergency Management Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
FFY	Federal fiscal year
GIS	Geographical Information Systems
ICS	Incident Command System
MQOs	Measurement Quality Objectives
MSA	Metropolitan Statistical Area
NATTS	National Air Toxics Trends Station
NERL	National Exposure Research Laboratory
NIST	National Institute of Standards and Technology
OAQPS	Office of Air Quality Planning and Standards
PPB	Parts per Billion
PPBV	Parts per Billion Volume
PT STUDY	Proficiency Testing Study
POC	Polluant Occurrence Code [AQS]
QA/QC	Quality Assurance/Quality Control
QA	Quality Assurance
QAA	Quality Assurance Assistant
QC	Quality Control

QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SOP	Standard Operating Procedure
SPM	Special Purpose Monitor
TAD	Technical Assistance Document
TSA	Technical System Audit
VOC	Volatile Organic Compound

1.0 Project Plan Identification and Approval

Title: South Carolina Ethylene Oxide Community Scale Grant

South Carolina

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2.0 Table of Contents

3.0 Distribution

A copy of this QAPP has been distributed electronically and in hardcopy format to the individuals in Table 3.0-1. The document is also available on the Agency network.

Table 3.0-1 Distribution List

Name	Position	Organization
South Carolina DHEC		
Paul Miller	Quality Assurance Manager	Environmental Affairs
Micheal Mattocks	Assistant Bureau Chief	Environmental Affairs Laboratories
Keith Frost	Assistant Bureau Chief	Bureau of Air Quality
Division of Air Quality Analysis		
Connie Turner	Director	Division of Air Quality Analysis
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Kevin Watts	Manager	Audit and Calibration/Technical Support Section
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EPA Region 4		
Sara Waterson	NATTS/Toxics Contact	Air and Radiation Division
Adam Zachary	NATTS/Toxics Contact	Laboratory Services and Applied Sciences Division

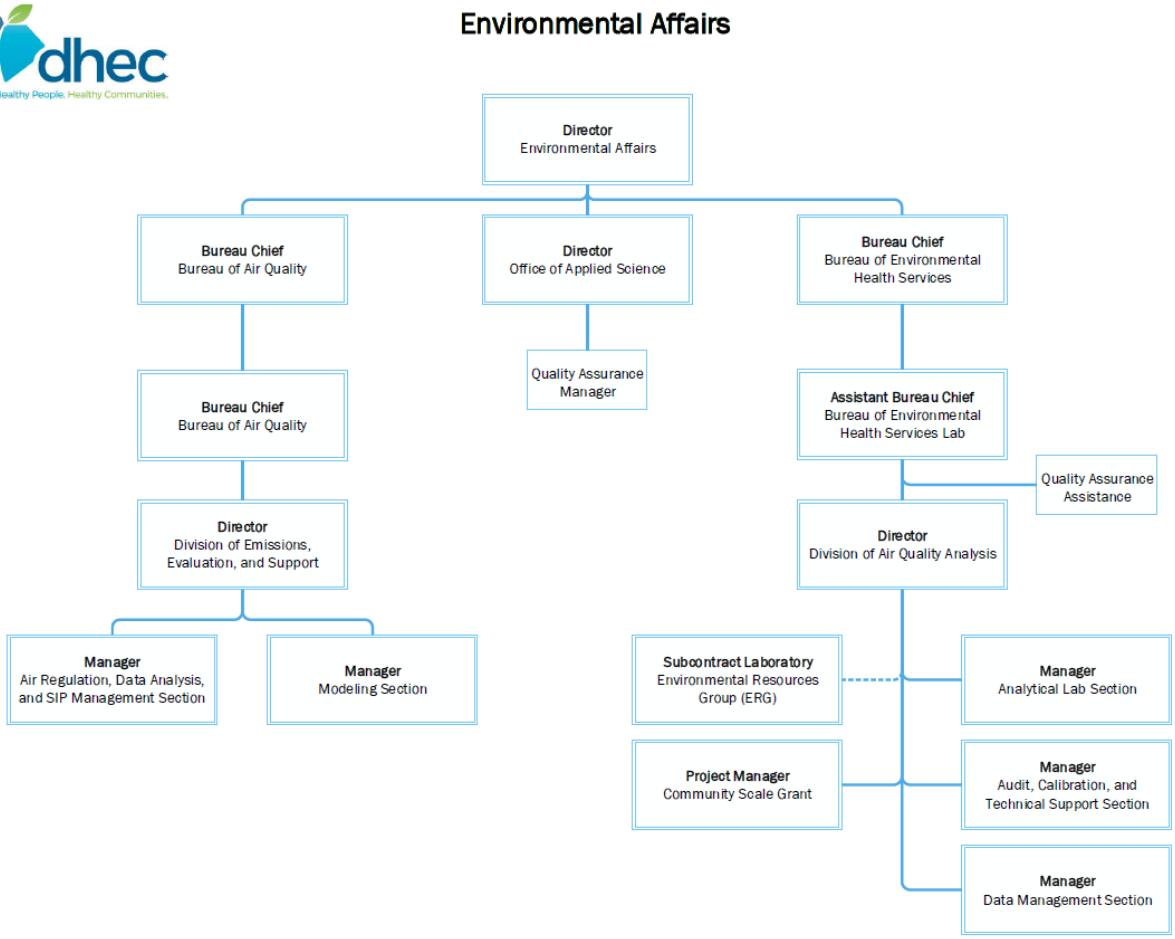
4.0 Project/Task Organization

The South Carolina Department of Health and Environmental Control (SCDHEC) and the Eastern Research Group Laboratory (ERG) have important roles in developing and implementing this ethylene oxide study. SCDHEC is responsible for taking this information and developing a study to meet the data quality requirements. ERG is the contract laboratory for the U.S. Environmental Protection Agency (EPA) for air toxics programs such as the National Air Toxics Trends (NATTS) sites. They are the laboratory utilized by EPA for previous ethylene oxide studies. Therefore, the laboratory quality assurance requirements are sufficient for the purposes of this study. For detailed information on the ERG Lab, see the ERG's *Support for the EPA National Monitoring*

Programs (UATMP, NATTS, CSATAM, PAMS, and NMOC Support) QAPP, dated March 2019 (Laboratory Attachment of this document). An organizational chart is presented in Figure 4.0-1 below.

To make the best use of available resources and to meet timelines for collection and analysis of this study, the flow of information and samples must be optimally organized. The deployment and operation of the project is a shared responsibility among all the involved parties. This section describes the roles of all parties and establishes the lines of authority, communication, and reporting, with the goal of facilitating a smoothly operated project. The following information lists the specific responsibilities of each position.

Figure 4.0-1 – Organizational Chart



4.1 South Carolina Department of Health and Environmental Control (SCDHEC)

40 CFR Part 58.1 defines a Primary Quality Assurance Organization (PQAO) as the "...organization that is responsible for a set of stations that monitor the same

pollutant and for which data quality assessments can be pooled". SCDHEC is the PQAO for the monitoring activity conducted by the state within South Carolina. In South Carolina the administration of the Air Program is the responsibility of the Department of Health and Environmental Control, Bureau of Air Quality (BAQ).

In support of the Air Program, the Bureau of Environmental Health Services Division of Air Quality Analysis (DAQA) has the responsibility for the operation of the ambient air monitoring network, including the implementation of the quality assurance program. The operations of the Bureau of Environmental Health Services include field operations by regional area staff and DAQA personnel. The following information lists the specific responsibilities of individual positions within the structures and are grouped by functions within and associated with DAQA.

4.2 Quality Assurance Manager

The Quality Assurance Manager (QAM) The Quality Assurance Manager (QAM) resides in Environmental Affairs Administration. The QAM is assisted by designated staff members to perform many of the duties related to environmental quality management practices. Because of the diverse subject matter covered by the EA program areas, the QAM also relies on the QA Liaisons as designees for the review of matters related to specific programs and functions within those programs. The QAM or designee shall:

- Be informed of each special environmental monitoring study.
- Be provided with a written QAPP for special studies
- Maintain a list of both internal and external QAPPs submitted to the QAM with the date the QAPP was approved.
- Identify and respond to QA needs, resolve problems, and answer DHEC EA QMP Revision 2.1 March 7, 2019 Page 21 of 57 requests for guidance and assistance to groups both internal and external to the Department. Provide guidance to staff to develop and maintain an acceptable QA program.
- Communicate and disseminate QA related information to all program areas, QA Liaisons, Project Managers, Bureau Chiefs, ABCs, and the EPA Regional Quality Assurance Manager.
- Serve as the environmental measurements clearinghouse in the preparation, approval, implementation, and revision of all QAPPs and SOPs.
- Delegate peer reviews and other bureau specific QA tasks to the QA Liaisons.
- Resolve disputes regarding quality assurance issues within the Department and also with external data producers.
- Report QA concerns to the EA Bureau Chiefs, EA Assistant Bureau Chiefs, and/or the Director of Environmental Affairs.

- Perform internal data quality assessments of internal laboratories and recommend corrective actions when necessary.
- Perform assessments of field procedures.

4.3 QA Liaison

In order to coordinate quality assurance activities throughout EA, each bureau shall designate one or more QA Liaisons. The QA Liaison assists in the coordination of bureau QA activities, and helps the QAM ensure understanding and implementation of the quality system. The QA Liaisons shall:

- Work with the QAM and other QA Liaisons to coordinate QA/QC activities.
- Identify and respond to QA needs, resolve problems, and answer requests for guidance or assistance.
- Work with the bureau's staff to develop and maintain an acceptable QA program.
- Work as a peer reviewer for QAPPs generated by their bureau. However, in the case where there would be a conflict of interest (for example, the Liaison is developing a QAPP or is the Project Manager), an alternate peer reviewer for the QAPP must be chosen. The Liaison may delegate QAPP review to a colleague in his/her bureau that has greater expertise in the subject matter, but this delegation must not cause a conflict of interest.
- Disseminate information regarding QA issues to their respective bureaus.
- Attend QA training provided by the QAM or other appropriate external training as funding is available.

4.4 BEHS Assistant Bureau Chief

The Assistant Bureau Chief (ABC) is responsible for data quality in the EA laboratory services. DAQA internal QA activities will be defined by the Division Director but will be managed daily within DAQA by the Quality Assurance Assistant (QAA). The QAA reports directly to the ABC. The responsibilities of this position within DAQA are defined within this section. The responsibilities of the ABC includes:

- full quality assurance authority regarding all EA laboratory services, including authority to stop work;
- Reviewing and approving QAPPs and SOPs used by the Division of Air Quality Analysis; and
- ensuring that environmental data operations are derived from appropriate QA planning documentation (e.g., QA project plans and data quality objectives).

4.5 Director Division of Air Quality Analysis (DAQA)

The Director has overall responsibility for managing the DAQA according to SCDHEC policy. The direct responsibility for assuring data quality rests with front-line management. Ultimately, the Director is responsible for establishing QA policy and for resolving QA issues for the Ambient Air Monitoring Network that are identified through the QA program. Responsibilities of the Director include:

- administering the Division budget and planning processes;
- assuring that the Division develops and maintains a current and appropriate quality system;
- assuring that the Division develops and maintains current QAPPs (revision every 4 years from the last revision date) and ensures adherence to the documents by staff, and where appropriate, other external entities the agency may work with requiring ambient air monitoring;
- establishing policies to ensure that QA requirements are incorporated in all ambient air environmental data operations;
- maintaining an active line of communication with the ABC, QAA, and Section Managers;
- ensuring that QAPPs describe project requirements and activity to meet project objectives; and
- has full and acute authority to stop work in the event of inclement weather which may impact ambient air monitoring or in the event of QA related issues.

Each Section Manager is required to ensure that the established QA directives are enforced as related to work performed in their sections. Oversight of the Division's QA program is the responsibility of the Director in conjunction with the ABC. The QAA aids the director in carrying out the QA objectives for DAQA on a daily basis. In the event of a decision to stop work for any reason, the Division Director will have consulted with his or her management team for firsthand information and briefed the ABC on all details regarding his or her decision. The ABC will confer with the Bureau chiefs of EA and BAQ. This upper management team have the right to veto the Director's actions if his or her decision is determined to be in contradiction with the best interest of the agency overall and the state of South Carolina environmental objectives as related to the EPA's Clean Air Act. The Act of Veto should be understood as the extreme action and good operational practices which provide the required communication between functional areas performing the work and upper management. This checks and balance system ensures that the SCDHEC will provide representative data information which is of the highest quality and technically defensible. Section Managers are responsible for the daily activities of their areas but in the event of the need to settle debatable issues within a section between management and staff or between sections, the Division Director will make the final decisions regarding the matter at hand. The DAQA Division

encourages participatory management to mean that input from staff is valued and used to arrive at hopefully the best decisions to provide the highest quality of work.

4.6 Quality Assurance Assistant (QAA)

The Quality Assurance Assistant (QAA) works with the Division Director in the daily QA oversight for the Division. The QAA reports to the Division Director any concerns related to quality activities within the Division. This position has direct and uninhibited access to the ABC and corresponds with the Quality Assurance Manager (QAM) on a regular basis with regards to SOP and other quality document reviews. Additionally, the QAA works with the Division Director to prepare the Division for TSAs and in responding to TSA findings or other inquiries from EPA, BAQ, SCDHEC management, and external entities. This position should be considered as a vital part of the QA activities for DAQA and defines the functional daily QA for the Division. Responsibilities of the QAA include:

- assist the ABC and Division Director(s) in oversight of daily QA activities;
- writes, reviews, revises SOPs;
- assist with QAPP review and revisions;
- serves as the lead for all DAQA internal assessments;
- works with staff to ensure that QC activities align with EPA requirements and applicable guidance;
- corresponds with the Environmental Affairs ABC;
- works with DAQA and agency resources to ensure that DAQA staff training files are current;
- works with DAQA resources to ensure that Quality Documents are archived;
- works with DAQA and agency resources to ensure that retention schedules are adhered to;
- writes reports related to QA issues for the Division;
- randomly audits data and performs quarterly data audits of DAQA's monitoring data; and
- works directly with the Section Managers to ensure DAQA generates accurate, timely, and technically defensible data.

4.7 Audit, Calibration, & Technical Support Section (ACTS) Manager

The ACTS Manager is responsible for the functions for field operations of ambient monitors and samplers. Additionally, he has oversight of the technical support functions. Since the functions of audit and calibration and equipment maintenance are so complimentary to each other, a close working relationship and constant communication is crucial between staff performing audit and calibration functions and the technical support activities for successful field functions. The ACTS

Manager ensures that focus is given to maintenance and malfunctions regarding the site equipment. He also assigns general maintenance duties related to grounds keeping, equipment stands, and buildings.

The ACTS Manager has direct access to the Director on all matters pertaining to calibrations, audits, technical support issues, and associated quality assurance matters. Responsibilities of the ACTS Manager include:

- ensures that staff adhere to and annually review relevant SOPs and QAPPs;
- ensures, oversees, participates in the review for revision of all Audit and Calibration SOPs, 3 years maximally from the last revision;
- oversight of the audit and calibration and technical support staff;
- scheduling and implementing sampler and monitor audits and calibrations;
- reviews audit and calibration information generated from audit and calibration activity and summarized in spreadsheets;
- provides training to DAQA Division and regional area technical staff;
- ensures timely follow-up and corrective actions resulting from auditing and evaluation activities;
- ensures that the audit and calibration and technical support section is prepared for all internal and external audits as they relate to audit and calibration and technical support functions and responds to any findings in a timely manner;
- final approver of information released from the audit, calibration, and technical support area and the representative final signature on quality documents such as SOPs generated for the section; and
- provides accurate and technically defensible information to upper management and other entities internally and externally as required and requested.

4.8 Data Management Section (DMS) Manager

The DMS manager is responsible for coordinating the information management activities of the DAQA ambient air monitoring program. The main responsibilities of the section include ensuring that data and information collected for the monitoring program are properly acquired, reviewed, verified, validated, quality assured, stored, and transmitted for use by program participants and data users. This section is responsible for the upload of all data for DAQA into AQS. The DMS manager has direct access to the Director on all matters pertaining to data handling. Responsibilities of the DMS manager include:

- ensures that staff adhere to and annually review relevant SOPs and the QAPPs;
- ensures, oversees, participates in the review and revision of all data handling SOPs, 3 years maximally from the last revision;

- oversight of the data management section and all data handling activities;
- provides or oversees training for staff in the Division as related to data management;
- follows good practices related to automated data processes to ensure that processes are functioning accurately and efficiently;
- coordinates the development of the information management system with data users;
- ensures the development of data standards for data structure, entry, transfer, and archive;
- verification and reporting of data to meet SOP and QAPP requirements;
- the data validator for the SC Ambient Air Monitoring Network
- reviews reported precision and bias data from audit and calibration activities for validation purposes;
- ensures access to data for timely reporting and interpretation processes;
- ensures timely delivery of all required data to the AQS;
- ensures that the data management section is prepared for all internal and external audits as they relate to the data handling functions and responds to any findings in a timely manner;
- serves as the final approver of information released from the data management section and the representative signature on quality documents such as SOPs generated for the section; and
- provides accurate and technically defensible information to upper management and other entities internally and externally as required and requested.

4.9 Project Manager

The project manager works directly for the DAQA director and is responsible for the following activities:

- Serves as the primary liaison with the contract laboratory;
- Obtaining sampling equipment from the contract laboratory, deploying them in the field, and retrieving them from the field;
- Ensuring equipment has been certified and meets pre-deployment criteria as specified in the SOP;
- Completing all sampling documentation, including chain of custody documentation;
- Receiving analytical reports from the contract laboratory, reviewing and verifying DQOs were met, and summarizing the results;

- Documenting quality issues with the sample data and creating data packets for the data;
- Providing reviewed data to the Analytical Laboratory Section for secondary review and release to the Data Management Section for tertiary review and validation;
- Providing project and grant reports to the DAQA Director;
- Providing preventive maintenance in coordination with the contract laboratory to maintain optimal sampler operation;
- Responds to sampler issues which affect optimal sampler function;
- Maintains site locations with regard to access, grass, etc.;
- Communicates with the Director of DAQA to ensure that supplies, equipment, and the site facility is adequate and conducive to ambient air monitoring work and study objectives;
- Provides emergency response to shutdown site locations upon notification from Division Director or his or her designee in the event of potential inclement weather that may affect ambient air sampling; and
- Reviews relevant SOPs and QAPP documents annually and provides update and revision comments, as necessary, using the SOP review process.

4.10 Administrative Assistant Support Staff

The Administrative Assistant for DAQA is responsible for oversight of the daily administrative functions. They are listed below:

- procures supplies and equipment for the division and handles all pre/post procurement logistics related to billing;
- manages training records and quality documents in collaboration with the QAA;
- assists the Director of DAQA with the budget;
- maintains personnel documents for DAQA staff;
- oversees and manages the daily administrative office for DAQA;
- pays all utility bills for monitoring sites and DAQA in general; and
- communicates and works directly with the Director of DAQA.

4.11 Bureau of Air Quality (BAQ)

4.11.1 Bureau Chief

The Bureau Chief of the Bureau of Air Quality is the head official for the Air program and is responsible for the implementation of the SC Pollution Control Act and delegated programs of the Clean Air Act. This position serves as the final decision maker regarding all matters related to ambient air monitoring in the state of South Carolina. Though not directly touching the daily functional ambient air monitoring activities for the agency, this position has indirect influence on the overall activities as they relate to the objectives of the monitoring network and serves as the first line liaison between South Carolina and EPA or other entities that may make requests of the agency related to ambient air monitoring. DAQA provides the analytical services and data for BAQ programmatic functions. While BAQ and DAQA are both a part of EA, DAQA resides in the BEHS.

4.11.2 Air Regulation & Data Analysis Section

The Section is responsible for several activities that support the monitoring network. The Section Manager and staff are responsible for:

- Scheduling and implementing network monitoring site reviews and assessments, including conducting Appendix E siting criteria evaluations;
- Providing meteorological information and input for site selection; and
- Providing wind rose maps.

4.12 Eastern Research Group Laboratory

While SCDHEC handles all ambient air monitoring field activities, the ERG Lab handles the laboratory supplies, sample analysis, and laboratory QA/QC. The ERG Lab forwards the analytical data to SCDHEC for further data processing, review, and data validation. The ERG Lab is a contract laboratory and is utilized by US EPA for National Air Toxic Trends Site (NATTS) analysis, which includes the TO-15 analysis, operating under a QAPP approved by EPA Office of Air Quality Planning and Support (OAQPS). Therefore, the quality assurance activities of the ERG Lab are presumed sufficient. For more description of the ERG Lab, see *Support for the EPA National Monitoring Programs (UATMP, NATTS, CSATAM, PAMS, and NMOC Support) QAPP* (Laboratory Attachment of this document).

4.12.1 Laboratory Lead

The Laboratory Lead has overall responsibility for managing all aspects of the ethylene oxide analyses for the ERG Lab. Ultimately, the Laboratory Lead is responsible for establishing the QA policy and for resolving QA

issues identified through the Laboratory QA program. The laboratory operates under an EPA approved QAPP for TO-15 analysis for volatile organic compounds.

4.12.2 QA Coordinator

The ERG Lab QA Coordinator has responsibility for ensuring that the ERG Lab follows the ERG Lab's QAPP, as approved by EPA.

5.0 Problem Definition/Background

Given EPA's determination that EtO has a greater health risk than previously known, SCDHEC is committed to addressing concerns of increased cancer risks from long term exposure in several North Charleston area environmental justice communities. Two 2020 priorities of SCDHEC's Environmental Affairs are collaborative partnerships and environmental justice/community involvement. As a testament to those priorities, SCDHEC has a long history of community involvement, partnerships, and longstanding relationships with several community groups in the North Charleston area. Included in these groups are the Lowcountry Alliance for Model Communities (LAMC) and the Charleston Community Research to Action Board (CCRAB). LAMC is a non-profit organization founded for the purpose of advocating environmental justice and promoting community development, education, employment, quality housing, and community involvement for the study area neighborhoods. CCRAB is a non-profit collaborative effort of diverse community-based organizations, academic institutions, and other stakeholders promoting environmental justice. These community relationships have been built over a decade and have involved several projects addressing community concerns including: the expansion of the Port of Charleston, the cleanup of Superfund sites in North Charleston, and air toxics sampling at Chicora Elementary.

This study will yield data of sufficient quality that will allow a preliminary assessment of any potential ethylene oxide found at the monitoring sites. The preliminary assessment will be used to determine subsequent steps.

This QAPP describes the quality system developed, implemented, and maintained by SC SCDHEC for the collection of air samples; the data quality assessment; the data validation; and the reporting of results to EPA's AQS data repository. SCDHEC is the primary quality assurance organization (PQAO) for the study.

6.0 Project/Task Description

This QAPP was developed to ensure that DAQA has a quality program to characterize ethylene oxide concentrations in the ambient air. The plan for this study is that samples will be collected for approximately one year. This study data will be posted to the EPA's AQS

as well as SCDHEC's website https://scdhec.gov/environment/air-quality/national-air-toxics-assessment-and-ethylene-oxide.

The monitoring objectives for this study include the following specific aims:

- Increase community and stakeholder awareness of EtO ambient concentrations in North Charleston Area
- Evaluate baseline EtO concentrations in the study area by conducting ambient air sampling.
- Provide additional data for the EPA's national effort to understand EtO ambient concentrations
- Keep communities and other stakeholders abreast of new information.
- Maintain historical strong relationships with the North Charleston community
- Educate the public, communities, and other stakeholders about EtO
- Evaluate seasonal and locational variation of EtO concentrations in the study area.

This study will utilize passive samplers for the measurement of ethylene oxide in the North Charleston area. Samples will be collected in accordance with EPA's one in 6-day sampling schedule. Samples will be collected in communities surrounding known EtO sources and in a high traffic area. The Irving site in the North Charleston area will be designated as a collocation site to help better understanding precision data as it relates to EtO. See Figures 6.0-1 and 6.0-2 below.

Figure 6.0-1 Location of Sites in the North Charleston area

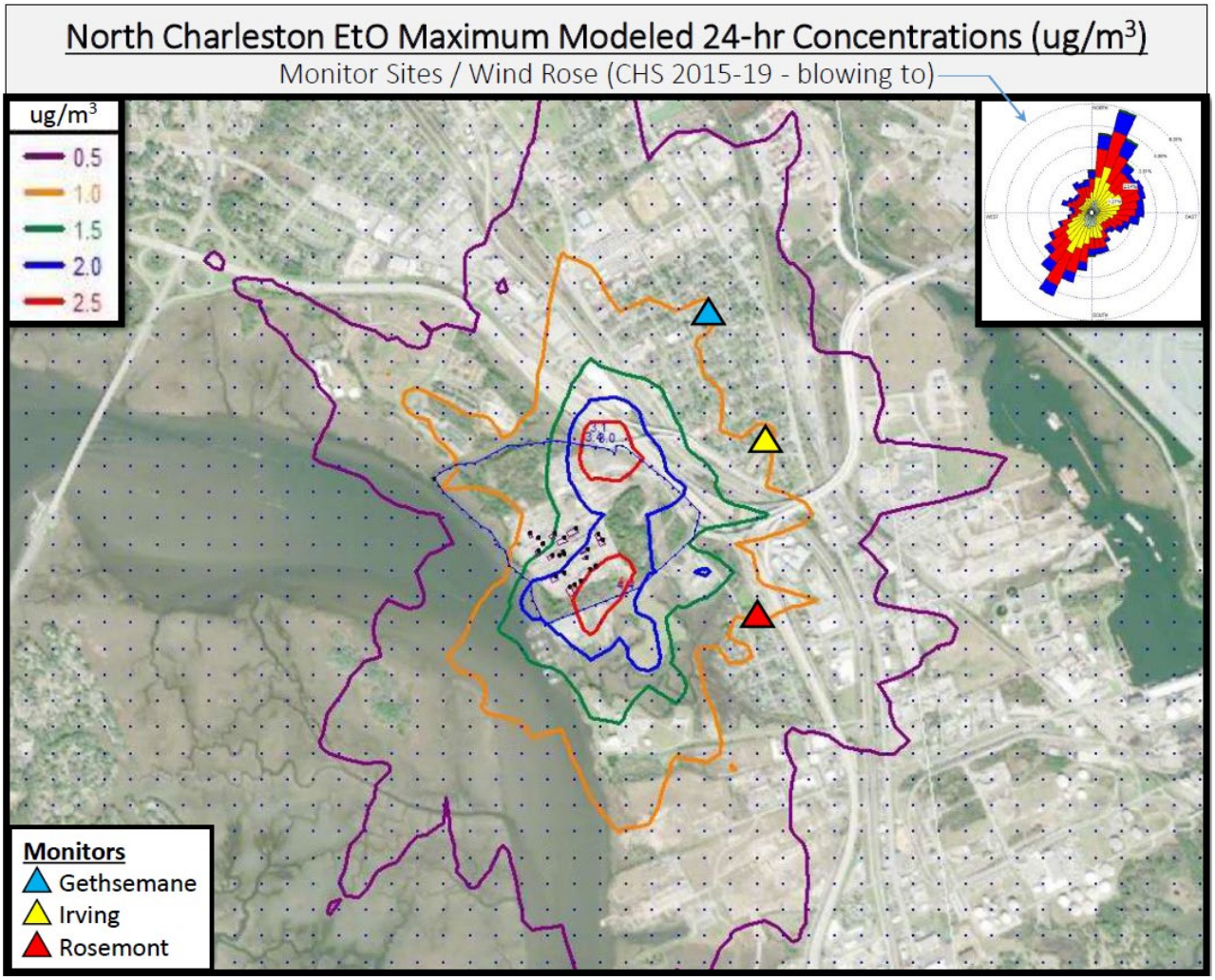


Figure 6.0-1 shows the proximity of the locations in the North Charleston area. The Chesterfield location is approximately 140 miles North of the North Charleston area.

Figure 6.0-2 North Charleston locations relative to the FAA site

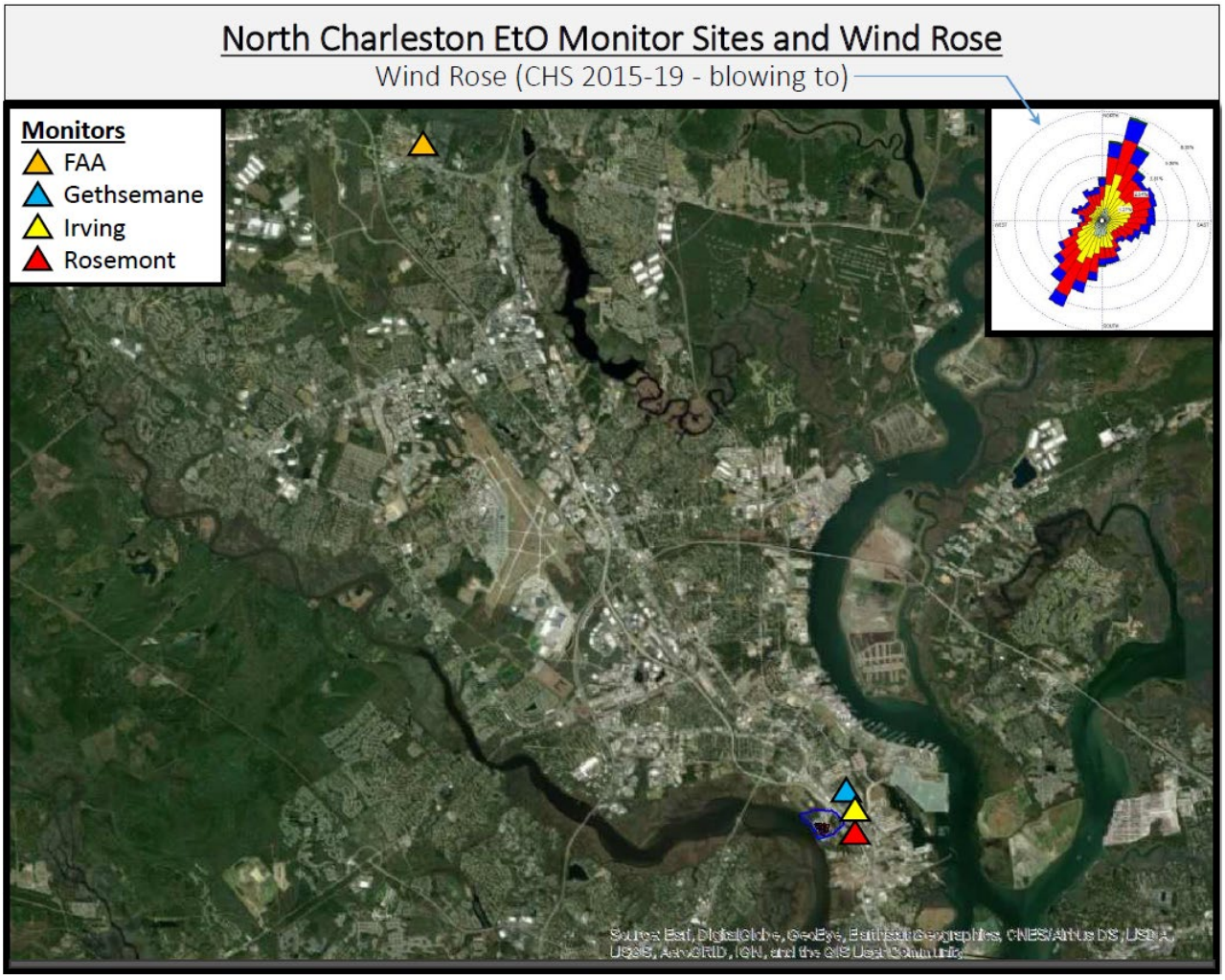


Figure 6.0-2 shows the proximity of the North Charleston locations to the FAA site. The FAA site is approximately 12 miles northwest of the Irving, Rosemont, and Gethsemane sites.

Wind rose data from the Charleston International Airport was assessed by SCDHEC and primary and secondary wind patterns were determined. Wind rose data from each airport is embedded in figures 6.0-1 and 6.0-2. It is approximately 6 miles from the Airport to the North Charleston sampling locations.

Reasonable precautions will be taken during placement of the passive samplers to ensure sample collector safety. The samplers will be placed in the best places to characterize

emissions in the air surrounding each sampling location, at heights up to 10 meters, within the breathing zone, and with an open fetch for unobstructed air flow across the samplers.

SCDHEC also collects EtO samples at the rural, background NATTS site. This background site is located at the Chesterfield site (45-025-0001). Samples are collected on a one in 6-day schedule at the Chesterfield site. The data set will be available and may be useful when trying to further understand precision between collocated pairs and differences between passive sampling and the use of fixed samplers.

Due to the difficulty in laboratory analysis, the ethylene oxide samples will be analyzed by the EPA contract laboratory, ERG Lab, for consistency in measurements as compared to previous EPA and SCDHEC studies.

To summarize, SCDHEC is sampling ethylene oxide as follows (also see Table 6 below):

- Every 6 days, samples will be collected at each of four sites in the North Charleston area: FAA (45-019-0048), Irving (45-019-0021), Rosemont (45-019-0009), and Gethsemane (45-019-0022).
- The Irving site is designated as the collocated site for the study. The collocated sample will be collected every six days.
- All samples will be collected in accordance with EPA's one in 6-day sampling calendar. Any necessary make-up samples will be made as close to the original sampling date as possible.
- Approximately 320 samples will be collected as part of this ethylene oxide study.

Each site will be assigned a site ID in AQS. All validated data will be uploaded to AQS. The measurement goal of the ethylene oxide study is to estimate the 24-hour average passive canister sampling concentrations in units of micrograms per cubic meter ($\mu g/m^3$). The SCDHEC ethylene oxide monitoring project will follow EPA Compendium Method TO-15, as applicable, for collecting volatile organic compounds. The sampling instruments, sampling media, sampling schedules and monitoring purposes used by SCDHEC to collect air samples for the analyses of ethylene oxide are shown in the following table. See Table 6.0-1 for a list of the site locations.

Table 6.0-1 – Sample Collection Locations

Site Location	Sampling Instruments	Sampling Media	Monitor Type	Sampling Schedule	Monitor Purpose
Gethsemane (45-019-0022)	Entech CS1200E Passive Canister Samplers and TM1200 Timers	6-Liter stainless steel canister	Primary	1:6 days	Characterization of air in communities located in urban areas near EtO sources
Rosemont (45-019-0009)	Entech CS1200E Passive Canister Samplers and TM1200 Timers	6-Liter stainless steel canister	Primary	1:6 days	Characterization of air in communities located in urban areas near EtO sources
FAA Site (45-019-0048)	Entech CS1200E Passive Canister Samplers and TM1200 Timers	6-Liter stainless steel canister	Primary	1:6 days	Characterization of air in high traffic areas
Irving (45-019-0021)	Entech CS1200E Passive Canister Samplers and TM1200 Timers	6-Liter stainless steel canister	Primary	1:6 days	Characterization of air in communities located in urban areas near EtO sources. This site will have collocated sampling for precision data.

6.1 Sampling Details for Collecting Ethylene Oxide Data

The work required to collect, document, and report the ethylene oxide data includes:

- Appropriate placement of the sampler
- Ensuring accurate and reliable records of data collected
- Developing SOPs for equipment checks, operation, and maintenance
- Establishing assessment criteria

- Validating the data produced in accordance with criteria herein

6.2 Field Activities

The project manager will perform field activities to include:

- Performing routine site operations and maintenance activities that include verifying sampler status, recording pertinent field data, and recording measurements
- Performing and documenting leak checks
- Collecting ethylene oxide samples
- Shipping collected samples to ERG Lab for analysis

6.3 Laboratory Activities

The Project Manager sends the ethylene oxide samples to the ERG Lab for analysis. The ERG Lab delivers an electronic data package to SCDHEC DAQA for validation and upload to AQS. Any issues observed with the laboratory data are discussed with the ERG Lab. The ERG Lab maintains copies of their SOPs and are available to the SCDHEC DAQA staff as needed. Copies of the ERG Lab SOPs are available upon request and the ERG Lab's *Support for the EPA National Monitoring Programs (UATMP, NATTS, CSATAM, PAMS, and NMOC Support) QAPP,* dated March 2019 is Attachment 1 of this document.

6.4 Project Assessment Techniques

The evaluation process used to measure the performance or effectiveness of the system is called an assessment. This includes the audit, performance evaluation, inspection, peer review, or surveillance.

An audit of the Project Manager's sample collection will be conducted at each of the four locations at least once during the study. This audit will review equipment to ensure the certified pressure gauges being used are within certification and meet certification criteria, adherence to the SOP, field documentation, and chain of custody records. Certification for all sampling equipment will be reviewed to ensure it is maintained with the data packet and demonstrates compliance with the requirements. The results of the audits (and any identified corrective actions) are summarized in reports to the DAQA Director.

6.5 Ethylene Oxide Project Records

DAQA will maintain procedures for preparation, review, approval, use, revision and maintenance of documents and records. The categories and types of records and

documents that are applicable to SCDHEC are shown in Table 6.5-1. More detail is shown in Section 9.0.

Table 6.5-1 Critical Documents and Records

Categories	Record/Document Types
Management and Organization	Organizational Chart of DAQA and BAQ Personnel
Network & Site Information	Project description Site characterization file Site maps/pictures
Environmental Data Operations	Quality Assurance Project Plans (QAPPs) Standard operating procedures (SOPs) Field and laboratory logbooks Sample handling/custody records Inspection/maintenance records
Raw Data	Any original data from the laboratory
Data Reporting	Data/summary reports
Data Management	Data Validation Files
Quality Assurance	Field audits of site operations and Data Validation of data uploaded to AQS

6.6 Project Schedule

The schedule for field and laboratory analysis activities are summarized in Table 6.6-1. As the project progresses, feedback from local stakeholders may initiate changes to the project. The dates of these activities may change due to unforeseen circumstances. However, this is the general timeline that SCDHEC will follow for this project.

Table 6.6-1 Schedule of Monitoring Activities

Activity	Date	Comments
QAPP development	March 31, 2022	Submit to EPA for approval in anticipation of approval by August 3, 2021
Contract in place for sample canisters and analysis	March 30, 2021	Contract was awarded March 17, 2021.
Sampling devices received from ERG	April 2022	Sampling equipment zero checked at ERG Laboratory

Identification of the monitoring sites	May 2021	Sites were reviewed and selected based on wind rose data and input from the community
Sampler siting	March 2022	Establishment of sites
Field / laboratory training	1st Quarter 2022	Field and laboratory training activities.
Sampling begins	1st Quarter 2022	Canisters deployed and ready for collection by April 2022
Laboratory analysis begins	April 2022	Samples received and analysis begins.
Field audit assessment	One (1) audit for the study duration	Approximately 3 months into the project (June to July 2022)
Data evaluation phase begins	2nd Quarter 2022	Determine if sampling frequency or locations need to be adjusted

7.0 Quality Objectives and Criteria for Measurement Data

This short-term study will be conducted under the quality program of the SCDHEC approved *Quality Management Plan,* dated July 3, 2018, where applicable.

7.1 Data Quality Objective (DQO)

SCDHEC did not go through a formal data quality objective (DQO) process for the ethylene oxide monitoring project; however, the SCDHEC agreed upon measurement quality objectives for this project with the stakeholders. Measurement quality objectives for the various data quality indicators were developed based on the requirements of EPA Compendium Method TO-15 and trends based on recent ethylene oxide studies.

7.2 Measurement Quality Objectives (MQOs) for Ethylene Oxide

Measurement quality objectives (MQOs), or acceptance criteria, are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process. These MQOs are defined in terms of the following data quality indicators (DQIs):

- Precision - “Precision is a measure of agreement between two replicate measurements of the same property, under prescribed similar conditions. This

agreement is calculated as either the range or as the standard deviation," (US EPA QA/G-5, Appendix D). This is the random component of error.

- Bias - "Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction," (US EPA QA/G-5, Appendix D). 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 in regard to the measurement of a specific variable or groups of variables," (US EPA QA/G5, Appendix D).
- 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. Representativeness is a qualitative term that should be evaluated to determine whether in situ or other measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the media and phenomenon measured or studied," (US EPA QA/G-5, Appendix D).
- Completeness - Completeness is a metric quantifying the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. Completeness can be expressed as a ratio or a percentage. Data completeness requirements are included in the reference methods (40 CFR Part 50).
- Sensitivity – Sensitivity is determined by method detection limits (MDLs) for each measurement method for each pollutant. ERG conducts MDL studies per their approved QAPP, SOPs, and the NATTS TAD.

The DQIs of representativeness, completeness, precision, bias, and sensitivity must meet specific MQOs, or acceptance criteria. The MQOs for each of the DQIs are as follows:

- Representativeness: Sampling must occur at one in 6-day frequency, from noon to noon or midnight to midnight local standard time, over 24 ± 1 hours. This determination will be made once testing of the sampling is conducted. Noon to noon sampling allows for less time in the field overall for samples collected Monday through Friday because the project manager, or alternate sample collector, can place and collect samples as closely to run begin and end time as possible. Using midnight to midnight will result in canisters staying in the field longer due the 24-hour period ending at midnight. Midnight to midnight analysis allows for all 24-hour averages, such as meteorological data and other midnight to midnight EtO samples to be directly related to a discreet day in conjunction with the EPA sampling

schedule. The benefits and drawbacks of each sampling method will be determined during testing. The primary variable will be observed leaks. The goal will be to minimize samples voided or flagged due to passive sampling leaks.

- Completeness: At least 70% of all data available in a given quarter must be reported. While 75% data completeness is usually the goal of a study, this is an investigatory study, and all data will be informative. Due to the nature of EtO and observed concerns with canister growth issues and leaks, a higher than normal rate of voided samples has been observed.
- Field Collection Precision: The desired percent difference for collocated samples is no more than 25%. Data has shown that EtO has more variability than other VOC compounds. As a result, an outlier test will be performed on the precision measurements obtained. This will be used to evaluate precision data obtained during this study.
- Laboratory Analysis Precision: ≤25% for samples with EtO concentrations > 5x MDL
- Bias: Measurement error must be <3X MDL
- Sensitivity: MDL as required by EPA as part of national contract (see ERG Laboratory's QAPP attached).

For the SCDHEC ethylene oxide community scale grant project to follow these MQOs, the data produced will be considered of sufficient quantity and quality for the decision making to commence. The following data validation table outlines the acceptance criteria to meet these MQOs. SCDHEC uses the acceptance criteria provided in EPA supplied guidance *Technical Assistance Document for the National Air Toxics Trends Stations Program, Revision 3*, dated October 2016 as a guide, and unless otherwise noted, the references shown in the table refer to this document. The MQOs are used by SCDHEC to control and assess measurement uncertainties.

Table 7.2-1 Data Validation Table VOCs via EPA Compendium Method TO-15

Parameter	Description and Required Frequency	Acceptance Criteria	TAD Section / Reference	Category
Field Readiness Checks and Collection Activities				
Canister Viability	All canisters	Canister must be used within 30 days from final evacuation	Section 4.2.6.2 .4 / TO-15 section 8.4.1.6	Operational
Timer check	Verified with each sample collection event	Timer accurate to ±5 minutes for digital timers and ±15 minutes for mechanical timers	Section 4.2.5.3 Table 3.3-1	Operational

Canister Starting Pressure Determination	Each canister prior to collection of a field sample	Vacuum ≥ 28 in Hg	Section 4.2.5.2.1	Critical
Sample Setup Leak Check	Each canister prior to collection - draw vacuum on canister connection	Leak rate must be <1 in Hg over at least 15 minutes	Section 4.2.5.2.1	Critical
Sampling Frequency	One sample every six days according to the EPA National Monitoring Schedule	Sample must be valid to be included in ≥70%	Section 4.2.5.3	Operational
Sampling Period	All field-collected samples	1380-1500 minutes (24 ± 1 hr) starting and ending at midnight or noon to noon	Section 4.2.5.3	Operational
Field-collected Sample Final Pressure	All field-collected samples	Must be determined with a pressure gauge	Section 4.2.5.2.4	Critical
Sample Receipt				
Chain-of-custody	All field-collected samples	Each canister must be uniquely identified and accompanied by a valid and legible COC with complete sample documentation	Sections 3.3.1.3.7 and 4.2.5.2.4	Critical
Sample Holding Time	All field-collected samples, laboratory QC samples, and standards	Analysis within 30 days of end of collection (field-collected samples)	Section 4.2.1 / TO-15 Sections 1.3, 2.3, and 9.2.8.1	Operational
Canister Receipt Pressure Check	All field-collected samples upon receipt at the laboratory – measured with calibrated pressure gauge or transducer	Pressure change of <3 in Hg from the final pressure at retrieval	Section 4.2.8	Critical
GC/MS Analysis (per ERG Approved QAPP)				
BFB Instrument Tune Performance Check	Daily (every 24 hours), prior to sample analysis	Evaluation criteria presented in Section 16.1.1 of the ERG SOP and Table 11-3 of the ERG approved QAPP.		
LCS ({ICV} Second source calibration verification check)	Following the calibration curve	The response factor <30% deviation from calibration curve average response factor		
CCV of approximately midpoint of the calibration curve using a Certified Standard	Before sample analysis on the days of sample analysis (24 hour analysis day)	The response factor ≤30% Deviation from the calibration curve average RRF (Relative Response Factor)		
Method Blank Analysis (Zero Air or N2 Sample Check)	Daily (24 hours), following BFB and calibration check; prior to sample analysis	1) <3x MDL or 0.2 ppbV, whichever is lower 2) IS area response ± 40% and IS RT ± 0.33 min. of most recent ICAL		
Duplicate and Replicate Analysis	All duplicate and collocate field samples	<25% RPD for compounds greater than 5 x MDL		
Canister Cleaning Certification	One canister analyzed on the Air Toxics system per batch of 12	<3x MDL or 0.2 ppbV, whichever is lower		
Preconcentrator Leak Check	Each standard and sample canister connected to the preconcentrator/ autosampler	≤0.2 psi change/minute		

Retention Time (RT)	All qualitatively identified compounds	RT within ± 0.06 RRT units of most recent initial calibration average RT		
Samples Internal Standards	All samples	IS area response within ± 40% and IS RT within ± 0.33 min. of most recent calibration average IS response		
Initial calibration (ICAL) consisting of at least 5 points bracketing the expected sample concentration.	Following any major change, repair, or maintenance or if daily QC is not acceptable. Recalibration not to exceed three months.	1) % RSD of Response Factors 30% RSD (with two exceptions of up to ± 40% for non-Tier I compounds only) 2) Internal Standard (IS) response ±40% of mean curve IS response 3) Relative Retention Times (RRTs) for target peaks ±0.06 units from mean RRT 4) IS RTs within 20 seconds of mean 5) Each calibration standard concentration must be within ±30% of nominal (for Tier I compounds)		
Site Specifications and Maintenance				
Sample Inlet Filter	Particulate filter maintenance Beginning of study	Change filter when canister pressure shows necessary Clean or replace the 2-µm sintered stainless steel filter	Section 4.2.3.3 TO-15 Section 7.1.1.5	Operational
Data Reporting				
Data Reporting to AQS	Sample data reported within 180 days of each calendar quarter	All field samples	Section 3.3.1.3.15	Operational
AQS reporting units	Concentration units reported to AQS	ppbv	Section 3.3.1.3.15	Critical
Data Completeness	Valid samples compared to scheduled samples annually	≥ 70%		Operational

7.3 Intended Use of Data

This data will be used to:

- Characterize ambient levels of ethylene oxide
- Evaluate background concentration of ethylene oxide

The quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement quality objectives (MQOs) are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process.

7.4 Measurement Scale

Each sampler operated by SCDHEC is assigned a scale of representativeness based on 40CFR58, Appendix D. The ethylene oxide monitors represent a middle scale to neighborhood scale. These representativeness definitions are found in EPA's QA Handbook for Air Pollution Measurement Systems: "Volume II: Ambient Air Quality Monitoring Program (PDF) located on the EPA's website at: www.epa.gov/amtic.

8.0 Personnel Training and Development Program

This section is not required for a Category III QAPP.

9.0 Documentation and Records

SCDHEC, as a PQAO performing environmental data operations and management activities, has established and maintained procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. These procedures are elaborated in this section as a documentation and records management policy to address at least the following elements:

- A list of files considered the official records and their media type (e.g., paper, electronic)
- Schedule for retention and disposition of records
- Storage and retrieval system of records
- Person(s) responsible at each level of storage and retrieval for records
- Assignment of appropriate levels of security

A document, from a records management perspective, is a volume that contains information that describes, defines, specifies, reports, certifies, or provides data or results pertaining to environmental programs. Table 5 lists the categories and types of records and documents that are applicable for document control in SCDHEC. Information on key documents in each category is included in this section. With the exception of Field Logbooks which are kept on-site, all paper records are stored in the DAQA central office. In addition to paper records, all the applicable documentation referred to in this section is saved as an electronic record with a format of MS Word, MS Excel, MS Access, or PDF on the local network on the SCDHEC server. Retention of both paper and electronic records is defined in the DAQA Retention Schedule 17607. The paper and electronic records are stored in a logical order for ease of access. For details of the ERG Lab's record management process, refer to the ERG Lab's QAPP attached.

Table 9.0-1 Types of Information Retained Through Document Control

Categories	Record/Document Types	Electronic and Paper Copy	Person Responsible for Documentation
Management and Organization	Organizational Chart of SCDHEC Personnel qualifications Support contracts	X X X	EA and DHEC Administration
Network & Site Information	Network description Site description for study Site characterization file Site maps/pictures	X X X X	Manager, Air Regulation, Data Analysis, & SIP Management Section
Environmental Data Operations	Quality Assurance Project Plans (QAPPs) Standard operating procedures (SOPs) Field logbooks Sample handling/custody records Inspection/maintenance records NIST traceable records	X X X X X X	SOPs and QAPPS are maintained by the QAA. Other records are maintained by the Manager, Analytical Laboratory Section.
Raw Data	Any original data	X	Manager, Data Management Section and Manager, Analytical Laboratory Section
Data Reporting	Data/summary reports	X	Manager, Data Management Section
Quality Assurance	Field Audits of Site Operations NIST traceable records	X X	QAA or Analytical Laboratory Staff

SC DHEC has permission from the property owners to place its ethylene oxide ambient air samplers.

