Air Toxics Monitoring Quality Assurance Project Plan

Air Quality Program

Washington State Department of Ecology
Olympia, Washington

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