Original copies of the SOPs and QAPPs are considered controlled copies and are maintained by the QAA. SOPs and QAPPs are available in ‘read only’ format on the local network drive and through online database records for operations. The current SOPs are retained on a SharePoint drive. Historical SOPs and QAPPs are removed as they are replaced.

SC DHEC's raw data records on the local network server are backed up every 24 hours per IT policy. Raw data records that are housed on the local network are only available to the SC DHEC staff. The raw data is validated as discussed in Section 20.0 and posted to SC DHEC's website. Historical QA documents are retained in hardcopy and/or electronic 'read only' access. Hardcopies of the data packets are maintained in the Data Management Section after upload to AQS. Electronic copies are maintained on the network drives in accordance with the DAQA retention schedule.

9.1 Routine Data Activities

SC DHEC maintains records in appropriate files that allow for the efficient archival and retrieval of records. Ambient air quality information is included in this system. Table 5 includes the documents and records that are filed according to the statute of limitations discussed in Section 9.3.

9.2 Documentation Control

The details of the documents and records listed in Table 5 will be discussed in the appropriate sections of this document. All raw data required for calculations is collected electronically or on data forms that are included in the field and analytical methods. All hardcopy information shall be filled out in indelible ink. Corrections shall be made by inserting one line through the incorrect entry, initialing and dating this correction, and placing the correct entry alongside the incorrect entry, if this can be accomplished legibly, or by providing the information on a new line if the above is not possible.

9.2.1 Logbooks

The project manager is responsible for using the appropriate field logbooks uniquely numbered and associated with the study sampling locations. These logbooks will be used to record information about the site and sampling equipment issues as well as document routine operations such as dates of deployment, collection, shipment to ERG, and date results are received.

Completion of data entry forms, associated with all routine environmental data operations, are required even when the field logbooks contain all appropriate and associated information required for the routine operation being performed.

- Field Logbook – A logbook will be used for all sites included in this study. The notebook will be hardbound and paginated. After use in the field, field logbooks are retained in the Project Manager's office.
- Laboratory Logbooks – An electronic log of when canisters are received, deployed in the field, shipped to ERG for analysis, when results are received,

and when results are reported. Data packets will be generated and used for the data review and validation process.

9.2.2 Chain-of-Custody Forms

ERG Chain-of Custody (COC) forms are used to track sample custody from sample canister shipping from ERG to sample receipt at ERG. Custody records document the "chain of custody": the date and person responsible for the various sample handling steps associated with each sample and the information that acknowledges that sample integrity remained intact. Custody records also provide a reviewable trail for quality assurance purposes and can be used as evidence in legal proceedings. SC DHEC and ERG Lab track and document the whereabouts of each sample at each stage throughout the data collection operation using the Field Data Sheet as shown in the applicable SOPs listed in Table 7. Entries on the COC form are made by hand. The information is then entered into the DHEC sample tracking system. More information about COC forms is detailed in Section 12.0.

9.3 Data Archiving and Retrieval

The storage and retrieval of the air quality monitoring data are conducted through the archiving system of SC DHEC. All the information listed in Table 5 will be retained in house for at least five years from the date of collection per the DAQA retention schedule 17607. However, if any litigation, claim, negotiation, audit, or other action involving the records has been started before the expiration of the five-year period, the records will be retained until completion of the action and resolution of all issues which arise from it, or until the end of the five year-period, whichever is later.

10.0 Network Description

For a detailed description of SC DHEC's ethylene oxide study sampling design, refer to Section 6.0. Figures 6.0-1 and 6.0-2 show the areas that will be monitored for ethylene oxide.

10.1 Monitoring Objective

SC DHEC's ethylene oxide sites are representative of a middle to neighborhood scale and collect data with a source-oriented monitoring objective.

10.2 Sampling Frequency

For a detailed description of the ethylene oxide study sampling frequency, refer to Section 6.0. Latitude and longitude coordinates will be disclosed after the study is

complete. Samples will be collected from noon to noon or midnight to midnight. Sampling frequencies are shown in Table 6.

Table 10.2-1 Sampling Frequency of Ethylene Oxide Monitors

Site Location	Sampling Instruments	Sampling Media	Monitor Type	Sampling Schedule	Monitor Purpose
Irving Avenue	Entech CS1200E Passive Canister Samplers with TM1200 Timers	6-Liter stainless steel canister	Primary and collocated	Primary and collocated -Every 6 days	Characterization of air in an urban area
Rosemont	Entech CS1200E Passive Canister Samplers with TM1200 Timers	6-Liter stainless steel canister	Primary	Every 6 days	Characterization of air in neighborhoods surrounding facilities
Gethsemane	Entech CS1200E Passive Canister Samplers with TM1200 Timers	6-Liter stainless steel canister	Primary	Every 6 days	Characterization of air in neighborhoods surrounding facilities
FAA	Entech CS1200E Passive Canister Samplers with TM1200 Timers	6-Liter stainless steel canister	Primary	Every 6 days	Characterize air with concentrated mobile sources and no EtO sources immediately nearby

10.3 Site Selection

SC DHEC considered the following aspects when establishing the ethylene oxide air monitoring sites:

- Understanding the monitoring objective(s)
- Identifying the spatial scale most appropriate for the monitoring objective(s)
- Identifying the general locations where the monitoring site(s) should be placed according to wind direction
- Identifying specific monitoring sites

The sites will be chosen based on the following factors:

- Modeled ethylene oxide emissions data showing highest concentrations

- Transport of pollutants downwind of facilities
- Characterize air near mobile sources away from facilities

11.0 Sampling Method Requirements

11.1 Field Collection Description

Ethylene oxide samples are collected in 6 Liter stainless steel canisters. The Sample Collectors receive certified "clean" and evacuated canisters from the ERG Lab. These canisters must show at least -28 inches of mercury vacuum pressure when connected to the samplers. When not attached to the sampler, the canister is capped using a brass or stainless-steel cap. Each canister also has a unique ID permanently written on and/or attached to the canister. ERG lab is responsible for providing canisters, timers, and flow controllers that meet TO-15 and NATTS TAD requirements including cleanliness and leak criteria.

Prior to sampling, each canister must pass the leak check procedure. All samples will be collected on a one in 6-day schedule. The sampling system will run in the field for 24 hours ± 1 hour. The Entech (or equivalent) passive sampling is complete when it reaches subambient pressure, typically -2 to -4 inches mercury (inHg). The filled canister is then retrieved from the field by the project manager and subsequently delivered to the DAQA laboratory and shipped to the ERG Lab for analysis. For more information regarding the ERG Lab, see Laboratory Attachment of this document.

11.2 Sampling Methodology

The methods described herein provide for measurement of the relative concentration of ethylene oxide in ambient air for a 24-hour sampling period. The method described in this section is based on *Compendium Method for the Determination of Toxic Organic Compounds in Air, United States Environmental Protection Agency, Section TO-15*, January 1999. The sampling system consist of a CS1200 Passive Sampler from Entech Instruments connected directly to an Entech TM1200 Timer. The timer will be connected to an evacuated and certified clean 6-liter stainless steel canister (Figure 11.2-1). The CS1200 sampler, TM1200 Timer, and 6-liter canister are treated with silica for non-reactivity, and the TM1200 Timer will be used to automatically start and stop the sampling at a 24-hour period. See SC DHEC's *Standard Operating Procedure for VOC Passive Sampling and Contract Analysis Review (SOP AQ-ADMIN-1052-0)* for more details.

Figure 11.2-1 Entech CS1200E Passive VOCs Sampler Set-Up

11.3 Standard Operating Procedures

To perform the sampling, analysis, and QC activities consistently; standard operating procedures (SOPs) for each routine or repetitive task have been referenced as a part of the QAPP. The SOPs prepared and updated by SC DHEC for the ethylene oxide monitoring study are summarized in Table 7. At the time of writing this QAPP, some SOPs were still being updated.

The SCDHEC and ERG Lab's SOPs detail the instrument operation requirements. Table 7 shows a list of SCDHEC's SOPs that apply to the passive VOC sampling. For ERG Lab's SOPs, see Section 8.0 and Appendix D of the ERG Laboratory Attachment of this document.

Table 11.3-1 SCDHEC's SOPs for Ethylene Oxide Collection

SOP	Revision	Date
Standard Operating Procedure for Ethylene Oxide Passive Sampling and Contract Analysis	0	March 2022
Standard Operating Procedure for Data Handling and Reporting	2	3/29/2019
Standard Operating Procedure for Yellow Card	3	5/5/2021

11.4 Sample Probe/Sample Train

For the VOCs samplers at the ethylene oxide monitoring sites, the SC DHEC uses the Entech Passive VOCs samplers and timers which are free standing samplers and do not have a sampler probe/train that requires maintenance.

11.5 Sample Canister Leak Check

SCDHEC performs a leak check before each sample is collected. Details are explained in the applicable SOPs listed in Table 7. Per the SOPs noted above and Table 4 contained in this QAPP, the passive ethylene oxide samplers underwent a leak check performed by the ERG Laboratory prior to beginning this study.

11.6 Modifications to Sampling Equipment

In the event of needed corrective action, the Project Manager notifies the DAQA Director. The SCDHEC Laboratory Manager and ACTS Manager should also be notified. Maintenance and malfunctions are tracked in the Yellow Card operating procedure noted in Table 7 above.

12.0 Sample Numbering and Custody

Unique sample IDs are generated by the ERG Lab and labeled appropriately on the sampling media (see Section 11.0 for details of how sample IDs are addressed). SCDHEC utilizes these sample IDs along with IDs assigned in the SCDHEC laboratory to match the laboratory data to the field data, as applicable. Samples are either in secured SCDHEC buildings, ERG buildings, secured at the sampling location, or in the possession of SCDHEC or ERG personnel.

A critical activity within any data collection phase involving physical samples is the handling of sample media prior to sampling; transporting sample media to the field, handling samples in the field at the time of collection; storage of samples (in the field or other locations); transport of samples from the field site; and the analysis of the samples.

Custody records document the “chain of custody”: the date and person responsible for the various sample handling steps associated with each sample and the information that acknowledges that sample integrity remained intact. Custody records also provide a reviewable trail for quality assurance purposes and can be used as evidence in legal proceedings. SCDHEC and ERG Lab track and document the whereabouts of each sample at each stage throughout the data collection operation using the Field Data Sheet, Chain of-Custody (COC) Form, and ERG Tracking Tag as shown in the applicable SOPs listed in Table 7. Entries on the COC form are made by hand. The information is then entered into DAQA’s sample tracking system, where an electronic record is kept. Examples of the COC Form are shown in Figure 12.0-1 below.

Figure 12.0-1 Example of Chain-of-Custody Form

ERG

ERG Lab ID #

601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

AIR TOXICS SAMPLE CHAIN OF CUSTODY

Lab Pre-Sampling

Site Code: _____ Canister Number: _____

City/State: _____ Lab Initial Can. Press. ("Hg): _____

AQS Code: _____ Cleaning Batch # : _____

Collection Date: _____ Date Can. Cleaned: _____

Options:

SNMOC (Y/N): _____ Duplicate Event (Y/N): _____

TOXICS (Y/N): _____ Duplicate Can # : _____

METHANE (Y/N): _____

Relinquished by: _____ Date: _____

Field Setup

Received by: _____ Date: _____

Operator: _____ MFC Setting: _____

System #: _____ Elapsed Timer Reset (Y/N): _____

Setup Date: _____ Canister Valve Opened (Y/N): _____

Field Initial Can. Press.: _____ **psig psia "Hg (Circle one)**

Field Recovery

Recovery Date: _____ Sample Duration (3 or 24 hr): _____

Operator: _____ Elapsed Time: _____

Field Final Can. Press.: _____ **psig psia "Hg (Circle one)**

Status: **VALID VOID** (Circle one) Canister Valve Closed (Y/N): _____

Relinquished by: _____ Date: _____

Lab Recovery

Received by: _____ Date: _____

Lab Final Can. Press.: _____ **psig "Hg (Circle one)** Converted to psia: _____

Status: **VALID VOID** (Circle one) Gauge: **1 2** (Circle one)

If void, why: _____

Samples stored in Air Tox Lab (Room 130)

5-2016

Comments: _____

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

12.1 Pre-Sampling Custody

The pre-sampling custody is the sample handling stage that includes sample media purchasing, logging in, labeling, identification, transportation, and deployment of the canister. For SCDHEC's SOPs, see the applicable SOPs listed in Table 7 for more details. For the ERG Lab, see Laboratory Attachment, Section 9.1 for more details.

12.1.1 Sample Preparation

Sample preparation is an essential portion of the ethylene oxide project. Cleaning, evacuation, testing, verification, and storage of canisters are functions that are required for sample preparation.

Sample set-up of the ethylene oxide samplers take place as soon as practicable after the previous sample has been recovered. Canisters for air collection for VOCs analyses must be used within 30 days after certified clean. Detailed sample set-up procedures are available from the corresponding SCDHEC's SOPs. For a description of ERG Lab's sample preparation, see Laboratory Attachment Section 10.0 of this document.

12.1.2 Sample Volume

The volume of air to be sampled is specified by the manufacturer and is in the method specifications. Samples are expected to be 24 hours; therefore, the flow controllers are set to collect a sufficient sample to obtain the minimum sample volume. A valid sample run should not be less than 23 hours or greater than 25 hours. If the sample period is less than 23 hours or greater than 25 hours, the sample will be nulled and the Director notified. The Entech passive sampler is complete when it reaches subambient pressure, typically -2 to -4 inHg.

12.2 Post Sampling Custody

Post sampling procedures include: sample removal, field record keeping and sample transportation, sample contamination prevention, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity. See the applicable SCDHEC SOPs in Table 7, and for the ERG Lab, see Laboratory Attachment, Section 9.1 for more details.

12.2.1 Sample Contamination Prevention

To prevent contamination during transport to the laboratory, the VOCs stainless steel canisters should be capped and handled to ensure that the

valve to canister connection remains closed and the interior surface is not compromised.

12.2.2 Temperature Preservation Requirements

During transport from the sampling location to the DHEC laboratory to the ERG laboratory, VOCs canisters have no specific requirements for temperature control per TO-15 Compendium Sections 1.3, 2.3, and 9.2.8.1.

12.2.3 Permissible Holding Times

The *Technical Assistance Document for the National Air Toxics Trends Station Program, Revision 3,* dated October 2016 states the permissible holding times for the VOCs samples. The VOC Canister analysis should be within 30 days of end of collection or preparation according to TO15 Compendium Sections 1.3, 2.3, and 9.2.8.1.

12.3 Delivery to ERG Laboratory

Once the ethylene oxide samples are collected from the sampling location and transported to the DHEC laboratory, the Project Manager prepares the samples for delivery to the ERG Lab via UPS, following protocol in applicable SOPs. When the samples are received at the ERG Lab, the chain-of custody form is completed to record the sample receipt by Laboratory personnel. The ERG Lab analyst maintains records of sample preparation, analysis, and data input and management. See the applicable ERG Lab SOPs and Section 9.0 of the Laboratory Attachment for details.

12.4 Make-up Samples

Make-up samples are not expected with this study. If data completeness objectives are affected, make-up samples may be scheduled.

13.0 Analytical Methods

The method stated here provides for chromatographic analyses at the ERG Lab for samples collected at the SCDHEC ethylene oxide sites. The basic method used by ERG Lab is based on the Toxic Organic Compendia (TO-15) listed in Section 11.0. The sample media used to collect samples at ethylene oxide sites is a canister as shown in Table 1. In addition, the laboratory blank must also be prepared. See Section 12.1.2 and the applicable ERG Lab's SOPs for more detail. The instruments used for laboratory analysis of the samples collected at SCDHEC's ethylene oxide sites are listed in Table 8.

Table 13.0-1 Instruments Used in the ERG Lab

Parameter	Instrument	Method
VOCs	Agilent HP 8890/5977B with Entech 7200A interface Agilent HP 6890/5973 with Entech 7200A interface	GC/MS, TO-15

13.1 Sample Contamination Prevention

The analytical support component of the ethylene oxide sites has rigid requirements for preventing sample contamination. To minimize contamination, the sample media clean-up and sample preparation rooms are separate from the instrumentation rooms. In addition, heating and ventilation systems are checked by certified technicians. Hoods are also checked quarterly.

For the VOCs analytical method, the best prevention of contamination is not opening the canister in the laboratory. All post sampling Entech passive canisters that enter the ERG Lab should have subambient pressure of -2 to -4 inHg. Care must be taken when the canisters are under vacuum and stored in the laboratory. If there is a slight leak in the canister cap or valve, then laboratory air can enter the canister and contaminate the sample.

13.2 Temperature Preservation Requirements

There are no temperature requirements.

13.3 Permissible Holding Times

The permissible holding times for the ethylene oxide samples are detailed in the TO Compendia and the SOPs shown in Table 7.

14.0 Quality Control Requirements

Quality Control (QC) is a means of periodic evaluation of the acceptability of the data. That is, does the data meet certain criterion? This section contains descriptions of the various QC checks which SCDHEC performs in conjunction with collecting ethylene oxide data. For a description of ERG Lab's quality control requirements, see Laboratory Attachment, Section 11.0.

14.1 Instrument Checks

The flow controllers, timers, and canisters are obtained from ERG. ERG is responsible for ensuring the equipment is cleaned and certified prior to sending it to SCDHEC for use. The certification data is stored on the SCDHEC's local

SharePoint for reference by anyone in the DAQA. For a description of ERG Lab's calibration requirements, see Laboratory Attachment, Section 13.0.

The initial canister pressure must be checked prior to sample collection by measurement of the canister vacuum with a certified digital pressure gauge. This initial pressure will be documented on the sample collection form. Canisters must show ≥28 in Hg vacuum.

Once vacuum is verified, the canister is connected to the sampling unit, and a leak check is performed. A leak check may be performed by quickly opening and closing the valve of the canister to generate a vacuum in the sampling unit. The vacuum/pressure gauge in the sampling unit will be observed for a minimum of 30 minutes to ensure that the vacuum does not change by more 1 in Hg.

The sampler inlet is checked and cleaned for any debris and moisture, and the o-ring on the sampler inlet cap checked for any deformity.

The battery level on the sampling timer is checked to be over 50% full, and the date and time displayed on the timer is set ±5 minutes of local standard time before programming the timer for the sampling time period.

14.2 Precision Checks

The Irving site will consist of collocated canisters for precision data.

14.2.1 Precision Determination

Collocated precision evaluates the results of two monitors sampling side by side. The monitors separately operate at the same time and undergo the same sample collection, handling, and analysis procedures. To determine the precision, one compares results from the primary sampler concentration to the collocated sampler concentration by using the Relative Percent Difference formula noted below:

Equation 14.2.1: Relative Percent Difference (% RPD) =

$$\left[\frac{abs\ (value_1 - value_2)}{\frac{value_1 + value_2}{2}}\right] \times 100$$

The replicate precision is a measure of the reproducibility of the laboratory analyses. A replicate evaluation is performed on each batch by the ERG Lab with results sent to SCDHEC. A replicate is simply a re-analysis of the same canister of sample and then comparing the results of the replicate analysis to the first analysis. The ERG Lab will perform replicate analysis on 10% of the samples in their analytical batch. The percent RPD calculation for determining replicate precision is the same as the collocated calculation. Refer to the ERG's Laboratory Attachment for more details.

14.2.2 Precision Acceptance Criteria

Precision acceptance criteria are found in Section 7.2 of this QAPP.

14.2.3 Corrective Actions

Any non-conformances from the criteria specified in Section 14.2 above will be validated and flagged in accordance with the SCDHEC SOPs referenced in Table 7 above. Validated data will be uploaded to AQS and the SCDHEC website. See SCDHEC's *Standard Operating Procedure for Data Handling and Reporting* for further details. For a description of ERG Lab's corrective actions, see Laboratory Attachment, Section 16.3 of this document.

14.3 Quality Assurance Audits

An in-house technical systems audit (TSA) will be performed on the SCDHEC's ethylene oxide sampling procedures at least once per location during the study period. This will include a review of the Sample Collector adherence to approved SOPs, QC checks, use of field logbooks, and adherence to chain of custody protocols, including chain-of-custody completion. A summary report will be prepared by the lab staff performing the audit.

15.0 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

SCDHEC receives each passive ethylene oxide sampler from ERG Lab. For details of ERG's maintenance and leak check procedures, see ERG's Laboratory Attachment, Section 12.0.

16.0 Inspection, Acceptance, Requirements for Supplies and Consumables

Certified canister gauges are used by DAQA to check the canister pressures upon receipt, deployment in the field, and recovery from the field. Annual certification for these gauges is maintained by DAQA. Information for the inspection, acceptance, and requirements for supplies and consumables associated with the analysis of the samples is located in the ERG QAPP.

17.0 Non-Direct Measurements

SCDHEC relies on the data that is generated through field and laboratory operations. However, other significant data is obtained from sources outside SCDHEC or from historical records. This section addresses data not obtained by direct measurement from the SCDHEC. Possible databases and types of data and information that might be used include:

- Chemical and Physical Properties Data
- Canister Manufacturers' Operational Literature
- Geographic Location Data
- External Monitoring Databases
- Population Data from the US Census Bureau
- Traffic Data from South Carolina Department of Transportation
- Wind Roses and other atmospheric data from other meteorological stations
- Emission Inventory from EPA

Meteorological data is obtained from NWS weather stations with known quality. Data may also be collected at specific sites, where available.

17.1 Chemical and Physical Properties Data

Physical and chemical properties data and conversion constants are often required in the processing of raw data into reporting units. This type of information that has not already been specified in the monitoring regulations will be obtained from the following nationally and internationally recognized sources. Other data sources may be used with approval of the Quality Assurance Manager.

- National Institute of Standards and Technology (NIST)
- ISO, IUPAC, ANSI, and other widely recognized national and international standards organizations
- EPA
- The current edition of certain standard handbooks may be used without prior approval of the Quality Assurance Manager

17.2 External Monitoring Databases

Data from the SCDHEC website may be used in published reports with appropriate caution. Data on the website is intended to match what is uploaded to the AQS website; however, the AQS website is the official record for the sample results. Care must be taken in reviewing and using any data that contain flags or data qualifiers. If data is flagged, such data shall not be utilized unless the data still meets critical QA/QC requirements. It is impossible to assure that a database such

as the SCDHEC website is completely free from errors including outliers and biases, so caution and skepticism is called for in comparing SCDHEC data from other reporting agencies. Users should review available QA/QC information to assure that the external data are comparable with SCDHEC measurements and that the original data generator had an acceptable QA program in place.

18.0 Data Management

This section identifies the procedures that are followed to acquire, transmit, transform, reduce, analyze, store, and retrieve ambient air monitoring data by the field and office personnel of SCDHEC. The details of the processes and procedures in the ERG Lab are described in the ERG Lab's *Support for the EPA National Monitoring Programs (UATMP, NATTS, CSATAM, PAMS, and NMOC Support) QAPP,* and the ERG Laboratory Attachment of this document.

18.1 Data Collection and Recording

SCDHEC uses EPA-approved ambient air canisters for collection of ethylene oxide data. The canisters are collected manually and sent to the ERG Lab for analysis. ERG's analytical results and associated quality control information is sent to SCDHEC where the information is shared on SCDHEC's local network and SharePoint. The leak check data is collected by the Project Manager during canister receipt and canister deployment and recorded in the logbook and/or chain of custody form. The internal assessment information is collected by the DAQA lab staff performing the internal assessment and stored on the local shared network for the DAQA Director, QAA, and Data Management staff to review.

18.2 Data Transmittal

For the SCDHEC ethylene oxide data, all sampling media is sent back to the ERG Lab for analysis. Once the ERG laboratory analysis is complete, the analytical results are sent to SCDHEC via email in a 'read only' portable document format (pdf) and an Excel file.

18.3 Data Review and Reduction (Validation)

For ethylene oxide data, the ERG Lab analyzes the samples and summarizes the data as well as the corresponding QA/QC information in the ERG LIMS system and sends a copy to SCDHEC. These files are 'read only' to ensure the data are not modified or deleted. The Project Manager reviews the laboratory data from the ERG Lab and the corresponding information on the chain-of-custody form and field data sheet. The holding time and delivery storage requirements for samples as listed in the SOPs shown in Table 7 must be followed; otherwise, the data will be flagged per revision 3 of the NATTS TAD. After completion of data review,

the Project Manager prepares the final data associated with any applicable flags or null data codes into AQS reportable data format and creates the data review packet. The Project Manager also creates the EtO report for management review. The data review packet is then reviewed by the Analytical Laboratory Manager for release to the Data Management Section. The Data Management Section validates the data by reviewing the packet, ensuring the data is properly reported, and any associated flags are added prior to upload. Once the data has been validated, the Project Manager submits a report, including the sample results, to the Division Director. For more detail, refer to SCDHEC SOP *Volatile Organic Compounds Passive Sampling and Contract Analysis Review,* AQ-ADMIN-1052.

18.4 Data Storage and Retrieval

The storage and retrieval of the air quality monitoring data are conducted through the archiving system of SCDHEC. The canister pressure checks are recorded on the chain of custody or logbook and stored in accordance with the approved retention schedule.

ERG's raw data reports are housed on local network and are only available to SCDHEC staff. The raw data is then validated as discussed in the next Sections, uploaded to AQS, and posted to the SCDHEC's website (https://scdhec.gov/environment/air-quality/national-air-toxics-assessment-and-ethylene-oxide).

19.0 Assessment and Response Actions

This section is not required for a Category III QAPP.

20.0 Reports to Management

This section is not required for a Category III QAPP.

21.0 Data Validation and Usability

For the ethylene oxide data to be usable, the data undergoes validation procedures to determine that the data has met quality specifications. Validation, performed by the project manager and the Data Management Section, can be defined as confirmation, through provision of objective evidence, that the requirements for a specific intended use are fulfilled. These staff evaluate the data to establish and confirm that the data was collected according to this QAPP and the SOP requirements. The Community Scale Grant workgroup, that includes independent quality assurance staff, estimates the potential effect that any deviation from the QAPP and SOP may have on the usability of the associated data item, its contribution to the quality of the reduced and analyzed data, and its effect on decisions.

For SCDHEC, data validation is a process of reviewing and reducing raw data, with the use of objective evidence, to confirm requirements have been fulfilled and the intended use of the processed data for posting on the SCDHEC's website (https://scdhec.gov/environment/air-quality/national-air-toxics-assessment-and-ethylene-oxide). The data validation process is based on sound documentation and checks. It is a systematic approach to produce reportable data that is accurate and complete. SCDHEC performs data validation as data is received from the ERG Lab. It involves the data handling personnel of the DAQA Laboratory and Data Management sections as shown in the organization chart (Figure 4.0-1 in Section 4). Refer to SCDHEC's *Standard Operating Procedure for Data Handling and Reporting* for more information.

21.1 Sampling Design

SCDHEC chose the ethylene oxide monitoring sites according to emission models, wind rose data, proximity to the facilities, and proximity to the interstate or rural area as described in Section 6.0 and Section 10.0.

21.2 Sample Collection Procedures

The ethylene oxide sample collection procedures for SCDHEC are outlined in SOP AQ-ADMIN-1050. The field audits discussed in Section 14.0 verify that the SOP is being followed when collecting samples. Potentially unacceptable data points are routinely identified in the data set through the application of error flags/codes. Each flag/code is associated with a unique error shown in Table 9. These error flags/codes are routinely reviewed as part of the data validation process. This activity assists in identifying suspect data points that could invalidate the data. Any deviation from the established sampling criteria must be documented in the appropriate logbook and on the chain of custody form. Accurate and complete documentation of any sample collection deviations may assist in any subsequent investigations or evaluations.

Table 21.2-1 Data Codes

Null Codes	Description
AA	Sample Pressure out of Limits
AB	Technician Unavailable
AC	Construction/Repairs in Area
AF	Scheduled but not Collected
AG	Sample Time out of Limits
AI	Insufficient Data (cannot calculate)
AL	Voided by Operator
AM	Miscellaneous Void

AN	Machine Malfunction
AO	Bad Weather
AP	Vandalism
AQ	Collection Error
AR	Laboratory Error
AS	Poor Quality Assurance Results
AU	Monitoring Waived
AW	Wildlife Damage
BA	Maintenance/Routine Repairs
BB	Unable to Reach Site
BE	Building/Site Repair
BH	Interference/co-elution/misidentification
BI	Lost or damaged in transit
BJ	Operator Error
DA	Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Shifts)
DL	Detection Limit Analyses
MB	Method Blank (Analytical)
SA	Storm Approaching
SC	Sampler Contamination
ST	Calibration Verification Standard
TC	Component Check & Retention Time Standard
TS	Holding Time Or Transport Temperature Is Out Of Specs.

Qualifier Codes	Description
1	Deviation from a CFR/Critical Criteria Requirement
2	Operational Deviation
3	Field Issue
4	Laboratory Issue
5	Outlier
6	QAPP Issue
7	Below Lowest Calibration Level
9	Negative value detected - zero reported
1V	Data reviewed and validated
CC	Clean Canister Residue
CL	Surrogate Recoveries Outside Control Limits
DI	Sample was diluted for analysis
EH	Estimated; Exceeds Upper Range

HT	Sample pick-up hold time exceeded
LB	Laboratory blank value above acceptable limit
LJ	Identification Of Analyte Is Acceptable; Reported Value Is An Estimate
LK	Analyte Identified; Reported Value May Be Biased High
LL	Analyte Identified; Reported Value May Be Biased Low
MD	Value less than MDL
MS	Value reported is 1/2 MDL substituted.
ND	No Value Detected
NS	Influenced by nearby source
QX	Does not meet QC criteria
SQ	Values Between SQL and MDL
TT	Transport Temperature is Out of Specs.
V	Validated Value
VB	Value below normal; no reason to invalidate
Y	Elapsed Sample Time out of Spec.
Inform Code	Description
IA	African Dust
IB	Asian Dust
IC	Chem. Spills & Industrial Accidents
ID	Cleanup After a Major Disaster
IE	Demolition
IF	Fire – Canadian
IG	Fire - Mexico/Central America
IH	Fireworks
II	High Pollen Count
IJ	High Winds
IK	Infrequent Large Gatherings
IL	Other
IM	Prescribed Fire
IN	Seismic Activity
IO	Stratospheric Ozone Intrusion
IP	Structural Fire
IQ	Terrorist Act
IR	Unique Traffic Disruption
IS	Volcanic Eruptions
IT	Wildfire-U. S.
J	Construction

Null codes are used when the data is not usable and needs to be invalidated.

Quality Assurance ("QA") qualifier codes are input when there is an issue that may affect the data due to a procedural malfunction, or general quality assurance.

Informational qualifiers ("INFORM") are only for informational purposes.

21.3 Sample Handling

Pertinent deviations from established sample-handling protocols for each sample physically retrieved for monitoring sites and equipment must be recorded on the sample custody sheet assigned to each filter for collection and recorded in the applicable electronic database for all pollutants.

21.4 Analytical Procedures

The ethylene oxide data is validated and verified utilizing both manual and electronic methods. Specific criteria are utilized at the ERG Lab with blanks, duplicates, replicates, and collocated samples to determine acceptable data, the minimum acceptable values, and other criteria that are indicative of valid qualifying data. The ERG Lab can flag suspect data utilizing the list provided in Table 9.

21.5 Instrument Check Procedures

Refer to Section 15.0 for details regarding checking the sampling instruments. More information can be found in applicable SOPs found in Table 7.

21.6 Quality Control Procedures

Section 14.0 specifies the QC checks that are to be performed during sample collection, handling, and analysis. These include analyses of standards, blanks, spikes, and replicates, which provide indications of the quality of data being produced by specified components of the measurement process. For each specified QC procedure, the acceptance criteria and corrective action (and changes) should be specified. The project manager and laboratory staff should document the corrective actions that were taken, which samples were affected, and the potential effect of the actions on the validity of the data. More information regarding QC checks and corrective actions can be found in Section 14.0, as well as the applicable SOPs found in Table 7.

21.7 Data Reduction and Processing Procedures

Data will be reviewed and used to create data packets by the Project Manager, Final concentration data and any noted flags will be validated by the Data Management Section staff prior to upload to AQS. Upon completion of the data validation process, the Data Management manager uploads the final monitoring data, along with any applicable null codes, to EPA's AQS database. The final values uploaded to AQS will be sent to the DAQA Director and the final ethylene oxide data will be uploaded to SCDHEC's website (https://scdhec.gov/environment/air-quality/national-air-toxics-assessment-and-ethylene-oxide) by SCDHEC personnel.

22.0 Validation and Verification Methods

This section is not required for a Category III QAPP.

23.0 Reconciliation with User Requirements

This section is not required for a Category III QAPP.

24.0 Record Retention

South Carolina Department of Archives & History
Division of Archives and Records Management

APPROVAL OF RECORDS RETENTION SCHEDULE

In accordance with provisions of Title 30, *Code of Laws of South Carolina, 1976*, Sections 30-1-10 through 30-1-140, as amended, the attached Records Retention Schedule is submitted for approval. This schedule supersedes any previously approved schedule for these same records series.

PART I
Agency

DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
ENVIRONMENTAL AFFAIRS
BUREAU OF ENVIRONMENTAL HEALTH SERVICES
DIVISION OF AIR QUALITY ANALYSIS
RECORD GROUP # 169

I certify that I am authorized to act for this agency in the disposition of its public records and hereby approve the attached Records Retention Schedule. The schedule meets all legal and audit requirements and the records have no further administrative, fiscal, or legal value to this agency after the expiration of the prescribed retention periods. Records series included in this approval are numbered:

17607 REVISED

April 26, 2021	Jessica K Moore	Records Officer
Date	Signature of Agency Representative	Title

PART II
Department of Archives and History

The records listed in the attached Records Retention Schedule have been evaluated by this department for their management, research, and permanent value and are approved for retention or disposal as described in this schedule.

4-30-21		
Date	Director, Department of Archives and History	

ARM-2

South Carolina Department of Archives and History
Records Management Division

RECORDS RETENTION SCHEDULE

DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

RECORD GROUP NUMBER: 169

ENVIRONMENTAL AFFAIRS

BUREAU OF ENVIRONMENTAL HEALTH SERVICES

DIVISION OF AIR QUALITY ANALYSIS

17607 DIVISION OF AIR QUALITY ANALYSIS RECORDS

Description

Records generated by Division of Air Quality Analysis to support functions within the laboratory, field operations, technical support of equipment, and data management. Information includes analytical data; gravimetric data; sample preparation records; laboratory supporting documentation/records; proficiency test studies; records and logs associated with equipment: audit, calibration, technical support, and maintenance; records and logs associated with continuous and non-continuous monitoring; Standard Operating Procedures; and any other related documents.

Retention

Quality Assurance and Standard Operating Procedure Manuals: until updated, superseded, or no longer needed for reference, destroy.

Records Associated with National Air Toxic Trends Station Program: 6 years, destroy.

All Other Records including Chain of Custody: 5 years, destroy.

REVISED

SCHEDULE APPROVED 04/30/21

25.0 Revision History

DATE	REV. #	CHANGE	SECTION
2/15/2022	0	NEW QAPP	All

26.0 References

Environmental Protection Agency. 2016. *Technical Assistance Document for the National Air Toxics Trends Stations Program, Revision 3*. Research Triangle Park, North Carolina. October 2016.
Quality Assurance Handbook for Air Pollution Measurement Systems Volume II, Appendix C Revision No. 0, January 2017.

Eastern Research Group. 2019. *Support for the EPA National Monitoring Programs (UATMP, NATTS, CSATAM, PAMS, and NMOC Support) QAPP*. Morrisville, Georgia. March 2019.

SCDHEC *Quality Assurance Project Plan for the Chesterfield, SC National Air Toxics Trends Station,* 1/30/2018.

Attachment 1
ERG QAPP

SUPPORT FOR THE EPA NATIONAL MONITORING PROGRAMS

(UATMP, NATTS, CSATAM, PAMS, and NMOC Support)

Contract No. EP-D-14-030

2021

Quality Assurance Project Plan
Category 1

Eastern Research Group, Inc.
601 Keystone Park Drive, Suite 700
Morrisville, NC 27560

2021 Quality Assurance Project Plan, Category 1
UATMP, NATTS, CSATAM, PAMS, and NMOC Support (Contract No. EP-D-14-030)

Approved by:

U.S. EPA Project Officer: JEFFREY YANE Digitally signed by JEFFREY YANE Date: 2022.02.16 16:20:29 -05'00' Date: _____
Jeff Yane

U.S. EPA QA Manager: GREGORY NOAH Digitally signed by GREGORY NOAH Date: 2022.02.02 09:21:03 -05'00' Date: _____
Greg Noah

U.S. EPA Delivery Order Manager: XI CHEN Digitally signed by XI CHEN Date: 2022.02.02 11:06:44 -05'00' Date: _____
Xi (Doris) Chen

ERG Program Manager: Julie L. Swift Date: 3/11/22
Julie Swift

ERG Program QA Officer: Donna Tedder Date: 3/11/22
Donna Tedder

ERG Deputy Program QA Officer: Jennifer C. Nash Date: 03/11/2022
Jennifer Nash

DISCLAIMER

This Category 1 Quality Assurance Project Plan has been prepared specifically to address the operation and management of the U.S. EPA National Monitoring Programs (UATMP, NATTS, CSATAM, PAMS and NMOC). The contents have been prepared in accordance with Level I Specifications of the EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5 and the EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5.

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ERG-MOR-017	Standard Operating Procedure for Developing, Documenting, and Evaluating the Accuracy of Spreadsheet Data
ERG-MOR-022	Standard Operating Procedure for the Preparation of Standards in the ERG Laboratory
ERG-MOR-024	Standard Operating Procedure for Preparing, Extracting, and Analyzing DNPH Carbonyl Cartridges by Method TO-11A
ERG-MOR-030	Standard Operating Procedure for Canister Sampling System Certification Procedures
ERG-MOR-033	Standard Operating Procedure for Hazardous Waste
ERG-MOR-039	Standard Operating Procedure for Maintaining Laboratory Notebooks
ERG-MOR-044*	Standard Operating Procedure for Method 8270C – GC/MS Analysis of Semivolatile Organics
ERG-MOR-045	Standard Operating Procedure for Sample Receipt at the ERG Chemistry Laboratory
ERG-MOR-046*	Field Procedure for Collecting Speciated and/or Total Nonmethane Organic Compounds Ambient Air Samples Using the ERG:S/NMOC Sampling System
ERG-MOR-047B	Field Procedure for Collecting Ambient Carbonyl Compounds Samples Using the ERG:C Sampling System
ERG-MOR-049	Standard Operating Procedure for analysis of Semivolatile Organic Compounds (Polynuclear Aromatic Hydrocarbons) Using EPA Compendium Method TO-13A & ASTM D 6209-13
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ERG-MOR-079	Standard Operating Procedure for Sample Login to the Laboratory Information Management System
ERG-MOR-084	Standard Operating Procedure for the Preparation and Extraction of High Volume Quartz and Glass Fiber Filters for Metals by ICP-MS using Method IO 3.1 and FEM Method EQL-0512-201
ERG-MOR-085	Standard Operating Procedure for the Preparation and Extraction of 47mm Filters for Metals by ICP-MS using Method IO 3.1 and FEM Method EQL-0512-202
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ERG-MOR-097	Standard Operating Procedure for Manual Integration of Chromatographic Peaks
ERG-MOR-098	Standard Operating Procedure for the Preparation of Monitoring Data for AQS Upload
ERG-MOR-099	Standard Operating Procedure for the Laboratory Information Management System
ERG-MOR-100	Standard Operating Procedure for Carbonyl System Certification
ERG-MOR-105	Standard Operating Procedure for Sample Canister Cleaning using the Wasson TO-Clean Automated System
ERG-MOR-108	Standard Operating Procedure for the Calibration and Verification of Support Equipment and Reference Standards
ERG-MOR-110	Standard Operating Procedure for the Management of Canister Certification and Inventory

ERG-MOR-111	Standard Operating Procedure for Corrective Action Reports
ERG-MOR-113	Standard Operating Procedure for PAMS AutoGC Data Validation

*These SOPs are not current because they are not in need. Once EPA/State/Local or Tribal agency requests this work, the SOP will be updated and provided to the EPA before work begins.

E Subcontractor QAPPs will be added if they are initiated

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SYMBOLS AND ABBREVIATIONS

AAC	Atmospheric Analysis and Consulting
AMTIC	Ambient Air Monitoring Technical Information Center
AQS	Air Quality Subsystem
ASTM	American Society for Testing and Materials
Auto-GC	Automatic Gas Chromatograph
BFB	4-Bromofluorobenzene
BS/BSD	Blank Spike/Blank Spike Duplicate
CAA	Clean Air Act
CAL2	Second Calibration Standard
CAR	Corrective Action Report
CCB	Continuing calibration blank
CCV	Continuing calibration verification
CFR	Code of Federal Regulations
COC	Chain of Custody
cps	Counts per second
CSATAM	Community Scale Air Toxics Ambient Monitoring
CV	Coefficient of Variation
DFTPP	Decafluorotriphenylphosphine
DL	Detection Limits
DNPH	2,4-Dinitrophenylhydrazine
DPR	Daily Performance Check
DQOs	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
ERG	Eastern Research Group, Inc.
ESMB	Extraction Solvent Method Blank
FAC	Federal Advisory Committee
FB	Field Blank
FC-43	perfluorotributylamine
FEM	Federal Equivalency Method
FID	Flame Ionization Detector
GC	Gas Chromatograph
GPRA	Government Performance and Results Act
HAPs	Hazardous Air Pollutant(s)

SYMBOLS AND ABBREVIATIONS (Continued)

He	Helium
H_2	Hydrogen
Hg	Mercury
HPLC	High Performance Liquid Chromatography
HSV	High standard verification
IC	Ion Chromatography
IC	Initial Calibration Standards (for ICP-MS)
ICAL	Initial Calibration
ICB	Initial Calibration Blank
ICP-MS	Inductively Coupled Plasma/Mass Spectrometer
ICSA/IFA	Interference Check Standard A
ICSAB/IFB	Interference Check Standard B
ICV	Initial calibration verification
ID	Identification
IR	Infrared
IS (or ISTD)	Internal Standard
KED	Kinetic Energy Discrimination
LCS	Laboratory Control Standard
LCV	Low Calibration Verification
LIMS	Laboratory Information Management System
LOQ	Limit of Quantitation
LRB	Laboratory Reagent Blank
m	Meter(s)
MB (or BLK)	Method Blank
MDLs	Method Detection Limit(s)
mL	Milliliter
mm	Millimeter
mM	Millimolar
MQOs	Measurement Quality Objective
MS	Mass Spectrometer
MS/MSD	Matrix Spike/Matrix Spike Duplicate

SYMBOLS AND ABBREVIATIONS (Continued)

µg/L	Micrograms per liter
µg/mL	Micrograms per milliliter
µg/m^3	Microgram per cubic meter
µL	Microliters
µm	Micrometer
N_2	Nitrogen
NAAQS	National Ambient Air Quality Standard
NATTS	National Ambient Toxics Trends Stations
ND	Not Detected
NIST	National Institute of Standards and Technology
NIOSH	National Institute for Occupational Safety and Health
ng	Nanogram
ng/m^3	Nanogram per cubic meter
nm	Nanometer
NMOC	Nonmethane Organic Compounds
NMP	National Monitoring Program
NO_x	Oxides of Nitrogen
O_3	Ozone
OAQPS	Office of Air Quality Planning and Standards
OD	Outer Diameter
OSHA	Occupational Safety and Health Administration
PAHs	Polycyclic Aromatic Hydrocarbons
PAMS	Photochemical Assessment Monitoring Stations
PCBs	Polychlorinated biphenyls
PDF	Portable Document Format
PDFID	Preconcentration Direct Flame Ionization Detection
PDS	Post digestion spike
PE	Performance Evaluation
POC	Parameter Occurrence Code
ppbC	Parts per Billion as Carbon
ppbV	Parts per Billion by volume
ppmC	Parts per Million as Carbon
psig	Pounds per square inch gauge

SYMBOLS AND ABBREVIATIONS (Continued)

PT	Proficiency Testing
PUF	Polyurethane Foam
QA	Quality Assurance
QAPPs	Quality Assurance Project Plan(s)
QC	Quality Control
QL	Quantitation Limit
RD	Raw Data
RE	Relative Error
RF	Response Factor
RfCs	Reference Concentration
RPD	Relative Percent Difference
RRF	Relative Response Factor
RRTs	Relative Retention Times
RSD	Relative Standard Deviation
RTS	Retention Time Standards
RT	Retention Time
RTP	Research Triangle Park
SCV	Secondary Source Calibration Verification
SIM	Selected Ion Monitoring
SIP	State Implementation Plan
SMB	Solvent Method Blank
SNMOC	Speciated Nonmethane Organic Compounds
SOPs	Standard Operating Procedure(s)
SQL	Sample Quantitation Limit
SRD	Serial dilution
SRM	Standard Reference Material
SSQC	Second Source Quality Control
STI	Sonoma Technology, Inc.
SVOC	Semivolatile Organic Compounds
TAD	Technical Assistance Document
TNI	The National Environmental Laboratory Accreditation Conference Institute
TSAs	Technical System Audits
TSP	Total Suspended Particulate
UAM	Urban Airshed Model

SYMBOLS AND ABBREVIATIONS (Continued)

UATMP	Urban Air Toxics Monitoring Program
UPS	United Parcel Service of America
UREs	Unit Risk Estimate
UV	Ultraviolet
VOCs	Volatile Organic Compound

DISTRIBUTION LIST

Copies of this plan and all revisions will be provided to:

- Jeff Yane, Work Assignment Manager, U.S. EPA, C404-02, RTP, NC
- Xi (Doris) Chen, Delivery Order Manager, U.S. EPA, C339-02, RTP, NC
- Greg Noah, AT QA Coordinator, U.S. EPA, C304-06, RTP, NC

U.S. EPA Regional contacts may obtain a copy of the QAPP by contacting the ERG Program Manager. It is the responsibility of each Regional contact to make copies of the plan for appropriate State personnel or to refer them to ERG Program Manager. The ERG staff working on this contract will receive a copy of this QAPP and all revisions.

PROJECT MANAGEMENT
SECTION 1
PROJECT/TASK ORGANIZATION

1.1 Assignment of Program Personnel

Table 1-1 presents the program organization listing the program assignment and responsible person for each aspect of the Environmental Protection Agency (EPA) National Monitoring Programs (NMP). The program organizational chart is presented in Figure 1-1. All Eastern Research Group, Inc. (ERG) staff working on this contract are provided access to a current electronic copy of this signed, EPA approved Quality Assurance Project Plan (QAPP).

ERG's primary support on this contract includes Nonmethane Organic Compounds (NMOC), Speciated Nonmethane Organic Compounds (SNMOC), Volatile Organic Compounds (VOCs), Polycyclic Aromatic Hydrocarbons (PAHs), Metals, Hexavalent Chromium, and other Hazardous Air Pollutants (HAPs). Subcontracting services are extended by ChromIan for onsite technical assistance for Photochemical Assessment Monitoring Stations (PAMS) analysis, Sonoma Technology, Inc. (STI) for data validation, Atmospheric Analysis and Consulting, Inc. (AAC) Lab for VOCs by Method TO-17, pesticides/Polychlorinated biphenyls (PCBs), anions, diisocyanates, and 4,4'-methylenedianiline, and RTI International for metals analysis, in the event of a large workload.

ERG is responsible to the client for the work of the subcontractor and choosing subcontractors that meet the applicable requirements for the methods and contracts. The subcontractor should meet the Data Quality Objectives (DQOs) requirements for the appropriate method. ERG shall maintain a record of subcontractor compliance, including documentation of subcontractor's Method Detection Limits (MDLs), QAPPs, etc. Sample analysis will not begin with the subcontractor until MDLs, QAPPs, etc., have been approved by EPA and ERG. Before sample analysis, the subcontractor may perform Proficiency Testing (PT) samples and/or Technical System Audits (TSAs) if they are available through Office of Air Quality Planning and Standards (OAQPS). If such measures are not

available, ERG will request audit reports performed by the subcontract lab and will supply PT audits if requested by the EPA when analysis is contracted with the laboratory.

1.1.1 Program Manager

Ms. Julie Swift, an ERG Vice President, serves as the Program Manager for EPA's NMP. In this role, she has the primary responsibility for understanding program level needs, both EPA's and their clients' (i.e., State, Local, and Tribal agencies). Ms. Swift is ultimately accountable for providing timely, cost effective, and high-quality services that meet the needs of the NMP efforts. Her responsibility is ensuring EPA/client satisfaction by verifying that all components necessary for effective management are in place and active during the contract performance period. Ms. Swift coordinates with the ERG Quality Assurance (QA) Coordinator, and task leaders to provide EPA/client perspective, communicate technical issues and needs, and ensure the program staff facilitates decisions appropriate to their roles on Contract EP-D-14-030. She prepares budgetary and schedule information and prepares all information for presentation to EPA at scheduled program meetings. As the Program Manager, Ms. Swift is responsible for the technical operation and the quality of the program on a day-to-day basis. She leads the analytical tasks and provides technical direction and support. She assists in the resolution of technical issues and serves as a resource for Task Leaders regarding any project issues. Ms. Swift also performs an overall review of the data that is reported monthly.

1.1.2 Program Technical Adviser

The Program Technical Adviser, Mr. Mitchell Howell assists in the resolution of technical issues. He communicates with ERG management and the technical staff for discussion of real and potential technical problems. He peer reviews draft and final program report products and provides oversight of efforts to evaluate and characterize data.

1.1.3 Program QA Coordinator

Ms. Donna Tedder, the Program and Laboratory QA Coordinator, is responsible for ensuring the overall integrity and quality of project results. Ms. Tedder, or her designee, will do a 10 percent QA review for all sample analyses delivered for reporting by the Program Manager. In the case of subcontracted work, 20 percent of data from subcontractor will be reviewed. The lines of communication between management, the Program QA Coordinator, and the technical staff are formally established and allow for discussion of real and potential problems, preventive actions, and corrective procedures. The key Quality Control (QC) responsibilities and QC review functions are summarized in Table 1-2. On major quality issues, Ms. Tedder reports independently to Ms. Jan Connery, ERG's corporate QA Officer.

1.1.4 Deputy Program QA Coordinator

The Deputy Program QA Coordinator, Ms. Jennifer Nash, is responsible for ensuring the integrity and quality of project results. The Deputy QA Coordinator will assist the Program QA Coordinator with the QA review for sample analyses delivered for reporting by the Program Manager. The major QC responsibilities and QC review functions are summarized in Table 1-2. The Deputy QA Coordinator will work closely with the Program QA Coordinator to ensure the overall quality of the Program. Ms. Nash is also the HAPs Support Task Leader and as such, will not do any of the QA review duties for these tasks.

1.1.5 Task Leaders

ERG Task Leaders are responsible for meeting the project objectives, meeting report schedules, and directing the technical staff in execution of the technical effort for their respective task(s). The Task Leaders will review 100 percent of all sample analyses. The Program QA Coordinator will request 10 percent of that data for review prior to data reporting by the Program Manager. The Task Leaders manage the day-to-day technical activities on delivery orders for this program. They assess and report on the project's progress and results (e.g., recordkeeping, data validation procedures, sample turnaround time) and ensure timely, high-quality services that meet the requirements in this QAPP.

Table 1-1
Program Organization

Program Assignment	Program Personnel Assigned	Phone Number	Email Address
Program Manager	Julie Swift	(919) 468-7924	julie.swift@erg.com
Task Leader - Network Site Coordination	Randy Bower	(919) 468-7928	randy.bower@erg.com
Task Leader - Shipping and Receiving	Kelly Barnes	(919) 468-7861	kelly.barnes@erg.com
Task Leader - Air Toxics	Randy Bower	(919) 468-7928	randy.bower@erg.com
Task Leader - Carbonyl Analysis	Agustina Illan	(919) 468-7887	agustina.illan@erg.com
Task Leader – Hexavalent Chromium	Glenn Isom	(919) 468-7940	glenn.isom@erg.com
Task Leader – Metals	Brodie Clark	(919) 468-7920	brodie.clark@erg.com
Task Leader - NMOC/SNMOC Analysis	Mitchell Howell	(919) 468-7915	mitch.howell@erg.com
Task Leader - Semivolatiles	Chris Kopp	(919) 468-7945	chris.kopp@erg.com
Task Leader - PAMS Support *	Julie Swift	(919) 468-7924	julie.swift@erg.com
Task Leader - HAPs Support **	Jennifer Nash	(919) 468-7881	jennifer.nash@erg.com
Task Leader - Data Characterization	Regi Oommen	(919) 468-7829	regi.oommen@erg.com
Task Leader - Annual Report/AQS Entry	Jaime Hauser	(919) 468-7813	jaime.hauser@erg.com
Program Technical Adviser	Mitchell Howell	(919) 468-7915	mitch.howell@erg.com
Program QA Coordinator	Donna Tedder	(919) 468-7921	donna.tedder@erg.com
Deputy QA Coordinator	Jennifer Nash	(919) 468-7881	jennifer.nash@erg.com
Project Administrator	Kerry Fountain	(919) 468-7962	kerry.fountain@erg.com

*Subcontracting support when requested from ChromIan and STI.
**Subcontracting support when requested from AAC and RTI International (miscellaneous HAPs).

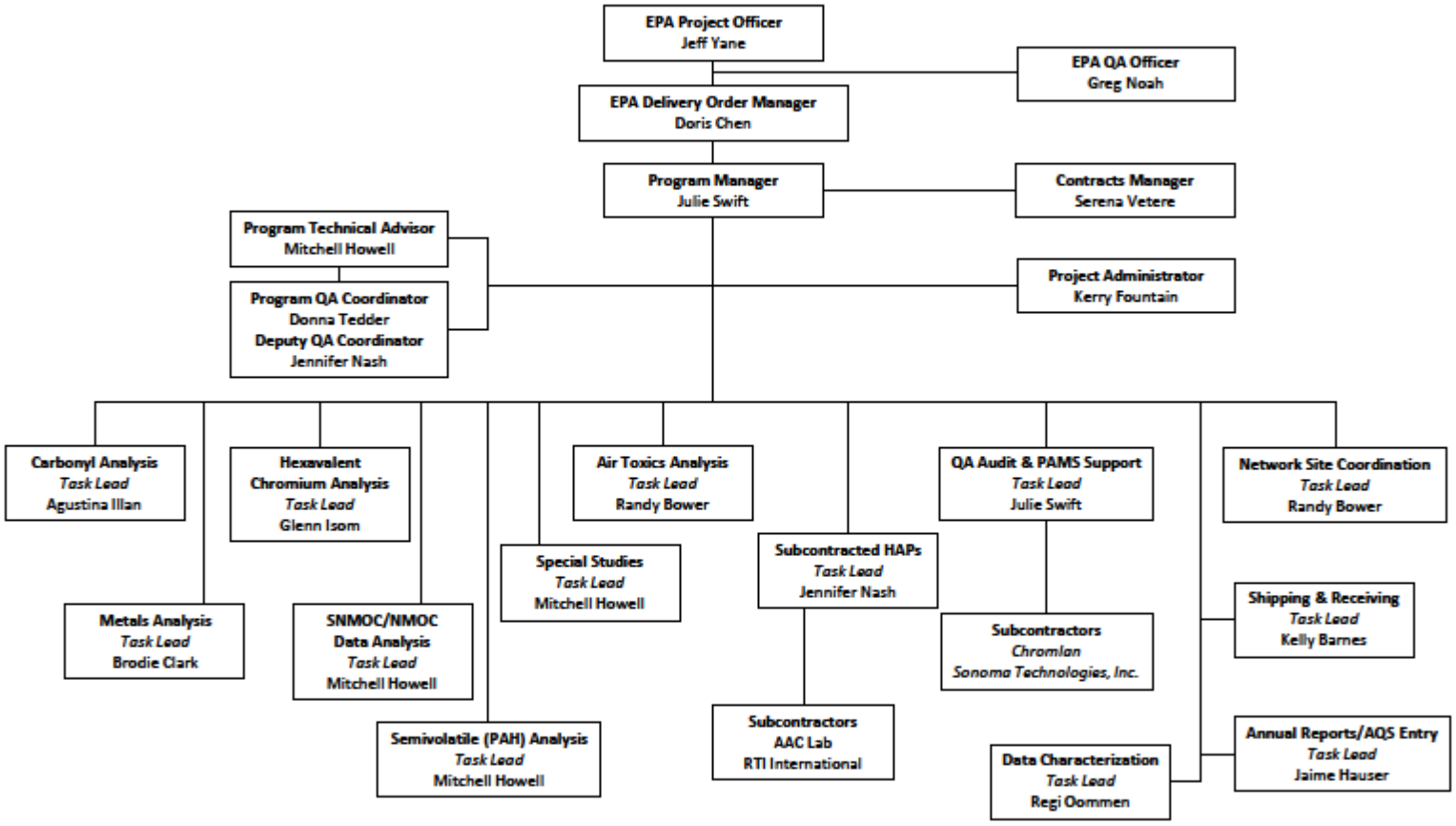


Figure 1-1. National Monitoring Programs Organizational Chart

Table 1-2
QC Responsibilities and Review Functions

Responsible Person	Major Responsibilities
Ms. Julie Swift, Program Manager	• Ensure overall timely performance of high quality technical services • Communicate technical issues and needs • Assist in the resolution of technical problems • Track all management systems and tools • Track deliverables and budget performance • Ensure appropriate level of staffing and committed resources exist to perform work • Communicate daily with the EPA/State/Local/Tribal agencies • Ensure data quality • Check information completeness • Review data completeness and quality before reporting to client • Review all reports • Report project performance (budget and deliverables) to EPA at scheduled meetings and in monthly progress reports • Day-to-day management of task leaders
Mr. Mitchell Howell, Program Technical Adviser	• Assist in the resolution of technical problems • Communicate potential technical issues and needs • Review draft and final data reports
Ms. Donna Tedder, Program QA Coordinator	• Make QA recommendations • Review QAPP • Audit laboratory • Review QA reports • Evaluate the effect of technical issues on data quality • Review 10% of all data for reporting • Review documentation [Standard Operating Procedures (SOPs), reports, etc.]
Ms. Jennifer Nash, Deputy Program QA Coordinator	• Assist QA Coordinator where needed • Make QA recommendations • Review QAPP • Assist with laboratory audit(s) • Evaluate the effect of technical issues on data quality • Review 10% of all data for monthly reporting • Review documentation (SOPs, reports, etc.)

Table 1-2
QC Responsibilities and Review Functions (Continued)

Responsible Person	Major Responsibilities
Task Leader(s)	• Review documentation • Review 100% of analytical data generated by analysts • Develop analytical procedures • Propose procedural changes • Train and supervise analysts • Meet task report schedules • Manage day-to-day technical activities • Check information completeness • Review instrument and maintenance logbooks • Review calibration factor drift • Perform preventive maintenance

SECTION 2
PROBLEM DEFINITION/BACKGROUND

The Clean Air Act (CAA) Amendments of 1990 required EPA OAQPS to set National Ambient Air Quality Standard (NAAQS) for the "criteria" pollutant ozone (O_3). In areas of the country where the NAAQS for O_3 was being exceeded, additional measurements of the ambient NMOC were needed to assist the affected States in developing/revising O_3 control strategies. Measurements of ambient NMOC are important to the control of VOCs that are precursors to atmospheric O_3. Due to previous difficulty in obtaining accurate NMOC concentration measurements, EPA started a monitoring and analytical program in 1984 to provide support to the States. ERG has continuously supported EPA for the NMOC programs since 1984.

In 1987, EPA developed the Urban Air Toxics Monitoring Program (UATMP) to help State, Local and Tribal air monitoring agencies characterize the nature and extent of potentially toxic air pollution in urban areas. Since 1987, several State and local agencies have participated in the UATMP by implementing ambient air monitoring programs. These efforts have helped to identify the toxic compounds most prevalent in the ambient air and indicate emissions sources that are likely to be contributing to elevated concentrations. Studies indicate that a potential for elevated cancer risk is associated with certain toxic compounds often found in ambient urban air[(1)]. As a screening program, the UATMP also provides data input for models used by EPA, State, local and risk assessment personnel to assess risks posed by the presence of toxic compounds in urban areas. The UATMP program is a year-round sampling program, collecting 24-hour integrated ambient air samples at urban sites in the contiguous United States every 6 or 12 days.

The SNMOC program was initiated in 1991 in response to requests by State agencies for more detailed speciated hydrocarbon data for use in O_3 control strategies and Urban Airshed Model (UAM) input.

Title I, Section 182 of the CAA Amendments of 1990 requires States to establish PAMS as part of their State Implementation Plan (SIP) for O_3 nonattainment areas. The rule revises the ambient air quality surveillance regulations to include enhanced monitoring of O_3 and its precursors. The regulations promulgated in 1993 require monitoring of O_3, oxides of nitrogen (NO_x), selected carbonyl compounds, and VOCs. The required monitoring is complex and requires considerable lead time for the agencies to acquire the equipment and expertise to implement their PAMS network. Under the PAMS program, each site may require a different level of support with respect to sampling frequency, sampling equipment, site support, sample analyses, data validation, and report preparation. Presampling, sampling, and analytical activities are performed according to the guidance provided in the Technical Assistance Document (TAD)[(2)], for Sampling and Analysis of Ozone Precursors, Revision 2, April 2019. The program objective of PAMS is to provide data that are consistent with the proposed rule for ambient air quality surveillance regulations in accordance with Code of Federal Regulations (CFR) Title 40, Part 58 Appendix D Section 5. The ERG team offers carbonyl samplers, carbonyl sample analysis, data validation, site support, and data reporting, and PAMS VOC automatic gas chromatograph (auto-GC) technical site support, data validation, and data reporting. The specific analytical methodology applicable to the PAMS program will be discussed in this QAPP.

In 1999, EPA expanded this program to provide measurements of additional CAA HAPs to support the Government Performance and Results Act (GPRA). As required under the GPRA, EPA developed a Strategic Plan that includes a goal for Clean Air. Under this goal, there is an objective to improve air quality and reduce air toxics emissions to levels 75 percent below 1993 levels by 2010 in order to reduce the risk to Americans of cancer and other serious adverse health effects caused by airborne toxics.

In 2001, EPA designed a national network for monitoring air toxics compounds present in ambient air entitled the National Ambient Toxics Trends Station (NATTS). The primary purpose of the NATTS network is tracking trends in ambient air toxics levels to facilitate measuring progress toward emission and risk reduction goals. The monitoring network is

intended for long term operation for the principle purpose of discerning national trends in air toxics ambient concentrations.

Beginning in 2003/2004, EPA conducted periodic Community Scale Air Toxics Ambient Monitoring (CSATAM) grant competitions. The resultant 1- to 2-year grants are designed to help State, Local, and Tribal communities identify and profile air toxics sources, characterize the degree and extent of local air toxics problems, and track progress of air toxics reduction activities. Grants have been awarded across the United States, in large, medium, and small communities. The ERG team can offer site support and analysis to any agency for the UATMP, NATTS and CSATAM programs.

The data obtained by following this QAPP will be used by EPA, State, Local, Tribal and risk assessment personnel to determine prevalent O_3 precursors and air toxics in the urban air. The data collected from the continuous yearly sites gives the data analyst consistent high quality analytical results. Sampling and analytical uncertainties are determined through this program by performing 10 percent sampling duplicate (or collocated) and analytical replicate samples for each of the ambient air sites.

This QAPP defines the preparation, sampling, laboratory analyses and QA/QC procedures conducted by ERG for EPA's NMP to deliver data of sufficient quality to meet the programs' objectives. Many of these procedures described in this QAPP are based on experiences obtained during previous National Program Studies.

SECTION 3
PROJECT/TASK DESCRIPTION

This section describes the activities performed under each of the major EPA NMP components (NMOC, SNMOC, UATMP, CSATAM, NATTS, and PAMS). ERG dedicates passivated canisters, sampling equipment and expendable sampling media to the program to maintain known quality that meets the program objectives. An applicable measurement methods list is presented in Table 3-1. Sampling and analysis are determined when delivery orders are provided by EPA.

3.1 PAMS, NMOC and SNMOC

The program objective of PAMS is to provide data that are consistent with the proposed rule for Ambient Air Quality Surveillance in accordance with 40 CFR Part 58 Appendix D Section 5. The ERG team can offer site support to any State that needs to set up a PAMS site, carbonyl, auto-GC, or canister site, and/or maintain it with technical help. ERG offers carbonyl and/or canister sample analysis, support with data validation and data reporting. Canister and/or carbonyl samples are collected typically every 3 days by State/Local/or Tribal agency personnel starting on the first sampling day in June through the end of August at each of the designated sites. ERG also performs certifications of PAMS carbonyl samplers and of the PAMS retention time standard (RTS) and calibration standard compressed gas cylinders.

The NMOC and SNMOC programs require collection of ambient air samples over a 3-hour period. This sample collection period occurs every third day. Three sequential 8-hour samples are to be collected on each sampling day, according to the following time schedule, standard local time, unadjusted for daylight savings time:

04:00 to 12:00 p.m. (noon)

12:00 p.m. (noon) to 20:00

20:00 to 04:00

ERG can provide NMOC/SNMOC samplers, sampler training, and any technical assistance needed throughout the monitoring program. At least one week before each sample collection episode, ERG ships the necessary clean, certified canisters and/or carbonyl cartridges to the site along with the field chain of custody (COC) forms. The time-integrated ambient samples are then collected and shipped to ERG for analysis.

3.2 UATMP, NATTS and CSATAM

The UATMP program was initiated as an analytical/technical support program focused on ascertaining ambient air levels of organic toxic species. The program has since expanded to provide for the measurement of additional HAPs and the standard sample collection frequency was increased to 1 in 6 days, with some sites continuing at 1 in 12 days.

The NATTS Network is intended for long term operation for the principle purpose of discerning national trends. The primary purpose of the NATTS network is tracking trends in ambient air toxics levels to facilitate measuring progress toward emission and risk reduction goals. The monitoring network is intended to be able to detect a 15 percent difference (trend) between two successive 3-year annual mean concentrations within acceptable levels of decision error. The standard sample collection frequency is 1 in 6 days.

The program objective of the CSATAM Program is designed to help State, Local, and Tribal communities identify and profile air toxics sources, characterize the degree and extent of local air toxics problems, and track progress of air toxics reduction activities. Grants have been awarded across the entire United States, in large, medium, and small communities. Awarded grants fall into one of three categories: community-scale monitoring, method development/evaluation, and analysis of existing data. The sample collection frequency may be 1 in 6 days or 1 in 12 days. Targeted pollutants generally reflect the NATTS core compounds, criteria pollutants, and/or pollutants related to diesel particulate matter.

The ERG team can offer site support and sample analysis to any State that needs VOC, carbonyl, or other analyses for the PAMS, UATMP, NATTS and CSATAM programs, as shown in Table 3-1. Relevant SOPs are also referenced in the table.

Table 3-1
List of Analytical and Support Services

Analysis	Based on Method	SOP (ERG-MOR-XXX)
Analysis		
Total NMOC	TO-12[3]	-060***
Speciated NMOC/PAMS Hydrocarbons via GC/FID	TAD for Ozone Precursors[2]	-005
VOCs via GC/MS	TO-15[4]	-005*
Concurrent SNMOC and VOC via GC/MS/FID	TAD for Ozone Precursors[2]/TO-15[4]	-005
Carbonyls via HPLC	TO-11A[5]	-024
PM_{10} HAP Metals via ICP-MS	IO-3.5[6]/EQL-0512-201[7]/ EQL-0512-202[8]	-095
TSP Hexavalent Chromium via IC	ASTM D7614[9]	-063
SVOC analysis via GC/MS (SCAN)	TO-13A[10] / Method 8270E[11]	-044***
PAH analysis via GC/MS (SIM)	TO-13A[10] / ASTM D6209[12]	-049
PCB/Pesticides via GC *	TO-4A[13]	*
Anions via IC *	NIOSH 7906 – Particulate Fluorides[14] NIOSH 7907 – Volatile Acids[15] NIOSH 7908 – Non-Volatile Acids[16] **	*
VOCs via GC/MS (from cartridge) *	TO-17[17]	*
Diisocyanates *	OSHA Method 42[18]	*
4,4'-Methylenedianiline *	NIOSH Method 5029[19]	*
Site Support		
NMOC/SNMOC	TAD for Ozone Precursors[2]	-046***
VOC	TO-15[4]	-003
Carbonyls	TO-11A[5]	-003 or -047
Hexavalent Chromium	ASTM D7614[9]	-013
PAMS Technical	TAD for Ozone Precursors[2]	NA
PAMS Data Validation	TAD for Ozone Precursors[2]	NA

*Will be supplied by subcontractor when analysis is requested.
**NIOSH Method 7903 was replaced with 7906, 7907 and 7908.
***SOP is currently archived but will be updated if needed for sample analysis.

Table 3-1
List of Analytical and Support Services (Continued)

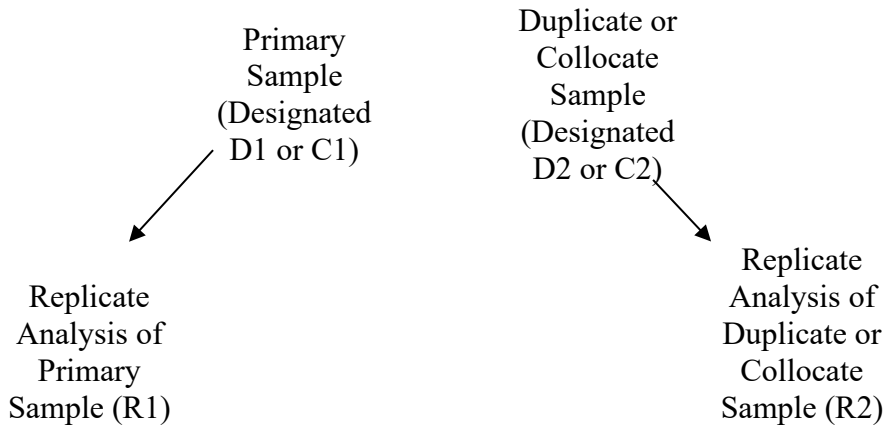
Analysis	Based on Method	SOP (ERG-MOR-XXX)
Other Services		
Performance Samples for VOC	TO-15[4]	-005 and -061
Performance Samples for Carbonyls	TO-11A[5]	-024
Performance Samples for PAH	TO-13A[10] / ASTM D6209[12]	-049
Performance Samples for PM10 HAP Metals	IO-3.5[6]/EQL-0512-201[7]/ EQL-0512-202[8]	-095
Performance Samples for TSP Hexavalent Chromium	ASTM D7614[9]	-063
Sampler Certification for Carbonyls	TO-11A[5]	-100
Sampler Certification for VOC	TO-15[4]	-030
Uniform Calibration Standards	TO-15[4]	NA
AQS Data Entry (per pollutant group)	NA	-098
Report Development/Data Characterization	NA	NA

*Will be supplied by subcontractor when analysis is requested.
**NIOSH Method 7903 was replaced with 7906, 7907 and 7908.
***SOP is currently archived but will be updated if needed for sample analysis.

ERG can provide sampler, sampler training, and any technical assistance needed throughout the monitoring program. Canister, carbonyl, and other HAPs samples are collected by State/Local/or Tribal agency personnel every 6 or 12-days at each of the designated sites. At least one week before each sample collection episode, ERG ships the necessary clean, certified canisters and/or sampling media to the site along with the field COC forms. The time-integrated ambient samples are then collected and shipped to ERG for analysis.

ERG then prepares the program data for a final annual report describing sampling and analysis procedures, results, discussion of results, compilation of statistics, and recommendations. To determine the overall precision of analysis for the programs, replicate analyses (10 percent of the total number of samples) are used following the schematic shown in Figure 3-1. ERG provides the final data summaries to the associated agencies electronically in Excel® and Adobe® formats. ERG staff finalizes and uploads the data into the Air Quality Subsystem (AQS) database.

Figure 3-1. Duplicate/Collocate and Replicate Analysis Schematic



SECTION 4
DATA QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

As ERG performs measurement services only, DQOs for defining a toxics network program are not identified in this QAPP. A well-prepared description of the Measurements Quality Objectives (MQOs) can be found in the TAD for the NATTS Program prepared for EPA in October 2016[20]. This section will discuss the MQOs of the ERG laboratory analyses, emphasizing the levels of uncertainty the decision maker is willing to allow/accept from the analytical results. The DQOs for the four programs – NMOC, UATMP, PAMS, and CSATAM – are similar but are not identical. Therefore, the programs are discussed separately.

The NATTS TAD presents the requirements for collecting and reporting data for the NATTS network. Eighteen compounds have been identified as major risk drivers based on a relative ranking performed by EPA and have been designated as NATTS Core or "Tier I" compounds. All other reported compounds, for any NMP, are considered compounds of interest, but do not necessitate the NATTS MQOs. The Tier I compounds are acknowledged throughout this document. ERG exemptions from the NATTS TAD are listed in Appendix A.

Once a DQO is established, the quality of the data must be evaluated and controlled to ensure that data quality is maintained within the established acceptance criteria. MQOs are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that the total measurement uncertainty is within the range prescribed by the DQOs. MQOs can be defined in terms of the following data quality indicators:

Precision - a measure of mutual agreement between individual measurements performed according to identical protocols and procedures. This is the random component of error.

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

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

Bias - the systematic or persistent distortion of a measurement process that causes error in one direction. Bias is determined by estimating the positive and negative deviation from the true value as a percentage of the true value.

Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. Data completeness requirements are included in the reference methods (see Section 3, Table 3-1).

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

Reporting units are consistent for each site across the network to ensure that the data can be reviewed with minimal manipulation. The units for each of the analytes are listed below:

- NMOC – parts per million by Carbon (ppmC)
- SNMOC – parts per billion by Carbon (ppbC)
- VOCs – parts per billion by volume (ppbV)
- Carbonyls – microgram per cubic meter ($\mu g/m^3$) or ppbV
- Metals – nanogram per cubic meter (ng/m^3)
- Hexavalent Chromium – ng/m^3
- Semivolatiles –ng/m^3
- PCB/Pesticides – ng/m^3
- Anions – ppbv
- VOC via cartridge – ppbv
- Diisocyanates - $\mu g/m^3$
- 4,4'-Methylenedianaline - $\mu g/m^3$

Analytical Precision is calculated by comparing the differences between Replicate analyses (two analyses of the same sample) from the arithmetic mean of the two results as shown below. Replicate analyses with low variability have a lower Relative Percent Difference (RPD) (better precision), whereas high variability samples have a higher RPD (poorer precision).

$$RPD = \frac{|X_1 - X_2|}{\bar{X}} \; x \; 100$$

Where:

X_1 = Ambient air concentration of a given compound measured in one sample;
X_2 = Concentration of the same compound measured during replicate analysis;
$\overline{X}$ = Arithmetic mean of X_1 and X_2.

Method precision is calculated by comparing the concentrations of the duplicates/collocates for each pollutant. The Coefficient of Variation (CV) calculation shown below is ideal when comparing paired values, such as a primary concentration versus a duplicate concentration.

$$CV = 100 \times \sqrt{\frac{\sum_{i=1}^{n}\left[\frac{(p-r)}{0.5 \times (p+r)}\right]^2}{2n}}$$

Where:

p = the primary result from a duplicate or collocated pair;
r = the secondary result from a duplicate or collocated pair;
n = the number of valid data pairs (the 2 adjusts for the fact that there are two values with error).

Bias has been the term frequently used to represent closeness to "truth" and includes a combination of precision and bias error components. Bias is determined through the analysis of PT samples. NATTS PT samples are provided bi-yearly for each of the four sample classes, VOC, carbonyls, metals and semivolatiles. The MQOs listed will attempt to separate measurement uncertainties into precision and bias components. Table 4-1 lists the MQOs for pollutants to be measured in all areas of the UATMP, NATTS, CSATAM, PAMS, and NMOC program.

Table 4-1
Measurement Quality Objectives for the National Program (UATMP, NATTS, CSATAM, PAMS, NMOC)

Program	Precision from analysis of Replicate Samples (RPD)	Precision (CV) from collection of Duplicate/Collocate Samples	Representativeness	Comparability/ Based on Method	Bias	Completeness	Sensitivity (MDL)*
NMOC	≤ 10%	≤ 20%	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	GC-PDFID EPA Compendium Method TO-12(3)	± 25%	≥85%	To be determined upon need
SNMOC	≤ 25% for concentrations ≥ 5x MDL	≤ 25% for concentrations ≥ 5x MDL	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	GC-FID TAD for O_3 Precursors (2)	± 25%	≥85%	See Table 11-11
VOC	≤ 25% for concentrations ≥ 5x MDL	≤15% for concentrations ≥ 5x MDL	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	GC-FID/MS EPA Compendium Method TO-15(4)	± 25%	≥85%	For NATTS Tier I, see NATTS TAD Table 4.1-1 Others, see Table 11-12
Carbonyls	≤ 10% ≥ 0.5 µg/cartridge	≤15% for concentrations ≥ 0.5 µg/cartridge	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	HPLC EPA Compendium Method TO-11A(5)	± 25%	≥85%	For NATTS Tier I, see NATTS TAD Table 4.1-1 Others, see Table 11-13
Metals	≤ 20% for concentrations ≥ 5x MDL	≤15% for concentrations ≥ 5x MDL	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	ICPMS IO-3.5(6)/EQL-0512-201(7)/ EQL-0512-202(8)	± 25%	≥85%	For NATTS Tier I, see NATTS TAD Table 4.1-1 Others, see Table 11-15
Hexavalent Chromium	≤ 20% for concentrations > 5x MDL	≤ 15% for concentrations > 5x MDL	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	IC-UV Detector ASTM D7614(9)	± 25%	≥85%	XXXXX ng/m^3

Table 4-1

Measurement Quality Objectives for the National Program (UATMP, NATTS, CSATAM, PAMS, NMOC) (Continued)

Program	Precision from analysis of Replicate Samples (RPD)	Precision (CV) from collection of Duplicate/Collocate Samples	Representativeness	Comparability/ Based on Method	Bias	Completeness	Sensitivity (MDL)
Semivolatiles	≤ 10% for conc. ≥ 0.5 µg/mL or lowest ICAL level, whichever is less	≤15%, for conc. ≥ 0.5 µg/mL or lowest ICAL level, whichever is less	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	GC/MS EPA Compendium Method TO-13A[10] and ASTM D6209[12], (or SW-846 Method 8270E[11])	± 25%	≥85%	For NATTS Tier I, see NATTS TAD Table 4.1-1 Others, see Table 11-14
PCB/ Pesticides	≤ 15%	≤ 15%	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	GC EPA Compendium Method TO-4A[13]	± 25%	≥85%	To be determined upon need
Anions	≤ 15%	≤ 15%	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	IC NIOSH Method 7906[14], 7907[15], 7908[16]	± 25%	≥85%	To be determined upon need
VOCs via cartridge	≤ 15%	≤ 15%	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	GC/MS EPA Compendium Method TO-17[17]	± 25%	≥85%	To be determined upon need
Diisocyanates	≤ 15%	≤ 15%	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	HPLC OSHA Method 42[18]	± 25%	≥85%	To be determined upon need
4,4'-Methylene-dianiline	≤ 15%	≤ 15%	24 hours ± 1 hours, flag samples 22-23 hours and 25-26 hours	HPLC NIOSH Method 5029[19]	± 25%	≥85%	To be determined upon need

SECTION 5
SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

The activities of EPA's NMP are performed using accepted EPA, National Institute for Occupational Safety and Health (NIOSH), and Occupational Safety and Health Administration (OSHA) sampling and analytical protocols for the field sampling training personnel and analytical laboratory staff.

5.1 Field Activities Training Personnel

Field activities training personnel involved in this project have over 30 years of experience in the duties they will be performing in the field. The training of ERG field activities personnel is recorded in the ERG Training Records files. Special certification is not needed for an operator to set up the sampling systems. Each State should document and record the training of their personnel on the field testing procedures provided by ERG.

The States' field testing staff will be subject to on-site surveillance by EPA. ERG's Task Leader will provide appropriate corrective action enforcement, if necessary, for the ERG personnel setting up the sampling equipment and the field testing staff. ERG provides on-the-job training in the field on sampler use and maintenance, for supervisors and field site operators. The appropriate SOPs used during training are presented in Appendix D. ERG does not provide SOPs for sampling systems that are not maintained by ERG. Sampling System Training forms used during operator training in the field is presented in Figure 7.2 for VOC/Carbonyl and Carbonyl samplers. The forms will only be provided when new site personnel are trained on the sampling systems. After training is completed and signed in the field, the yellow copy is retained for site records. The original copy is scanned in the laboratory and stored by the QA coordinator.

The sampling equipment for monitoring sites may be inside a sampling building or outside. There are no hazards inherent to the samplers and no special safety training or equipment will be required. Site hazards should be addressed on a site-by-site basis by the site

operator's SOPs. All ERG field activities training personnel will follow the ERG Corporate Health and Safety Plan.

5.2 Analytical Laboratory Personnel

Analytical laboratory personnel involved in this project have been trained in their tasks and have over 30 years of experience in the duties they will be performing in the analytical laboratory. Training of ERG laboratory personnel is recorded in ERG Training Records in an Excel® database and filed as a hardcopy. It is the responsibility of the trainee and the laboratory's Project Administrator to keep the Training Records up to date. It is the responsibility of the Program Manager and Quality Assurance Coordinator to approve analysis training records. Technical training and overview are provided to the analyst by the Task Leader for that analysis. Technical training includes general techniques and specific training based on the appropriate SOP, method, and program QAPP. The trainee first observes the task, then performs the task under supervision of the trainer, then performs the task under supervision of the Task Lead (if the Task Lead is not the trainer). After training, demonstration of each personnel's ability to perform an analytical task involves repeated measurements of a standard, which is described in more detail in each analytical SOP. Currently, no special certifications are needed for the analysis of the ambient samples received for these programs.

ERG maintains appropriate SOPs for each of the analytical methods. These SOPs are presented in Appendix D. All SOPs document equipment and/or procedures required to perform each specific laboratory activity. Laboratory staff will be subject to on-site surveillance by the QA staff and periodic performance evaluation (PE) samples. These audits will assure the program that the appropriate analysts and analytical procedures are being used. The samples involved in this program are generated by monitoring air emissions. Health and Safety training is performed annually. The laboratory personnel will adhere to the ERG Corporate Health and Safety manual.

SECTION 6
DOCUMENTATION AND RECORDS

The EPA NMP are a collection of individual ambient monitoring programs that generate documents and records that need to be retained/archived. All ERG staff working on this contract are provided access to a current electronic copy of this signed, EPA approved QAPP. Annually, the staff is required to sign a form to document that they read and understood the QAPP. In this QAPP, ERG's reporting package (information required to support the analytical results) includes all data required to be collected as well as support data deemed important by ERG/EPA.

6.1 Data Management

ERG has a structured records management system that allows for the efficient archive and retrieval of records. Each laboratory archives the data from the computer systems onto the shared network drive. The laboratory paper copies of all analyses are stored on site in a secured temperature-controlled area for at least five years after the close of the contract. The laboratory also archives the data in the Laboratory Information Management System (LIMS) data server, which is backed up weekly, monthly, and biannually. The Program Manager has final authority for the storage, access to, and final disposal of all records kept for the EPA NMP.

6.2 Preliminary Monthly Data Reports

Preliminary monthly summary data reports are sent in Adobe Portable Document Format (PDF) and Excel formats to EPA and appropriate State/Local/Tribal agencies. The monthly data reports includes analytical results, associated MDL, final units, associated QC samples, and data qualifiers.

6.3 Quarterly QA Report

A QA report for each type of data analysis is sent to EPA and appropriate State/Local/Tribal agencies on a quarterly basis in the form of control charts including initial calibration verifications, continuing calibration verifications, method blanks, initial calibration blanks, continuing calibration blanks, and blank spikes.

6.4 Annual Summary Reports Submitted to EPA

Beginning with the 2017 sampling year, the written annual report was replaced with a QlikSense® app, which allows users to view and explore data visualizations on their own. The QlikSense app is provided to EPA in the form of a mash-up, or web page developed from the app, and is housed on EPA's server. The intent is for EPA to make the app publicly available such that State/Local/Tribal clients can access the app. The data products are based on data collected from January 1 to December 31 for a given year. The data products contained in the app are similar to those presented in past annual reports and can contain the following information:

- A summary of site- and laboratory-specific happenings affecting data collected in a given year;
- Names of participating sites and corresponding metadata information, including city name, location and the AQS codes;
- Completeness of the monitoring effort for each site;
- General combined and individual site statistical summary of the year's results;
- Risk screening evaluations using toxicity factors [e.g., Unit Risk Estimate (UREs) or Reference Concentration (RfCs)];
- For specific HAPs identified via the risk screening evaluation, summary statistics, time-series plot, bar charts and table presenting annual and quarterly average concentrations, and historical box and whisker plots (where applicable).
- Results of coefficient of variation calculations used to assess precision; and

- Results of audits (e.g., PT audits) conducted during the sampling year.

ERG developed a User Guide and an accompanying Memorandum to help users learn how to maneuver around in the app and understand how the data were treated during the development of the app. If corrections or changes are needed after the app are presented to EPA, they can be made relatively easily.

6.5 Records and Supporting Data

All raw data required for the calculation of air toxics concentrations, submission to the EPA/AQS database, and QA/QC data are collected electronically or on data forms that are included in the field and analytical methods sections. All hardcopy information is filled out in indelible ink. Corrections are made by inserting one line through the incorrect entry, initialing the correction (ERG maintains a signature log), and placing the correct entry alongside the incorrect entry, if this can be accomplished legibly, or by providing the information on a new line. Table 6-1 presents the location of the data records for field and laboratory operations stored at the ERG laboratory.

Table 6-1
Data Documentation and Records

Item	Record	Short Term Location Storage	Long Term Location Storage
Field Operations			
Sampling System Training	Sampling System Training Form	ERG	Copy scanned and hardcopy stored by ERG
COC	ERG COCs	Field gets “pink” copy, ERG gets “yellow” and “white” copy	Copy scanned and stored on ERG LIMS
QC Sample Records (field blanks, duplicate/ collocated, sample integrity, etc.)	COC	Field	Copy scanned and stored on ERG LIMS

Table 6-1
Data Documentation and Records (Continued)

Item	Record	Short Term Location Storage	Long Term Location Storage
General Field Procedures	COC	Field	Copy scanned and stored on ERG LIMS
Laboratory Records			
Sample Prep Data	Bench sheets	Hardcopy filed, LIMS, shared network drive	Hardcopy archived, LIMS, shared network drive
Laboratory Operations			
Sample Management Records (sample receipt, handling, storage, etc.)	COCs	LIMS, with sample analytical data	LIMS, with sample analytical data
Test Methods	SOPs	Hardcopy filed, shared network drive	Shared network drive
QA/QC Reports (General QC records, MDL information, calibration, etc.)	Individual records for each analysis	Hardcopy filed, shared network drive	Hardcopy archived, shared network drive
Corrective Action Reports	Individual records for each analysis	Hardcopy filed, a copy in data package if appropriate	All copies archived
Data Reduction, Verification, and Validation			
Electronic Data (used for reporting and AQS)	Excel® and Access®	Shared network drive	Shared network drive

6.5.1 Notebooks

ERG issues laboratory notebooks upon request. These notebooks are uniquely numbered and associated with the laboratory personnel. Notebooks are archived upon completion for at least 5 years from the end of a project. Although LIMS data entry forms are associated with all routine environmental data operations, the notebooks can be used to record additional information about these operations. The procedures for maintaining notebooks are presented in *SOP for Maintaining Laboratory Notebooks* (ERG-MOR-039) in Appendix D.

Field Notebooks - Field notebooks are the responsibility of EPA, States, Local or Tribal agencies as ERG is not responsible for the collection of samples.

Laboratory Notebooks - Notebooks are associated with general procedures such as calibration of analytical balances, standard preparation logs, etc., used in this program.

Logbooks are generated and bound by the laboratory's Project Administrator for procedures such refrigerator/freezer temperatures, canister cleaning, etc. Logbook pages have a unique version identifier. Upon completion, logbooks are archived indefinitely, at a minimum at least 5 years from the end of a project.

6.5.2 Electronic Data Collection

To reduce the potential for data entry errors, automated systems are utilized (where appropriate) and record the same information that is found on data entry forms. In order to provide a back-up, hardcopy data collected on an automated system will be stored for 5 years after the end of the closed EPA NMP contract.

6.6 Data Reporting Package Archiving and Retrieval

In general, all the information listed above will be retained for at least 5 years from the date of the end of the closed contract with EPA. However, if any litigation, claim, negotiation, audit, or other action involving the records has been started before the expiration of the 5-year period, the records will be retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular 5-year period, whichever is later. The long-term storage is on-site in a locked climate-controlled file room with limited-access. The Project Administrator keeps a record of documents entering and leaving long-term storage. Access to the facility storage area is limited to authorized personnel only.

6.7 Quality System Document Control

To ensure the use of the most current version of quality system documents, all quality documents (QAPP, SOPs, etc.) generated at the ERG Laboratory must be uniquely identified. Original documents shall include the date of issue, revision number, page number, the total number of pages, and appropriate signatures. Copies of quality documents shall be controlled and include a copy control number. When an original quality document is updated, the QA Coordinator or designee will ensure that the copy documents are also updated, and old versions are destroyed. During the project, revised QAPPs will be circulated to appropriate EPA personnel and ERG's laboratory staff. For copies of documents out of the laboratory's control, a stamp or watermark stating "Uncontrolled" or "Draft", if applicable, will be applied. Each approved QAPP will be posted on EPA's Ambient Air Monitoring Technical Information Centers (AMTIC) Website without the associated SOPs.

MEASUREMENT DATA ACQUISITION
SECTION 7
SAMPLING PROCESS DESIGN

Sampling procedures for the NMOC, SNMOC, UATMP, NATTS, and CSATAM programs are discussed in this section. ERG provides site-specific support for the PAMS and HAPs sampling. All parameters listed in this section are necessary for the sampling systems listed below. ERG is not responsible for the collection of samples nor the design of these programs.

7.1 NMOC and SNMOC Canister Samplers

Sampling for NMOC and SNMOC takes place each workday from the beginning of June to the end of September at designated NMOC and SNMOC sites from 0400-1200, 1200-2000, and 2000-0400 local time. Sampling procedures have been discussed in detail in other documents.[1, 2] Figure 7-1 is a diagram of the ERG sampling system used for collecting the ambient air samples. Clean, evacuated passivated stainless-steel canisters are shipped daily from ERG's Research Triangle Park (RTP) Laboratory to the NMOC and SNMOC sites. Canisters are connected to the sampling system by local operators. The digital timer automatically activates the pump and solenoid valve to start and stop sample collection. The pump pressurizes air samples during the sampling period to about 15 pounds per square inch gauge (psig), and the flow control valve (variable orifice) ensures a constant sampling rate over the 8-hour period. A 2-micron stainless steel filter is installed in the sampling line to remove particulate from the ambient air that may damage or plug the variable orifice. The sample probe inlet is positioned from 2 to 10 meters (m) above ground level.

ERG installs the sampling systems at the site location and trains associated local operators on site. Operator training is documented on the Sampler Training Form (Figure 7-2). It is the responsibility of the local operators to operate the sampling apparatus and complete the field sample COC form that ERG supplies with each canister. ERG staff maintain telephone

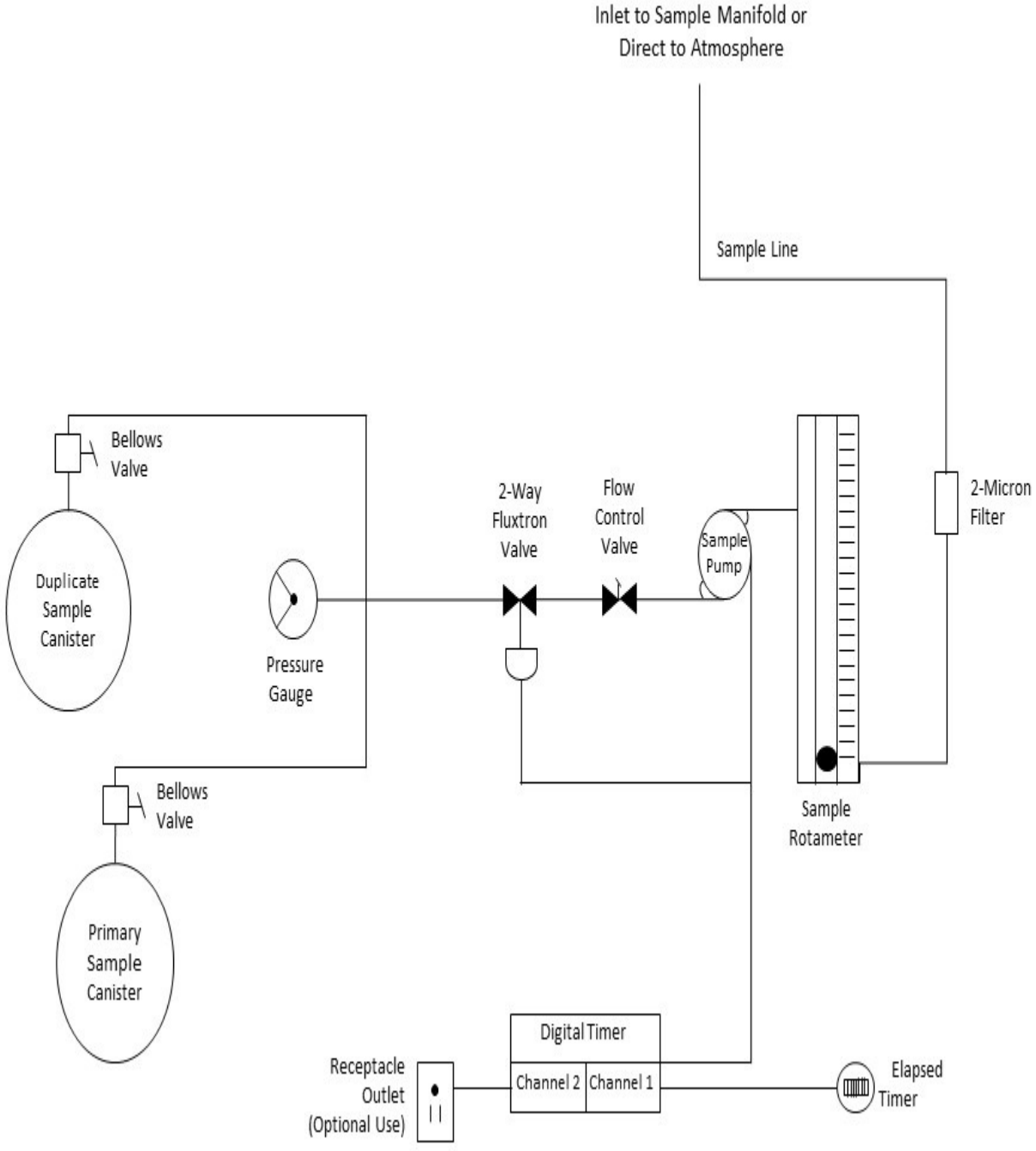


Figure 7-1. NMOC, SNMOC, and 3-Hour Air Toxics Sampling System Components

VOC/Carbonyl Sampling System Training

3-2018

Installation Date: _____ Trainer: _____

Site ID: _____ Copy of SOP on Site: (Y/N) _____

Installed Sampler ID #: _____ Replaced Sampler ID #: _____

Time Set: _____ Carb Line Replaced: (Y/N) _____

Timer Set: _____ VOC Line Replaced: (Y/N) _____

Trainee:	Signature:	Date:

NOTES:

_____

_____

_____

_____

_____

_____

_____

ERG assumes no personal and/or property liability realized by the user from the use of ERG provided equipment. The user, by virtue of accepting the ERG equipment for use, undertakes any/all personal and/or property liabilities that could be associated with its use (including operational, housing, and/or safety).

Figure 7-2. VOC/Carbonyl Sampler Training Form

and/or email contact throughout the project to provide whatever assistance is needed to resolve technical issues that arise during the sampling program.

For an 8-hour ambient air sample, NMOC, SNMOC, and VOC measurements may all be performed from the same canister. Refer to Section 7.2 for sampler certification.

7.2 VOC and Carbonyl 24-Hour Samplers

ERG provides the sites with a sampling schedule each year. A total of 31 sampling days will be scheduled per site for a 12-day sampling schedule and 61 sampling days for the 6-day sampling schedule. Days for duplicate (or collocated) sampling and field blank (if applicable) sampling will also be designated. The 2021 Sampling calendar is presented in Appendix B.

Prior to installation of an ERG sampler at a UATMP, NATTS or CSATAM site, the sampler is certified at the ERG laboratory. Certification establishes that the system is functioning correctly and provides for the appropriate level of specified compound recovery and cleanliness. To certify the sampling system, cleaned, humidified nitrogen (N_2) is first flushed through the sampler for at least 12 hours to remove the potential for organic contaminants in the manifold and system. The canister sub-system of the samplers is then challenged with a mixture of representative VOCs at known concentrations to qualify the sampler recovery characteristics (as recommended in the NATTS TAD)[20]. After the sampler has been challenged, it is flushed again with humidified N_2 for at least 12 hours. A Sampling System Blank is then collected in canisters and on carbonyl cartridges and is analyzed based on EPA Compendium Method TO-15[4] and Method TO-11A[5] to verify that the system meets the required cleanliness criteria and can produce non-biased samples (as required by the NATTS TAD[20]). These results are documented in a file specific to each sampler by system identification number. The certification procedures are presented in *SOP for Canister Sampling System Certification Procedures* (ERG-MOR-030) and *SOP for Carbonyl System Certification Procedures* (ERG-MOR-100) in Appendix D.

Integrated ambient air samples are collected in 6-liter passivated stainless-steel canisters (SUMMA, Silonite®, TO-Can, etc.) and carbonyl cartridges for a 24-hour period beginning at midnight for each scheduled sampling event. Carbonyl cartridges are shipped cold and the cleaned, quality-controlled canisters are shipped under vacuum to the site from the ERG laboratory. After sampling, the final pressure in the canister should ideally be between 2 to 8 inches of Mercury ("Hg) vacuum. The sampling assembly for the sample collection is shown in Figure 7-3.

The physical mechanism for filling the canister is vacuum displacement. The vacuum pump shown in Figure 7-3 is used to purge the mass flow controller and the sample inlet lines. A second vacuum pump is used to draw ambient air through the carbonyl sampling probe and cartridges. Ozone is removed from the sample stream prior to collection on the 2,4-Dinitrophenylhydrazine (DNPH) sampling cartridge. To accomplish O_3 removal, the sample stream (ambient air) is drawn through a potassium iodide-coated denuder O_3 scrubber which is an internally integrated component of the sampler. Carbonyl samplers can be collected with or without canister samples.

7.3 Carbonyl Only 24-Hour Samplers

Carbonyl samples are collected using DNPH-impregnated sampling cartridges with an integrated sampling system (e.g., vacuum pump, critical orifices, and O_3 scrubber), shown in Figure 7-4. Ambient air is drawn through the cartridges via a separate sampling probe. A potassium iodide-coated denuder O_3 scrubber is an internally integrated component of the sampler that removes O_3 from the sample stream prior to the DNPH sampling cartridge.

Prior to installation of an ERG sampler at a UATMP, NATTS or CSATAM site, the sampler is certified at the ERG laboratory. Certification establishes that the system is functioning correctly and provides for the appropriate level of cleanliness. To certify the sampling system, cleaned, humidified N_2 is first flushed through the sampler for at least 12 hours to remove the

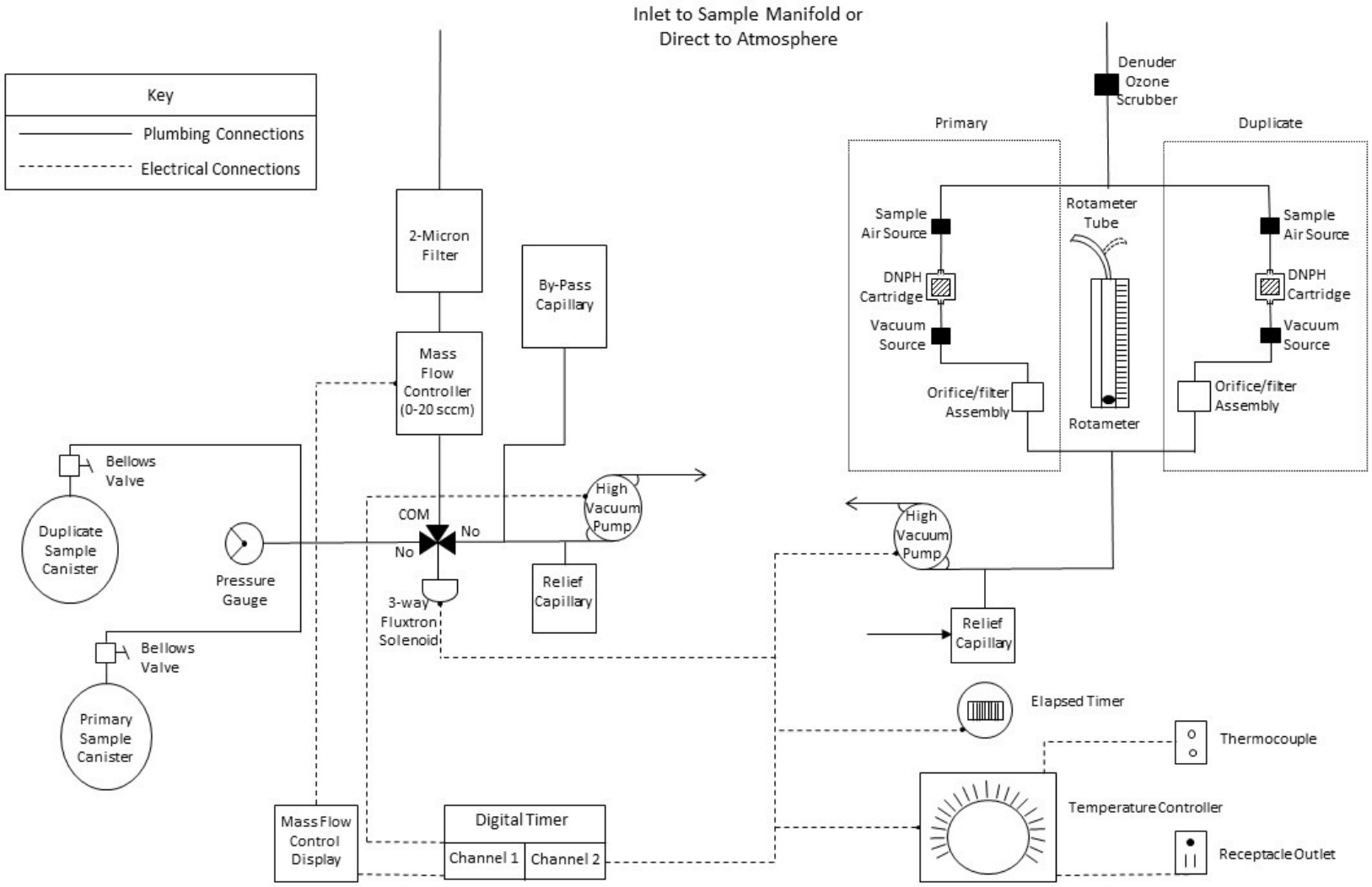


Figure 7-3. 24-Hour Integrated Air Toxics Sampling System Components

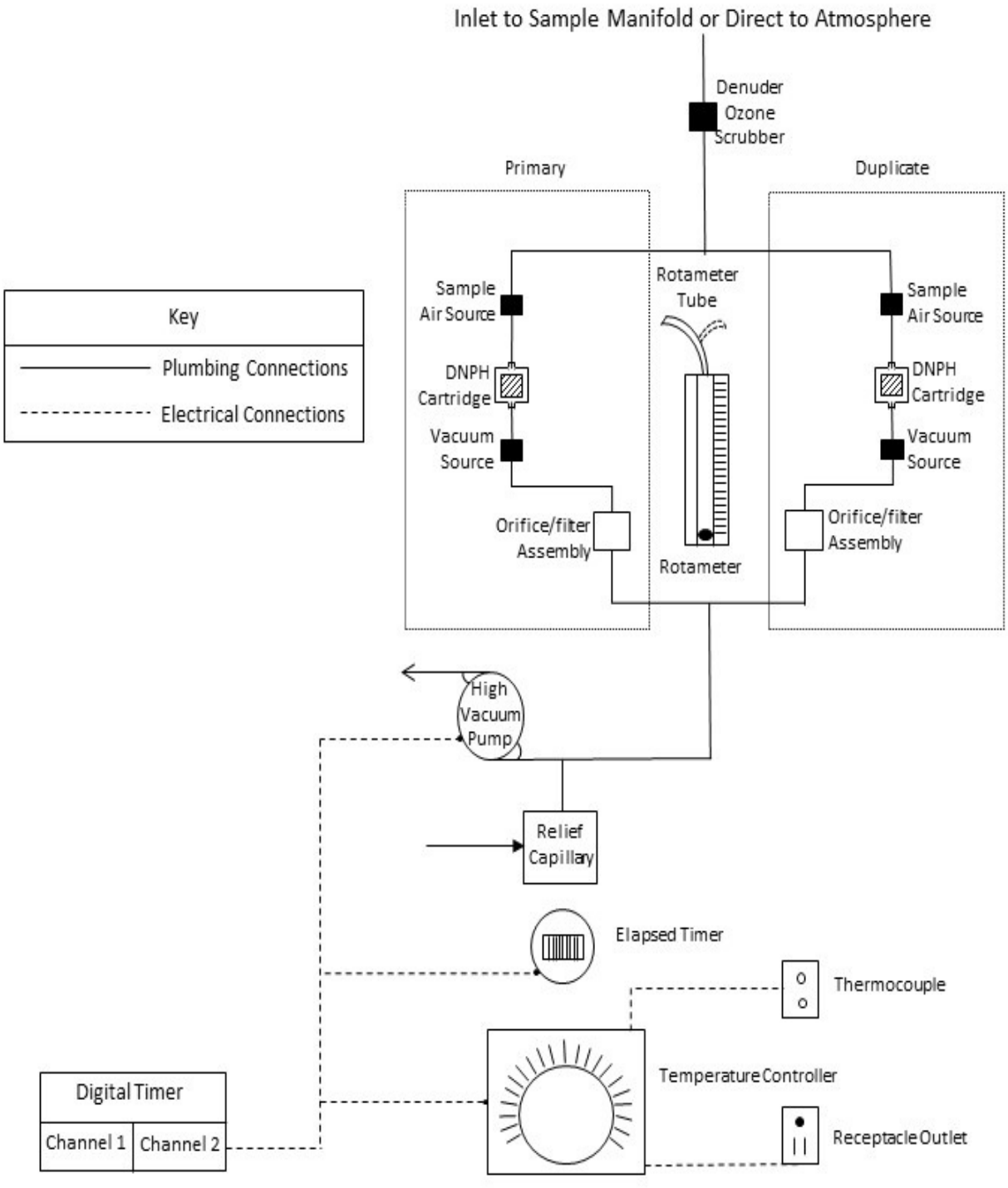


Figure 7- 4. Carbonyl Sampling System Components

potential contaminants from the manifold and system. A Sampling System Blank and a reference blank are then collected on carbonyl cartridges and are analyzed based on EPA Compendium Method TO-11A[5] to verify that the system meets the required cleanliness criteria and can produce non-biased samples as required by the NATTS TAD[20]. These results are documented in a permanent file specific to each sampler by system identification number. The certification procedure is presented in the *SOP for Carbonyl Sampling System Certification* (ERG-MOR-100) in Appendix D.

A total of 31 sampling cartridges for a 12-day sampling schedule and 61 sampling cartridges for a 6-day sampling schedule will be collected and analyzed per site. Duplicate (or collocated) samples and field blanks will be collected monthly and are designated in the 2021 Sampling calendar presented in Appendix B.

7.4 Hexavalent Chromium Samplers

Sodium bicarbonate-impregnated cellulose filters are connected to the Hexavalent Chromium sampler as shown in Figure 7-5 and ambient air is drawn through the filters through a glass sampling probe using Teflon sampling lines. Prepared filters are shipped to each site for the hexavalent chromium sampling. ERG ships the bicarbonate-impregnated sodium cellulose filters to each site in coolers (chilled with blue ice packs). The samples are collected for a 24-hour period. Disposable polyethylene gloves are used by the field operators when handling the filters to reduce background contamination. After sampling, the filters are removed from the sampling apparatus, sealed, and returned to the ERG laboratory in the coolers and ice packs in which they were received. Additional qualifying information for the hexavalent chromium sampling and analysis techniques is presented in the American Society for Testing and Materials (ASTM) D7614[9] method and specific details are provided in ERG's *SOP for the Preparation and Analysis of Ambient Air for Hexavalent Chromium by Ion Chromatography* (ERG-MOR-063) presented in Appendix D.

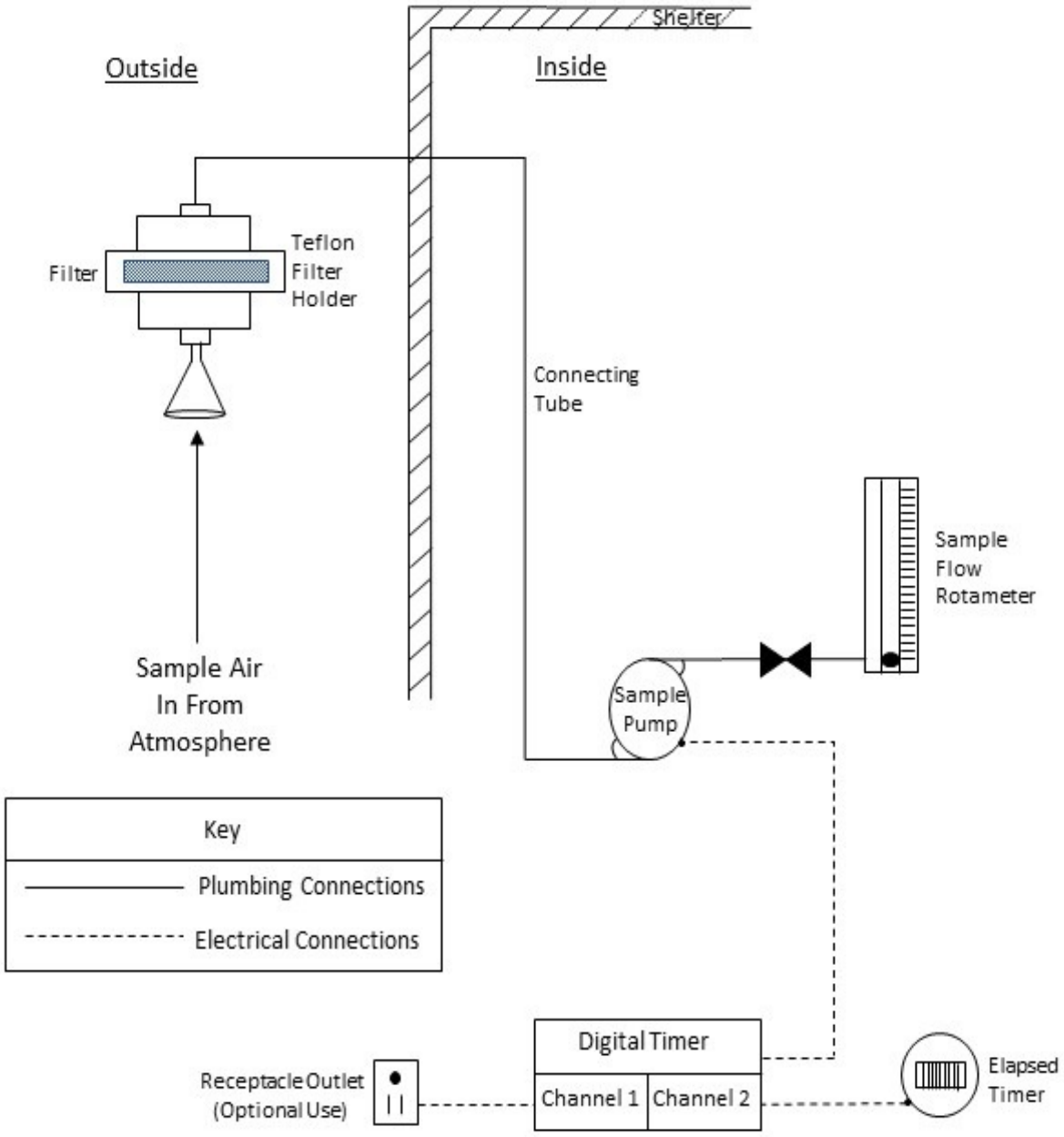


Figure 7-5. Hexavalent Chromium Sampling System Components

7.5 PAMS Sampling

PAMS sampling is performed completely by the PAMS sites in accordance with the Ozone Precursors TAD[2] with ERG only supplying support as requested [e.g., sampling system for automated gas chromatograph (GC) systems]. The need for support of automated GC systems is site specific. ERG ships cleaned canisters and prepared carbonyl cartridges to the PAMS sites on the appropriate schedule to support the sampling program, and the samples are shipped to the ERG laboratory for analysis.

7.6 HAPs Sampling

HAPs sampling is performed by the sites in accordance with the methods listed in Table 3-1, with the exception of hexavalent chromium sampling (see Section 7.4). ERG provides the hexavalent chromium sampling systems and media and receives the samples from the sites for analysis.

SECTION 8
SAMPLING METHOD REQUIREMENTS

The sampling methods that are used in this program are described in this Section. Since there are four separate sampling systems and subsequently four separate analytical techniques, each of the sampling methods is different.

As ERG is not responsible for actual execution of the field sampling in this program, the ERG SOPs list general sampling guidelines needed for the NMOC, UATMP, Carbonyl, and Hexavalent Chromium sampling for sites using ERG sampling systems. Table 8-1 identifies the different methods and SOP numbers for operation of each type of sampler ERG provides. Some HAPs sampling is not addressed in the NMP Support contract (Metals, PAHs, etc.), and are not discussed in this QAPP.

Table 8-1
EPA Methods and ERG SOPs for each Sampling System

Sampling System	Based on Applicable Method	ERG SOP Number
NMOC	EPA Compendium Method TO-12[3]	ERG-MOR-046
VOC	EPA Compendium Method TO-15[4]	ERG-MOR-003
Carbonyl	EPA Compendium Method TO-11A[5]	ERG-MOR-047
Hexavalent Chromium	ASTM D7614 Method[9]	ERG-MOR-013

SECTION 9
SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Similar sample custody procedures are followed for all monitoring programs. However, program-specific differences exist because the analytical requirements for the programs vary. As these activities are conducted under one EPA contract, United Parcel Service of America (UPS) with Overnight Delivery will handle all shipping to and from the sites. Unless specified below, samples taken in the field should not require any extra special precautions for shipping.

The Shipping and Receiving Task Leader will ensure that sample media that leaves and field samples that are received in the laboratory follow all procedures listed in this QAPP and the individual SOPs. The Task Leader will also advise the Project Manager of any issues or obstacles regarding sample shipping, receipt, login and storage. The sample custodian working under the Shipping and Receiving Task Leader will ship sample media to the field and receive custody of samples, complete COC receipt information, document sample receipt, and enter COC information into LIMS to create a work order.

9.1 Canister Sample Custody

9.1.1 Canister Custody

A color-coded, three-copy canister sample COC form (Figures 9-1 and 9-2) is shipped with each 6-liter canister for the NMOC, SNMOC, UATMP, NATTS, CSATAM, or PAMS sites. If duplicate or collocated samples are to be taken, two canisters and two COC forms are sent in the shipping container(s) to the site. When a sample is collected, the site operator fills out the form, detaches the pink copy to be retained on-site and sends the remaining copies with the canister in the shipping container to ERG's laboratory.

ERG Lab ID #

601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

NMOC SAMPLE CHAIN OF CUSTODY

Lab Pre-Sampling

Site Code: _____ Canister Number: _____
City/State: _____ Lab Initial Can. Press. ("Hg): _____
AQS Code: _____ Date Can. Cleaned: _____
Collection Date: _____ Cleaning Batch # : _____
Options
NMOC (Y/N): _____
SNMOC (Y/N): _____ Duplicate Event (Y/N): _____
TOXICS (Y/N): _____ Duplicate Can # : _____

Field Setup

Operator: _____ Sys. #: _____ Rotameter Setting: _____
Setup Date: _____ Elapsed Timer Reset (Y/N): _____
Field Initial Can. Press. ("Hg): _____ Canister Valve Opened (Y/N): _____

Field Recovery

Recovery Date: _____ Sample Duration (3 or 24 hr): _____
Field Final Can. Press. (psig): _____ Elapsed Time: _____
Canister Valve Closed (Y/N): _____

Lab Recovery

Received by: _____ Date: _____ Lab Final Can. Press. (psig): _____
Status: Valid Void (Circle one)
If void, why: _____

NMOC

Analyst: _____ Database entry by: _____ Date: _____
Date: _____ Batch ID _____
NMOC Instrument: _____
Inj. 1 (AC): _____ (ppmC): _____
Inj. 2 (AC): _____ (ppmC): _____
Inj. 3 (AC): _____ (ppmC): _____
Average AC: _____
Standard Dev. (AC): _____
Average Conc. (ppmC): _____
Standard Dev. (ppmC): _____

SNMOC Option

Analyst: _____ Date: _____
Batch ID _____

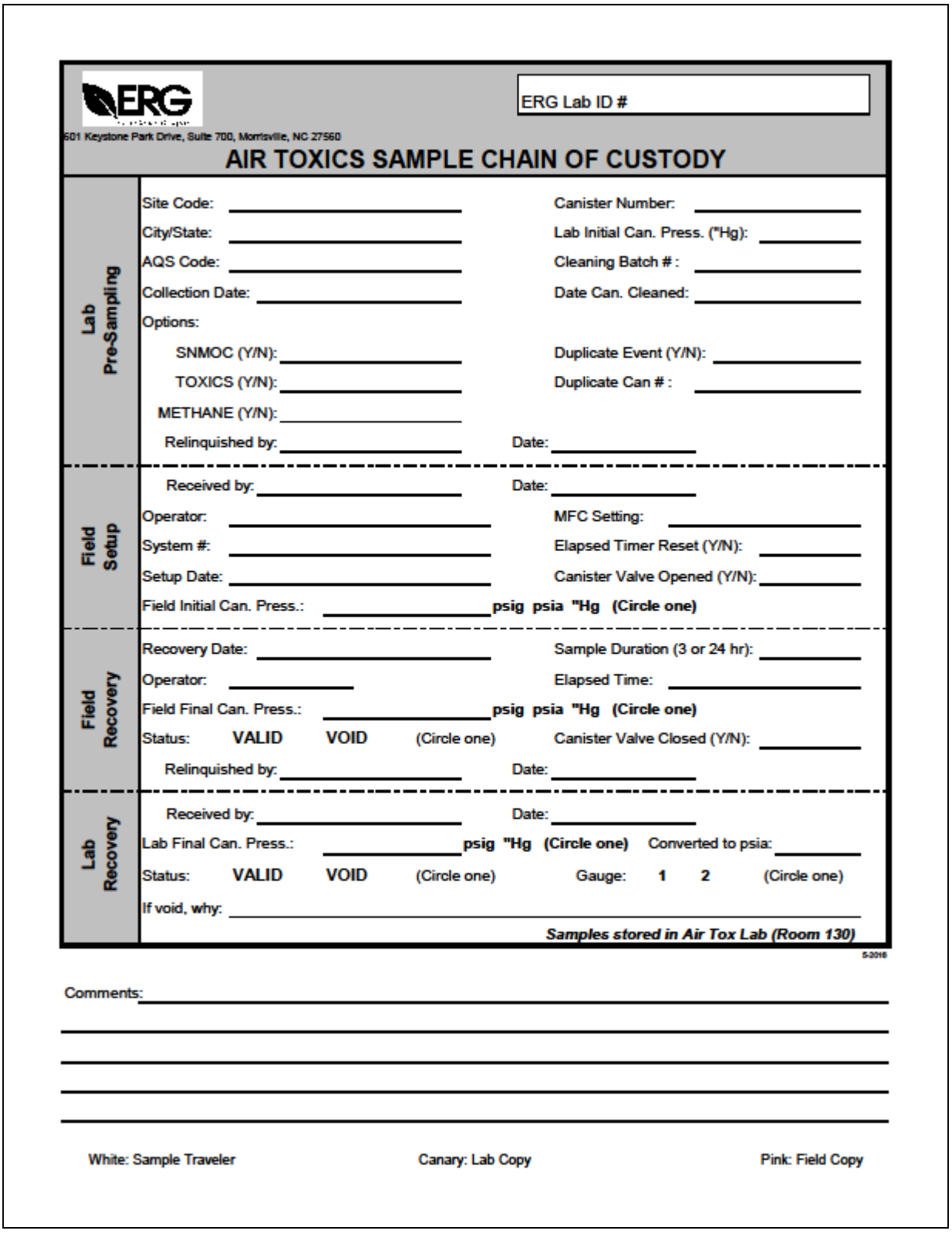
Toxics Option

Analyst: _____ Date: _____
Batch ID _____

Comments: _____

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

Figure 9-1. Example NMOC COC



ERG

601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

ERG Lab ID #

AIR TOXICS SAMPLE CHAIN OF CUSTODY

Lab Pre-Sampling

Site Code: _____ Canister Number: _____

City/State: _____ Lab Initial Can. Press. ("Hg): _____

AQS Code: _____ Cleaning Batch # : _____

Collection Date: _____ Date Can. Cleaned: _____

Options:

SNMOC (Y/N): _____ Duplicate Event (Y/N): _____

TOXICS (Y/N): _____ Duplicate Can # : _____

METHANE (Y/N): _____

Relinquished by: _____ Date: _____

Field Setup

Received by: _____ Date: _____

Operator: _____ MFC Setting: _____

System #: _____ Elapsed Timer Reset (Y/N): _____

Setup Date: _____ Canister Valve Opened (Y/N): _____

Field Initial Can. Press.: _____ **psig psia "Hg (Circle one)**

Field Recovery

Recovery Date: _____ Sample Duration (3 or 24 hr): _____

Operator: _____ Elapsed Time: _____

Field Final Can. Press.: _____ **psig psia "Hg (Circle one)**

Status: **VALID VOID** (Circle one) Canister Valve Closed (Y/N): _____

Relinquished by: _____ Date: _____

Lab Recovery

Received by: _____ Date: _____

Lab Final Can. Press.: _____ **psig "Hg (Circle one)** Converted to psia: _____

Status: **VALID VOID** (Circle one) Gauge: **1 2** (Circle one)

If void, why: _____

Samples stored in Air Tox Lab (Room 130)

5-2016

Comments: _____

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

Figure 9-2. Example Air Toxics COC

Upon receipt, the sample canister vacuum/pressure is measured and compared against the field documented vacuum/pressure to ensure the canister remained airtight during transport. If the receiving vacuum differs from the field vacuum more than 3“Hg, the program manager is notified, and sample canister may be voided. Because there are potential differences in barometric pressures and temperatures between the sampling site and the receiving laboratory (such as those sites at high altitudes), and different accuracies for different types of pressure gauges, there can be a consistent difference in final field pressure and lab receipt pressure for canister samples. This difference and other parameters are considered to determine the validity of the canister samples. These are monitored daily and the pressures are logged into an Excel spreadsheet. This allows the laboratory the ability to determine if the canister leaked en route or if the difference is typical for that site. A sample of the spreadsheet is presented in Table 9-1.

Table 9-1

Example of Canister Pressure Check Spreadsheet

Date Received	Site	Field Pressure Reading	Lab Pressure Reading	Difference
8/30/20	NBIL	2 “Hg	6 “Hg	4 “Hg
9/7/20	NBIL	1 “Hg	4 “Hg	3 “Hg
9/14/20	NBIL	3 “Hg	7 “Hg	4“Hg
9/16/20	NBIL	4 “Hg	7 “Hg	3 “Hg
8/30/20	BLKY	5 “Hg	5 “Hg	0 “Hg
9/7/20	BLKY	5 “Hg	3.5 “Hg	1.5 “Hg
9/13/20	BLKY	5 “Hg	5 “Hg	0 “Hg
9/16/20	BLKY	5 “Hg	4 “Hg	1 “Hg

The canister should be cleaned no more than 30 days before sampling. If the canister is older than 30 days, a note will be made in LIMS and a flag will be added to the sample results in AQS. More detailed sample receipt procedures and sample acceptance policies are presented in the *SOP for Sample Receipt at the ERG Chemistry Laboratory,* ERG-MOR-045 in Appendix D. The sample specific information from the COC is then entered into LIMS (example login page is shown in Figure 9-3) following the *SOP for Sample Login to the Laboratory Information Management System,* ERG-MOR-079 found in Appendix D. The sample is given a unique LIMS

identification (ID) number and tagged (see Figure 9-4), noting the desired analysis, site location and the sample collection date.

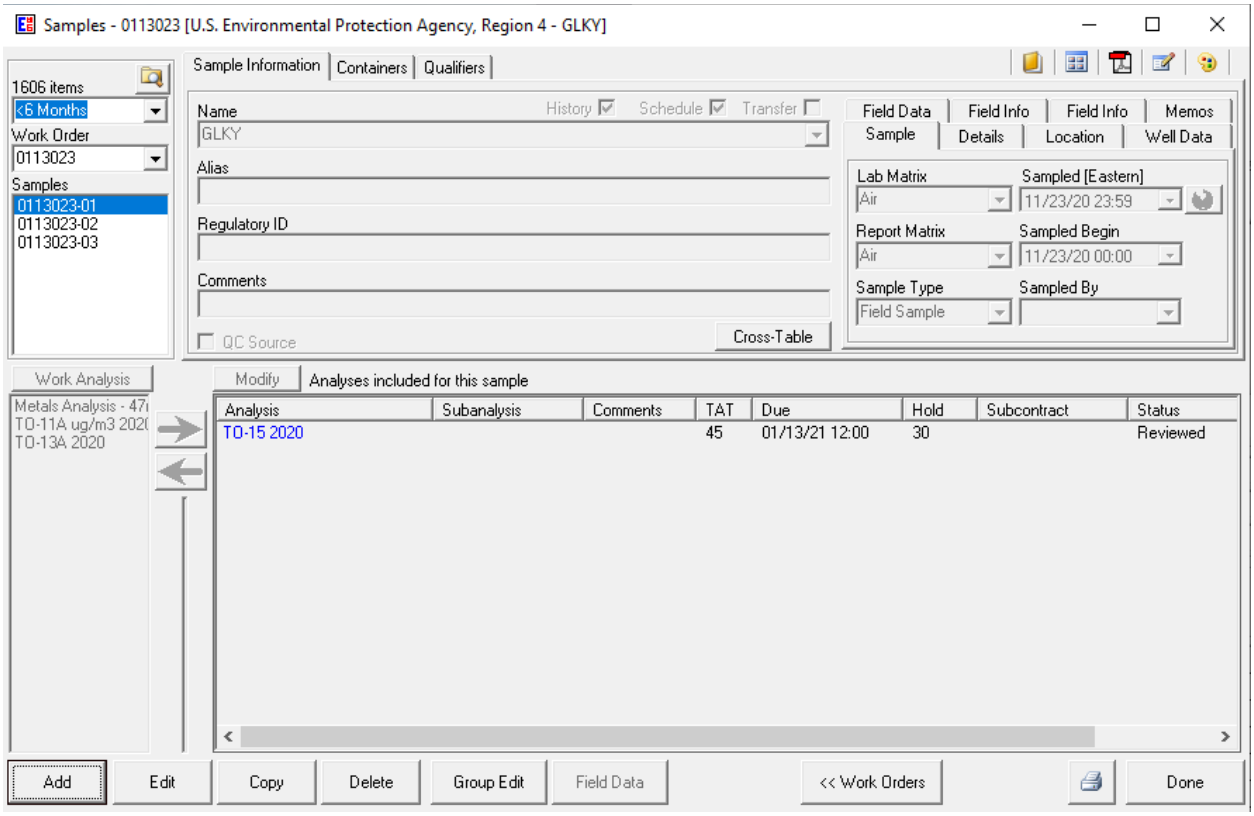


Figure 9-3. Example ERG LIMS Login Page

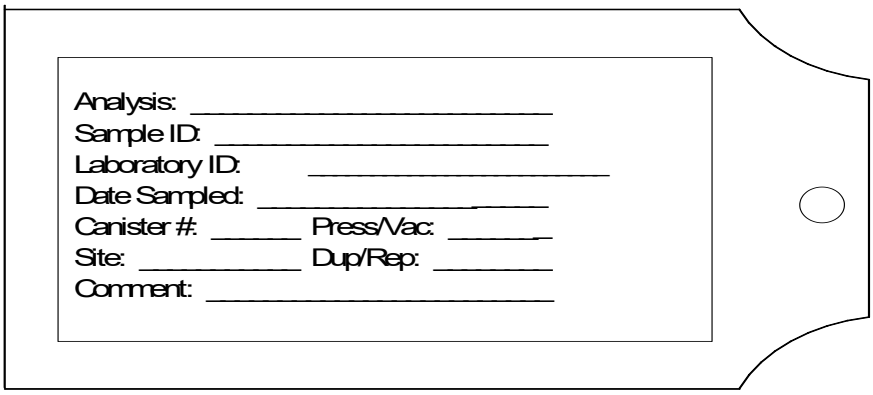


Figure 9-4. Canister Tag

The LIMS ID number is recorded on all ERG copies of the COC. The remaining copies of the canister sample COC are separated. The white copy is scanned (the PDF is stored in the

LIMS system) and is kept with the canister sample until analysis is complete. After sample analysis, the white copy goes into the data package with the sample data. The yellow copy is stored chronologically in a designated file cabinet for 6 months. The file cabinet is in Room 102 in the Laboratory building.

9.1.2 Canister Analytical Routing Schedule

Each canister has a unique canister identification number inscribed on the canister. This number is used during can cleaning, field collection, laboratory receipt, and laboratory sample analysis, is included on the individual Toxics/SNMOC COCs and entered into the LIMS.

The canister sample analysis hold time is 30 days from the sampling date. The canister samples are sent to the ERG Air Toxics Laboratory for VOC and SNMOC/PAMS analysis via GC/Flame Ionization Detector/Mass Spectrometer (FID/MS) or GC/MS, as applicable. The canister sample is analyzed and kept in the laboratory until after the analyst reviews the relevant analytical data.

9.1.3 Canister Cleanup

All canisters are cleaned prior to reuse following SOP ERG-MOR-105 (*SOP for Sample Canister Cleaning using Wasson TO-Clean Automated System*) as shown in Appendix D. The canisters are cleaned using the procedure described in Section 10.1.1. The unheated system (following SOP ERG-MOR-062, *SOP for Sample Canister Cleaning*) is maintained as a backup, if needed, and is described in Section 10.1.2. The canisters are cleaned to <3x MDL or 0.2 ppbV, whichever is lower, and 10 ppbC for Total SNMOC. If the canister fails the Blank criteria, it is returned to the cleaning system bank with the other canisters that were cleaned along with it and all canisters are put through an additional Vacuum and Pressure cycle. The same canister is analyzed again. All canisters, whether used for NMOC, SNMOC, UATMP, NATTS, CSATAM, or PAMS, are cleaned by the same procedure and are entered into the canister cleanup log, shown in Figure 9-5 for the heated systems and in Figure 9-6 for the unheated systems.

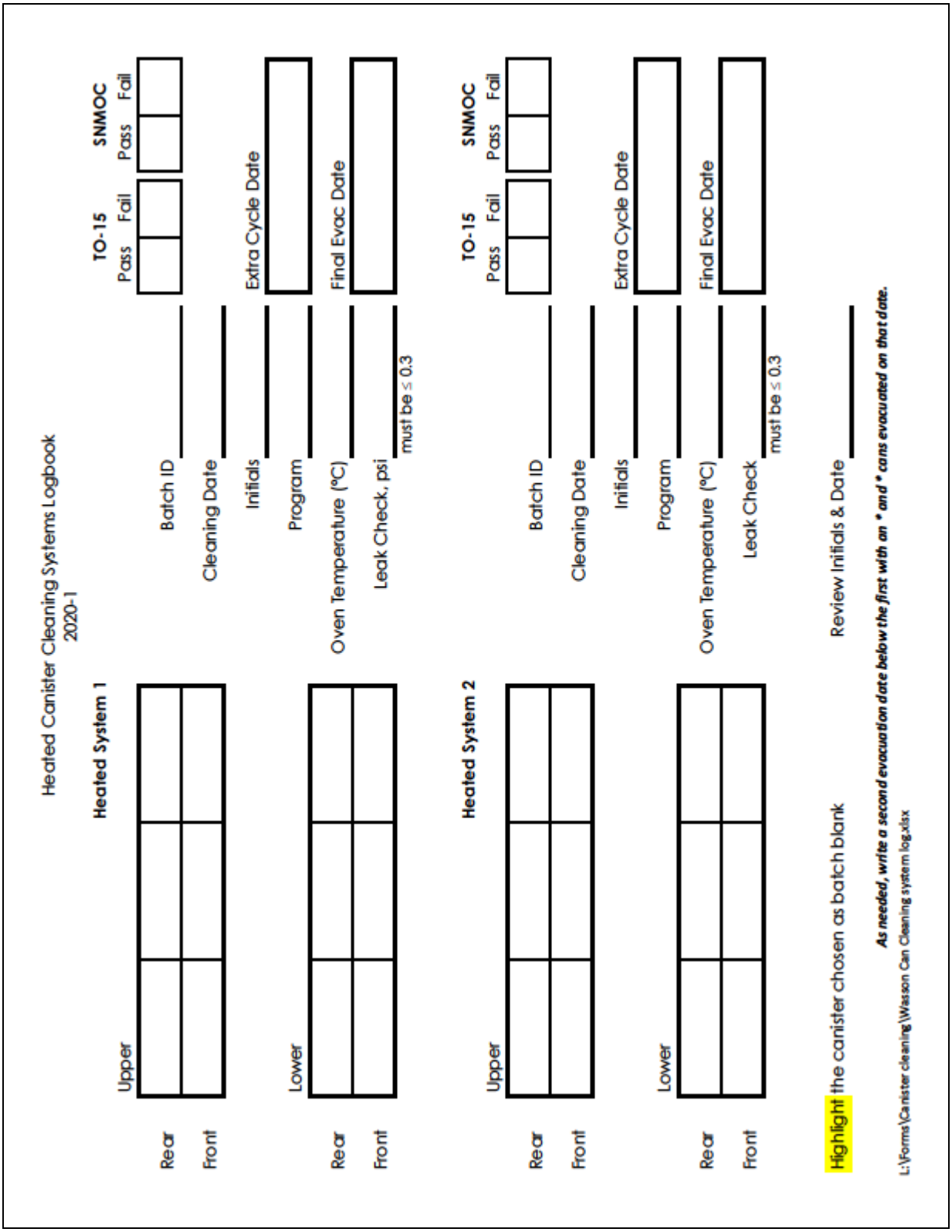


Figure 9-5. Canister Cleanup Log for the ERG Heated Cleaning System

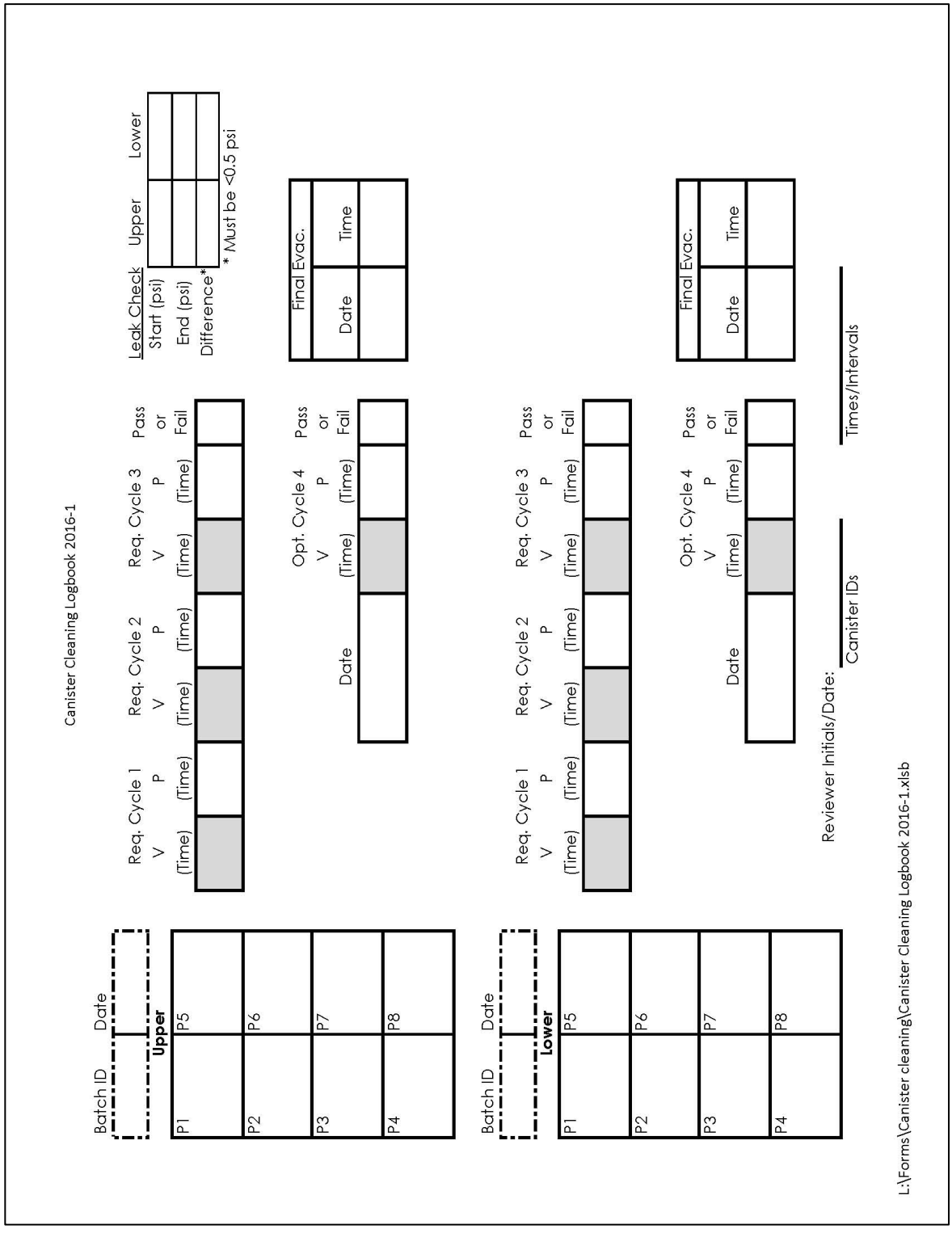


Figure 9-6. Canister Cleanup Log for the ERG Unheated Cleanup System

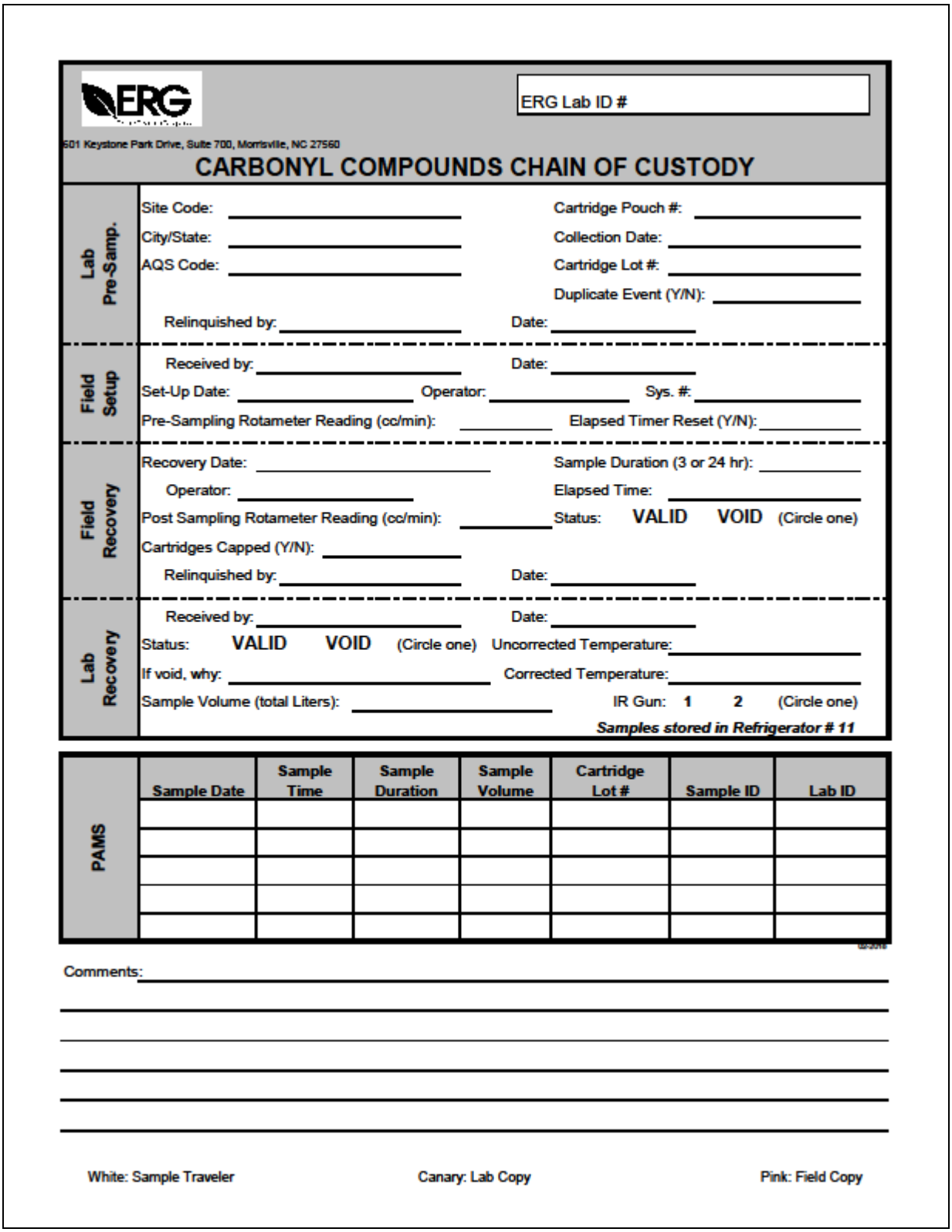
9.2 Carbonyl Sample Custody

Figure 9-7 shows the color-coded, three-copy COC form used for all NATTS, UATMP, CSATAM type carbonyl sampling documentation. Figure 9-8 shows the color-coded, three copy COC form used for all PAMS carbonyl sampling. One PAMS COC can be used for each sampling day, 3-samples per day. A COC is shipped to the site with each of the carbonyl cartridges. After sampling, the COC form is completed by the site operator and the pink copy is retained for site records. The carbonyl sample cartridges and remaining COC copies are shipped to ERG's analytical laboratory.

When samples are received, they are logged into the LIMS database and given a unique LIMS ID number following the *SOP for Sample Login to the Laboratory Information Management System,* SOP ERG-MOR-079, found in Appendix D. The remaining copies of the COC are separated. The white copy of the COC is scanned (the PDF is stored in the LIMS system) and is labeled with the LIMS ID number, site code, sampling date, individual sample designations, and date of receipt and initials of receiving personnel and put into a bag. The sample bag is stored in a refrigerator designated for carbonyl samples only. The yellow copy is stored chronologically in a designated file cabinet for 6 months. The file cabinet is in Room 102 in the Laboratory building. More detailed sample receipt procedures and sample acceptance policies are presented in the *SOP for Sample Receipt at the ERG Chemistry Laboratory,* ERG-MOR-045.

9.2.1 Carbonyl Analytical Routing Schedule

The carbonyl cartridge samples are extracted within 14 days of the sampling day and analyzed within 30 days after extraction. The extracts are kept in the designated extract refrigerator until after the analyst and the Task Leader reviews all the relevant analytical data.



ERG

ERG Lab ID #

601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

CARBONYL COMPOUNDS CHAIN OF CUSTODY

Lab Pre-Samp.

Site Code: _____ Cartridge Pouch #: _____

City/State: _____ Collection Date: _____

AQS Code: _____ Cartridge Lot #: _____

Duplicate Event (Y/N): _____

Relinquished by: _____ Date: _____

Field Setup

Received by: _____ Date: _____

Set-Up Date: _____ Operator: _____ Sys. #: _____

Pre-Sampling Rotameter Reading (cc/min): _____ Elapsed Timer Reset (Y/N): _____

Field Recovery

Recovery Date: _____ Sample Duration (3 or 24 hr): _____

Operator: _____ Elapsed Time: _____

Post Sampling Rotameter Reading (cc/min): _____ Status: VALID VOID (Circle one)

Cartridges Capped (Y/N): _____

Relinquished by: _____ Date: _____

Lab Recovery

Received by: _____ Date: _____

Status: VALID VOID (Circle one) Uncorrected Temperature: _____

If void, why: _____ Corrected Temperature: _____

Sample Volume (total Liters): _____ IR Gun: 1 2 (Circle one)

Samples stored in Refrigerator # 11

PAMS

Sample Date	Sample Time	Sample Duration	Sample Volume	Cartridge Lot #	Sample ID	Lab ID

Comments: _____

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

Figure 9-7. Example Carbonyl Compounds COC

ERG

ERG Lab ID #

601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

PAMS CARBONYL COMPOUNDS CHAIN OF CUSTODY

Lab Pre-Samp.

Site Code: _____ Cartridge Lot #: _____

Duplicate Event (Y/N): _____ Collection Date: _____

Field Blank Event (Y/N): _____

Relinquished by: _____ Date: _____

Field Setup

Received by: _____ Date: _____

Set-Up Date: _____ Operator: _____ Sys. #: _____

City/State: _____ AQS Code: _____

Field Recovery

Recovery Date: _____ Sample Duration (8 or 24 hr): _____

Operator: _____ Status: VALID VOID (Circle one)

Cartridges Capped (Y/N): _____

Relinquished by: _____ Date: _____

Lab Recovery

Received by: _____ Date: _____

Status: VALID VOID (Circle one) Uncorrected Temperature: _____

If void, why: _____ Corrected Temperature: _____

IR Gun: 1 2 (Circle one)

Samples stored in Refrigerator # 11

PAMS

Sample Date	Sample Time	Sample Duration	Sample Volume	Cartridge Pouch #	Sample ID	Lab ID

Comments: _____

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

Figure 9-8. Example PAMS Carbonyl Compounds COC

9.3 HAPs Sample Custody

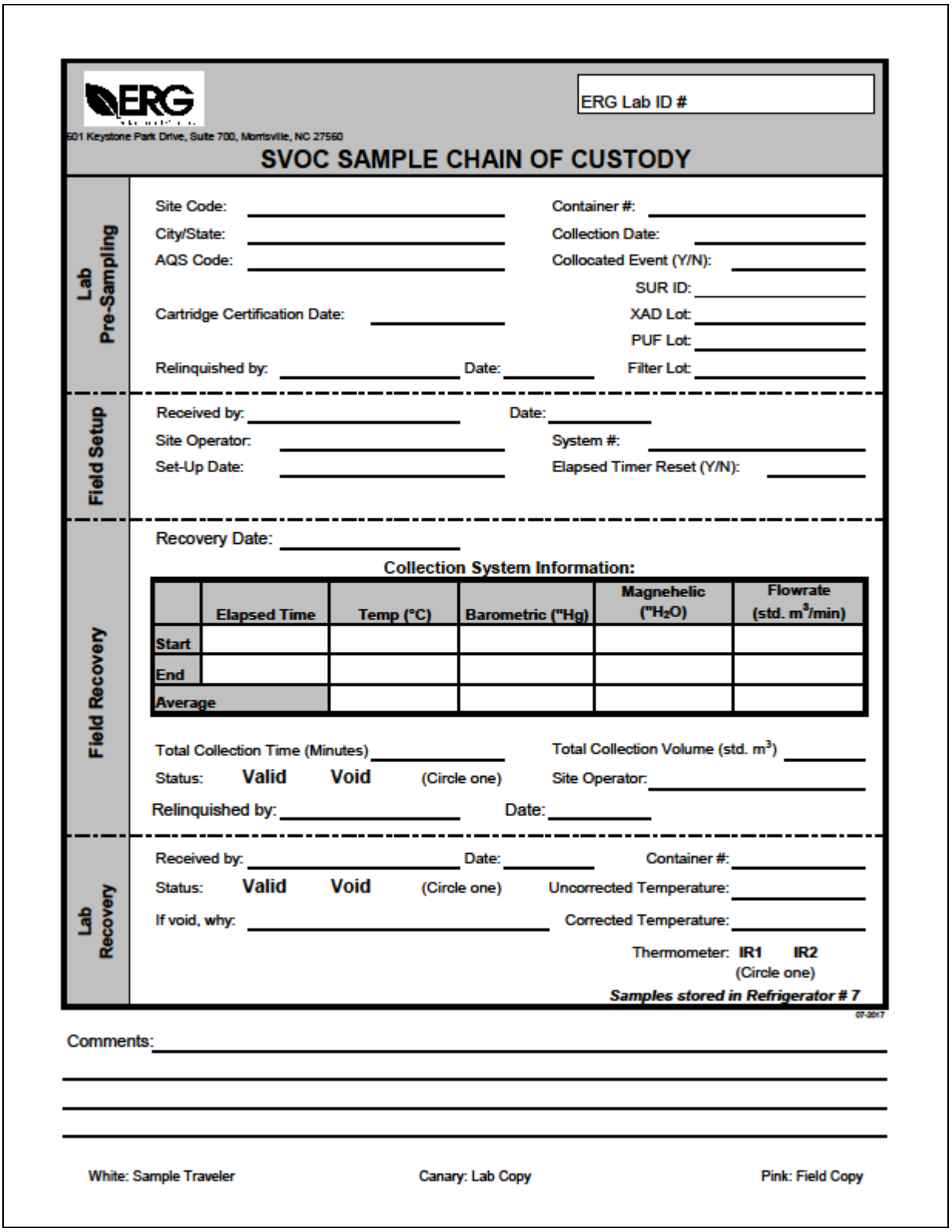
Samples collected on prepared sample media (i.e., XAD-2®, Polyurethane Foam (PUF), hexavalent chromium filters, etc.) use supplied three-copy COC forms to document sample collection. Field testing personnel will record applicable collection data (such as time, date, location, meteorological parameters) on the appropriate COC forms (Figures 9-9 and 9-10) and keep the pink copies for site records. The COCs are then shipped to ERG with the collected samples.

Because the sites supply the filters used for metal analysis, COC forms are normally supplied by the State, Local or Tribal agency for these samples. If needed, however, COC forms can be supplied by ERG electronically inputting multiple filters for metal analysis (Figure 9-11 and 9-12). Samples are received at ERG's laboratory as presented in the *SOP for Sample Receipt at ERG Chemistry Laboratory*, ERG-MOR-045.

All HAPs samples received at the ERG laboratory will be logged into the LIMS as described in the *SOP for Sample Login to the Laboratory Information Management System,* ERG-MOR-079.

9.4 Invalid Samples

The sample COC form may indicate that the sample sent from a site is invalid. The sample can be determined invalid at the site or in the laboratory. SOP ERG-MOR-045 describes the sample receiving procedure and sample acceptance. Individual sites will be contacted if there are any questions about the samples upon receipt. When a sample is designated as invalid, the assigned LIMS ID number is notated as a void and is invalidated on the individual respective COC form. Another sample media will be sent to the site with the COC designated to make up on non-standard sampling days. If the site has repeated invalid samples, normally three voids in a row, the ERG site coordinator Task Leader will work with the site personnel to diagnose and correct the problem. The sites will also be notified in the monthly analytical reports of any invalid samples.



ERG

601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

ERG Lab ID #

SVOC SAMPLE CHAIN OF CUSTODY

Lab Pre-Sampling

Site Code: _____ Container #: _____

City/State: _____ Collection Date: _____

AQS Code: _____ Collocated Event (Y/N): _____

SUR ID: _____

Cartridge Certification Date: _____ XAD Lot: _____

PUF Lot: _____

Relinquished by: _____ Date: _____ Filter Lot: _____

Field Setup

Received by: _____ Date: _____

Site Operator: _____ System #: _____

Set-Up Date: _____ Elapsed Timer Reset (Y/N): _____

Field Recovery

Recovery Date: _____

Collection System Information:

	Elapsed Time	Temp (°C)	Barometric ("Hg)	Magnehelic ("H_2O)	Flowrate (std. m^3/min)
Start					
End					
Average					

Total Collection Time (Minutes) _____ Total Collection Volume (std. m^3) _____

Status: **Valid** **Void** (Circle one) Site Operator: _____

Relinquished by: _____ Date: _____

Lab Recovery

Received by: _____ Date: _____ Container #: _____

Status: **Valid** **Void** (Circle one) Uncorrected Temperature: _____

If void, why: _____ Corrected Temperature: _____

Thermometer: **IR1** **IR2**
(Circle one)

Samples stored in Refrigerator # 7

07-2017

Comments: _____

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

Figure 9-9. Example SVOC Sample COC

ERG

601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

ERG Lab ID #

AMBIENT HEXAVALENT CHROMIUM CHAIN OF CUSTODY FORM

Lab Pre-Sampling

Site Code: _____ Collection Date: _____
City/State: _____ Primary Event (Y/N): _____
AQS Code: _____ Collocated Event (Y/N): _____
Relinquished by: _____ Date: _____

Field Setup

Received by: _____ Date: _____
Site Operator: _____ System #: _____
Set-Up Date: _____ Elapsed Timer Reset (Y/N): _____
Collection Date: _____
Batch I.D. No.: _____
Initial Rotameter Setting (C.O. B.): _____ (After 5 minutes warm-up)
Programmed Start Time: _____ Programmed End Time: _____

Field Recovery

Recovery Date: _____ Recovery Time: _____
Site Operator: _____
Final Rotameter Reading (C.O.B.): _____ (After 5 minutes warm-up)
Elapsed Time: _____ Status: **Valid** **Void** (Circle one)
Relinquished by: _____ Date: _____

Lab Recovery

Received by: _____ Date: _____ Container #: _____
Status: **Valid** **Void** (Circle one) Uncorrected Temperature: _____
If void, why: _____ Corrected Temperature: _____
Collection Time (Minutes): _____ IR Gun: **1** **2** (Circle one)
Avg. Flowrate (L/min): _____
Total Volume of Air Sampled (m^3): _____

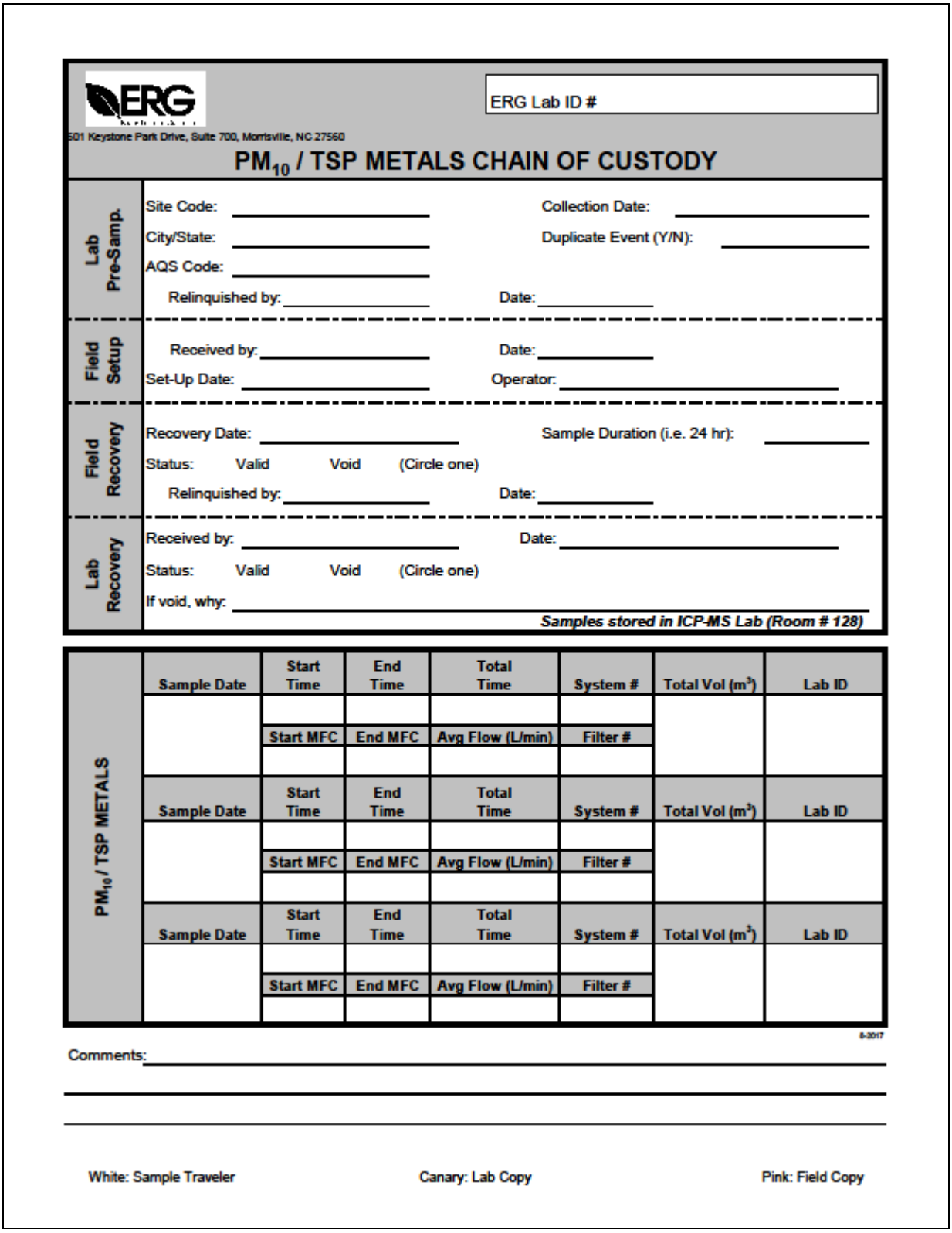
Samples stored in Freezer # 11

02/2017

Comments: _____

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

Figure 9-10. Example Ambient Hexavalent Chromium COC



ERG

ERG Lab ID #

601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

PM_{10} / TSP METALS CHAIN OF CUSTODY

Lab Pre-Samp.

Site Code: _____ Collection Date: _____

City/State: _____ Duplicate Event (Y/N): _____

AQS Code: _____

Relinquished by: _____ Date: _____

Field Setup

Received by: _____ Date: _____

Set-Up Date: _____ Operator: _____

Field Recovery

Recovery Date: _____ Sample Duration (i.e. 24 hr): _____

Status: Valid Void (Circle one)

Relinquished by: _____ Date: _____

Lab Recovery

Received by: _____ Date: _____

Status: Valid Void (Circle one)

If void, why: _____

Samples stored in ICP-MS Lab (Room # 128)

PM_{10} / TSP METALS

Sample Date	Start Time	End Time	Total Time	System #	Total Vol (m^3)	Lab ID
	Start MFC	End MFC	Avg Flow (L/min)	Filter #		
Sample Date	Start Time	End Time	Total Time	System #	Total Vol (m^3)	Lab ID
	Start MFC	End MFC	Avg Flow (L/min)	Filter #		
Sample Date	Start Time	End Time	Total Time	System #	Total Vol (m^3)	Lab ID
	Start MFC	End MFC	Avg Flow (L/min)	Filter #		

8-2017

Comments: _____

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

Figure 9-11. Example Metals COC

ERG

Chain of Custody Record

601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

Page _____ of _____

PROJECT			NO. OF CONTAINERS	ANALYSES					STORAGE LOCATION	
SITE										
COLLECTED BY (Signature)										
FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME							REMARKS	ERG LIMS ID (For lab use only)

REMARKS:

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP °C	SEAL #	CONDITION

REMARKS:

8-2017

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

Figure 9-12. ERG Blank COC Record

9.5 Analytical Data

After analysis, the laboratory will provide narratives describing any anomalies and modifications to analytical procedures, data and sample handling records, and laboratory notes for inclusion in the final report. All laboratory electronic records will be stored for archive on the shared network drive. The shared network has limited access. Raw data will be stored on the shared network for at least 5 years after the end of the closed contract.

All records generated include physical or electronic signatures of the person performing the work and are reviewed by an appropriate Task Leader.

9.6 Sampling Monitoring Data

All COC forms from the monitoring sites will be stored with the analytical results. The forms are also scanned and stored in the LIMS as described in the *SOP for Sample Login to the Laboratory Information Management System,* SOP ERG-MOR-079. The COC forms will be reviewed by the sample custodian(s), Task Leaders and Program Manager. The laboratory will contact the individual site if necessary, information is not completed on the COC forms. The original field data will remain in ERG custody and will eventually be stored on file with the final report until 5 years after the end of the closed contract.

SECTION 10
ANALYTICAL METHODS REQUIREMENTS

Analytical procedures are program-specific because the instrumentation and the target compounds of the programs differ. The primary analytical instrument is GC/FID/MS or GC/MS for VOCs; GC/FID/MS or GC/FID for SNMOC, and PAMS hydrocarbons; High Performance Liquid Chromatography (HPLC) for carbonyls; GC/MS for Semivolatiles (SVOC); Inductively Coupled Plasma/Mass Spectrometer (ICP-MS) for Metals; and Ion Chromatography (IC) for Hexavalent Chromium. Corrective action for analytical system failures realized at time of analyses is initiated by the Analyst and supported by the Task Leader for that method. All analytical method SOPs are provided in Appendix D. The methods used for NMOC and other individual HAPs analysis not currently discussed will be added to this QAPP when the individual States request the analyses. Samples will not be analyzed until ERG receives approval from EPA.

The analytical SOPs for each method are reviewed annually and updated as necessary. The QA Coordinator, Program Manager and Writer/Editor will review, sign and date SOPs before distributing to the laboratories satellite file areas. The previous copies will be replaced with the revised edition. The original, and all previously revised edits, are stored in a historical file maintained by ERG's Project Administrator.

10.1 Canister Cleanup System

Canisters are cleaned using Wasson TO-Clean Model TO 0108 heated systems and the procedure is explained in Section 10.1.1. The unheated canister cleaning system is used as backup and is described in Section 10.1.2. A bulk liquid N_2 dewar is located external to the ERG laboratory facility. This dewar continuously produces a volume of ultrapure gaseous N_2 from its headspace area (~100 psig) that is more than adequate to accommodate all in-lab gaseous N_2 applications. Ultrapure gaseous N_2 is extracted from the dewar headspace and delivered to the cleaning systems. Transport of the gas is accomplished through a 3/8" outer diameter (OD) pre-cleaned stainless-steel tubing.

10.1.1 Heated Canister Cleaning System

The TO-Clean heated cleaning systems are commercially available systems manufactured by Wasson-ECE (Figure 10-1). These systems can clean up to twelve canisters per system at a selected temperature from ambient to 100°C. Each system consists of an oven that holds the canisters, an Edwards RV8 vacuum pump, a stainless-steel humidification chamber for the dilution gas, and a control unit. The procedure for cleaning canisters is the *SOP for Sample Canister Cleaning using the Wasson-ECE,* ERG-MOR-105 in Appendix D.

The cleaning system oven has enough capacity to clean up to 12 canisters at a time. Two racks hold up to six canisters each. Canisters are connected to a 12-port, two-level manifold with compression fittings and flexible stainless-steel tubing. Ultra-pure N_2 is the dilution gas and is applied to the manifold via an electrically actuated valve. Vacuum is applied to the manifold through a pneumatically-actuated vacuum valve. The oven is heated to 40°C during the cleaning cycles.

The control unit controls the pressure, vacuum, and vent valves and houses the front panel control unit and oven temperature controller. The touchscreen front panel control stores and executes the cleaning programs, provides manual valve control and leak check diagnostics, and displays vacuum, pressure, and program time information. The oven temperature controller is separate from the front panel control within the control unit and regulates the oven temperature to a preset value.

The Edwards RV8 vacuum pump is separated from the system by a cryogenic trap. This trap removes contaminants and water vapor from the canisters before reaching the pump, and it prevents the sample canisters from being contaminated by back-diffusion of hydrocarbons from the vacuum pump into the cleanup system. The humidifier system is a modified SUMMA®-treated 6-liter canister partially filled with HPLC-grade water. The ultra-pure N_2 dilution gas is

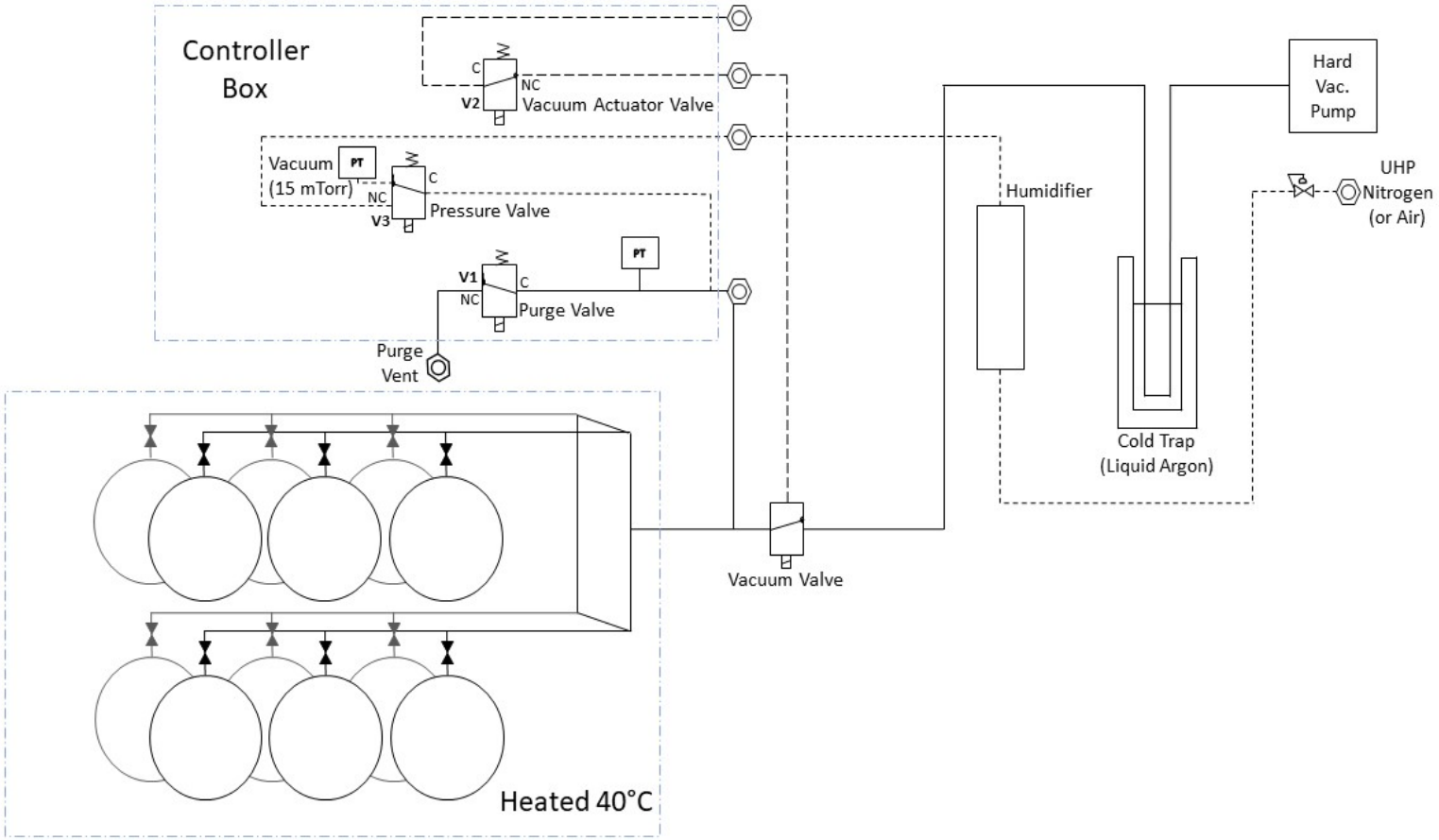


Figure 10-1. Heated Canister Cleanup System Schematic

bubbled through the water prior to entering the manifold, achieving an estimated relative humidity of 75 percent.

After sample analyses and data review are completed, 12 canisters are connected to the manifold in the oven. The bellows valve on each canister is opened. The vacuum pump is started and one of the vacuum routing valves is opened, drawing a vacuum on the canisters connected to the corresponding manifold. The canisters are evacuated to a vacuum reading of 100 millitorr and held for 4 minutes. The vacuum valve is then closed and the ultrapure gaseous N_2 that has been humidified is introduced into the evacuated canisters at a rate of 5.0 liters per minute until the pressure in the canisters reach approximately 15 psig. The canisters are held at this pressure for 4 minutes. This evacuation and pressurization of the canisters constitutes one Cleanup Cycle.

The Cleanup Cycle is repeated fourteen times to facilitate a complete canister cleanup procedure. Each canister ends at a pressure around 10 psig. Following the final pressurization, the canister bellows valves are closed and one canister (out of the 12 cleaned) is selected for cleanliness verification analysis. The cleanliness of the canister is qualified by GC/MS and FID analysis. The pass/fail results of the analyses are documented on a shared network so that the pass/fail rate can be monitored. The cleanliness criterion for each batch bank (1 of 12 canisters) is < 3x MDL or 0.2 ppbV for each individual VOC, whichever is lower, and 10 ppbC for Total SNMOC. If the canister does not pass the cleanliness criteria, the canister is reconnected to the cleanup manifold with the other 11 canisters it was cleaned with and another cleaning cycle is performed, and the same canister is analyzed again. Upon meeting these criteria, the canister is reconnected to the cleanup manifold with the other 11 canisters constituting the original bank of 12. All 12 canister bellows valves are opened, and the canisters are evacuated to a vacuum reading of 50 millitorr. The bellow valves are closed, and canisters are ready to be packaged and shipped to each network site.

10.1.2 Unheated Canister Cleaning System

A canister cleanup system (Figure 10-2) has been developed and is used to prepare sample canisters for use in collecting representative whole air samples (*SOP for Sample Canister*

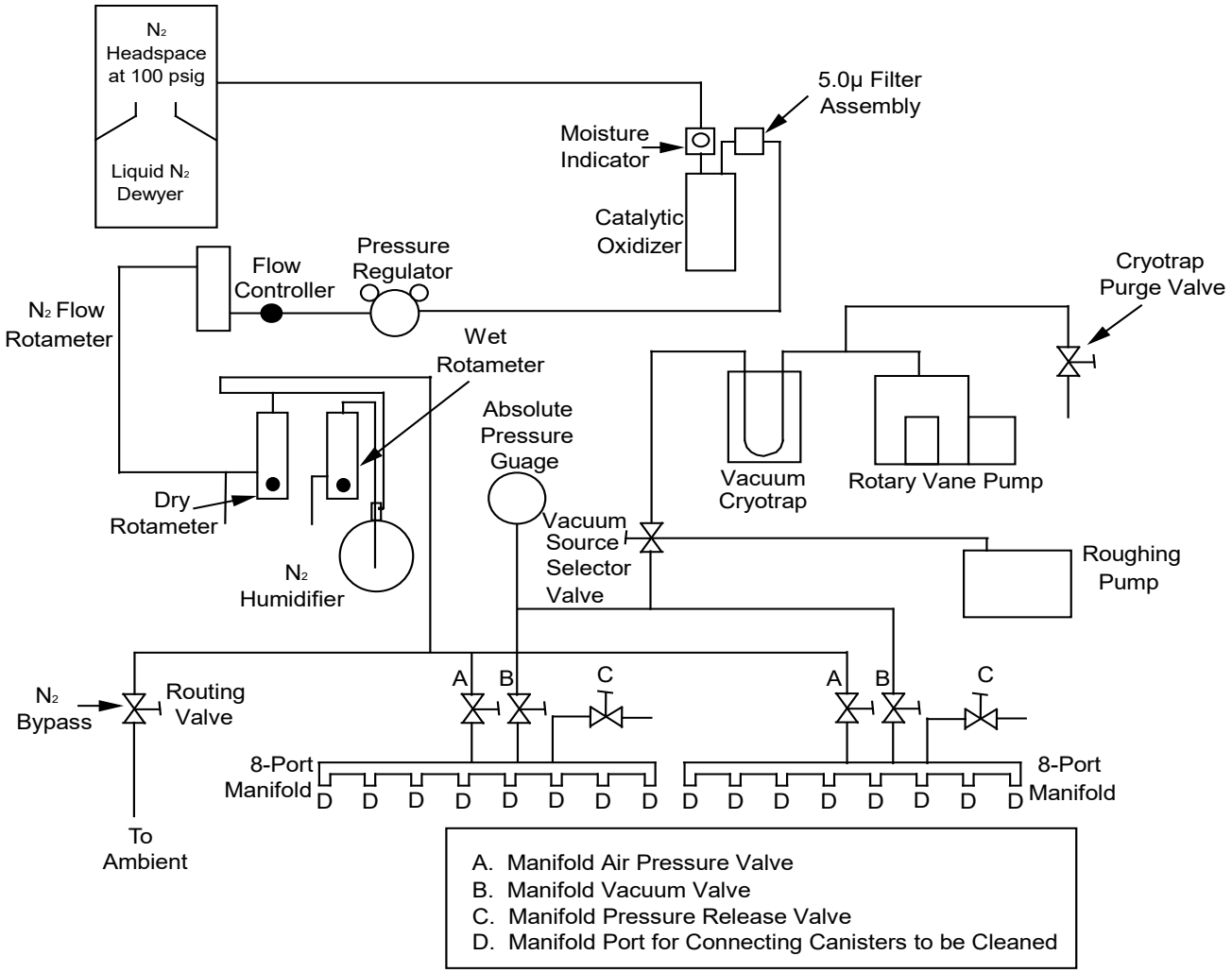


Figure 10-2. Unheated Canister Cleanup System Schematic

Cleaning, ERG-MOR-062 in Appendix D). This cleaning system is used as a backup to the heated canister cleaning system explained in Section 10.1.1.

A single-stage regulator controls the final N_2 pressure in the canisters and a metering valve is used to control the flow rate at which the canisters are filled during a cleanup cycle. The flow direction is controlled by a separate flow meter, installed in the N_2 gas line. A shutoff valve exists between the N_2 gas line and the humidifier system (which is a modified SUMMA®-treated 6-liter canister partially filled with HPLC-grade water). One rotameter and flow-control valve direct the gaseous N_2 into the humidifier where it is bubbled through the HPLC-grade water. A second flow-control valve and flow meter allow gaseous N_2 to bypass the humidifier system, if desired. By setting the flow-control valves separately, the downstream relative humidity can be regulated. Approximately 75 percent relative humidity is used for canister cleaning. This is accomplished by routing 100 percent of the gaseous N_2 flow through the humidifier. Another shutoff valve is located between the humidifier and each 8-port manifold where the canisters are connected for cleanup.

The vacuum system consists of a Precision Model DD-310 vacuum pump, a cryogenic trap, a vacuum and pressure gauge, and a manifold vacuum valve connected as shown in Figure 10-1. The cryogenic trap prevents the sample canisters from being contaminated by back-diffusion of hydrocarbons from the vacuum pump into the cleanup system. The manifold vacuum valves enable isolation of the vacuum pump from the system without shutting off the vacuum pump.

After sample analyses and data review are completed, a bank of eight canisters is connected to each manifold as shown in Figure 10-1. The canister bellows valve on each canister is opened. The vacuum pump is started and one of the vacuum routing valves is opened, drawing a vacuum on the canisters connected to the corresponding manifold. The bank of eight canisters is evacuated to a vacuum reading of 29.5 “Hg (as indicated by the pressure gauge) and held for 30 minutes. The vacuum routing valves are then closed and the ultrapure gaseous N_2 that has been humidified is introduced into the evacuated canisters at a rate of 4.0 liters per minute until

the pressure in the canisters reach approximately 20 psig. This “Evacuation and Pressurization” of the canisters constitutes one Cleanup Cycle.

The Cleanup Cycle is repeated twice more to facilitate a complete canister cleanup procedure. Following the third pressurization, the canister bellows valves are closed and one canister (out of the eight cleaned) is selected for cleanliness verification analysis. The cleanliness of the canister is qualified by GC/MS and FID analysis. The pass/fail results of the analyses are documented on a shared network so that the pass/fail rate can be monitored. The cleanliness criterion for each bank of eight canisters is < 3x MDL or 0.2 ppbV for each individual VOC, whichever is lower, and 10 ppbC for Total SNMOC. If the canister does not pass the cleanliness criteria, the canister is reconnected to the cleanup manifold with the other seven canisters it was cleaned with and another cleaning cycle is performed, and the same canister is analyzed again. Upon meeting these criteria, the canister is reconnected to the cleanup manifold with the other seven canisters constituting the original bank of eight. All eight canister bellows valves are opened, and the canisters are evacuated to a vacuum reading of approximately 29.5 ”Hg for a fourth time. The bellow valves are closed, and the canisters are ready to be packaged and shipped to each network site.

10.2 VOC and Concurrent Analytical System

The VOC GC/MS analyses are performed on a 250-milliliter (mL) sample from the canister with an Agilent 8890 GC, equipped with an Agilent 5977 MS with Selected Ion Monitoring (SIM) using a 60 m by 0.32-millimeter (mm) Inner Diameter and a 1.8-micrometer (µm) film thickness Restek R_{xi}-624Sil capillary.

The VOC GC/FID/MS, for concurrent analyses, are performed on a 250 mL sample from the canister with an Agilent 6890 GC/FID and an Agilent 5975 MS with SIM using a 60 m by 0.32 mm Inner Diameter and a 1 µm film thickness Restek R_{xi}-l_{ms} capillary column followed by a Y-union connector that splits the mobile phase between the MS and the FID. Instrument optimization is ongoing and the most up-to-date operating conditions will be presented in the analytical *SOP for the Concurrent GC/FID/MS Analysis of Canister Air Toxic Samples using*

EPA Compendium Method TO-15 and EPA Ozone Precursor Method (ERG-MOR-005) presented in Appendix D. Table 10-1 shows the operating conditions for the VOC GC/FID/MS analytical system.

Table 10-1
VOC GC/FID/MS Operating Conditions

Parameter	GC/MS/FID System (Concurrent VOC/ SNMOC analysis)
Sample Volume	250 mL
Restek R_{xi}-l_{ms} Capillary Column: Length: Inside diameter: Film thickness: Oven temperature:	 60 m 0.32 mm 1 µm -50°C for 5 minutes, 15°C/min to 0°C then 5°C/min to 150°C, then 25°C/min to 220°C for 1 minute then 25°C/min to 150°C for 4 minutes
Temperatures: FID: Injector Oven Temperature: MS Quad Temperature: MS Source Temperature:	 300°C 220°C 200°C 280°C (350°C 5975)
Gas Flow Rates: Column Carrier Gas (Helium (He)): FID Make-up (He): FID (Hydrogen (H_2)): FID (Air):	 2 mL/min 30 mL/min 30 mL/min 300 mL/min
Entech Sample Interface Conditions: Module 1 - Glass Bead/Tenax® Trap Initial Temperature: Module 2 - Tenax® Trap Initial Temperature: Module 3 - Cryofocuser Temperature:	 -150°C -50°C -196°C

Figure 10-3 shows the GC/MS systems and Figure 10-4 shows the GC/MS/FID arrangement. Canister samples must be analyzed within 30 days from sample collection.

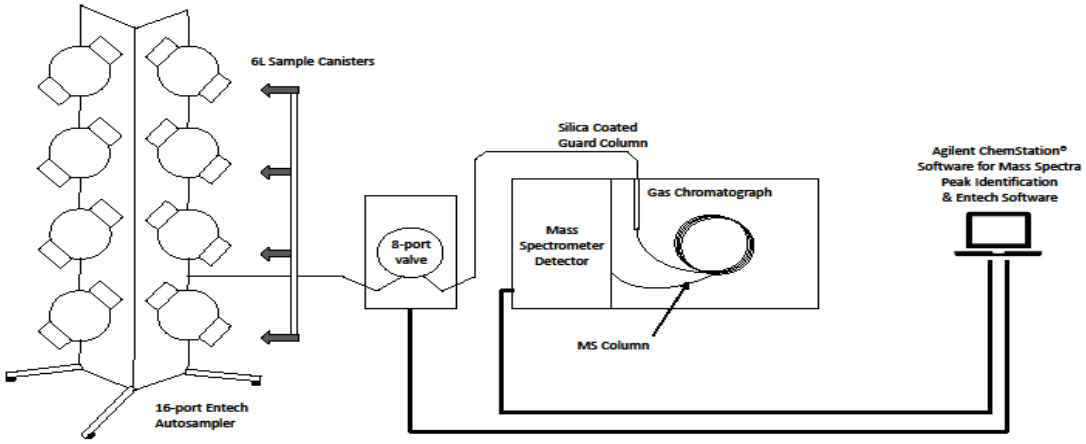


Figure 10.3 VOC GC/MS Systems

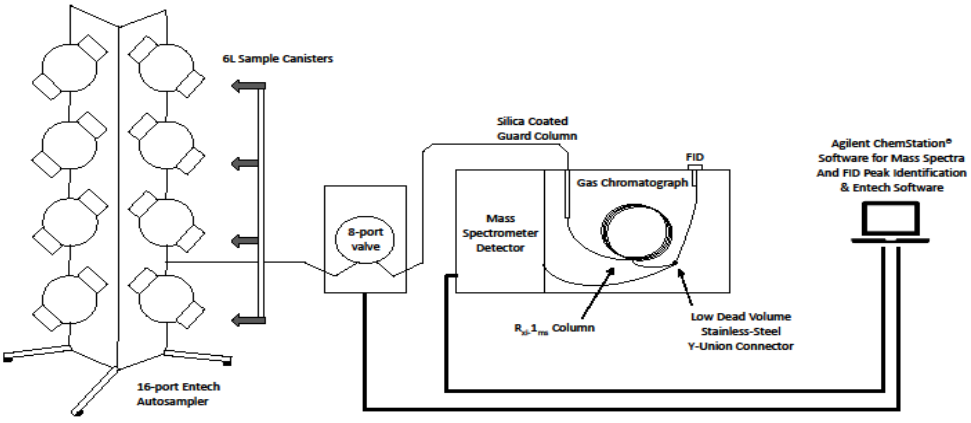


Figure 10-4. VOC GC/MS/FID System

10.3 Carbonyl Analytical System

Carbonyl samples are stored in the refrigerator after they are received from the field prior to analysis. The carbonyl cartridge samples are extracted within 14 days of the sampling day and analyzed within 30 days after extraction. Samples are prepared using an extraction manifold by which 5 mL of acetonitrile is vacuum filtered through a cartridge into a 5 mL Cass A volumetric flask and filled to volume. The extract is transferred to a 2 mL autosampler vial fitted with a Teflon-lined, self-sealing septum and a 4 mL vial with a Teflon-lined cap. Both vials are stored in a dedicated refrigerator at 4°C or below until analysis.

The analytical separation of carbonyls is performed using a Waters HPLC configured with a reverse-phase 250 mm by 4.6 mm C-18 silica analytical column with a 5-micron particle size. A typical HPLC system is shown in Figure 10-5 ERG's system uses an Agilent HPLC chromatographic data software system. Typically, 15-microliters (µL) of sample extract is injected with an automatic sample injector. A mobile phase gradient of HPLC water, acetonitrile, and methanol is used to perform the analytical separation at a flow rate of 1.0 mL/minute. The multiwavelength Ultraviolet (UV) detector operates at 360 nanometer (nm). The complete *SOP for Preparing, Extracting, and Analyzing DNPH Carbonyl Cartridges by Method TO-11A* (ERG-MOR-024) is presented in Appendix D. Sample and waste disposal procedures are outlined in ERG-MOR- 033, the *SOP for Hazardous Waste*.

10.4 Polycyclic Aromatic Hydrocarbons Analytical Systems

After PAH sampling, sampling modules containing PUF/XAD-2®, petri dishes containing glass microfiber filters, tweezers and completed COC forms will be shipped to the ERG laboratory from the field. Each filter should be folded in quarters, placed inside the cartridge (with the PUF/XAD) and capped by field operator before shipment. Upon receipt at the laboratory, samples will be logged into the LIMS system and stored in the refrigerator. Sample preparation and analysis

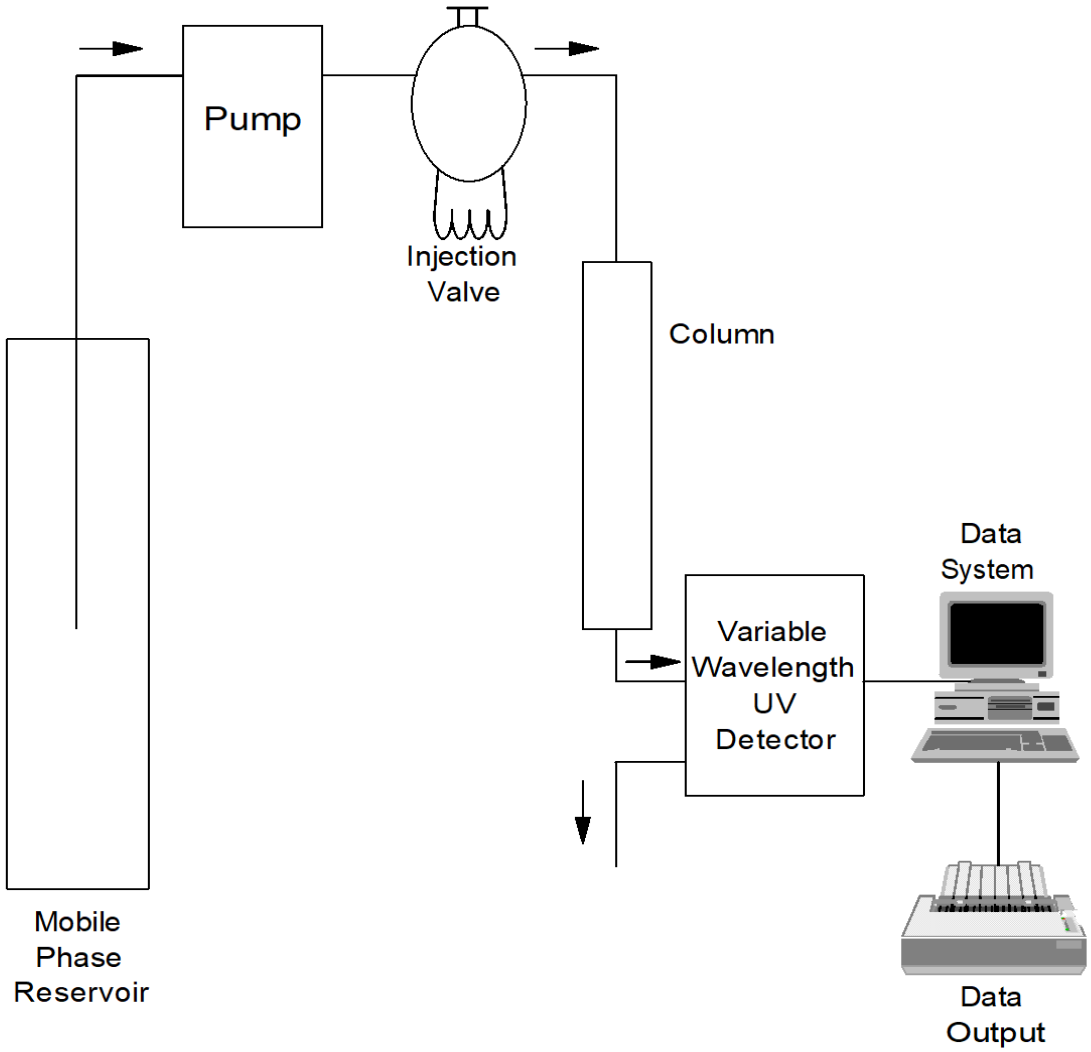


Figure 10-5. HPLC System

procedures are based on EPA Compendium Method TO-13A[10] and the ASTM D6209 [12] method. Hold times are 14 days after sampling for extraction and 40 days after extraction for analysis.

Sample extracts will be analyzed for PAHs using GC/MS in SIM mode. The MS will be tuned and mass-calibrated as required using perfluorotributylamine (FC-43), per the analytical procedures presented in the *SOP for analysis of Semivolatile Organic Compounds (Polynuclear Aromatic Hydrocarbons) Using EPA Compendium Method TO-13A and ASTM D6209 (*ERG-

MOR-049) (see Appendix D). Sample and waste disposal procedures are outlined in ERG-MOR-033, the *SOP for Hazardous Waste*.

10.5 Metals Using an Inductively Coupled Argon Plasma Mass Spectrometry Analytical System

Upon receipt from the field, the samples are checked against the COC forms and then logged into the LIMS system. Each sample component is examined to determine if damage occurred during travel. Abnormal color, appearance, and other sample particulars are noted when necessary. Sample preparation and analysis procedures are based on EPA Compendium Methods IO-3.1[(23)] and IO-3.5[(6)], respectively for the Determination of Metals in Ambient Particulate Matter using ICP-MS techniques. A complete description of the preparation procedures are presented in the SOPs for quartz and glass fiber (8x10") filter prep (ERG-MOR-084) and for Teflon 47mm filter prep (ERG-MOR-085) and all sample types are analyzed by ICP-MS (ERG-MOR-095). These procedures were approved as NAAQS Federal Equivalency Methods (FEM) for the analysis of Lead for Total Suspended Particulate (TSP) on quartz and glass fiber filters (EQL-0512-201[(7)]) and for PM_{10} on Teflon filters (EQL-0512-202[(8)]). Analysis hold time for all metals filters is 180 days.

The ICP-MS consists of an inductively coupled plasma source, ion optics, a quadrupole MS, a recirculating chiller, autosampler, and a desktop computer for operational control. The MS is mass calibrated and resolution checked before each analysis. Resolution across the mass range is indicated by the following isotopes 7Li; 24, 25, and 26Mg; 59Co; 115In; 206, 207, and 208Pb; and 238U. Instrument stability must be demonstrated by running 10 replicates of a tuning (daily performance check) solution [1 micrograms per liter (µg/L) of barium, bismuth, cerium, cobalt, indium, lead, lithium and uranium, and 15 µg/L of magnesium] with a resulting Relative Standard Deviation (RSD) of absolute signals for all analytes less than 2 or 5 percent, depending on element and instrument acquisition mode. Sample and waste disposal procedures are outlined in ERG-MOR-033, the *SOP for Hazardous Waste*.

10.6 Hexavalent Chromium Analytical System

Hexavalent chromium filter samples are stored in the freezer after they are received from the field prior to analysis. Internal studies have shown that the hexavalent chromium does not degrade for up to 21 days if the samples are stored in the freezer before extraction. Upon receipt from the field, the samples are checked against the COC forms and then logged into LIMS. Due to oxidation/reduction and conversion between the trivalent and hexavalent chromium, the extraction is performed immediately prior to analysis. Therefore, it is important that the IC be equilibrated, calibrated and ready for analysis before filters are extracted. Sample preparation is performed by removing the filter from the filter holder and placing it into a 14 mL polystyrene tube. The filters are extracted in 10 mL of a 20 millimolar (mM) sodium bicarbonate solution. The tubes are shaken for 45 minutes using a wrist action shaker before a 2.5 mL aliquot is removed for analysis on the IC. All analysis is completed within 24 hours of the filter extraction.

The analytical separation for the hexavalent chromium is performed using a Dionex-600 IC or Dionex ICS-5000 with a Dionex LC 20 Chromatography Enclosure with a post-column reagent delivery device and an advanced gradient pump configured with an IonPac AS7 analytical column and an IonPac NG1 guard column. Both of ERG's ICs use the Dionex Chromeleon® data system. For the Dionex-600 IC, samples are injected using a Dionex AS40 autosampler. The samples analyzed with the Dionex ICS-5000 are injected using an AS-DV autosampler. A mobile phase is used to perform the analytical separation at a flow rate of 1.0 mL/min, and a post-column reagent flow rate of 0.3 mL/min. The multiwavelength UV detector is set at 530 nm. The samples are prepped and analyzed following ASTM D7614[9] method and the *SOP for the Preparation and Analysis of Ambient Air for Hexavalent Chromium by Ion Chromatography* (ERG-MOR-063) that is presented in Appendix D. Sample and waste disposal procedures are outlined in ERG-MOR-033, the *SOP for Hazardous Waste*.

SECTION 11
QUALITY CONTROL REQUIREMENTS

This section describes the quality control requirements for each of the major program components (NMOC, SNMOC, VOC, Carbonyls, PAMS, HAPs – SVOC, Metals and Hexavalent Chromium). As there is not a current need for some of the HAPS (SVOC analysis following TO-13A[10]/SW 846 Method 8270E[11], PCB/Pesticides[13], inorganic acids[14, 15, 16], etc.), this information is not provided. As soon as these analyses are requested by EPA or States, however, the QAPP will be modified and a new set of MDLs will be completed and presented to EPA. The 2021 MDLs are presented in this section.

11.1 Sample Canister Integrity Studies

Before any SNMOC or VOC samples are collected for a program, all stainless-steel sample canisters are checked for leaks. The canisters are evacuated to less than 25" Hg. The canister vacuum, measured on a Heise gauge, and the barometric pressure is recorded. After 7 days, the canister vacuum and barometric pressure is remeasured. The canisters are considered leak-free if there is less than 1" Hg difference in vacuum (adjusted for differences in the barometric pressure). The canisters are then cleaned using the procedure described in Section 10. For the canister to be used without further cleanup, an analysis must show that it meets the quality objective for cleanliness.

11.2 Standard Traceability

The standards used for all analytes are vendor-supplied National Institute of Standards and Technology (NIST) standards or vendor-supplied referenced to a NIST standard. All analytical methods are also certified by comparison to a second source NIST-traceable standard. The ERG-MOR-022 *SOP for the Preparation of Standards in the ERG Laboratory*, provides direction for preparing standards from solid or liquid chemicals. The SOP used to prepare canister standards is *SOP for Standard Preparation Using Dynamic Flow Dilution System*, ERG-MOR-061 (Appendix D).

11.3 Accuracy and Acceptance

As ambient air measurements encompass a range of compounds and elements whose individual concentrations are unknown, defining absolute accuracy is not possible. Instead, accuracy is determined by comparing the analysis of duplicate samples and of standards of known concentration. The criteria for the analysis of duplicate (or collocated) samples and their replicate analyses are found in Section 4. Accuracy of analysis is based on the accuracy of the calibration, including the accuracy of the calibration standards. Each instrument calibration is discussed by method in Section 13 of this QAPP. Accuracy is monitored throughout the program using QC samples. Required QC samples and their criteria and corrective actions are discussed by the methods listed below.

11.3.1 SNMOC Analysis

Prior to sample analysis for SNMOC, a continuing calibration verification (CCV) standard of hydrocarbons, prepared using either a NIST-traceable Linde or Air Environmental high pressure gas, is analyzed daily to ensure the validity of the current Response Factors (RF). This standard will have an approximate concentration range from 10 ppbC to 50 ppbC. The concentrations are compared to the calculated theoretical concentrations of the CCV. The standard analysis is considered acceptable if the percent recovery is 70-130 percent for 10 pre-selected compounds.

If the CCV does not meet the percent recovery criterion, a second CCV is analyzed. If the second CCV meets the criterion, the analytical system is considered in control. If the second CCV does not meet acceptance criteria, the CCV can be reprepared and analyzed, otherwise, recalibration or system maintenance is performed. If maintenance causes a significant change in system response, a new calibration curve is required.

A system blank of cleaned, humidified N_2 is analyzed after the CCV and before the sample analysis. The system is considered in control if the total NMOC concentration for the system blank is < 10 ppbC and no individual compounds > 0.5 ppbC.

CCV requirements are presented in Table 11-1. If both the hydrocarbon and TO-15[(4)] parameters are requested from same sample, the instrument must conform to the standard QC procedures listed in both Tables 11-1 and 11-2 (for VOC QC requirements).

11.3.2 VOC Analysis

The tune of the GC/MS is verified using a 4-Bromofluorobenzene (BFB) instrument performance check sample daily. The acceptance criteria for the BFB are presented in Table 11-3. The internal standards for this method are hexane-d_{14}, 1,4-difluorobenzene, and chlorobenzene-d_5. The internal standard responses must be evaluated to ensure instrument stability throughout the day.

Before sample analyses, a standard prepared at approximately 2.5 ppbV from a NIST-traceable Linde or Air Environmental gas cylinder is used for a CCV. The resulting response factor for each compound is compared to the average calibration curve response factors generated from the GC/MS using the Agilent ChemStation® Software. Correspondence within an absolute value of less than or equal to 30 percent difference is considered acceptable for the quantitated compounds. If the first CCV does not meet this criterion, a second CCV will be analyzed. If the second CCV is acceptable, sample analysis can continue. If the second CCV does not meet acceptance criteria, the CCV can be reprepared and analyzed, otherwise, a leak check, recalibration or system maintenance is performed. If the maintenance causes a significant change in the system response, a new calibration curve must be analyzed before sample analyses can begin.

Table 11-1
Summary of SNMOC Quality Control Procedures

QC Check	Frequency	Acceptance Criteria	Corrective Action
Multiple point calibration (5 points minimum); propane, hexane, benzene, octane, and decane bracketing the expected sample concentration. Laboratory Control Standard (LCS) (or Initial Calibration Verification (ICV))	Upon CCV failure, not to exceed 1 year.	Average Response Factor (RF) curve fit with RF RSD within ±20% ICV Recovery for selected hydrocarbons 70-130%	1) Repeat individual Initial Calibration (ICAL) standard analysis 2) Repeat ICAL 3) Reprepare ICAL standards and analyze
Continuing calibration verification (CCV) using Certified Standard	Daily, prior to sample analysis	Recovery for 10 selected hydrocarbons spanning the carbon range 70-130 %	1) Repeat analysis 2) Reprepare CCV and analyze 3) Repeat calibration curve
Method Blank Analysis	Daily, following calibration check	< 10 ppbC and no individual compounds > 0.5 ppbC	1) Repeat analysis 2) Reprepare Method Blank (MB) and analyze 3) Check system for leaks/contamination
Canister cleaning certification	One canister analyzed on the Air Toxics system per batch of 12	≤ 10 ppbC total	Reclean canisters and reanalyze

Table 11-2
Summary of Air Toxics Canister VOC Quality Control Procedures

QC Check	Frequency	Acceptance Criteria	Corrective Action
BFB Instrument Tune Performance Check	Daily[b], prior to sample analysis	Evaluation criteria presented in Section 16.1.1 of the SOP and Table 11-3 of this QAPP.	1) Retune 2) Clean ion source and/or quadrupole
ICAL consisting of at least 5 points bracketing the expected sample concentration.	Following any major change, repair, or maintenance or if daily QC is not acceptable. Recalibration not to exceed three months.	1) % RSD of Response Factors ≤ 30% RSD (with two exceptions of up to ± 40% for non-Tier I compounds only) 2) Internal Standard (IS) response ±40% of mean curve IS response 3) Relative Retention Times (RRTs) for target peaks ±0.06 units from mean RRT 4) IS RTs within 20 seconds of mean 5) Each calibration standard concentration must be within ±30% of nominal (for Tier I compounds)	1) Repeat individual ICAL standard analysis within 24 hours of original 2) Repeat ICAL 3) Reprepare ICAL standards and analyze
LCS ({ICV} Second source calibration verification check)	Following the calibration curve	The response factor ≤ 30% Deviation from calibration curve average response factor	1) Repeat ICV 2) Reprepare ICV and analyze 3) Repeat calibration curve
CCV of approximately mid-point of the calibration curve[a] using a Certified Standard	Before sample analysis on the days of sample analysis [b]	The response factor ≤ 30% Deviation from the calibration curve average Relative Response Factor (RRF)	1) Repeat CCV 2) Reprepare CCV and analyze 3) Repeat calibration curve

[a] The same QA criteria are needed for SNMOC and PAMS analysis.
[b] Every 24 hours frequency.

Table 11-2
Summary of Air Toxics Canister VOC Quality Control Procedures (Continued)

QC Check	Frequency	Acceptance Criteria	Corrective Action
Method Blank Analysis (Zero Air or N_2 Sample Check)	Daily[b], following BFB and calibration check; prior to sample analysis	1) <3x MDL or 0.2 ppbV, whichever is lower 2) IS area response ± 40% and IS Retention Time (RT) ± 0.33 min. of most recent ICAL	1) Repeat MB 2) Reprepare MB and analyze 3) Check system for leaks, contamination
Duplicate and Replicate Analysis	All duplicate and collocate field samples	<25% RPD for compounds greater than 5 x MDL	1) Repeat sample analysis 2) Flag data in LIMS and flag in AQS as permitted
Canister Cleaning Certification	One canister analyzed on the Air Toxics system per batch of 12	<3x MDL or 0.2 ppbV, whichever is lower	Reclean canisters and reanalyze
Preconcentrator Leak Check	Each standard and sample canister connected to the preconcentrator/ autosampler	≤ 0.2 psi change/minute	1) Retighten and re-perform leak check 2) Perform maintenance 3) Re-perform leak check test

[a] The same QA criteria are needed for SNMOC and PAMS analysis.
[b] Every 24 hours frequency.

Table 11-2
Summary of Air Toxics Canister VOC Quality Control Procedures (Continued)

QC Check	Frequency	Acceptance Criteria	Corrective Action
Sampler Certification - Standard Challenge with a reference can and a Zero Check with a reference can	Annual	Challenge: Within 15% of the concentration in the reference canister (25% for acrolein and carbon tetrachloride). Zero: up to 0.2 ppbV or 3x MDL (whichever is lower) higher than the reference canister for all Tier I compounds. Non-Tier I compounds up to 0.1 ppbV or 3x MDL (whichever is higher, with the upper limit of 0.2 ppbV) higher than the reference canister.	1) Repeat certification of samplers, a requirement for Tier I compounds 2) Notify Program Manager (flagging non-Tier I compound data for sampler may be an option)
Sampling Period	All samples	24 hours ± 1 hours	1) Notify Program Manager 2) Flag samples 22-23 hours and 25-26 hours in AQS with a "Y" flag 3) Invalidate and re-sample for > 24±2 hours
Retention Time (RT)	All qualitatively identified compounds	RT within ± 0.06 RRT units of most recent initial calibration average RT	Repeat analysis
Samples – Internal Standards	All samples	IS area response within ± 40% and IS RT within ± 0.33 min. of most recent calibration average IS response	Repeat analysis

[a] The same QA criteria are needed for SNMOC and PAMS analysis.
[b] Every 24 hours frequency.

Table 11-3. BFB Key Ion Abundance Criteria

Target Mass	Rel. To Mass	Lower Limit %	Upper Limit %
50	95	8	40
75	95	30	66
95	95	100	100
96	95	5	9
173	174	0	2
174*	95	50	120
175	174	4	9
176	174	93	101
177	176	5	9

* alternate base peak

After acceptable analysis of the daily standard has been demonstrated, a system blank consisting of clean, humidified air or N_2 is analyzed. A concentration per compound of < 3x MDL or 0.2 ppbV, whichever is lower (as outlined in Table 11-2) indicates that the system is in control. If a concentration greater than the acceptance criterion is detected, a second system blank is analyzed. If the second system blank fails, system maintenance is performed. Another system blank can be analyzed and if it is in control, ambient air samples are analyzed. All other QC procedure acceptance criteria and corrective actions are presented in Table 11-2.

11.3.3 Carbonyl Compounds Analysis

Daily CCVs prepared from NIST traceable stocks are analyzed at least every twelve hours over the course of an analytical sequence to ensure that the analytical procedures are in control. Compound responses in the CCVs must have a percent recovery between 85-115 percent. The analytical software is configured so that only peaks within acceptable retention time parameters are identified. Retention times outside a 5% window of the most recent calibration signal chromatographic drift are investigated and resolved when this problem is identified.

If one of these CCV does not meet the criterion, analysis of a second injection of the CCV is performed. If the second CCV does not pass or if more than one CCV over the course of

a sequence does not meet the criterion, a new standard is prepared and analyzed. If the QC check fails after preparing a new standard, a new calibration curve (at least 5 concentration levels) is analyzed. All samples analyzed with the unacceptable CCV are reanalyzed.

Crotonaldehyde tautomerizes into two chromatographically separate peaks after it is spiked onto the DNPH cartridge. The best analytical recovery for crotonaldehyde is determined when both the peaks are integrated together for all samples and QC.

Acetaldehyde elutes with its stereoisomer. The best analytical recovery for acetaldehyde, based on data from spike and biannual audit recoveries, is determined when both peaks are integrated together for all samples and QC.

Acetonitrile system blanks (or solvent blanks) are analyzed at a minimum at the beginning and end of the sequence. The system is considered in control if target compound concentrations are less than the current laboratory MDLs. Quality procedures determined for the carbonyl analysis ensure that ambient air samples are collected in the prescribed manner and that compound quantitative analyses are performed with known bias and precision. Quality control such as checking for remaining DNPH ensures that there was sufficient DNPH available in the cartridge to collect all carbonyls at the sampling location. The quality procedures for carbonyl analysis are presented in Table 11-4.

11.3.4 PAH Analysis

Every 12 hours, the mass spectrometer used for PAH analysis must have an acceptable Decafluorotriphenylphosphine (DFTPP) instrument performance tune check meeting the criteria listed in Table 11-5 when 1 µL or less of the GC/MS tuning standard, depending on instrument sensitivity, is injected through the GC (50 nanogram (ng) on column).

Samples should be received with filters folded and inserted into the glass thimble cartridge with the sorbent media. It will be noted on the COC and extraction bench sheet if a filter is received in

a petri dish, instead of a glass thimble. Prior to sample analyses, a daily CCV must be analyzed, a standard prepared at approximately the midpoint of the calibration curve from NIST-traceable PAH stock solution. The resulting response factor for each compound will be compared to the average calibration curve response factors. Correspondence within an absolute value of less than or equal to 30 percent difference is considered acceptable. If the first CCV does not meet this criterion, a second CCV will be analyzed. If the second CCV is acceptable, sample analysis can continue. If the second CCV does not meet acceptance criteria, then a leak check and system maintenance are performed, or the CCV reprepared. If the system maintenance is completed and a third CCV analysis meets the criterion, then analysis may continue. If the maintenance causes a change in the system response, a new calibration curve must be analyzed before sample analyses can begin.

EPA Compendium Method TO-13A[10] employs and spikes two different types of surrogates. The Field Surrogates, fluoranthene-d_{10} and benzo(a)pyrene-d_{12}, are spiked onto the PUF media prior to shipment to the field; acceptable recoveries for these field surrogates are in the range of 60 to 120 percent. The laboratory surrogates, fluorene-d_{10} and pyrene-d_{10}, are spiked into the PUF immediately before extraction; acceptable recoveries for these laboratory surrogates are 60 to 120 percent.

Table 11-4
Summary of Carbonyl Quality Control Procedures

Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
HPLC Efficiency	Analyze Second Source QC (SSQC) sample	Once per 12 hours or less	1) Resolution between acetone and propionaldehyde ≥ 1.0 2) Column efficiency > 5,000 plate counts	1) Eliminate dead volume 2) Back flush 3) Replace the column repeat analysis
DNPH Peak	All samples	Every chromatogram from an extracted cartridge (field sample, method blank, lot blank, and BS/BSD)	DNPH must be ≥ 50% of the DNPH are in the laboratory QC samples	1) Sample concentration will be flagged with a "DNPH" flag in LIMS and a "DN" flag in AQS
Sampler Certification	Zero Challenge cartridge with a reference cartridge	Annual	Each compound must be ≤ 0.2 ppbV above the reference cartridge	1) Repeat certification of samplers, a requirement for Tier I compounds 2) Notify Program Manager (flagging non-Tier I compound data for sampler may be an option)
ICAL	Run a 5-point calibration curve	At setup or when calibration check is out of acceptance criteria (at least every 6 months)	1) Correlation coefficient at least 0.999, relative error for each level against calibration curve ≤ 20% 2) The absolute value of the intercept/slope of the calibration curve must be less than the MDL for each compound	1) Check integration 2) Reanalyze 3) Reprepare standards and recalibrate
ICV	Analyze SSQC sample	After calibration in triplicate	85-115% recovery	1) Check integration 2) Recalibrate 3) Reprepare standard

Table 11-4
Summary of Carbonyl Quality Control Procedures (Continued)

Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
Retention Time	Analyze SSQC	Once per 12 hours or less	Each target compound within ± 2.5% of the mean calibration standards RT (set in Agilent® software)	1) Check integration, 2) Check for plug in LC 3) Check column temperature in LC
CCV	Analyze SSQC sample	Once per 12 hours or less	85-115% recovery	1) Check integration 2) Reanalyze, reprepare standard, or recalibrate 3) Reanalyze samples not bracketed by acceptable standard
Solvent Blank (aka Continuing calibration blank (CCB), System Blank, or Laboratory Reagent Blank (LRB))	Analyze acetonitrile	Bracket sample batch, 1 at beginning and 1 at end of batch	Measured concentration must be < MDL for each compound	1) Locate contamination and correct 2) Flag associated data
Sampling Period	All samples	All samples	24 hours ± 1 hours	1) Notify Program Manager 2) Flag samples 22-23 hours and 25-26 hours in AQS with a “Y” flag 3) Invalidate and re-sample for > 24±2 hours

Table 11-4
Summary of Carbonyl Quality Control Procedures (Continued)

Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
Lot Blank Check	Analyze blank for new lots received	Analyze 1.0 % of total lot or a minimum of 3 cartridges, whichever is greater	Compounds must be less than values listed: Formaldehyde <0.15 µg/cartridge (0.03 µg/mL) Acetaldehyde <0.10 µg/cartridge (0.02 µg/mL) Acetone <0.30 µg/cartridge (0.06 µg/mL) Others <0.10 µg/cartridge (0.02 µg/mL)	1) Reanalyze an additional set of cartridges from the new lot 2) Notify vendor if lot blank continues to fail and acquire new lot if possible 3) Flag data associated with bad lot
Extraction Solvent Method Blank (ESMB)	Aliquot of extraction solvent prepared with samples during extraction	First extraction per month and when acetonitrile lot changes	All target compounds must be < MDL	1) Check integration 2) Reanalyze 3) Locate and resolve contamination in extraction glassware/solvent 4) Flag batch data
Field Blank (FB) Check	Field blank samples collected in the field	Monthly (if provided by site)	Underivatized compound concentrations must be less than values listed: Formaldehyde <0.3 µg/cartridge (0.06 µg/mL) Acetaldehyde <0.4 µg/cartridge (0.08 µg/mL) Acetone <0.75 µg/cartridge (0.15 µg/mL) Others <7.0 µg/cartridge (1.4 µg/mL)	1) If FB fails, notify site coordinator, schedule another FB. Additional FBs are collected until the problem is corrected and data are acceptable 2) Flag samples since the last acceptable FB

Table 11-4
Summary of Carbonyl Quality Control Procedures (Continued)

Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
Duplicate or Collocate Samples	Analysis of duplicate and collocated samples	As collected (10% of sampling schedule)	≤ 20% RPD for concentrations ≥ 0.5 µg/cartridge	1) Check integration 2) Check instrument function 3) Reanalyze duplicate samples 4) Flag data in LIMS (and AQS as permitted)
Replicate Analyses	Replicate injections	One per batch. Performed on every duplicate and collocate sample or if not available on a field sample	≤ 10% RPD for concentrations ≥ 0.5 µg/cartridge	1) Check integration 2) Check instrument function 3) Reanalyze sample
MB (BLK)	Analyze MB	One per batch of 20 samples	Underivatized compound concentrations must be less than values listed: Formaldehyde <0.15 µg/cartridge (0.03 µg/mL) Acetaldehyde <0.10 µg/cartridge (0.02 µg/mL) Acetone <0.30 µg/cartridge (0.06 µg/mL) Others <0.10 µg/cartridge (0.02 µg/mL)	1) Reanalyze MB 2) Check extraction procedures 3) Flag batch data

Table 11-4
Summary of Carbonyl Quality Control Procedures (Continued)

Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
Blank Spike/Blank Spike Duplicate, (BS/BSD or LCS/LCSD)	Analyze BS/BSD (or LCS/LCSD)	One BS/BSD (LCS/LCSD) per batch of 20 samples	80-120% recovery for Formaldehyde and Acetaldehyde and 70-130% for all other compounds. BSD (LCSD) precision ≤20% RPD of BS (LCS)	1) Reanalyze BS/BSD (LCS/LCSD) 2) Check calibration 3) Check extraction procedures

Note: Crotonaldehyde tautomerizes into two chromatographically separate peaks after it is spiked onto the DNPH cartridge. The best analytical recovery is determined when both peaks are integrated together for all samples and QC. Acetaldehyde elutes with its stereoisomer. The best analytical recovery for Acetaldehyde is determined when both peaks are integrated together for all samples and QC. Breakthrough cartridges are not submitted or analyzed as specified by Compendium Method TO-11A.

Table 11-5. DFTPP Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
51	10 to 80% of base peak
68	< 2% of mass 69
69	Present
70	< 2% of mass 69
127	10 to 80% of base peak
197	< 2% of mass 198
198	Base peak (100% relative abundance) or >50% of mass 442
199	5 to 9% of mass 198
275	10 to 60% of base peak
365	> 1.0% of mass 198
441	Present but < 24% of mass 442
442	Base peak, or >50% of mass 198
443	15 to 24% of mass 442

Note: All ion abundances must be normalized to the nominal base peak, 198 or 442. This criterion is based on the tune criteria for Method 8270D.

Internal standard responses and retention times must also be evaluated for stability. The SIM procedures of EPA Compendium Method TO-13A[(10)] preclude the use of guidelines for qualitative analysis of mass spectra, since complete mass spectra are not acquired when SIM procedures are used. Quantitative analysis for each compound is performed relative to the assigned internal standard. The suggested internal standard assignments are suggested for PAH analysis are presented in Table 11-6. All method criteria and MQOs for ERG's PAH analysis are listed in Table 11-7.

Table 11-6. Internal Standards and Associated PAHs

Internal Standard	Associated Compound
Naphthalene-d_8	Naphthalene
Acenaphthelene-d_{10}	Acenaphthylene Acenaphthene Fluoranthene Fluorene Pyrene
Phenanthrene-d_{10}	Anthracene Phenanthrene
Chrysene-d_{12}	Benz(a)anthracene Benzo(e)pyrene Benzo(b)fluoranthene Benzo(a)pyrene Benzo(k)fluoranthene Chrysene
Perylene-d_{12}	Benzo(g,h,i)perylene Coronene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Perylene

Table 11-7
Summary of Quality Control Procedures for Analysis of SVOC Samples for PAHs

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
DFTPP instrument tune check	Daily prior to calibration check and sample analysis; every 12 hours if instrument is operated 24 hours/day	Evaluation criteria presented in Section 11, Table 11-5	1) Re-analyze 2) Prepare new tune check standard; analyze 3) Re-tune instrument; reanalyze 4) Clean ion source; re-tune instrument; reanalyze
Five-point (minimum) calibration (ICAL)	Following any major change, repair, or maintenance if daily quality control check is not acceptable. Minimum frequency every six weeks	≤ 30% RSD of the RRFs for each compound; Avg Relative Response Factor (RRF) above or equal to minimum RRF limit for each pollutant; ≤ 30% the nominal concentration required for Tier I compounds RRTs within ± 0.06 RRT units of mean RRT of calibration IS RT within ± 20.0 sec of mean RT of calibration	1) Check integrations and calculations 2) Repeat individual calibration standard analyses 3) Prepare new calibration standards and repeat analysis 4) Perform maintenance on GC, especially leak check and repeat analysis 5) Clean ion source and repeat analysis

Table 11-7
Summary of Quality Control Procedures for Analysis of SVOC Samples for PAHs (Continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Retention Time (RT)	All qualitatively identified compounds and internal standard	RRT set in software to be no larger than + 0.25 minutes	Repeat analysis
Secondary Source Calibration Verification (SCV)	Immediately after each ICAL	≤ 30% Difference for each compound RRF compared to the mean RRF of the calibration curve.	1) Check integrations and calculations 2) Repeat SCV analysis 3) Prepare a new SCV standard and repeat analysis 4) Perform maintenance on GC, especially leak check; reanalyze 5) Recalibrate; reanalyze 6) Clean ion source; reanalyze
Continuing Calibration Verification (CCV) Standard	Daily; every 12 hours during instrument operation	Above or equal to RRF minimum and ≤ 30% Difference for each compound RRF compared to the mean RRF of the calibration curve.	1) Check integrations and calculations 2) Repeat CCV analysis 3) Prepare a new CCV standard and repeat analysis 4) Perform maintenance on GC, especially leak check; reanalyze 5) Recalibrate; reanalyze 6) Clean ion source; reanalyze
Solvent Method Blank (SMB)	One with every extraction batch of 20 or fewer field-collected samples.	All target compounds < MDL	1) Check integrations and calculations 2) Reanalyze 3) Flag sample data 4) Remove solvent lot from use
Method Blank (MB)	With every extraction batch ≤ 20 samples	All analytes < 2x MDL	1) Repeat analysis 2) Flag sample data

Table 11-7
Summary of Quality Control Procedures for Analysis of SVOC Samples for PAHs (Continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Blank Spike (BS) or (LCS) BSD (or LCSD)	One BS (or LCS) with every extraction batch ≤ 20 samples. BSD (or LCSD) once per quarter.	60-120% recovery of nominal for all compounds ≤ 20% RPD compared to BS (or LCS)	1) Repeat analysis 2) Flag sample data
Surrogate compound recoveries: Laboratory surrogates fluorene-d_{10} pyrene-d_{10} Field Surrogates fluoranthene-d_{10} benzo(a)pyrene-d_{12}	Every sample/blank/BS	60-120% Recovery	1) Check integrations and calculations 2) Repeat analysis 3) Flag surrogate data 4) Flag sample data if both field or both lab surrogates fail 5) Invalidate sample if three or more surrogates fail
Internal Standard Response: naphthalene-d_8 acenaphthylene-d_{10} phenanthrene-d_{10} chrysene-d_{12} perylene-d_{12}	Every sample/blank/BS	Within 50% to 200% of the ISs in the most recent initial calibration CAL4	1) Repeat analysis 2) Invalidate or flag data if unable to reanalyze
Cartridge Lot Blank	One cartridge (and filter) for each batch of prepared cartridges for a particular sample date.	All target compounds ≤ MDL	1) Repeat analysis 2) Invalidate or flag data if unable to reanalyze prior to cartridge shipment

Table 11-7
Summary of Quality Control Procedures for Analysis of SVOC Samples for PAHs (Continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Field Blank	Monthly (or as provided by site)	Target compounds ≤ 5x MDL	1) If FB fails, notify site coordinator, schedule another FB. Additional FBs are collected until the problem is corrected and data are acceptable 2) Flag samples since the last acceptable FB when input in AQS
Replicate Analysis	Replicate sample, on each collocate or at a minimum one per sequence	≤ 10% RPD for concentration ≥ 0.5 ng/µL or lowest ICAL level, whichever is less.	1) Check integrations and calculations 2) Check instrument function 3) Repeat analysis 4) Flag replicate samples
Collocate Samples	Collocated samples, 10% of field samples, or as collected	≤ 20% RPD for concentration ≥ 0.5 ng/µL or lowest ICAL level, whichever is less	1) Check integrations and calculations 2) Verify collocated primary sample results agree with their replicate within the Replicate Analysis Criteria 3) Check instrument function 4) Flag collocated samples
Sampling Period	All samples	24 hours ± 1 hours	1) Notify Program Manager 2) Flag samples 22-23 hours and 25-26 hours in AQS with a “Y” flag 3) Invalidate and re-sample for > 24±2 hours

NOTE: Matrix Spikes are not performed as required by Compendium Method TO-13A. Matrix spikes are not required by ASTM D2609.

11.3.5 Metals Analysis

The mass spectrometer used for metals analysis must meet the daily performance check criteria using the tuning solution before each analysis. Daily performance checks are acquired in standard and kinetic energy discrimination (KED) mode to verify instrument performance depending on the analysis type. Performance specifications, optimized for each of the two models of ICP-MS instruments, are presented in Table 11-8. Analysis of the metals will be performed by ICP-MS for antimony, arsenic, beryllium, cadmium, total chromium, cobalt, lead, manganese, mercury, nickel, and selenium. The internal standards for this method are lithium, scandium, germanium, yttrium, indium, terbium, holmium, and bismuth. Internal standard responses must be evaluated for stability. Gold is added to each of the standards and samples to stabilize mercury in solution and prevent its loss on labware and sample introduction components of the ICP-MS.

Daily calibration, using a calibration blank and at least 5 non-zero standards prepared from NIST-traceable stock solutions, is performed to ensure that the analytical procedures are in control. To be considered acceptable, the calibration curve must have a correlation coefficient ≥ 0.995. Replicate analysis of the calibration standards must have an intensity (cps) RSD ≤ 10 percent, except for the second calibration standard (CAL2). This standard uses the same concentrations as the Limit of Quantitation (LOQ) standard, which are near or less than that of the MDL, therefore an RSD $\leq$20% percent is acceptable. After calibration, a second source ICV, Initial Calibration Blank (ICB), High Standard Verification (HSV), Interference Check Standard A (ICSA), and Interference Check Standard B (ICSAB), CCV, Low Calibration Verification (LCV), and Continuing Calibration Blank (CCB) are analyzed to ensure quality before the analysis of the samples.

If the ICV does not meet performance criteria, the ICV is reanalyzed a second time. If the rerun does not pass, or if one or more of the daily QC checks do not meet criteria, the QC standard may be reprepared and reanalyzed. If the reprepared QC standard fails, a new calibration curve is prepared and analyzed. All samples analyzed with an unacceptable QC check

will be reanalyzed or flagged appropriately when necessary. During the analysis of the samples, the CCV and CCB are analyzed immediately before the analysis of samples, every 10 samples, and at the end of every analysis batch. The ICSA and ICSAB are analyzed before the analysis of samples, every eight hours and at the end of every analysis sequence. The LCV is analyzed at the beginning and the end of the analysis. Quality procedures for metals analysis are shown in Table 11-9.

Table 11-8
Instrument Mass Calibration & Performance Specifications

Parameter	Peak Width	Sensitivity/Criteria*	RSD
iCAP-Q Criteria			
Standard Mode			
Bkg4.5	NA	< 1.0 cps	N/A
7Li	0.65–0.85	> 50,000 cps	< 2% RSD
24Mg	0.65–0.85	> 500,000 cps	< 2% RSD
25Mg	0.65–0.85	> 70,000 cps	< 2% RSD
26Mg	0.65–0.85	> 80,000 cps	< 2% RSD
59Co	0.65–0.85	> 100,000 cps	< 2% RSD
115In	0.65–0.85	> 220,000 cps	< 2% RSD
206Pb	0.65–0.85	> 70,000 cps	< 2% RSD
207Pb	0.65–0.85	> 60,000 cps	< 2% RSD
208Pb	0.65–0.85	> 100,000 cps	< 2% RSD
238U	0.65–0.85	> 300,000 cps	< 2% RSD
140Ce16O/140Ce	NA	< 0.02	N/A
137Ba++/137Ba+	NA	< 0.03	N/A
Bkg220.7	NA	< 2.0 cps	N/A
Analyzer Pressure	NA	< 10^{-6} mbar	NA
KED Mode†			
Bkg4.5	NA	< 0.5 cps	N/A
24Mg	0.65–0.85	> 3,000 cps	< 5% RSD
25Mg	0.65–0.85	> 500 cps	< 5% RSD
26Mg	0.65–0.85	> 600 cps	< 5% RSD
59Co	0.65–0.85	> 30,000 cps	< 2% RSD
115In	0.65–0.85	> 30,000 cps	< 2% RSD
206Pb	0.65–0.85	> 60,000 cps	< 2% RSD
207Pb	0.65–0.85	> 50,000 cps	< 2% RSD
208Pb	0.65–0.85	> 80,000 cps	< 2% RSD
238U	0.65–0.85	> 80,000 cps	< 2% RSD
140Ce16O/140Ce	NA	< 0.01	N/A
59Co/35Cl16O	NA	> 18.0	N/A
Bkg220.7	NA	< 2.0 cps	N/A

*cps – Counts per second
† – There are no vacuum requirements for KED mode

Table 11-8
Instrument Mass Calibration & Performance Specifications (Continued)

Parameter	Peak Width	Sensitivity/Criteria*	RSD
iCAP-RQ Criteria			
Standard Mode			
Bkg4.5	NA	< 1.0 cps	N/A
7Li	0.65–0.85	> 55,000 cps	< 2% RSD
24Mg	0.65–0.85	> 500,000 cps	< 2% RSD
25Mg	0.65–0.85	> 80,000 cps	< 2% RSD
26Mg	0.65–0.85	> 100,000 cps	< 2% RSD
59Co	0.65–0.85	> 100,000 cps	< 2% RSD
115In	0.65–0.85	> 240,000 cps	< 2% RSD
206Pb	0.65–0.85	> 80,000 cps	< 2% RSD
207Pb	0.65–0.85	> 70,000 cps	< 2% RSD
208Pb	0.65–0.85	> 160,000 cps	< 2% RSD
238U	0.65–0.85	> 330,000 cps	< 2% RSD
140Ce16O/140Ce	NA	< 0.02	N/A
137Ba++/137Ba+	NA	< 0.03	N/A
Bkg220.7	NA	< 2.0 cps	N/A
Analyzer Pressure	NA	< 10^{-6} mbar	NA
KED Mode†			
Bkg4.5	NA	< 0.5 cps	N/A
24Mg	0.65–0.85	> 10,000 cps	< 5% RSD
25Mg	0.65–0.85	> 2,000 cps	< 5% RSD
26Mg	0.65–0.85	> 3,000 cps	< 5% RSD
59Co	0.65–0.85	> 30,000 cps	< 2% RSD
115In	0.65–0.85	> 35,000 cps	< 2% RSD
206Pb	0.65–0.85	> 100,000 cps	< 2% RSD
207Pb	0.65–0.85	> 90,000 cps	< 2% RSD
208Pb	0.65–0.85	> 200,000 cps	< 2% RSD
238U	0.65–0.85	> 85,000 cps	< 2% RSD
140Ce16O/140Ce	NA	< 0.01	N/A
59Co/35Cl16O	NA	> 18.0	N/A
Bkg220.7	NA	< 2.0 cps	N/A

*cps – Counts per second
† – There are no vacuum requirements for KED mode

Table 11-9
Summary of Quality Control Procedures for Metals Analysis

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Daily Performance Check (DPR) STD Mode	Before each analysis	See Table 24-7	1) Repeat analysis of DPR 2) Re-optimize instrument tuning parameters 3) Reprepare DPR standard 4) Perform instrument maintenance
Daily Performance Check (DPR) KED Mode	Before each analysis	See Table 24-7	1) Repeat analysis of DPR 2) Re-optimize instrument tuning parameters 3) Reprepare DPR standard 4) Perform instrument maintenance
Initial Calibration Standards (IC)	At least 5 non-zero calibration points and a blank before each analysis	Correlation of Determination of (R^2) ≥ 0.995 & %RSD ≤ 10. RSDs >10 are acceptable for target elements in the CAL2 (at LOQ concentration) standard.	1) Repeat analysis of calibration standards 2) Reprepare calibration standards and reanalyze
Initial Calibration Verification (ICV)	Immediately after calibration	Recovery 90-110%	1) Repeat analysis of ICV 2) Reprepare ICV standard 3) Recalibrate and reanalyze
Initial Calibration Blank (ICB)	Immediately after ICV	Absolute value must be < MDL	1) Locate and resolve contamination problems before continuing 2) Reanalyze or recalibrate failing elements for the entire analysis when appropriate
High standard verification (HSV)	After ICB and before ICS	Recovery from 95-105%	1) Repeat analysis of HSV 2) Reprepare HSV
Interference Check Standard (ICSA/IFA)	Following the HSV, every 8 hours and at the end	Within determined DQO criteria (See Section 16.8.2 and Appendices I & II)	1) Repeat analysis of ICSA 2) Reprepare ICSA and analyze 3) Recalibrate or flag failing elements as necessary
Interference Check Standard (ICSAB/IFB)	Following each ICSA, every 8 hours and at the end	Recovery 80-120% of true value plus standard background contamination when present	1) Repeat analysis of ICSAB 2) Reprepare ICSAB and analyze 3) Recalibrate or flag failing elements as necessary
Continuing Calibration Verification (CCV)	Analyze before samples, after every 10 samples, and at the end of each run	Recovery 90-110%	1) Reanalyze CCV 2) Reprepare CCV 3) Recalibrate and reanalyze samples since last acceptable CCV
Low Calibration Verification (LCV)	At the beginning and end of each analysis, between the CCV and CCB	Recovery 70-130% for Pb only	1) Reanalyze LCV 2) Reprepare LCV 3) Recalibrate and reanalyze samples since last acceptable LCV
Continuing Calibration Blanks (CCB)	Analyzed after each CCV	Absolute value must be < MDL, however beryllium absolute value must be <5 times the MDL	1) Reanalyze CCB 2) Reanalyze samples since last acceptable CCB

Note: antimony tends to adhere to quartz media, which causes low recoveries for BS/MS/MSD; associated data is qualified.

Table 11-9
Summary of Quality Control Procedures for Metals Analysis (continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Laboratory Reagent Blank (LRB/BLK1)	1 per batch of ≤ 20 samples	Absolute value must be < MDL	1) Reanalyze for verification 2) If > 5x MDL, failing elements for all batch QC and samples must be flagged 3) When enough sample filter remains, a reextraction and analysis of the batch should be considered
Method Blank (MB/BLK2)	1 per batch of ≤ 20 samples	Absolute value < MDL	Flag the failing elements in the MB. Note: This QC sample is not required by the IO-3.5 method and there is no further corrective action
Standard Reference Material (SRM)	1 per batch of ≤ 20 samples	Recovery 80-120% for Pb only	1) Reanalyze 2) Flag sample data 3) Re-extract batch
Laboratory Control Sample (LCS/BS/BSD)	1 BS per batch of ≤ 20 Quartz/Glass Fiber samples, a minimum of 1 per batch 1 BS/BSD per batch of ≤ 20 samples	Recovery 80-120%.	1) Reanalyze 2)Flag data 3) Re-prepare sample batch if recovery for most elements fail criteria.
Duplicate (DUP1) (Laboratory Duplicate)	1 per batch of ≤ 20 samples	≤ 20% RPD for quartz/glass fiber sample, ≤10% RPD for Teflon samples, and duplicate values ≥ 5x MDL (see Section 16.4.3 for details)	1) Check for matrix interference 2) Repeat duplicate analysis if necessary 3) Flag data, "D-F" (see Section 16.4.3 for procedure)
Replicate Analysis (Analytical Duplicate)	On a minimum one sample per batch, ensuring 6 per site per year	≤ 10% RPD for sample and duplicate values ≥ 5x MDL (see Section 16.4.5 for details)	1) Repeat replicate analysis if necessary 2) Flag data, "R-F" (see Section 16.4.5 for procedure)
Collocated Samples (C1/C2)	10% of samples annually (for sites that conduct collocated sampling)	≤ 20% RPD for sample and collocate values ≥ 5x MDL (see Section 16.4.4 and 16.4.3 for details)	1) Repeat C1 and/or C2 analyses if necessary. 2) Flag C1 and C2 data if necessary, "D-F" (see Section 16.4.3 for procedure)
Matrix Spike (MS) and Matrix Spike Duplicate (MSD) for 8x10" Quartz and glass filters only	1 per batch of ≤ 20 samples	Quartz/Glass Fiber Recovery 80-120%when the parent sample concentration is less than 4 times the spike concentration. Not applicable to Teflon method	1) Flag data if recovery for only one or two elements fail criteria, or when a matrix interference is confirmed by Serial Dilution (SRD) and/or PS results. 2) Reanalyze 3) Reprepare sample batch if recovery for most elements fail criteria or contamination is evident. 4) Sb failures must be flagged on MS/MSD and all samples, "SL"
MS/MSD RPD for 8 x 10" Quartz and glass filters only	1 per batch of ≤ 20 samples	RPD ≤20% Not applicable to Teflon method	1) Check for 4x spike concentration and non-homogenous matrix, flag as necessary 2) Reanalyze for verification
Post Digestion Spike (PDS)	1 per batch of ≤ 20 samples	Recovery 75%-125%	1) Flag failed elements for parent sample and PS 2) Reprepare PS if preparation issue is suspected reason for failure.

Note: antimony tends to adhere to quartz media, which causes low recoveries for BS/MS/MSD; associated data is qualified.

Table 11-9
Summary of Quality Control Procedures for Metals Analysis (continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SRD	1 per batch of ≤ 20 samples	±10% RPD of undiluted sample if the element concentration is ≥ 25x MDL	1) Re-prepare dilution if preparation issue is suspected reason for failure. 2) Flag failed analytes
Field Blank	As received	< 5x MDL in ng/m3	1) Flag failed elements in FB
Internal Standards (ISTD)	Every Calibration, QC and Field Sample	Recovery 60-125% of the measured intensity of the calibration blank	1) If drift suspected, stop analysis and determine cause, recalibrate if necessary 2) Reanalyze sample 3) If recovery > 125% due to inherent ISTD, dilute sample and reanalyze

Note: antimony tends to adhere to quartz media, which causes low recoveries for BS/MS/MSD; associated data is qualified.

11.3.6 Hexavalent Chromium Analysis

CCVs prepared from NIST-traceable stocks are performed each analysis day to ensure that the analytical procedures are in control. During the analysis of the samples, the ICV and ICB are analyzed immediately before the analysis of samples, a CCV and CCB after every ten injections, and at the end of every analysis batch. The acceptance criteria are between 90-110 percent recovery for the ICVs and CCVs and less than MDL for the ICBs and CCBs.

If these daily CCVs (and/or CCBs) do not meet the criteria, a second analysis of the same standard is performed. If the second CCV does not pass or if more than one daily CCV does not meet the criteria, a new standard is prepared and analyzed. If it fails a third time, a new calibration curve (with at least 5 concentration levels) is analyzed. All samples analyzed with the unacceptable CCV will be reanalyzed. The quality procedures for hexavalent chromium analysis are presented in Table 11-10.

Table 11-10
Summary of Quality Control Procedures for Hexavalent Chromium

QC Check	Frequency	Acceptance Criteria	Corrective Action
Initial 6-point calibration standards	Before every sequence	Correlation coefficient ≥ 0.995; Relative Error (RE) < 20%	1) Repeat analysis of calibration standards 2) Reprepare calibration standards and reanalyze
ICV	Before every sequence, following the initial calibration	Recovery 90-110%	1) Repeat analysis of initial calibration verification standard 2) Repeat analysis of calibration standards 3) Reprepare calibration standards and reanalyze
ICB	One per batch, following the ICV	Analyte must be < MDL	1) Reanalyze 2) Reprepare blank and reanalyze 3) Correct contamination and reanalyze blank 4) Flag data of all samples in the batch
CCV	Every 10 injections and at the end of the sequence	Recovery 90-110%	1) Repeat analysis of CCV 2) Reprepare CCV 3) Flag data bracketed by unacceptable CCV
Laboratory Control Sample (LCS/LCSD)	Two per sample batch of ≤ 20 samples	Recovery 90-110%	1) Reanalyze 2) Reprepare standard and reanalyze 3) Flag data of all samples since the last acceptable LCS
MB	One per batch	Analyte must be ≤ MDL	1) Reanalyze 2) Flag data for all samples in the batch
Replicate Analysis	Duplicate, Collocate, BS/BSD and/or replicate samples only	RPD ≤ 20% for concentrations greater than 5 x the MDL	1) Check integration 2) Check instrument function 3) Flag samples
CCB	After every CCV and at the end of the sequence	Analyte must be < MDL	1) Reanalyze 2) Reprepare blank and reanalyze 3) Correct contamination and reanalyze blank 4) Flag data of all samples in the batch

Table 11-10
Summary of Quality Control Procedures for Hexavalent Chromium (Continued)

QC Check	Frequency	Acceptance Criteria	Corrective Action
Retention Time (RT)	For identification of analyte	RT must be within 5% window of the average RT of initial calibration standards	1) Check integration/identification 2) Reanalyze
Sampling Duration	All samples	24 hours ± 1 hours	1) Notify Program Manager 2) Flag samples 22-23 hours and 25-26 hours in AQS with a "Y" flag 3) Invalidate and re-sample for > 24±2 hours

11.4 Precision

Analytical precision is estimated by repeated analysis of approximately 10 percent of the samples. The second analysis is performed in the same analytical batch as the first analysis. Duplicate and collocated samples are reanalyzed once each to determine overall precision, including sampling and analysis variability.

Precision estimates are calculated in terms of absolute percent difference. Because the true concentration of the ambient air sample is unknown, these calculations are relative to the average sample concentration.

Precision is determined as the RPD using the following calculation:

$$RPD = \frac{|X_1 - X_2|}{\overline{X}} \times 100$$

Where:

X_1 is the ambient air concentration of a given compound measured in one sample;
X_2 is the concentration of the same compound measured during duplicate/collocate/replicate analysis; and
$\overline{X}$ is the arithmetic mean of X_1 and X_2.

11.5 Completeness

Completeness, a quality measure, is calculated at the end of each year. Percent completeness is calculated as the ratio of the number of valid samples received to the number of scheduled samples (beginning with the first valid field sample received through the last field sample received). This quality measure is presented in the final report. The completeness criteria for all parameters were previously presented in Table 4-1.

Completeness is determined using the following calculation:

$$\text{Completeness} = \frac{Number\ of\ valid\ samples}{Total\ expected\ number\ of\ samples}\ x\ 100$$

11.6 Representativeness

Representativeness measures how well the reported results reflect the actual ambient air concentrations. This measure of quality can be enhanced by ensuring that a representative sampling design is employed. This design includes proper integration over the desired sampling period and following siting criteria established for each task. The experimental design for sample collection should ensure samples are collected at proper times and intervals for their designated purpose per the data quality objectives. For example, carbonyl samples are collected to gain information about PAMS carbonyl compounds. Therefore, collection of 8-hour samples from 0400-1200, 1200-2000, and 2000-0400 every third day is appropriate. Quality measures for duplicate sample collection and replicate analyses are included. ERG is not responsible for the sampling design; therefore, representativeness is beyond the scope of this QAPP. The state and local areas should designate the representativeness following EPA guidelines, however a copy of the 2021 EPA sampling schedule is presented in Appendix B.

11.7 Sensitivity (Method Detection Limits)

Based on changing EPA guidance on MDL determination procedures, the NATTS program has adopted two MDL procedures, a modified Definition and Procedure for the Determination of the Method Detection Limit[21] and the Federal Advisory Committee (FAC) Single Laboratory Procedure (v2.4)[22]. In the modified EPA method detection limit procedure, the MDLs are determined using spiked sample and blank sample data, using the larger value for the new MDL. The MDLs determined from spiked samples are verified by analyzing standards at one to four times the newly determined limits. For the FAC, the historic blank sample data is used to determine the MDL and spiked samples are used if the blank data does not meet requirements.

The MDL for NMOC has not been determined in 2021. If this method is needed, a detection limit study will be performed before analysis begins. The MDLs for the SNMOC are listed in Table 11-11, for VOCs in Table 11-12, and carbonyl compounds (based on a sample volume of 1000 L) in Table 11-13. The PAH MDLs, based on a sampling volume of 300 m^3, are presented in Table 11-14.

The Sample Quantitation Limit (SQL) is also reported in Table 11-13 through Table 11-15. The SQL is defined as the lowest concentration an analyte can be reliably measured within specified limits of precision and bias during routine laboratory operating conditions. The SQL is defined by EPA as a multiplier (3.18) of the MDL and is considered the lowest concentration that can be accurately measured, as opposed to just detected. ERG submits this data into AQS using flags to show where the data is in respect to the detection level.

Table 11-11
2021 SNMOC Method Detection Limits

Target Compound	ppbC	SQL	Target Compound	ppbC	SQL
1,2,3-Trimethylbenzene*	0.093	0.296	Cyclohexane*	0.0268	0.085
1,2,4-Trimethylbenzene*	0.364	1.158	Cyclopentane*	0.0178	0.057
1,3,5-Trimethylbenzene*	0.070	0.223	Cyclopentene	0.019	0.061
1,3-Butadiene*	0.1143	0.363	Ethane*	0.336	1.070
1-Butene*	0.035	0.111	Ethylbenzene*	0.080	0.255
1-Dodecene	0.548	1.744	Ethylene*	0.170	0.541
1-Heptene	0.030	0.095	Isobutane*	0.0615	0.196
1-Hexene*	0.069	0.221	Isobutene	0.056	0.178
1-Nonene	0.074	0.236	Isopentane*	0.020	0.064
1-Octene	0.083	0.263	Isoprene*	0.0188	0.060
1-Pentene*	0.0559	0.178	Isopropylbenzene*	0.049	0.157
1-Tridecene	0.308	0.979	m,p-Xylene*	0.086	0.275
1-Undecene	0.168	0.533	m-Diethylbenzene*	0.121	0.383
2,2,3-Trimethylpentane	0.0504	0.160	Methylcyclohexane*	0.0324	0.103
2,2,4-Trimethylpentane*	0.0274	0.087	Methylcyclopentane*	0.085	0.270
2,2-Dimethylbutane*	0.0237	0.075	m-Ethyltoluene*	0.066	0.209
2,3,4-Trimethylpentane*	0.0489	0.155	n-Butane*	0.088	0.280

* PAMS compounds

Table 11-11
2021 SNMOC Method Detection Limits (Continued)

Target Compound	ppbC	SQL	Target Compound	ppbC	SQL
2,3-Dimethylbutane*	0.0256	0.081	n-Decane*	0.076	0.241
2,3-Dimethylpentane*	0.0268	0.085	n-Dodecane*	0.300	0.956
2,4-Dimethylpentane*	0.0272	0.086	n-Heptane*	0.0520	0.165
2-Ethyl-1-butene	0.038	0.121	n-Hexane*	0.10	0.315
2-Methyl-1-Butene	0.0222	0.071	n-Nonane*	0.055	0.176
2-Methyl-1-Pentene	0.0309	0.098	n-Octane*	0.064	0.203
2-Methyl-2-Butene	0.046	0.147	n-Pentane*	0.025	0.080
2-Methylheptane*	0.048	0.152	n-Propylbenzene*	0.049	0.155
2-Methylhexane*	0.162	0.516	n-Tridecane	0.353	1.124
2-Methylpentane*	0.445	1.415	n-Undecane*	0.187	0.594
3-Methyl-1-Butene	0.0393	0.125	o-Ethyltoluene*	0.091	0.289
3-Methylheptane*	0.038	0.120	o-Xylene*	0.098	0.311
3-Methylhexane*	0.401	1.274	p-Diethylbenzene*	0.109	0.345
3-Methylpentane*	0.0640	0.204	p-Ethyltoluene*	0.047	0.151
4-Methyl-1-Pentene	0.0329	0.105	Propane*	0.087	0.277
Acetylene*	0.0218	0.069	Propylene*	0.151	0.481
α-Pinene*	0.232	0.739	Propyne	0.024	0.078
Benzene*	0.043	0.136	Styrene*	0.428	1.360
β-Pinene*	0.723	2.298	Toluene*	0.159	0.506
cis-2-Butene*	0.0269	0.085	trans-2-Butene*	0.0179	0.057
cis-2-Hexene	0.026	0.083	trans-2-Hexene	0.039	0.124
cis-2-Pentene*	0.0344	0.109	trans-2-Pentene*	0.0251	0.080

* PAMS compounds

Table 11-12
2021 Air Toxics Method Detection Limits

Target Compounds	µg/m³	SQL µg/m³	Target Compounds	µg/m³	SQL µg/m³
1,1,1-Trichloroethane	0.0393	0.125	Dibromochloromethane	0.122	0.388
1,1,2,2-Tetrachloroethane	0.109	0.346	Dichlorodifluoromethane	0.121	0.385
1,1,2-Trichloroethane	0.0591	0.188	Dichloromethane	0.359	1.14
1,1-Dichloroethane	0.0288	0.0916	Dichlorotetrafluoroethane	0.0490	0.156
1,1-Dichloroethene	0.0347	0.110	Ethyl Acrylate	0.0529	0.168
1,2,4-Trichlorobenzene	0.510	1.62	Ethyl tert-Butyl Ether	0.0417	0.133
1,2,4-Trimethylbenzene	0.0635	0.202	Ethylbenzene	0.0412	0.131
1,2-Dibromoethane	0.119	0.377	Ethylene Oxide	0.0471	0.150
1,2-Dichloroethane	0.0294	0.0934	Hexachloro-1,3-Butadiene	0.201	0.639
1,2-Dichloropropane	0.0393	0.125	m,p-Xylene	0.0835	0.266
1,3,5-Trimethylbenzene	0.0739	0.235	m-Dichlorobenzene	0.0952	0.303
1,3-Butadiene*	0.0366	0.116	Methyl Isobutyl Ketone	0.0309	0.098
Acetonitrile	0.0883	0.281	Methyl Methacrylate	0.142	0.453
Acetylene	0.117	0.373	Methyl tert-Butyl Ether	0.0332	0.106
Acrolein*	0.234	0.745	n-Octane	0.0382	0.122
Acrylonitrile	0.0372	0.118	o-Dichlorobenzene	0.0994	0.316
Benzene*	0.0375	0.119	o-Xylene	0.0557	0.177
Bromochloromethane	0.0604	0.192	p-Dichlorobenzene	0.0904	0.287
Bromodichloromethane	0.0626	0.199	Propylene *	0.224	0.713
Bromoform	0.141	0.448	Styrene	0.0700	0.223
Bromomethane	0.0393	0.125	tert-Amyl Methyl Ether	0.0603	0.192
Carbon Disulfide	0.0593	0.189	Tetrachloroethylene	0.125	0.398
Carbon Tetrachloride*	0.0700	0.223	Toluene	0.224	0.711
Chlorobenzene	0.0609	0.194	trans-1,2-Dichloroethylene	0.0281	0.0894
Chloroethane	0.0280	0.0891	trans-1,3-Dichloropropene	0.0723	0.230
Chloroform*	0.0359	0.114	Trichloroethylene	0.0786	0.250
Chloromethane	0.105	0.334	Trichlorofluoromethane	0.0777	0.247
Chloroprene	0.0621	0.197	Trichlorotrifluoroethane	0.0914	0.291
cis-1,2-Dichloroethylene	0.0679	0.216	Vinyl Chloride	0.0221	0.0701
cis-1,3-Dichloropropene	0.0352	0.112			

*NATTS Tier I compounds

Table 11-13
2021 Carbonyl Method Detection Limits (Underivatized Concentration)

Compound	MDL ($\mu g/m^3$)	SQL ($\mu g/m^3$)
2-Butanone (Methyl Ethyl Ketone)	0.162	0.516
Acetaldehyde*	0.0401	0.127
Acetone	0.376	1.20
Benzaldehyde	0.0466	0.148
Butyraldehyde	0.0529	0.168
Crotonaldehyde	0.0110	0.0349
Formaldehyde*	0.0511	0.162
Hexaldehyde	0.0176	0.0560
Propionaldehyde	0.0860	0.274
Valeraldehyde	0.00749	0.0238

NOTE: Assumes 1000 L sample volume.
*NATTS Tier I compounds

Table 11-14
2021 PAH Method Detection Limits

Compounds	MDL (ng/m^3)	SQL (ng/m^3)
Acenaphthene	0.0789	0.251
Acenaphthylene	0.00415	0.0132
Anthracene	0.0297	0.0944
Benzo(a)anthracene	0.00364	0.0116
Benzo(a)pyrene*	0.00725	0.0231
Benzo(b)fluoranthene	0.00813	0.0258
Benzo(e)pyrene	0.00484	0.0154
Benzo(g,h,i)perylene	0.00504	0.0160
Benzo(k)fluoranthene	0.00753	0.0239
Chrysene	0.00397	0.0126
Coronene	0.0132	0.0419
Dibenz(a,h)anthracene	0.00612	0.0195
Fluoranthene	0.0563	0.179
Fluorene	0.0857	0.272
Indeno(1,2,3-cd)pyrene	0.00576	0.0183
Naphthalene*	0.900	2.86
Perylene	0.0112	0.0355
Phenanthrene	0.214	0.680
Pyrene	0.0401	0.128

NOTE: Assumes a 300 m^3 sample volume.
*NATTS Tier I compounds

Three MDLs are determined for the metals analysis: High Volume analysis with quartz and glass fiber filters, and Low Volume analysis with Teflon filters. The glass fiber filters are only used for the analysis of lead. The detection limits for metals are determined by the FAC[(22)] method using compiled method blank data. If the resulting MDL for any element does not meet criteria, then seven to 10 replicate blank filter strips should be spiked at a concentration of two to five times the estimated MDL, digested, and analyzed to determine the MDL values using the modified EPA method detection limit procedure. Each procedure should be prepared following the entire analytical method procedure. The metals MDLs are shown in Table 11-15 and are

based on a sampling volume of 2000 m^3 for the quartz and glass fiber filters and 24.04 m^3 for the Teflon filters. The FAC procedure was used to determine the MDLs for the quartz, glass fiber and Teflon filters. The hexavalent chromium MDL is also included in Table 11-15 and is based on a sampling volume of 21.6 m^3.

The NATTS Program requires sampling and analysis for 18 target air toxic analytes. Hexavalent chromium is no longer required by the NATTS program but was given a target MDL in the latest NATTS TAD[20] and the NATTS Work Plan Template (April 2019)[24]. The NATTS program uses sensitivity to assess quantification from a monitoring site with the appropriate level of certainty. In order to meet this objective, target MDLs have been established for the NATTS Program and are compared to the current 2021 ERG MDLs in Table 11-16.

Table 11-15
2021 Metals Method Detection Limit

	47 mm Teflon		8x10" Quartz		8x10" Glass Fiber	
Element	**MDL (ng/m^3)**	**SQL (ng/m^3)**	**MDL (ng/m^3)**	**SQL (ng/m^3)**	**MDL (ng/m^3)**	**SQL (ng/m^3)**
Antimony *	0.119	0.378	0.0375	0.119		
Arsenic *	0.0332	0.106	0.00775	0.0246		
Beryllium *	0.00395	0.0125	0.00168	0.00534		
Cadmium *	0.00504	0.0160	0.00487	0.0155		
Chromium *	9.14	29.1	1.22	3.88		
Cobalt *	0.0770	0.245	0.00968	0.0308		
Lead *	0.0647	0.206	0.145	0.460	0.398	1.27
Manganese *	0.313	0.995	0.513	1.63		
Mercury	0.0133	0.0424	0.00329	0.0104		
Nickel *	0.663	2.11	0.349	1.11		
Selenium *	0.0516	0.164	0.00906	0.0288		
Hexavalent Chromium MDL (47mm Cellulose)						
Hexavalent Chromium	0.00380	0.0121				

NOTE: For total metals: Assumes total volume of 24.04 m^3 for Teflon filters and 2000 m^3 for Quartz filters.
For hexavalent chromium: Assumes total volume of 21.6 m^3.
*NATTS Tier I Compounds

Table 11-16
Target MDLs for the NATTS Program

Pollutant	NATTS Target MDL (µg/m³)	ERG 2021 MDL (µg/m³)	Is ERG MDL < Target MDL?		
NATTS Tier I VOC HAPs					
Acrolein	0.090	0.234	No		
Benzene	0.13	0.0375	Yes		
1,3-Butadiene	0.10	0.0366	Yes		
Carbon Tetrachloride	0.17	0.0700	Yes		
Chloroform	0.50	0.0359	Yes		
Ethylene Oxide	0.11	0.0471	Yes		
Tetrachloroethylene	0.17	0.125	Yes		
Trichloroethylene	0.20	0.0786	Yes		
Vinyl Chloride	0.11	0.0221	Yes		
NATTS Tier I Carbonyl HAPs					
Acetaldehyde	0.45	0.0401	Yes		
Formaldehyde	0.080	0.0511	Yes		
Pollutant	**NATTS Target MDL (ng/m³)**	**ERG 2021 MDL (ng/m³)**	**Is ERG MDL < Target MDL?**		
NATTS Tier I PAH HAPs					
Benzo(a)pyrene	0.91	0.00725	Yes		
Naphthalene	29	0.900	Yes		
NATTS Tier I Metal HAPs					
		(Low Vol PM_{10})		***(High Vol PM_{10})***	
Arsenic (PM_{10})	0.23	0.0332	Yes	0.00775	Yes
Beryllium (PM_{10})	0.42	0.00395	Yes	0.00168	Yes
Cadmium (PM_{10})	0.56	0.00504	Yes	0.00487	Yes
Lead (PM_{10})	15.0	0.0647	Yes	0.145	Yes
Manganese (PM_{10})	5.0	0.313	Yes	0.513	Yes
Nickel (PM_{10})	2.1	0.663	Yes	0.349	Yes

NOTE: Target MDL's were obtained from the NATTS Work Plan Template[24], Section 3.1 and the NATTS TAD[20]

SECTION 12
INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

To ensure the quality of the sampling and analytical equipment, ERG conducts performance checks for all equipment used in each of the programs. ERG checks the sampling systems annually and makes repairs as needed. ERG tracks the performance of the analytical instrumentation to ensure proper operation. ERG also maintains a spare parts inventory to shorten equipment downtime. Table 12-1 details the maintenance items, how frequently they will be performed, and who is responsible for performing the maintenance. All checks, testing, inspections, and maintenance done on each instrument are recorded in the appropriate Maintenance Logbook or LIMS Instrument Maintenance Logs for each instrument.

Table 12-1
Preventive Maintenance in ERG Laboratories

Item	Maintenance Frequency	Responsible Party
Analytical Systems		
Replace GC/LC/IC Column	As necessary (i.e., observe peaks tailing, retention time shifts, increased baseline noise, etc.)	Analyst
Detector Maintenance	As necessary	Analyst
Computer Backup	Biweekly, Daily preferred	Analyst
Accelerated Solvent Extractor		
Piston Rinse Seal	Quarterly, or as needed	Analyst
Standard Rinse Seal	Quarterly, or as needed	Analyst
High Performance Liquid Chromatography		
In-line filter	As necessary (when pressure increases above 2500 psi)	Analyst
Inspect Delivery System Motor	Annually	Service Technician
Replace Teflon Delivery Tubing	Annually	Service Technician

Table 12-1
Preventive Maintenance in ERG Laboratories (Continued)

Item	Maintenance Frequency	Responsible Party
Ion Chromatography		
Rinse Post Column Reagent lines with methanol	As necessary	Analyst
Rinse Eluent Lines with Deionized water	After every sequence	Analyst
Sonicate Inlet and Outlet Check Valves	As necessary	Analyst
Rinse Autosampler Injector	As necessary	Analyst
Inorganic Laboratory		
Flush system for 5 minutes with the plasma on with a rinse blank	After every sequence	Analyst
Cleaning cones, torch, injector, spray chamber	Quarterly, or as needed for analysis quality	Analyst
Change Roughing Pump Oil	Annually	Service Engineer
Replace Air Filters	Annually	Service Engineer
Sampling Field Equipment (UATMP, Carbonyl, NMOC/SNMOC, and Hexavalent Chromium)		
Inspect/Replace vacuum pump diaphragms and flapper valves	At each system certification effort	ERG
Inspect Sampler (overall)	At each system certification effort and prior to each scheduled collection event	ERG/Field Operator
Inspect/Replace Cartridge Connectors	Prior to each collection event, replace as needed	ERG/Field Operator
Replace Ozone Scrubber	At each system certification effort	ERG
MFM Check or Flow check	At each system certification effort	ERG
Inspect/Replace Fans	At each system certification effort	ERG

12.1 SNMOC, VOC, and PAMS

The GC/FID/MS systems are maintained under a service agreement. ERG personnel perform minor maintenance, such as filament changes, carrier gas filter replacements, column

maintenance, and source cleaning. The following spare parts should be kept in the lab: traps, filament, column, and split for the column. All procedures, checks, and scheduled maintenance checks for VOC GC/FID/MS analysis are provided in ERG's SOP (ERG-MOR-005) presented in Appendix D.

12.2 Carbonyls

The carbonyl HPLC analytical systems are maintained under a service agreement. ERG personnel perform minor maintenance, such as column and detector maintenance, on an as-needed basis. The following spare parts should be kept in the lab: solvent frit, column, in-line filter and guard column. All procedures, checks, and scheduled maintenance checks are provided for carbonyl HPLC analysis in ERG's SOP (ERG-MOR-024) presented in Appendix D.

12.3 HAPs

The GC/MS systems for PAH and VOC analysis are maintained under the same service agreement. ERG personnel perform minor maintenance as needed. The following spare parts are kept in the lab: injector sleeve, filament, and column.

For the HAPs sample analyses performed on the ICP-MS and IC, routine preventive maintenance is performed by the Analyst or Task Lead. ERG personnel perform minor maintenance, such as cleaning/replacing sample introduction components, columns or detectors, on an as-needed basis. Contracted service agreements are in place for non-routine maintenance. Spare peristaltic pump tubing, sample and skimmer cones, nebulizers, torches, injectors and o-rings are kept in the lab for the ICP-MS. A spare guard and analytical column, piston seals, reaction coil, and reservoir frits are kept in the lab for the IC. More procedures, checks, and scheduled maintenance checks are provided in ERG's SOP (ERG-MOR-049) for PAH analysis by GC/MS, ERG-MOR-095 for metals analysis by ICP-MS, and ERG-MOR-063 for hexavalent chromium by IC presented in Appendix D.

SECTION 13
INSTRUMENT CALIBRATION AND FREQUENCY

The programs are discussed separately in this section because the requirements for analytical system calibrations differ. Analytical instruments and equipment are calibrated when the analysis is set up, when the laboratory takes corrective action, following major instrument maintenance, or if the continuing calibration acceptance criteria have not been met. Appropriate standards are prepared by serial dilutions of pure substances or accurately prepared concentrated solutions. Many analytical instruments have high sensitivity, so calibration standards must be extremely dilute solutions. In preparing stock solutions of calibration standards, great care is exercised in measuring weights and volumes, since analyses following the calibration are based on the accuracy of the calibration.

Each calibration analysis is stored, electronically and hardcopy, with traceability for the samples analyzed using that calibration. Each of the analytical systems is calibrated for all reported target analytes, except for the NMOC and SNMOC calibrations. The NMOC calibration is based on propane and the SNMOC calibration is based on propane, hexane, benzene, octane, and decane average response factors. NMOC calibration will be discussed in more detail when the analysis is requested by a State.

13.1 SNMOC Calibration

For the SNMOC method, average carbon response factors are obtained annually (at a minimum) based on the analysis of humidified calibration standards prepared in canisters. The Dynamic Flow Dilution System (SOP Number ERG-MOR-061, Appendix D) is used to dilute certified Linde or equivalent alkanes into clean, evacuated SUMMA®- treated canisters. The gas standards are traceable via the gravimetric preparation using NIST-traceable weights. These gas standards are recertified annually. HPLC grade water is used to humidify the standard to approximately 50 percent. The standard is diluted with scientific-grade air to achieve the desired concentrations for the calibration. The response factors generated from the calibration are used to

determine concentrations of detected compounds, on the assumption that FID response is linear with respect to the number of carbon atoms present in the compound.

At least five calibration standards are prepared in ranges from approximately 5 to 400 ppbC concentrations. The average response factors for propane, hexane, benzene, octane, and decane are determined using the response correlated to concentration. Individual concentrations for the C_2 through C_{13} compounds detected on the FID are calculated using one of the five response factors, with a similar Carbon number. The calibration is considered representative if the average RF RSD for the curve is within ±20 percent. Daily, before sample analysis, a CCV standard (such as Air Environmental gas standard), is analyzed to ensure the validity of the current response factors. Ten selected hydrocarbons, ranging from C_2 through $C_{10,}$ from the QC standard are compared to the calculated theoretical concentrations. A percent recovery of 70-130 percent is considered acceptable showing the analytical system is in control.

A blank of cleaned, humidified air or N_2 is analyzed after the CCV and before sample analyses. The system is considered in control if the total NMOC concentration for the blank is less than or equal to be < 10 ppbC and no individual compounds > 0.5 ppbC.

13.2 VOC Calibration

Calibration of the GC/FID/MS is accomplished quarterly (at a minimum) by analyzing humidified calibration standards prepared in canisters generated from NIST-traceable Linde or Air Environmental (or equivalent) gas standards. The certified standards contain the VOC target compounds at approximately 500 ppbV.

Calibration standards are prepared with a dynamic flow dilution apparatus (Figure 13-1, see Standard Operating Procedure ERG-MOR-061, Appendix D). The gases are mixed in a SUMMA®-treated mixing sphere and bled into evacuated canisters. One dilution air stream is humidified by routing it through a SUMMA®- treated bubbler containing HPLC-grade water; the other stream is not humidified. The dilution air streams are then brought together for mixing with the streams from the certified cylinders. Flow rates from all streams are gauged and controlled by mass flow controllers. The split air dilution streams are metered by "wet" and "dry" rotameters (~50 percent relative humidity) from the humidified and unhumidified dilution air streams, respectively.

The system is evacuated with a vacuum pump while the closed canister is connected. The lines leading to the canister and to the mixing sphere are flushed for at least 20 minutes with standard gas before being connected to the canister for filling. A precision pressure gauge measures the canister pressure before and after filling.

Initial calibration standards are prepared at nominal concentrations of 0.25, 0.5, 1, 2.5, 5, and 10 ppbV for each of the target compounds (a minimum of 5 levels are required). All standards and samples are analyzed with the following internal standards: *n*-hexane-d_{14}, 1,4-difluorobenzene, and chlorobenzene-d_5. The calibration requires average response factors, based on the internal standard, of ± 30 percent RSD, however per Compendium Method TO-15[(4)] acceptance criteria, up to two compounds can have ± 40 percent RSD (non-Tier I compounds). The CCV is made from a second source certified gas at an average concentration of 2.5 ppbV. The CCV must have RRFs within ± 30% of the mean initial calibration RRFs.

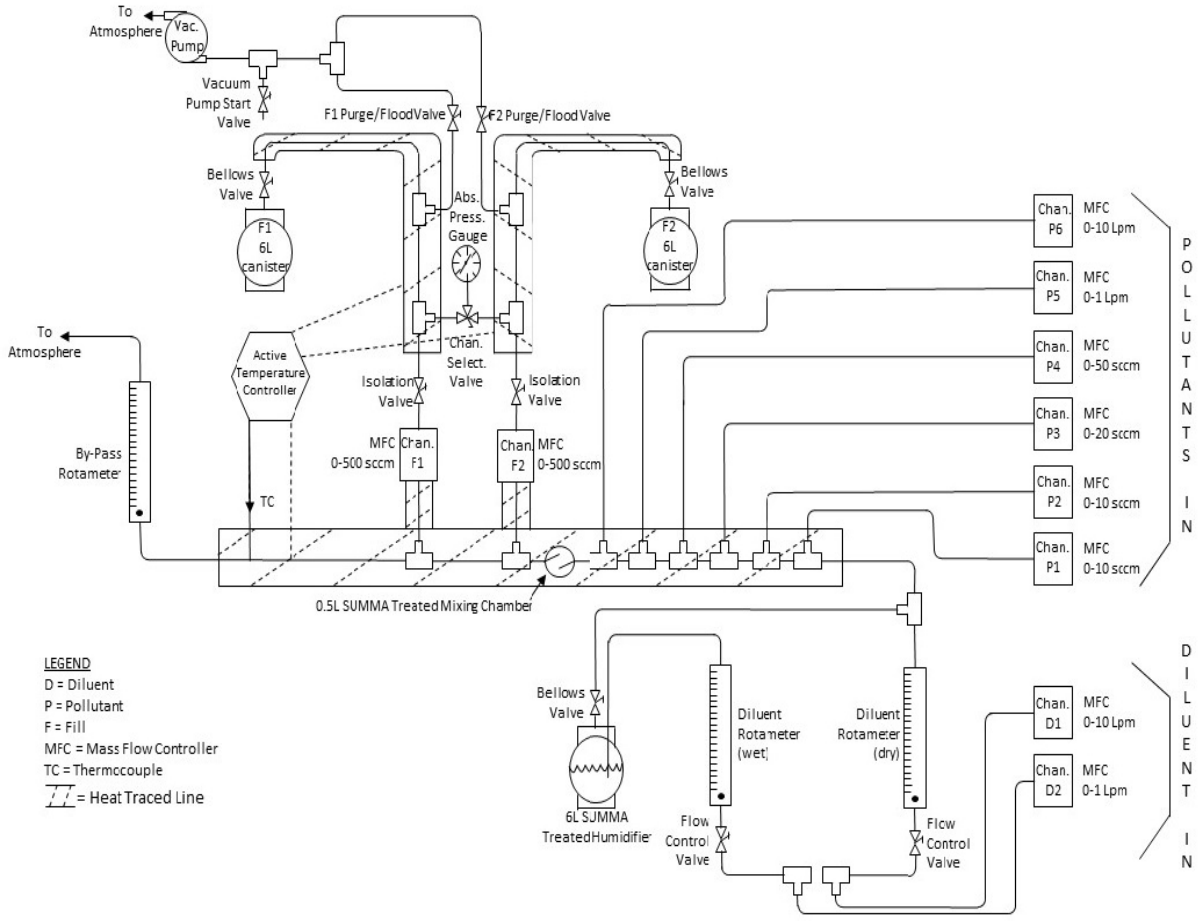


Figure 13-1. Dynamic Flow Dilution Apparatus

13.3 Carbonyl Calibration

For the carbonyl analyses, the HPLC instrument is calibrated using an acetonitrile solution containing the derivatized targeted compounds. The calibration curve consists of six concentration levels ranging from 0.01 to 3.0 microgram per milliliter (µg/mL) (underivatized), and each level is analyzed in triplicate. The standard linear regression analysis performed on the data for each analyte must have a correlation coefficient greater than or equal to 0.999. The Relative Error (RE) for each compound at each level against the calibration curve must be ≤ 20 percent. To verify the calibration standards and check HPLC column efficiency, a SSQC sample solution containing target carbonyl compounds at a known concentration is analyzed in triplicate after every calibration curve, with an 85-115 percent recovery criterion.

In each sequence, a CCV (prepared from a second source standard) is analyzed every 12 hours or less while samples are analyzed and must yield within 15 percent of the nominal concentration. A system blank is analyzed at the beginning and at the end of each sequence, minimally.

13.4 HAPs Calibration

The GC/MS system in SIM mode is calibrated for PAH analysis at a minimum every six weeks. The average calibration RRF must be greater than or equal to the minimum RRF presented in Table 13-1. For the other HAPs sample analyses, calibration is performed on the ICP-MS and IC. Calibration requirements for the HAPs analytical methods are in Tables 11-7, 11-9 and 11-10.

Table 13-1
Relative Response Factor Criteria for Initial Calibration of Common Semivolatile Compounds

Semivolatile Compounds	Minimum RRF	Maximum %RSD	Maximum % Difference
Naphthalene	0.700	30	30
Acenaphthylene	1.300	30	30
Acenaphthene	0.800	30	30
Fluorene	0.900	30	30
Phenanthrene	0.700	30	30
Anthracene	0.700	30	30
Fluoranthene	0.600	30	30
Pyrene	0.600	30	30
Benz(a)anthracene	0.800	30	30
Chrysene	0.700	30	30
Benzo(b)fluoranthene	0.700	30	30
Benzo(k)fluoranthene	0.700	30	30
Benzo(a)pyrene	0.700	30	30
Indeno(1,2,3-cd)pyrene	0.500	30	30
Dibenz(a,h)anthracene	0.400	30	30

Note – The ASTM method includes no minimum RRF criteria, therefore none are listed here for the ASTM[12] compounds.

Table 13-1
Relative Response Factor Criteria for Initial Calibration of Common Semivolatile Compounds (Continued)

Semivolatile Compounds	Minimum RRF	Maximum %RSD	Maximum % Difference
Benzo(g,h,i)perylene	0.500	30	30
Perylene	0.500	30	30
Coronene	0.700	30	30
Benzo(e)pyrene	--	30	30

Note – The ASTM method includes no minimum RRF criteria, therefore none are listed here for the ASTM[12] compounds.

13.5 Laboratory Support Equipment Calibration

Analytical balances are serviced and calibrated annually with NIST traceable weights by a vendor service technician. The same vendor also verifies the Class 1 weights annually. The balance calibrations are checked daily on days of use with Class 1 weights and recorded. The data loggers used for temperature/humidity/pressure have calibration checks annually performed by the vendor. The infrared (IR) thermometers are annually vendor calibrated with NIST-traceable standards. Thermometers requiring a calibration check will be checked against a thermometer with an annual NIST traceable vendor calibration. The pressure gauges used for measuring sample canister pressure at receipt are calibrated annually by a certified vendor. Other pressure gauges, used in canister cleaning or canister sample dilution, are checked against a "transfer standard" gauge that is calibrated annually by a certified vendor. MFCs used in the canister dynamic dilution standard system are calibrated annually and the calibrations are checked quarterly.

Pipette calibrations are checked and recorded quarterly. If a pipette fails a calibration check, they are rechecked. If it continues to fail, it is sent back to the manufacturer for recalibration. If recalibration is not possible it will be repaired or replaced with a new pipette. Syringe calibrations are checked and recorded annually. If a syringe fails the calibration check, it will be replaced with a new one. Class A volumetric glassware is used throughout the laboratory for bringing sample extracts up to final volume.

SECTION 14
INSPECTION/ACCEPTANCE FOR SUPPLIES AND CONSUMABLES

14.1 Purpose

The purpose of this element is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the NMP. By having documented inspection and acceptance criteria, consistency of the supplies can be assured. This section details the supplies/consumables, their acceptance criteria, and the required documentation for tracing this process.

14.2 Critical Supplies and Consumables

Table 14-1 details the various components for the field and laboratory operations.

14.3 Acceptance Criteria

Acceptance criteria for supplies/consumables must be consistent with overall project technical and quality criteria. As requirements change, so do the acceptance criteria. Knowledge of laboratory equipment and experience are the best guides to acceptance criteria. It is the laboratory analyst's responsibility to update the criteria for acceptance of consumables. Other acceptance criteria such as observation of damage due to shipping can only be performed once the equipment has arrived on site.

All supplies and consumables are inspected and accepted or rejected upon receipt in the laboratory. The ERG employee who ordered the supply is responsible for verifying that the order is acceptably delivered, stored and dispersed upon receipt in the laboratory. The recipient's signature on the packing slip indicates the received goods were received and are acceptable. Some supplies or consumables listed in Table 14-1 must be deemed acceptable through testing or blanking, such as with the carbonyl DNPH cartridges. Any changes in standards and sample

media must meet the acceptance criteria outlined in Section 11 for that particular method. Such testing and blanking data is stored with the sample data. Staff should not use supplies or consumables of different model numbers or grades without first discussing it with the Program Manager and specific Task Leader and testing the supply or consumable. Staff should keep any certificate of analysis or documentation pertaining to cleanliness that arrives with the supply/consumable on file. For specific information on reagents and standards used, see applicable method SOP.

Table 14-1
Critical Supplies and Consumables

Area	Item	Description	Vendor	Model Number
Field Supplies and Consumables (Fabrication Lab)				
All Samplers	Various Swagelok® fittings	All Samplers	Swagelok	Various
NMOC Sampler	Pump	Metal Bellows	KNF Newberger	UN 05-SV.91
VOC Sampler	Vacuum Pump	VOC System	Thomas	2107VA20
	Canisters	VOC Canisters	Entech	6-liter Silonite® Canisters
Carbonyl Sampler	DNPH Cartridges	DNPH coated plastic cartridges	Waters	WAT 037500
Hexavalent Chromium Sampler	Pump	High Vacuum	Thomas	VA-2110
Laboratory Supplies and Consumables (Laboratories listed below)				
All Laboratories	Powder Free Gloves	Polyethylene	VWR	32915-246
All Laboratories	Gloves	Nitrile	Expotech, ThermoFisher, VWR	1461558 (Expotech)
Liquid Chromatography	Guard column	Zorbax ODS	Agilent	820950-902
Liquid Chromatography	Chromatographic Column	Zorbax ODS	Agilent	880952-702
Liquid Chromatography	UV Lamp	For 2489 detector	Waters	WA 5081142
GC/MS – VOC	Chromatographic Column	0.32 x 1 µ - 60 m column	Restek	Rxi-lms

Table 14-1
Critical Supplies and Consumables (Continued)

Area	Item	Description	Vendor	Model Number
GC/MS – SVOC	Chromatographic Column	0.25 x 0.25 µ - 30 m column	Restek	Rxi®-5Sil MS
GC/MS – SVOC	Inject seal	Injection port seal	Expotech	2264837
GC/MS – SVOC	Liner	Injection port liner	Expotech	2377232
GC/MS & Liquid Chromatography	Helium	Carrier Gas	Air Gas	UHP
GC/MS – VOC	Chromatographic Column	0.32 x 1 µ - 60 m column	Restek	Rxi-lms
GC/MS – VOC	Chromatographic Column	1.8-micrometer (µm) film thickness	Restek	R_{xi}-624Sil capillary
GC/MS	Hydrogen Gas	FID Gas	Air Gas	UHP
GC/MS	Liquid Nitrogen	Coolant Gas	Air Gas	Bulk
GC/MS	Liquid Argon	Coolant Gas	Air Gas	Bulk
GC/MS	Air	FID Gas	Air Gas	Zero
GC/MS	Traps	Glass bead/Tenax Trap	Entech	01-04-11340
GC/MS	Trap Heater	Sample Trap Heater	Entech	01-09-13010
GC/MS	Cryogenic Valve	Cryogenic Valve	Entech	01-01-71760
ICP-MS	Liquid Argon	Coolant Gas	Air Gas	Bulk
ICP-MS	Acid	High Purity Nitric	Fisher/SCP Science	A200-212/Plasma Pure Plus
ICP-MS	Acid	Hydrochloric Acid	Fisher/SCP Science	A466-1/Plasma Pure Plus
ICP-MS	Hydrogen Peroxide	Hydrogen Peroxide, 30%	SCP Science	Plasma Pure Plus
ICP-MS	Whatman 8”x11” Quartz/Glass Fiber Filters MTL 47mm Teflon™ Filters	Filters	GE Healthcare Life Sciences & MTL	1851-8531 1882-8532 PT47-EP
IC	Reaction Coil	Knitted Reaction Coil	ThermoFisher	042631
IC	Guard Column	Dionex Ion Pac NG1	ThermoFisher	039567
IC	Analytical Column	Dionex Ion Pac AS7	ThermoFisher	035393
IC	Methanol	Solvent	Expotech, Fisher, VWR	HPLC grade
IC	Sample vials 14 mL, polystyrene with caps	Sample containers	ThermoFisher	352057

Table 14-1
Critical Supplies and Consumables (Continued)

Area	Item	Description	Vendor	Model Number
IC	Whatman Filters	Filters–47mm ashless cellulose	Expotech, Fisher	09-850H
Prep	Water Filter	Ultrapure Ion Exchange Cartridge	Expotech	1425973
Prep	Water Filter	Cartridge submicron	Expotech	1425977
Prep	Water Filter	Pretreatment Cartridge	Expotech	1426051
Prep	Whatman Filters	Filters–110mm GFA	Expotech	1422153
Prep	PUF	Pre-cleaned PUF	Cen-Med, Expotech	824-20038, 2256468
Prep	XAD®	XAD®	Expotech	2255045
Prep	Petri Dish	Filter container	Expotech	1426833
Prep	Tweezers	Tweezers	VWR	100499-866
Prep	Acetonitrile	Solvent	Expotech, Fisher, VWR	HPLC grade
Prep	Methylene Chloride	Solvent	Expotech, Fisher, VWR	Optima grade
Prep	Methanol	Solvent	Expotech, Fisher, VWR	Optima grade
Prep	Hexane	Solvent	Expotech, Fisher, VWR	95% (Optima grade)
Prep	Toluene	Solvent	Expotech, Fisher, VWR	Optima grade
Prep	Water	Solvent	Expotech, Fisher, VWR	HPLC grade
Prep	Nitrogen	Evaporation gas	Air Gas	UHP (or Bulk)
Prep	Amber glass bottles 250 mL	Sample containers	Expotech	2373176
Prep	110mm Whatman paper filters	Sample filters	Expotech	1422153
Prep	30mm glass fiber filters	Extraction filters	Expotech	2262135
Prep	Extraction cells	Sample containers	Thermo Electron	068077
Prep	Ottawa sand	Extraction filler	Expotech	2262138
Prep	Seals	ASE Vespel Seals	Fisher	056776
Prep	O-rings	Extraction cell o-rings	Expotech	2374568
Prep	Disposable pipets	Disposable pipets	Expotech	1405717

Table 14-1
Critical Supplies and Consumables (Continued)

Area	Item	Description	Vendor	Model Number
Prep	2 mL amber sample vials	Sample containers	Sigma-Aldrich	27000
Prep	4 mL amber sample vials	Sample containers	Expotech, Fisher, VWR	66030-734 (VWR)
Prep	4 mL sample Teflon lined caps	Sample containers	Expotech, Fisher, VWR	66030-771 (VWR)
Prep	Autosampler snap-it vials	Sample containers	Waters	WAT 094220
Prep	Autosampler snap-it caps	Sample containers	Waters	18000303

Consumables and supplies with special handling and storage needs must be handled and stored as suggested by the manufacturer. Consumables with expiration dates, such as solvents and standards, must be labeled with a receipt date, date opened, and the initials of the person that opened the consumable and standard expiration dates must be entered into the standards section of LIMS. To decrease waste, the oldest supplies or consumables should be used first.

SECTION 15
DATA MANAGEMENT

15.1 Data Recording

Data management for sample data is presented in Figure 15-1. The sample data path is shown from sample origination to data reporting and storage. The LIMS allows the laboratory to manage and track samples, instrument workflow, and reporting. The LIMS stores the raw instrument data and performs the conversion calculations to put the data into final reporting units. These calculations are reviewed and documented annually by the QA coordinator and kept in the QA files in Room 102. The main procedures are described in the *SOP for the Laboratory Information Management System* (ERG-MOR-099). The main functions of the LIMS system include, but are not limited to:

- Sample login;
- Sample scheduling, and tracking;
- Sample processing and quality control; and
- Sample reporting and data storage.

All LIMS users must be authorized by the LIMS Administrator and permitted specified privileges. The following privilege levels are defined:

- Data Entry Privilege – The individual may see and modify only data within the LIMS that he or she has personally entered.
- Reporting Privilege – Without additional privileges.
- Data Administration Privilege – Data Administrators for the database are allowed to change data as a result of QA screening and related reasons. Data Administrators are responsible for performing the following tasks on a regular basis:
  - Merging/correcting the duplicate data entry files;
  - Running verification/validation routines, correcting data as necessary.

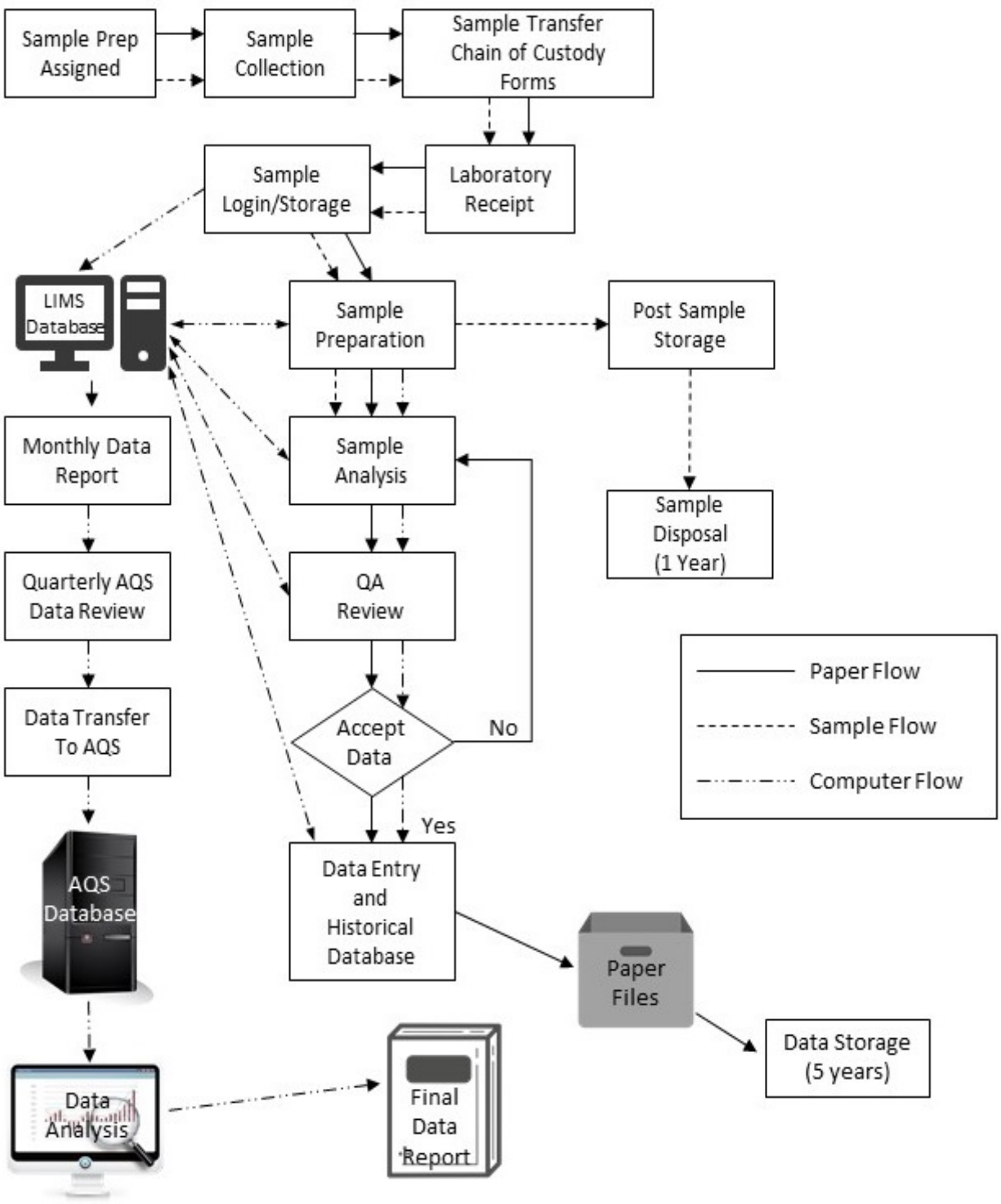


Figure 15-1. Data Management and Sample Flow Diagram

15.2 Data Validation

Data validation is a combination of checking that data processing operations have been carried out correctly and of monitoring the quality of the field operations. Data validation is confirmed by examination of objective evidence that the requirements for a specific intended use are fulfilled as presented in Section 4. This data validation is performed prior to the annual final report. The data reported monthly are considered preliminary until the data is validated, entered into the AQS database, and reported in the annual final report. Data validation is discussed in more detail in Section 18.5.

15.3 Data Reduction and Transformation

Data generated on an instrument is reduced by the analyst via instrument chromatographic software. Any manual integration to chromatographic data follows SOP ERG-MOR-097, the *SOP for Manual Integration of Chromatographic Peaks*. Specific equations used by the instrument chromatographic software to calculate concentration are documented in the individual analytical SOPs found in Appendix D. The equations for transforming raw data are set up to automatically calculate to final concentrations in the LIMS system. The initial and final reporting units for SNMOC are ppbC. All other analyses are reported in units different from their raw data. The initial units for the Carbonyl Compounds analysis are µg/mL, while the final reporting units are in either ppbV or µg/m^3, per site request, however the NATTS sites are to be reported in µg/m^3 per the NATTS TAD[20]. The initial units for VOC are ppbV and the LIMS data reports are in ppbV and µg/m^3. The PAH initials units are ng/µL with final reporting units of ng/m^3. The initial units for metals are ng/L with final reporting units of ng/m^3. The initial units for the hexavalent chromium analysis are ng/mL with final reporting units of ng/m^3. The associated MDLs are reported in final reporting units with the final concentrations. MDLs are adjusted for dilution, actual prep volumes, and sample collection volume where applicable, before reporting.

The electronic data file is uploaded onto a network server (which is backed-up daily) and into the LIMS. Once the data is in LIMS, the Task Leader reviews it following the checklists presented in the SOPs using instrument software, quality control procedure tables in Section 11, and the method-specific control limits set up in LIMS. Ten percent of all data is reviewed by the QA Coordinator or designee following the checklist and method specific acceptance criteria in the summary quality control procedure tables outlined in Section 11. After data has successfully completed both reviews and the checklists have been signed, it is available for reporting by the Program Manager.

The *SOP for Project Peer Review* discusses the manual calculations and visual verification used to review all data reported to EPA and State/Local/Tribal agencies, SOP ERG-MOR-057 (see Appendix D). *SOP for Developing, Documenting, and Evaluating the Accuracy of Spreadsheet Data*, presented in SOP ERG-MOR-017 (see Appendix D), is consulted in special cases where the calculations are performed via spreadsheets instead of the LIMS system.

Reporting formats are designed to fulfill the program requirements and to provide comprehensive, conventional tables of data. The LIMS data reporting format includes any required data qualifiers, footnotes, detection limits for each analyte, and appropriate units for all measurements. The LIMS can produce Adobe and Excel data reports, which is standard for this program. Each report is reviewed by the Program Manager or designee before it is sent to the client.

15.4 Data Transmittal

Data transmittal occurs when data are transferred from one person or location to another or when data are copied from one form to another. Some examples of data transmittal are copying raw data from a notebook into a LIMS bench sheet and electronic transfer of raw chromatographic data to a LIMS data entry table. Each individual method SOP listed in Appendix D discusses the procedures for determining the calculations of concentrations for data entry.

ERG reports ambient air quality data and associated information to AQS as specified by the documentation at the following website https://www.epa.gov/aqs/aqs-manuals-and-guides . Such air quality data and information will be fully screened and validated and will be submitted directly to the AQS database via electronic transmission, in AQS format, and in accordance with required quarterly schedule. The *SOP for the Preparation of Monitoring Data for AQS Upload* is presented in Appendix D (SOP ERG-MOR-098).

15.5 Data Summary

ERG implements the data summary and analysis for the NMP in the final annual report. The following specific summary statistics will be tracked and reported for the network:

- Single sampler bias or accuracy (based on laboratory audits if available);
- Analytical precision (based on analytical replicates);
- Sampler precision (based on duplicate and collocated data);
- Network-wide bias and precision; and
- Data completeness.

Equations used for these reports are given in Table 15-1.

Table 15-1. Report Equations

Criterion	Equation
Coefficient of Variation (CV)- *p* and *r* are concentrations from the primary and duplicate samplers, respectively. This equation is also used for collocated samples and replicate analysis.	$CV = 100 \times \sqrt{\frac{\sum_{i=1}^{n}\left[\frac{(p-r)}{0.5 \times (p+r)}\right]^2}{2n}}$
Percent Completeness - Where, N_{valid} is the number of valid samples collected and analyzed in the sampling year and $N_{expected}$ is the number of valid samples that are expected within that same sampling year.	$Completeness = \frac{N_{valid}}{N_{expected}} \times 100$

15.6 Data Tracking

The ERG LIMS database contains the necessary input functions and reports appropriate to track and account for the status of specific samples and their data during processing operations. The following input locations are used to track sample and sample data status:

- Sample Control
  - Sample collection information (by Work Order);
  - Sample receipt/custody information;
  - Unique sample number (LIMS ID);
  - Storage location;
  - Required analyses;

- Laboratory
  - Batch/bench assignment;
  - Sequence assignment (if applicable);
  - Data entry/review;
  - Query/update analysis status;
  - Standards/calibration information.

15.7 Data Storage and Retrieval

Data archival policies for hardcopy records are shown in Table 15-2.

Table 15-2
Data Archive Policies

Data Type	Medium	Location	Retention Time	Final Disposition
Laboratory notebooks	Hardcopy	Laboratory	5 years after close of contract	N/A
LIMS Database	Electronic (on-line)	Laboratory	Backup media after 5 years	Backup tapes retained indefinitely

All data are stored on the ERG LIMS server. This system has the following specifications:

- Operating System: Windows Server 2019 Standard
- Memory: 16G RAM
- Hard Drives: 1.5T hard drive space
- Security: Network login password protection on all workstations; Additional password protection applied by application software.

Security of the data in the database is ensured by the following controls:

- Password protection on the data base that defines three levels of access to the data;
- Logging of all incoming communication sessions, including the originating telephone number, the user's ID, and connect times; and
- Storage of media, including backup tapes, in an alternate location that is at a locked, restricted access area.

ASSESSMENT/OVERSIGHT
SECTION 16
ASSESSMENTS AND RESPONSE ACTIONS

An assessment is defined as an evaluation process used to measure the performance or effectiveness of the quality system or the establishment of the monitoring network and sites and various measurement phases of the data operation.

The results of QA assessments indicate whether the control efforts are adequate or need to be improved. Documentation of all QA and QC efforts implemented during the data collection, analysis, and reporting phases are important to data users, who can then consider the impact of these control efforts on the data quality. Both qualitative and quantitative assessments of the effectiveness of these control efforts will identify those areas most likely to impact the data quality. ERG will perform the following assessments to ensure the adequate performance of the quality system.

16.1 Assessment Activities and Project Planning

16.1.1 External Technical Systems and Data Quality Audits

A TSA is a thorough and systematic on-site qualitative audit, where facilities, equipment, personnel, training, procedures, subcontractor systems, and record keeping are examined for conformance to the QAPP. The TSAs will be performed by EPA or its designee at the ERG Laboratory. The TSAs for the contract are conducted approximately every 3 years. The EPA QA Office will implement the TSA either as a team or as an individual auditor. ERG will participate in any data quality audits by EPA or designee at the discretion of the EPA QA Coordinator.

The EPA audit team will prepare a brief written summary of findings for the Program Manager and Program QA Coordinator. Problems with specific areas will be discussed and an attempt made to rank them in order of their potential impact on data quality. ERG will work with

EPA to solve required corrective actions. As part of corrective action and follow-up, an audit finding response letter will be generated by the Program Manager and Program QA Coordinator. The audit finding response letter will address what actions are being implemented to correct the finding(s) of the TSA. This summary from EPA and the following response from ERG are filed in the QA/QC file in Room 102. The findings and the follow-up corrective actions are discussed in the annual QA Management Systems Review.

As part of the ongoing accreditation under The National Environmental Laboratory Accreditation Conference Institute (TNI), TSAs are performed at ERG through the Florida Department of Health by an auditing contractor every two years. A summary of findings is sent to ERG, specifically the QA Coordinator. The QA Coordinator sends a response of corrective actions which is either accepted or denied by Florida Department of Health. This documentation is stored in the QA/QC file in Room 102. The findings and the follow-up corrective actions are discussed in the annual QA Management Systems Review.

16.1.2 Internal Technical Systems Audits

An internal TSA is performed examining facilities, equipment, personnel, training, procedures, and record keeping for conformance to the individual SOPs and this QAPP. The TSAs will be performed by the Program QA Coordinator and/or Program QA Coordinator Deputy and will be conducted at least once per year. The checklists for the internal TSAs are based on the NATTS TSA or the 2016 TNI Environmental Laboratories Standards Accreditation checklists with additional areas addressing the individual SOPs and this QAPP. The content of the checklists vary episode to episode to ensure comprehensive in-depth coverage of procedures over time. Such elements will be included in the checklists:

- Criteria listed in Section 11 of this QAPP
- SOP specifications
- Method specifications
- Supporting equipment specifications
- Other laboratory wide QA systems in place (ex. Satellite SOP notebooks)

The Program QA Coordinator will report internal audit findings to the Program Manager within 30 days of completion of the internal audit in the form of a report. The EPA Delivery Order Manager will be informed if issues from the internal audit impact the quality of this program. The report is filed in the QA/QC file in Room 102. All corrective actions are addressed and implemented as soon as they are determined. The findings and the follow-up corrective actions are discussed in the annual QA Management Systems Review to assess effectiveness of the corrective actions.

16.1.3 Proficiency Testing

The PT is an assessment tool for the laboratory operations. 'Blind' samples are sent to the laboratory, where they follow the normal handling routines that any other sample follows. The results are sent to the Program Manager and Program QA Coordinator for final review and reporting to the auditing agency. The auditing agency prepares a PT report and sends a copy of the results to the Program Manager, Program QA Coordinator, and the EPA QA Office(s). Any results outside the acceptance criteria are noted in the PT report. Repeated analyte failures are investigated to determine the root cause and documented on a Corrective Action Report (CAR). If the determined root cause also affects samples, the affected analytes will be flagged. The PT reports are filed in the QA/QC file in Room 102. The performance on these audits is discussed in the annual QA Management Systems Review.

Currently, there is one PT audit program supported by this contract. This is provided through the NATTS program for carbonyl, metals, VOC, and PAH audits. These PT audits are provided to ERG from EPA (or an EPA contractor) throughout the year. The acceptable limits are provided on the annual reports presented to the participating States and EPA.

ERG participates in round robin studies, such as Regional EPA round robin studies, when available for VOC, metals, carbonyls, and SNMOC. In these studies, each participating laboratory result is compared against the calculated average. Reports from these studies are kept

in the QA/QC file in Room 102. The performance on these studies is discussed in the annual QA Management Systems Review.

16.1.4 Data Assessment for Final Report

A data quality assessment is the statistical analysis of environmental data to determine whether the quality of data is of adequate quality, based on the MQOs. The data assessment in the final report is presented to EPA and State agencies and includes the following:

- Review of the MQOs of the program, which includes completeness, precision and accuracy.
- Present the results of the data quality assessment using summary statistics, plots and graphs while looking for and discussing any patterns, relationships, or anomalies.
- Qualify the data that does not meet the MQO for completeness for each monitoring site and for site-specific summary statistics.

16.2 Documentation of Assessments

16.2.1 TSA, Data Quality Audit, and PT Documentation

All reports from EPA or designated contractors regarding ERG's performance on TSAs, Data Quality Audits, and PTs are filed in the QA/QC file in Room 102. PT reports are dispersed and discussed with contributing staff.

Reports from internal TSAs are prepared and discussed with the contributing staff and Program Manager and filed in the QA/QC file in Room 102.

16.2.2 Internal Data Review Documentation

Internal data review is performed on 100 percent of the data by the Task Leader and 10 percent of the data by the Program QA Coordinator or designee against the criteria in the

individual method SOPs and this QAPP prior to being reported each month. The assessment is documented on the data review checklist, which is returned to the Task Leader for minor correction action and inclusion in the data package. The checklists used for analyses are shown in their respective SOPs (Appendix D) as follows:

- **VOC** – ERG-MOR-005, *SOP for the Concurrent GC/FID/MS Analysis of Canister Air Toxic Samples using EPA Compendium Method TO-15 and EPA Ozone Precursor Method.*

- **Carbonyl** – ERG-MOR-024, *SOP for Preparing, Extracting, and Analyzing DNPH Carbonyl Cartridges by Method TO-11A.*

- **SVOC/PAH** – ERG-MOR-049, *SOP for Analysis of Semivolatile Organic Compounds (Polynuclear Aromatic Hydrocarbons) Using EPA Compendium Method TO-13A & ASTM D6209.*

- **Metals** – ERG-MOR-095, *SOP for the Analysis of High Volume Quartz, Glass Fiber Filters, and 47 mm Filters for Metals by ICP-MS using Method IO 3.5 and FEM Method EQL-0512-201* and *FEM Method EQL-0512-202.*

- **Hexavalent chromium** – ERG-MOR-063, *SOP for the Preparation and Analysis of Ambient Air for Hexavalent Chromium by Ion Chromatography.*

- **SNMOC** – ERG-MOR-005, *SOP for the Concurrent GC/FID/MS Analysis of Canister Air Toxic Samples using EPA Compendium Method TO-15 and EPA Ozone Precursor Method.*

During the internal data review, major QC problems identified are brought to the attention of the Program Manager and are documented on a CAR. The final project report also addresses QA considerations for the whole project.

16.3 Corrective Action

The Response/CAR will be filed whenever a problem is found such as an operational problem, or a failure to comply with procedures that affects the quality of the data. A CAR is an important ongoing report to management because it documents primary QA activities and provides valuable records of QA actions. A CAR can be originated by anyone on the project but

must be sent to the Program QA Coordinator and Program Manager. Any problem that affects the quality of the overall program will be discussed with EPA.

On the numbered CAR, the description of the problem, the cause of the problem, the corrective action, and the follow-up are documented. CARs will be handled in a timely manner, with follow-up within 45 days. The follow-up assists the QA coordinator in determining if the corrective action was successful and if it was handled in a timely manner. The CAR is recorded on a form, the original copy goes into the QA file (Room 102), and as necessary, a copy goes into the data package. An example of the ERG CAR Form is shown in Figure 16-1.

Each recommendation addresses a specific problem or deficiency and requires a written response from the responsible party. The Program QA Coordinator will verify that the corrective action has been implemented. A summary of the past years' CARs is discussed during the annual QA Management Systems Review.

The following actions are taken by the laboratory QA Coordinator and Program Manager when any aspect of the testing work, or the results of this work, does not conform to the requirements of the quality system or testing methods:

- Identify nonconforming work and take actions such as halting of work or withholding test reports;
- Evaluate of the impact of nonconforming work on quality and operations;
- Take remedial action and make decision about the acceptability of the nonconforming work (resample, use as is with qualification, or unable to use);
- Notify the client, and if necessary, recall the work; and
- Authorize the continuation of work.

ERG and its subcontractors are responsible for implementing the analytical phase of this program and are not responsible for the overall site specific program DQOs. Therefore, this QAPP tries to ensure that analytical results are of known and adequate quality to ensure the achievement of the various program DQOs.

ERG

CAR Number: Click or tap here to enter text.

Corrective Action Report Version 2021-01

CAR Initiator: Click or tap here to enter text. **Initiation Date:**

Area/Procedure Affected: Click or tap here to enter text.

Is Immediate Stop of Work Required? Choose an item.

Non-Conformance

Date of Discovery:

Description of Non-Conformance: What happened? How is this a non-conforming event?

Click or tap here to enter text.

Investigation of Non-Conformance: How was the non-conformance discovered?

Click or tap here to enter text.

Impact Assessment: What is affected by the nonconformance? If no impact, provide documentation to that proves this to be the case whenever possible.

Click or tap here to enter text.

Root Cause Analysis: What caused the nonconformance?

Click or tap here to enter text.

Further Analysis: Could this nonconformance be evident in other areas? Are other CARs related to this nonconformance?

Click or tap here to enter text.

Corrective Action

Due Date for Remedial Action Completion:

Immediate and/or Long-Term Remedial Corrective Actions Taken: Include both successful and unsuccessful corrective actions used.

Click or tap here to enter text.

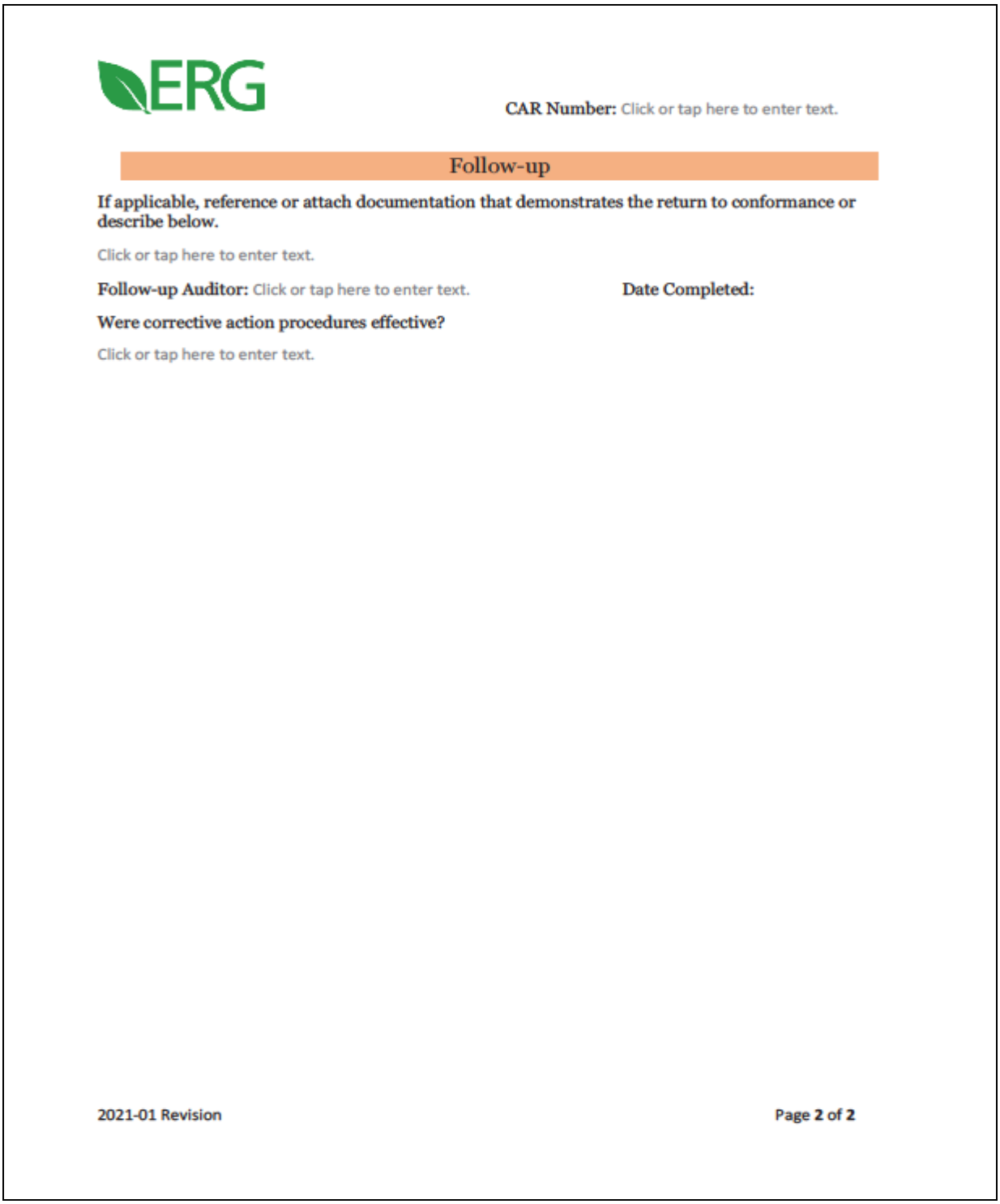
Assessment of Corrective Action Effectiveness: This section may be left blank if follow-up is required.

Click or tap here to enter text.

Signatures

	Signature & Date	Comments
QA Officer:	_____	Click or tap here to enter text.
Project Manager:	_____	Click or tap here to enter text.
Initiator:	_____	Click or tap here to enter text.

Figure 16-1. ERG Response/Corrective Action Report Form, Page 1



ERG

CAR Number: Click or tap here to enter text.

Follow-up

If applicable, reference or attach documentation that demonstrates the return to conformance or describe below.

Click or tap here to enter text.

Follow-up Auditor: Click or tap here to enter text. **Date Completed:**

Were corrective action procedures effective?

Click or tap here to enter text.

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Page **2** of **2**

Figure 16-1. ERG Response/Corrective Action Report Form, Continued

SECTION 17
REPORTS TO MANAGEMENT

This section describes the quality-related reports and communications to management necessary to support monitoring network operations and the associated data acquisition, validation, assessment, and reporting. Important benefits of regular monthly reports to EPA provide the opportunity to alert of data quality problems, to propose viable solutions to problems, and to procure necessary additional resources.

Effective communication among all personnel is an integral part of a quality system. Regular, planned quality reporting provides a means for tracking the following:

- Adherence to scheduled delivery of data and reports;
- Documentation of deviations from approved QA and test plans, and the impact of these deviations on data quality; and
- Analysis of the potential uncertainties in decisions based on the data.

17.1 Frequency, Content, and Distribution of Reports

Frequency, content, and distribution of reports for monitoring are shown below.

17.1.1 Monthly and Annual Reports

Analytical data reports prepared by the Program or Deputy Program Manager are sent to EPA, State, Local and Tribal agencies monthly. These reports include the analytical data for each sample collected monthly including sample results, MDLs, sample information (canister ID, sample volume, etc.) and a QA report (could include duplicates, MB, CCB, CCV, MS/MSD, etc., depending on the analysis). Quarterly QA reports are distributed which include a summary of analyte specific quality control charts (ICV, ICB, CCB, CCV, BLK, BS/BSD, etc.). An annual data report, containing a summary of the yearly assessment of the air toxics data, is reported to EPA and State agencies by the Program Manager after the conclusion of a sampling year via a

QlikSense app housed on EPA's server. This app provides some statistical analysis and quality assessments for the measurement data and, in some cases, whether the data objectives for the program were met.

The annual report app includes the quality information for each participating air toxics monitoring site. The app includes a Program and update and select Method Quality Objectives for measurement data and associated data quality assessment:

- Completeness determinations;
- Estimates for method and analytical precision and bias; and
- PTs that were performed during the sampling year, if applicable.

17.1.2 Internal Technical System Audit Reports

The Program QA Coordinator or designee performs an internal technical system audit at least once a year for the monitoring network for EPA, State, and NATTS contracts. The findings are listed in reports which are presented to the Program Manager and filed in the QA/QC storage file cabinet located in Room 102. These reports are available to EPA personnel during their TSA. More detail on internal TSAs is provided in Section 16.

DATA VALIDATION AND USABILITY
SECTION 18
DATA REVIEW AND VERIFICATION

Data verification is a two-stage process to determine if the sampling and analytical data collection process is complete, consistent with the DQOs discussed in this QAPP and associated method SOPs, and meets the program requirements. First the data is reviewed for completeness, accuracy, and acceptability. Then the data is verified to meet the quality requirements of the program.

18.1 Data Review Design

Information used to verify air toxics data, includes:

- Sample COCs, holding times, preservation methods.
- Multi-point calibrations – the multipoint calibrations are used to establish proper initial calibration and can be used to show changes in instrument response.
- Standards – certifications, identification, expiration dates.
- Instrument logs – all activities and samples analyzed are entered into the LIMS logs (batches, sequences, etc.) to track the samples throughout the measurements procedures.
- Supporting equipment – identification, certifications, calibration, if needed.
- Blank, CCVs, replicate and spike results – these QC indicators can be used to ascertain whether sample handling or analysis is causing bias in the data set.
- Review Checklists – these record data quality review performed on all data by Task Leader and on 10 percent of the data by the QA Coordinator or designee. The checklists used to review data is presented in the method SOPs.
- Summary Reports – monthly summary data reports present the preliminary data to EPA and respective State/Local/Tribal representatives including data qualifiers.

The reliability and acceptability of environmental analytical information depends on the rigorous completion of all the requirements outlined in the QA/QC protocol. During data analysis and validation, data are filtered and accepted or rejected based on the set of QC criteria listed in the individual SOPs included in Appendix D.

18.2 Data Verification

Data verification by examination confirms that specified method requirements have been fulfilled. The specific requirements are QC checks, acceptable data entry limits, etc. as presented in Section 11. The analytical procedures performed during the monitoring program will be checked against those described in the QAPP and the SOPs for the UATMP, PAMS, and NMOC support included in Appendix D. Deviations from the QAPP will be classified as acceptable or unacceptable, and critical or noncritical. During review and assessment, qualifiers will be applied to the data as needed; data found to have critical flaws (such as low spike for surrogate recoveries, contaminated blanks, etc.) will be invalidated and a CAR filled out and implemented, if needed. All data management guidelines followed for this contract are presented in Section 15.

18.3 Data Review

The COC forms are checked to ensure accurate transcription. The data are scrutinized daily to eliminate the collection of invalid data. The analyst records any unusual circumstances during analysis (e.g., power loss or fluctuations, temporary leaks or adjustments, operator error) on the LIMS bench sheet and notifies the analytical Task Leader.

The data are critically reviewed to locate and isolate spurious values. A spurious value, when located, is not immediately rejected. All questionable data, whether rejected or not, are maintained along with rejection criteria and any possible explanation. Such a detailed approach can be time-consuming but can also be helpful in identifying sources of error and, in the long run, save time by reducing the number of outliers.

QC samples and procedures performed during the monitoring program will be checked against those described in Section 11 of the QAPP. If QC is found unacceptable, corrective actions are implemented (as described in the same section). Prior to reporting, 100 percent of the data is reviewed by the Task Leader(s). To verify accuracy, at least 10 percent of the data is checked by the QA Coordinator or designated reviewer. Items checked can include required QC, original raw data, COCs, checks of all calculations (from calibration to sample analysis), and data transfers. As the data are checked, corrections are made to the database as errors or omissions are encountered. If major errors are found, a greater percent of the data is checked to verify data quality. The Program Manager reviews all data before it is reported to EPA or the State/Local/Tribal agencies.

18.4 Data Reduction and Reporting

Monthly site-specific data reports for the NMP are distributed to the participating EPA technical staff, administrators, and to the administrators of the State/Local/Tribal agencies involved in the study. NATTS, CSATAM, and UATMP data consists of any toxics including VOC, SNMOC, carbonyl, or other HAPs (metals, semivolatiles, etc.) requested by the program participants. Each report is prepared after 45 days from the end of the sampling month. Cumulative listings are periodically generated upon request. This timely turnaround of data assists in planning, preliminary modeling, and program development for the participating State/Local/Tribal agencies. Any changes made in the preliminary data because of subsequent data validation processes performed by EPA and/or State/Local/Tribal agencies are noted in the separate data reports for each specific sampling site. The data reports include:

- Site code;
- Sample identifications;
- Sample dates;
- Target compound list;
- Concentrations (ppbv, ppbC, ng/m^3 and/or µg/m^3); and
- Method detection limits.

Values below the MDL for QC results in the Adobe reports are recorded as not detected (ND), however the actual values are reported in the accompanying Excel report with a "U" flag (Under the detection limit). Preliminary monthly data reports are emailed to the program participants. These data reports are considered preliminary until the data is validated and entered into the AQS database, as detailed in Section 18.6.

The Program Manager reviews all data before they are reported to EPA and/or the State/Local/Tribal agencies. ERG prepares a final report containing all aspects of the individual programs including data summaries, QA, QC, and data analysis results for EPA, and distributes site-specific summaries of the final data to designated personnel.

18.5 Data Validation

Data validation is confirmed by examination of objective evidence that the requirements for a specific intended use are fulfilled as presented in Section 4. Intended use deals with data of acceptable quality to permit making decisions at the correct level of confidence. Ongoing data review and adherence to the data quality objectives keeps the data quality consistent, while data validation ensures the data quality. This data validation is performed prior to the annual final report.

To assess precision, a CV is calculated for each site and compound using the equation in Table 15-1, and across each method. Method precision is based on measurements from the collection and analysis of duplicate (inter-system) and collocated (intra-system) samples while analytical precision is based on replicate analysis only. The overall CVs for each method are compared against the precision DQO for the NATTS program and provided in the annual final report.

As discussed in Section 11.6, ERG is not responsible for the sampling design; therefore, representativeness is beyond the scope of this QAPP. Comparability is based on the measure of confidence with one data set compared to another. Ongoing data review and adherence to the

data quality objectives keeps the data quality consistent and therefore comparable over the project. Comparability is an ongoing data quality review followed by a data assessment prior to the preparation of the annual final report.

Completeness is determined by comparing the number of valid samples reported to the number of valid samples expected. The number of expected samples is determined by counting the number of scheduled samples based on the sampling calendar for that site. Eighty-five percent completeness is the DQO/MQO for all programs. This is an ongoing assessment used to facilitate make-up sampling in the same quarter when possible.

To ensure that the data is reliable in the ranges of concern, the minimum detection limit targets are those specified for the NATTS program, even though the other programs may be less stringent. This is an ongoing assessment since detection limits are determined annually.

18.5.1 PAMS Data Validation

To process and validate PAMS Auto-GC data, data will be handled in the following manner. The SOP for PAMS autoGC data validation, ERG-MOR-112, is listed Appendix D.

- Received data will be imported into a database and queries will be run to quantitatively perform the screening checks identified in Table 10-1 of the PAMS TAD. An initial summary of data failing screening checks will be provided to the PAMS Site.
- Data will be pulled into a customized QlikSense app and so that data can be reviewed using pre-populated data visualizations (e.g., time series, bar charts, etc.). Any questionable data identified during this review will also be summarized and provided to the PAMS site. The QlikSense app will be made available to the PAMS Site such that the app can support their own data review processes.
- Data will be revised per the PAMS Site instruction. Steps 1-3 may be repeated based on additional feedback and collaboration.

- Finalized data will be coded for AQS and undergo the same quality assurance steps outlined in Section 18.6.

18.6 Air Quality System

ERG submits data collected for the NMOC, UATMP, NATTS, CSATAM, PAMS, and other air toxics programs to the AQS database.

Prior to ERG's submittal of data to AQS, the State/Local/Tribal agency submits, at a minimum, Basic Site Information transactions (Type AA) for each sampling site, and transaction Types AB through AE, if necessary, to the AQS database. ERG then submits monitor transactions (Types MA through MX, as applicable) to prepare the AQS database for data upload. Data that are uploaded into AQS include Raw Data transactions (Type RD), QA transactions (Type Duplicate, Replicate, and Pb Analysis Audit) and Blank transactions (Type RB). ERG follows the NATTS[20] and PAMS[2] TADs to code data for the AQS database.

The submittal process involves the following steps:

- The raw data are formatted into pipe-delimited (|) coding that is accepted by AQS. Raw data, data generated by single sample episodes, by the primary sample (D1) of a duplicate episode, or by collocates (C1 and C2), are submitted using RD transactions.

- Precision data, data generated by Duplicate and Replicate samples (R1, D2, and/or R2), are submitted using QA transactions, specifically Duplicate and Replicate transactions. Accuracy data, generated for lead-FEM audit results, are also submitted using QA transactions.

- The RD QA (specifically duplicate, replicate and Pb Analysis Audit), and RB coding are generated and reviewed following guidelines specified in the *SOP for the Preparation of Monitoring Data for AQS Upload (ERG-MOR-098)* to ensure that the monitor ID (including state, county, site, parameter, and Parameter Occurrence Code (POC) codes), sampling duration, units, method, sample date, start time, and sample values, and MDLs are correct. The transactions are stored as text files for upload into the AQS database.

- Transaction files are primarily loaded under the Monitoring and Quality Assurance screening group.

- Transactions are edited to correct any errors found by AQS and then resubmitted. This step is repeated until the transactions are free of errors.

- AQS performs a statistical check on the data submitted to validate the data and determines if there are any outliers based on past data.

- Raw data (RD) transactions are then posted into the AQS database.

18.6.1 AQS Flagging and Reporting

Air toxics data submittals may be submitted to AQS with flags to indicate additional information related to the sample. There are two qualifier flag types that may be applied: Null codes and Qualifier codes.

- **Null Code —** assigned when a scheduled sample is not usable (e.g., canister leaked, sample damaged in shipment, etc.).

- **Qualifier Code —** used to note a procedural or quality assurance issue that could possibly affect the concentration value or the uncertainty of the result. These flags can also be applied to indicate atypical field conditions (e.g., nearby fires, construction in the area).

Qualifier Codes can be used in combination, with up to 10 possible codes applied. If a Null code is used, no other flag is normally used since no results are reported. Table 18-1 presents the Qualifier codes and Table 18-2 presents the Null codes available to AQS users, however more flags are listed on the AQS website. These flags are applicable to the various steps of sample collection and analysis such as field operations, chain of custody, and laboratory operations.

Blank issue flags are qualifier flags used if reported blank values are above the limits set by the method SOPs or QAPP. If high blank values are associated with samples, the sample values are reported but appropriately flagged as described in the NATTS TAD[20]. Samples will not be invalidated due to high blank values. Blank issue flags are included in Table 18-1.

Table 18-1
Qualifier Codes

Qualifier Code	Qualifier Description
1	Deviation from a CFR/Critical Criteria Requirement
1V	Data reviewed and validated
2	Operational Deviation
3	Field Issue
4	Lab Issue
5	Outlier
6	QAPP Issue
7	Below Lowest Calibration Level
9	Negative value detected - zero reported
CB	Values have been Blank Corrected
CC	Clean Canister Residue
CF	Canister Bias: NATTS/UATMP Data for compounds that have failed certification for the canister.
CL	Surrogate Recoveries Outside Control Limits
DI	Sample was diluted for analysis
DN	DNPH peak less than NATTS TAD requirement, reported value should be considered an estimate
EH	Estimated; Exceeds Upper Range
FB	Field Blank Value Above Acceptable Limit
FX	Filter Integrity Issue
HT	Sample pick-up hold time exceeded
IA	African Dust
IB	Asian Dust
IC	Chemical Spills & Industrial Accidents
ID	Cleanup After a Major Disaster
IE	Demolition
IF	Fire – Canadian
IG	Fire - Mexico/Central America
IH	Fireworks
II	High Pollen Count
IJ	High Winds
IK	Infrequent Large Gatherings
IL	Other
IM	Prescribed Fire
IN	Seismic Activity
IO	Stratospheric Ozone Intrusion
IP	Structural Fire
IQ	Terrorist Act
IR	Unique Traffic Disruption
IS	Volcanic Eruptions
IT	Wildfire-U. S.
J	Construction
LB	Lab blank value above acceptable limit

Table 18-1
Qualifier Codes, Continued

Qualifier Code	Qualifier Description
LJ	Identification of Analyte Is Acceptable; Reported Value Is an Estimate
LK	Analyte Identified; Reported Value May Be Biased High
LL	Analyte Identified; Reported Value May Be Biased Low
MD	Value less than MDL
MS	Value reported is ½ MDL substituted
MX	Matrix Effect
ND	No Value Detected, Zero Reported
NS	Influenced by nearby source
PQ	Value Between PQL and MDL
QP	Pressure Sensor Questionable
QT	Temperature Sensor Questionable
QX	Does not meet QC criteria
SB	Sampler Bias: NATTS/UATMP Data for compounds that have failed certification for the sampler
SP	NATTS/UATMP data Spike Recovery outside acceptance limits
SQ	Values Between SQL and MDL
SS	Value substituted from secondary monitor
SX	Does Not Meet Siting Criteria
TB	Trip Blank Value Above Acceptable Limit
TT	Transport Temperature is Out of Specs
V	Validated Value
VB	Value below normal; no reason to invalidate
W	Flow Rate Average out of Spec.
X	Filter Temperature Difference or Average out of Spec.
Y	Elapsed Sample Time out of Spec.

Table 18-2
Null Codes

Null Code	Qualifier Description
1C	A 1-Point QC check exceeds acceptance criteria but there is compelling evidence that the analyzer data is valid
AA	Sample Pressure out of Limits
AB	Technician Unavailable
AC	Construction/Repairs in Area
AD	Shelter Storm Damage
AE	Shelter Temperature Outside Limits
AF	Scheduled but not Collected
AG	Sample Time out of Limits
AH	Sample Flow Rate out of Limits
AI	Insufficient Data (cannot calculate)
AJ	Filter Damage
AK	Filter Leak

Table 18-2
Null Codes (Continued)

Null Code	Qualifier Description
AL	Voided by Operator
AM	Miscellaneous Void
AN	Machine Malfunction
AO	Bad Weather
AP	Vandalism
AQ	Collection Error
AR	Lab Error
AS	Poor Quality Assurance Results
AT	Calibration
AU	Monitoring Waived
AV	Power Failure
AW	Wildlife Damage
AX	Precision Check
AY	Q C Control Points (zero/span)
AZ	Q C Audit
BA	Maintenance/Routine Repairs
BB	Unable to Reach Site
BC	Multi-point Calibration
BD	Auto Calibration
BE	Building/Site Repair
BF	Precision/Zero/Span
BG	Missing ozone data not likely to exceed level of standard
BH	Interference/co-elution/misidentification
BI	Lost or damaged in transit
BJ	Operator Error
BK	Site computer/data logger down
BL	QA Audit
BM	Accuracy check
BN	Sample Value Exceeds Media Limit
BR	Sample Value Below Acceptable Range
CS	Laboratory Calibration Standard
DA	Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Shifts)
DL	Detection Limit Analyses
EC	Exceeds Critical Criteria
FI	Filter Inspection Flag
MB	Method Blank (Analytical)
MC	Module End Cap Missing
QV	Quality Control Multi-point Verification
SA	Storm Approaching
SC	Sampler Contamination
ST	Calibration Verification Standard
SV	Sample Volume out of Limits
TC	Component Check & Retention Time Standard

Table 18-2
Null Codes (Continued)

Null Code	Qualifier Description
TS	Holding Time or Transport Temperature Is Out Of Specs.
XX	Experimental Data

ERG submits data to AQS using qualifier flags to show where the data are with respect to the detection level. A variety of terms and acronyms are used for defining the lowest level that can be detected for each analytical method. These terms and applications are derived from EPA's TAD for the NATTS program and are presented below:

- **Quantitation Limits (QL) —** the lowest level at which the entire analytical system must provide a recognizable signal and acceptable calibration point for the analyte.

- **Detection Limits (DL) —** the minimum concentration of an analyte that can be measured above instrument background.

- **MDL —** the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in each matrix containing the analyte (Part 136, App. B).

- **SQL —** the lowest concentration of an analyte reliably measured within specified limits of precision and accuracy during routine laboratory operating conditions. Per the NATTS TAD, the SQL is a multiplier of the method detection limit (3.18 times the MDL) and is considered the lowest concentration that can be accurately measured, as opposed to just detected.

The qualifier flags associated with quantitation and detection limits are also included in Table 18-1, while Table 18-3 summarizes how they are applied to the data.

Table 18-3
Summary of Quantitation and Detection Limit Flags and Applications

If Concentration is:	Value to Report	Flag Applied
> SQL	Value	None
≥ MDL and ≤ SQL	Value	SQ
< MDL	Value	MD
Not Detected	0	ND

SECTION 19
DATA VALIDATION, VERIFICATION METHODS

Many of the processes for verifying and validating the measurement phases of the data collection operation have previously been discussed in Section 18. If these processes are followed, and the sites are representative of the boundary conditions for which they were selected, one would expect to achieve the DQOs. However, exceptional field events may occur, and field and laboratory activities may negatively affect the integrity of samples. In addition, it is expected that some of the QC checks will fail to meet the acceptance criteria. This section will outline how ERG will take the data to a higher level of quality analysis by performing software tests, plotting, and other methods of analysis.

19.1 Process for Validating and Verifying Data

19.1.1 Verification of Data

For the analytical data, the entries are reviewed to reduce the possibility of entry and transcription errors. Once the data are transferred to the ERG LIMS database, the data will be reviewed for routine data outliers and data outside acceptance criteria. These data will be flagged appropriately. Prior to reporting, 100 percent of the data is reviewed by the Task Leaders and 10 percent of the database is checked by the QA Coordinator or designated reviewer via review checklist. The PM also reviews the data prior to the preliminary report. After a preliminary reporting batch is completed, a review of 10 percent of the data will be conducted for completeness and manual and electronic data entry accuracy by the Annual Report/AQS Task Leader.

19.1.2 Validation of Data

Data validation is performed by examination of objective evidence that the requirements for a specific intended use are fulfilled as presented in Section 4. Data is examined for comparability, completeness, precision, and bias. This data validation, some of it performed with

summary statistical analysis, is performed prior to the annual final report. Data validation is discussed in more detail in Section 18.5.

19.2 Data Analysis

Data analysis refers to the process of interpreting the data that are collected. Although there are a large number of parameters to analyze, many of these parameters present similar characteristics, (i.e., VOC, SVOC, and particulate metals, grouped according to their physical and chemical properties).

ERG will employ software programs, described below, to help analyze the data.

Spreadsheet – Select ERG employees perform analysis on the data sets using Excel® spreadsheets (analysts, Task Leaders, and QA reviewers) and Access® databases (AQS data entry). Spreadsheets and databases allow the user to input data and statistically analyze, graph linear data. This type of analysis will allow the user to see if there are any variations in the data sets. In addition, various statistical tests such as tests for linearity, slope, intercept, or correlation coefficient can be generated between two strings of data.

QlikSense - Time series plots, compound-specific plots, and control charts can help identify the following trends:

- Large jumps or dips in concentrations;
- Periodicity of peaks within a month or quarter; and
- Expected or unexpected relationships among species.

SECTION 20
RECONCILIATION WITH DATA QUALITY OBJECTIVES

The project management team, QA Coordinator, and sampling and analytical team members are responsible for ensuring that all measurement procedures are followed as specified and that measurements data meet the prescribed acceptance criteria. Prompt action is taken to correct any problem that may arise.

20.1 Conduct Preliminary Data Review

A preliminary data review will be performed as discussed in Sections 16 and 18 to uncover potential limitations to using the data, to reveal outliers, and generally to explore the basic structure of the data. The next step is to calculate basic summary statistics, generate graphical presentations of the data, and review these summary statistics and graphs to determine if the program requirements in Section 4, representativeness, comparability, completeness, precision, bias, and sensitivity, were met. These steps are discussed in more detail in Section 18.5. Comparability is based on method measure of the level of confidence with which one data set can be compared to another. Completeness is measured by the amount of valid sample data obtained compared to what was expected. Precision is determined from replicate analyses for a given method. Laboratory bias is demonstrated through PT samples and second source standards. Sensitivity is demonstrated through minimum detection limits.

20.2 Draw Conclusions from the Data

If the sampling design and statistical tests conducted during the final reporting process show results that meet acceptance criteria, it can be assumed that the network design and the uncertainty of the data are acceptable. This conclusion can then be reported to EPA and the States/Local/Tribal agencies, who then decide whether to perform risk assessments and analyze the data to determine whether these data can be used to address health effects.

SECTION 21

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Appendix A

ERG Exemptions from the NATTS TAD, Revision 3

2017 Quality Assurance Project Plan, Category 1
UATMP, NATTS, CSATAM, PAMS, and NMOC Support
(Contract No. EP-D-14-030)

The proposed **ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3,** listed in Appendix A of the QAPP have been deemed acceptable as noted by the signatures below.

Approved by:

U.S. EPA QA Manager: _____ Date: 9/22/17

U.S. EPA Delivery Order Manager: _____ Date: 9/20/17

ERG Program Manager: Jules L. Swift Date: 9/22/17

ERG Deputy Program Manager: Laura VanEnkevort Date: 9/22/17

ERG Program QA Officer: Donna Teddar Date: 9/22/17

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3 (2017 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Dave Shelow (EPA Delivery Order Manager) & Greg Noah (QA Manager)
VOCs	4.2.2, pg 66	Both sample results must be qualified when entered into AQS for instances in which collocated or duplicate samples fail precision specifications.	The precision tables do not allow flags. Flags will be uploaded into AQS as permitted.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
VOCs	4.2.4.1.1.1, pg 74	Canisters with leak rates > 0.1 psi/day must be removed from service and repaired.	ERG evacuates the canisters to ~25" Hg and measured again in seven days. Our acceptance criteria is <1" Hg (QAPP section 11.1). This more accurately mimics the vacuum of the canisters shipped to the field when there is greater potential of major leak affecting the sample concentration.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
VOCs	4.2.4.2.4, pg 77 Table 4.2-3, pg 93	States on canister per batch cleaned in Section 4.2.4.2.4. but in Table 4.2-3 it states that the canister chosen must represent no more than 10 total canisters.	ERG heated canister cleaning systems are 12-port systems. We propose to continue verifying cleanliness on one canister for each batch of 12. Historical data can be provided if needed.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
VOCs	4.2.6, pg 80	The recommended tolerance is a pressure change of ≤0.5 psia.	Because of the wide variety of sites, gauges, operators, ERG has created a spreadsheet to track the pressure differences between field and laboratory. If these values differ by historical differences > 3", the samples are invalidated	Approved at June 2017 EPA/ERG meeting (June 23, 2017)

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3 (2017 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Dave Shelow (EPA Delivery Order Manager) & Greg Noah (QA Manager)
VOCs	4.2.8.5.2.2, pg 87 Table 4.2-3, pg 93	Analysis of swept carrier gas through the Preconcentrator to demonstrate the instrument is sufficiently clean to begin analysis (IB).	This is listed as a recommendation in Section 4.2.8.5.2.2 but as a requirement in Table 4.2-3. Because the samples are checked with the analysis of blank samples, ERG will analyze the IB only for trouble shooting purposes.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
Carbonyls	4.3.2, pg 97	The sample must be kept cold during shipment such that the temperature remains ≤ 4°C, and the temperature of the shipment must be determined upon receipt at the laboratory.	This requirement will be extremely difficult to achieve during summer months and is not required in Method TO-11A. The vendor does not ship the cartridges to the laboratory in coolers but the samples are shipped overnight with receipt in the laboratory Tuesday through Friday. ERG will conduct a summer study to determine the necessity of this requirement and present it to the EPA in 2017.	Study presented to the EPA on August 25, 2017 validating ERG's exemption. The exemption was approved at this meeting.
Carbonyls	4.3.9.4, pg 115 Table 4.3-4, pg 121	EMSB - For batch sizes of more than 20 field-collected cartridges, n such QC samples of each type must be added to the batch, where n = batch size / 20, and where n is rounded to the next highest integer.	ERG has previously only performed this type of extraction to see if there were problems in a new lot of solvents. Our procedure will perform this extraction once a month, in the first batch of samples prepared each month.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3 (2017 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Dave Shelow (EPA Delivery Order Manager) & Greg Noah (QA Manager)
Carbonyls	4.3.9.5.2, pg 117	For positive identification, the RT of a derivatized carbonyl must be within three standard deviations (3s) or ± 2%, whichever is smaller, of its mean RT from the ICAL	ERG's Carbonyl software (Agilent®) allows a ±2.5% window, not ±2.0%, but will automatically check if compounds are outside of this window. ERG believes the automatic function is advantageous and will perform LC maintenance checks if the RT fall outside this RT window.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
Metals	4.4.5, pg 128	Field blank analysis must demonstrate all target elements < MDL.	ERG does not get filters from the same lot that are provided to the field for sampling. Our filters are purchased and we determine the MDLs based on the background in that particular lot. Because of the wide variety of filter lots coming in from the different sites, and until the manufacturers of the filters provide clean enough samples, the majority of the elements could potentially be flagged. ERG proposes to flag only those elements over 5xMDL in order to better accommodate the potential lot differences.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3 (2017 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Dave Shelow (EPA Delivery Order Manager) & Greg Noah (QA Manager)
Metals	4.4.10.5, pg 137	RBS- spiked digestion solution only (no filter strip – ensures proper spike recovery without the filter matrix)	ERG will prepare Standard Reference Material samples (required by NAAQS lead) and perform Post Digestion Spike analysis to ensure proper spike recovery without the filter matrix, instead of preparing and analyzing the RBS.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
Metals	4.4.10.5.2.1, pg 139	Each filter strip must be accordion folded or coiled and placed into separate digestion vessels.	ERG does not use accordion folding for the QFF filters. The digestion procedure is detailed in SOP 084. Historical data for over 10 years show acceptable recoveries using this method. ERG proposes to keep current folding procedures in place.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
Metals	4.4.11.7.1, pg 142	Replicate analyses of the calibration standards must show %RSD ≤ 10%	ERG's lowest calibration point is at the LOQ concentration. Our standard practice is to have all cal points at %RSD ≤10%, but the low cal point at %RSD ≤20%. This standard uses the same concentrations as the Limit of Quantitation (LOQ) standard, which are near or less than that of the MDL, therefore an RSD ≤ 20 percent is acceptable.	Added text in QAPP Section 11.3.5, "Replicate analysis of the calibration standards must have an RSD ≤ 10 percent, except for the second calibration standard (CAL2). This standard uses the same concentrations as the Limit of Quantitation (LOQ) standard, which are near or less than that of the MDL, therefore an RSD ≤ 20 percent is acceptable." Approved at June 2017 EPA/ERG meeting (June 23, 2017)

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3 (2017 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Dave Shelow (EPA Delivery Order Manager) & Greg Noah (QA Manager)
Metals	4.4.11.7.3, pg 143 4.4.11.7.6, pg 144 4.4.11.8, pg 145 Table 4.4-3	The ICB is again analyzed following the ICV; all element responses must be less than the laboratory's established MDLsp for MDLs determined via Section 4.1.3.1 or the portion of the MDL represented by s·K for MDLs determined via Section 4.1.3.2. Also for CCB, negative values, BLK1, and RB.	ERG references the MDL for the ICB, CCB, negative values, reagent blanks and method blanks, not the s * K. ERG does not believe there should be 2 different sets of criteria for instrument/batch QC. These are all < MDL.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
Metals	4.4.11.7.4, pg 143 Table 4.4-3, pg 147	ICSA - All target elements < MDLsp (refer to Section 4.1.3.1) or s·K (refer to Section 4.1.3.2) – may be subtracted for ICS A certificate of analysis	ERG's critieria is for the results to be within ±3 times LOQ from zero or from the stock standard. This allows us to take into account the background in the interference solution when present.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
Metals	4.4.9.5.1, pg 132 4.4.10.5.1, pg 137 Table 4.4-3, pg 148	LCS - Recovery within 80-120% of nominal for all target elements, Sb recovery 75-125%.	ERG does not currently flag Sb if it is over 80-120%. ERG will monitor Sb with control charts for 6 months or gather existing data to allow us to statistically determine reasonable acceptance criteria.	Historical control charts presented and it was decided to flag QC and sample data starting 11/1/17. Discussed at the September 2017 EPA/ERG meeting (September 22, 2017)
Metals	4.4.10.5.1, pg 137 Table 4.4-3, pg 148	MS/MSD - Recovery within 80-120% of the nominal spiked amount for all target elements, Sb recovery 75-125%.	ERG does not currently flag Sb if it is over 80-120%. ERG will monitor Sb with control charts for 6 months or gather existing data to allow us to statistically determine reasonable acceptance criteria.	Historical control charts presented and it was decided to flag QC and sample data starting 11/1/17. Discussed at the September 2017 EPA/ERG meeting (September 22, 2017)

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3 (2017 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Dave Shelow (EPA Delivery Order Manager) & Greg Noah (QA Manager)
PAH	4.5.3, pg 152 Table 4.5-3	Lot Blank - Regardless of the source of materials or the specific cleaning procedures each agency adopts, the QFF and PUF/XAD-2/PUF present in cartridges must meet the batch blank acceptance criteria of < 10 ng each for all target compounds. One cartridge for each batch of 20 or fewer prepared cartridges	ERG's procedure has been to prepare one filter per preparation shipment day. Background contamination (even when precleaned before preparing cartridges by the laboratory) show targets > 10 ng per target compound. ERG's criteria is to flag only those compounds which have recoveries > 5x MDL. ERG will monitor 6 months of lot blank data to provide to the EPA to justify exemption.	Historical control charts presented and it was decided to allow a new exemption criteria to be less than the MDL starting 11/1/17. Discussed at the September 2017 EPA/ERG meeting (September 22, 2017)
PAH	4.5.3.3, pg 153	Field surrogates are added no sooner than two weeks prior to the scheduled sample collection date.	ERG will be unable to provide sites with an extra sample media on each sampling day (standard practice) if we are not allowed to have cartridges spiked no sooner than two weeks. This practice is not listed in TO-13A or the ASTM 6209. ERG will perform a study or gather existing data to determine how long the spiked surrogates are stable on the cartridges (up to 3 months) and present it to the EPA to justify exemption.	Study presented to the EPA on August 25, 2017 validating ERG's exemption. The exemption was approved at this meeting.

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3 (2017 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Dave Shelow (EPA Delivery Order Manager) & Greg Noah (QA Manager)
PAH	4.5.4.1b, pg 154	Samples which are shipped overnight should be packed with sufficient cold packs or ice to ensure they arrive at the laboratory at ≤ 4°C.	This requirement will be extremely difficult to achieve during summer months. ERG will conduct a summer study to determine the necessity of this requirement and present it to the EPA in 2017.	Study presented to the EPA on August 25, 2017 validating ERG's exemption. The exemption was approved at this meeting.
PAH	4.5.5.5.2, pg 160	Tuning the MS. Table 4.5-2	ERG currently uses the version from 8270D Rev5 July 2014 version which is the updated tune table for where the TO-13A method originally lifted their tune criteria. It is our opinion the original table listed (in Table 4.5-2) was created for older machines with less capability. The 2014 revision gives the operator the ability to tune to the heavier masses and get better resolution on the complex compounds. ERG proposes to continue using the 8270D criteria.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
PAH	4.5.5.5.3, pg 161	An SB which is not fortified with IS must be analyzed just prior to calibration to ensure the instrument is sufficiently clean to continue analysis. Analysis of the SB must show all target compounds, IS, and surrogate compounds are not detected	Table 4.5-3 states that the SB must be analyzed before each DFTPP tune, Section 4.5.5.5.3 states before each calibration. ERG will analyze the SB prior to the ICAL which is required in our DQOs not to exceed 6 weeks.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3 (2017 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Dave Shelow (EPA Delivery Order Manager) & Greg Noah (QA Manager)
PAH	4.5.5.5.3, pg 162	The RRTs of each surrogate or target compound across the ICAL are then averaged to determine the ICAL RRT. All RRTs must be within ± 0.06 RRT units of RRT.	ERG's VOC software (ChemStation) allows different time deltas for lower and upper time limits. For instance, the window for acenaphthylene is RT – 0.175 and RT + 0.25. The largest delta in the database is RT + 0.25, and it's used for several compounds. These windows for each compound are well within those required using the mean RRT. A table presenting RRTs to ERG's current procedure of tracking RT's is presented in Appendix B.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
All Analytes	VOC Table 7.1, pg 190	The sampling period for all field samples collected should be 1380-1500 minutes (24±1 hour) starting and ending at midnight.	ERG has reported any sample that was 22-23 hours or 25-26 hours, but flagged them with a "Y" (Elapsed Sample Time out of Spec.). Anything greater than ±2 hours is invalidated.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
	Carbonyl, 4.3.8.1.3, pg 110			
	Metals, 4.4.9.4.1 & 4.4.10.4.1, pg 131 & pg 137			
	PAH, 4.5.4.1, pg 154			

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 4 (2018 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Dave Shelow (EPA Delivery Order Manager) & Greg Noah (QA Manager)
VOCs	4.2.3.5.1, pg 71	The zero check is performed by simultaneously providing humidified (50 to 70% RH) hydrocarbon- and oxidant-free zero air (must meet the cleanliness criterion of < 0.2 ppbv or < 3x MDL, whichever is lower) or UHP nitrogen to the sampling unit for collection into a canister and to a separate reference canister connected directly to the supplied HCF zero air gas source.	For the compound acetonitrile, ERG will use the previous criteria from TAD, Rev 2 of <0.2 ppbv.	Approved at July 2018 EPA/ERG meeting (July 27, 2018)

Changes to Exceptions for 2020 QAPP

Analyte	TAD Reference Location	QC Parameter	ERG Exception	EPA Approval/Decision Doris Chen (EPA Delivery Order Manager) & Greg Noah (QA Manager)
VOC	4.2.3.5.1	Analysis by GC/MS for target compounds must show all Tier I core compounds in the zero challenge canister are not greater than 0.2 ppbv or 3x MDL (whichever is lower) higher than the reference canister and the remaining core compounds should also meet these criteria. Where exceedances are noted in the zero challenge canister for Tier I core compounds, corrective action must be taken to remove the contamination attributable to the sampling unit and the sampling unit zero challenge repeated to ensure criteria are met before sampling can be conducted. Subsequent collected field sample results for non-Tier I compounds that fail this criterion must be qualified when input to AQS.	For sampler certification zero checks, ERG will follow the TAD for NATTS Tier I compounds, however criteria for non-Tier I compounds is to 0.1 ppbV or 3x MDL (whichever is higher, with the upper limit of 0.2 ppbV) higher than the reference canister.	
PAH	4.5.5.5.3 Table 4.5-3	An SB which is not fortified with IS must be analyzed just prior to calibration to ensure the instrument is sufficiently clean to continue analysis. Analysis of the SB must show all target compounds, IS, and surrogate compounds are not detected	Table 4.5-3 states that the SB must be analyzed before each DFTPP tune, Section 4.5.5.5.3 states before each calibration. Previous exception for SB: Approved at June 2017 EPA/ERG meeting (June 23, 2017): ERG will analyze the SB prior to the ICAL which is required in our DQOs not to exceed 6 weeks. Because the samples are checked with the analysis of blank samples, ERG will analyze the SB only for trouble shooting purposes. The requirement would be removed from the QC tables and added to the Maintenance section of the SOP.	

Analyte	NATTS TAD Reference Location	QC Parameter	ERG Exception	EPA Approval/Decision Doris Chen (EPA Delivery Order Manager) & Greg Noah (QA Manager)
Metals	4.4.11.7.6 Table 4.4-3	CCB analysis must show that the absolute value of the instrument concentration response for each target element is less than the laboratory's established MDLsp for MDLs determined via Section 4.1.3.1 or the portion of the MDL represented by $s \cdot K$ for MDLs determined via Section 4.1.3.2. If the CCB does not meet this criterion, the analysis sequence must be stopped and the source of the contamination found before analysis may continue. Samples analyzed since the last acceptable CCB require reanalysis.	Due to the low MDL for Be in the STD mode, any drift can cause failed CCB analyses. Because of this, for Teflon filters, ERG will use criterion of < | 5 x MDL |, instead of < | MDL | for Be in CCBs. ERG will continue to use criterion of < | MDL | for all other elements.	Final approval pending per EPA/ERG meeting February 28, 2020.
Analyte	**PAMS TAD Reference Location**	**QC Parameter**	**ERG Exception**	**EPA Approval/Decision Doris Chen (EPA Delivery Order Manager) & Greg Noah (QA Manager)**
Carbonyls	5.2, Table 10-3	The sample must be kept cold during shipment such that the temperature remains ≤ 4°C, and the temperature of the shipment must be determined upon receipt at the laboratory.	This requirement will be extremely difficult to achieve during summer months and is not required in Method TO-11A. The vendor does not ship the cartridges to the laboratory in coolers but the samples are shipped overnight with receipt in the laboratory Tuesday through Friday. ERG will conduct a summer study to determine the necessity of this requirement and present it to the EPA in 2017.	Study presented to the EPA on August 25, 2017 validating ERG's exemption. The exemption was approved at this meeting.

Analyte	PAMS TAD Reference Location	QC Parameter	ERG Exception	EPA Approval/Decision Doris Chen (EPA Delivery Order Manager) & Greg Noah (QA Manager)
Carbonyls	5.9.4.1, Table 5-5 Table 10-3	EMSB - For batch sizes of more than 20 field-collected cartridges, n such QC samples of each type must be added to the batch, where n = batch size / 20, and where n is rounded to the next highest integer.	ERG has previously only performed this type of extraction to see if there were problems in a new lot of solvents. Our procedure will perform this extraction once a month, in the first batch of samples prepared each month.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
Carbonyls	5.9.5.2 Table 5-5 Table 10-3	For positive identification, the RT of a derivatized carbonyl must be within three standard deviations (3s) or ± 2%, whichever is smaller, of its mean RT from the ICAL	ERG's Carbonyl software (Agilent®) allows a ±2.5% window, not ±2.0%, but will automatically check if compounds are outside of this window. ERG believes the automatic function is advantageous and will perform LC maintenance checks if the RT fall outside this RT window.	Approved at June 2017 EPA/ERG meeting (June 23, 2017)
VOC	4.6.1 Table 4-4	The response for each target analyte in the SYSB should be as low as possible, and will be less than or equal to 0.5 ppbC or the MDL, whichever is lower. TNMOC should be less than 10 ppbC.	For RTS/SSCV subscription canisters, ERG's method blank TNMOC will be ≤ 10 ppbC.	

ERG EXEMPTIONS FROM THE NATTS TAD, REVISION 3 (2021 QAPP, Contract EP-D-14-030)

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Doris Chin (EPA Delivery Order Manager) & Greg Noah (QA Manager)
PAH	4.5.5.5.6, pg 162	Prior to analysis of laboratory QC samples or field-collected samples, a SMB consisting of an aliquot of the batch extraction solvent fortified with IS must be analyzed and demonstrate target compounds are < MDL	ERG would like to revise to < 2X MDL due to calculating values at MDL to determine if passing, at an area of concentration where there is no confidence. Note that the criterion of 2 x MDL is still below the NATTS MDL MQO values (Nap: 29 ng/m^3, benzo(a) pyrene: 0.91 ng/m^3). Note that ERG MDLs for the NATTS compounds have dropped since 2017. (MDL presented below)	
PAH	4.5.3, pg 152 Table 4.5-3	Cartridge Batch Blank: ERG's current criterion of <1X MDL (set by ERG based on control charting in an approved NATTS TAD exemption in 2017; was ≤ 10 ng/cartridge).	ERG would like to revise to < 2X MDL due to calculating values at MDL to determine if passing, at an area of concentration where there is no confidence. The method blank gets pulled from the prepped batch of cartridges also. One becomes the cartridge lot blank and one becomes the method blank. The cartridge blank has a criterion of 1 x MDL and the method blank has a criterion of 2 x MDL. Note that the criterion of 2 x MDL is still below the NATTS MDL MQO value (Nap: 29 ng/m^3, benzo(a) pyrene: 0.91 ng/m^3). Note that ERG MDLs for the NATTS compounds have dropped since 2017. (MDL presented below)	

ERG has provided the documentation to demonstrate that ERG meets the standard, in the form of historical data and/or experimental study results. These exemptions from Revision 3 NATTS TAD were approved and will remain in effect throughout the current contract.

Analyte	TAD Reference Location *	QC Parameter	ERG Exception	EPA Approval/Decision Doris Chin (EPA Delivery Order Manager) & Greg Noah (QA Manager)
PAH	Section 4.5.5.5.3, pg 161 Table 4.5-3	An SB which is not fortified with IS must be analyzed just prior to calibration to ensure the instrument is sufficiently clean to continue analysis. Analysis of the SB must show all target compounds, IS, and surrogate compounds are not detected.	ERG would use the SB for troubleshooting purposes, when there is an issue with other required blanks, as approved for TO-15 in 2017.	

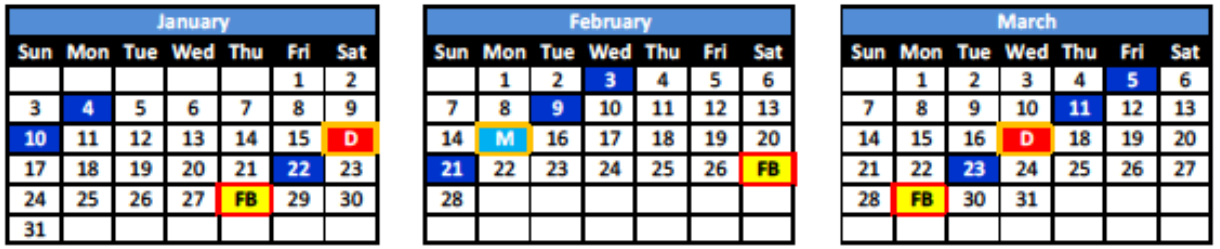
MDL comparison 2017 to 2020

Analyte	2017 MDL (ng/m^3)	2018 MDL (ng/m^3)	2019 MDL (ng/m^3)	2020 MDL (ng/m^3)
Naphthalene	2.05	1.81	1.15	1.02
Benzo(a)pyrene	0.0241	0.0106	0.0143	0.0143

Appendix B

2021 Sampling Schedules
(1-in-6 day Sampling Schedule and
PAMS Sampling Schedule)

2021 6-Day Sampling Calendar



January						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	D
17	18	19	20	21	22	23
24	25	26	27	FB	29	30
31						

February						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	M	16	17	18	19	20
21	22	23	24	25	26	FB
28						

March						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	D	18	19	20
21	22	23	24	25	26	27
28	FB	30	31			

April						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	M	17
18	19	20	21	22	23	24
25	26	27	FB	29	30	

May						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
D	17	18	19	20	21	22
23	24	25	26	27	FB	29
30	31					

June						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	M	16	17	18	19
20	21	22	23	24	25	26
FB	28	29	30			

July						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	D	16	17
18	19	20	21	22	23	24
25	26	FB	28	29	30	31

August						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	M
15	16	17	18	19	20	21
22	23	24	25	FB	27	28
29	30	31				

September						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	D	14	15	16	17	18
19	20	21	22	23	24	FB
26	27	28	29	30		

October						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	M	20	21	22	23
24	25	26	27	28	29	30
FB						

November						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	D	19	20
21	22	23	24	25	26	27
28	29	FB				

December						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	M	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	FB	31	

Standard Sample Collection

FB Field Blank Collection

D Duplicate Sampling Collection

M Makeup Duplicate Collection or normal sample

2021 3-Day PAMS Sampling Calendar (with duplicates)

June

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	D	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	FB			

July

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	D	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	FB	31

August

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
D	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
FB	30	31				

Standard Sample Collection

FB Field Blank Collection

D Duplicate Sampling Collection

Appendix C

ERG Changes/Comments for 2021 QAPP

Appendix D

Relevant ERG Standard Operating Procedures

Appendix E

Subcontractors

Quality Assurance Project Plan

RTI Laboratories

Will be provided when work is initiated.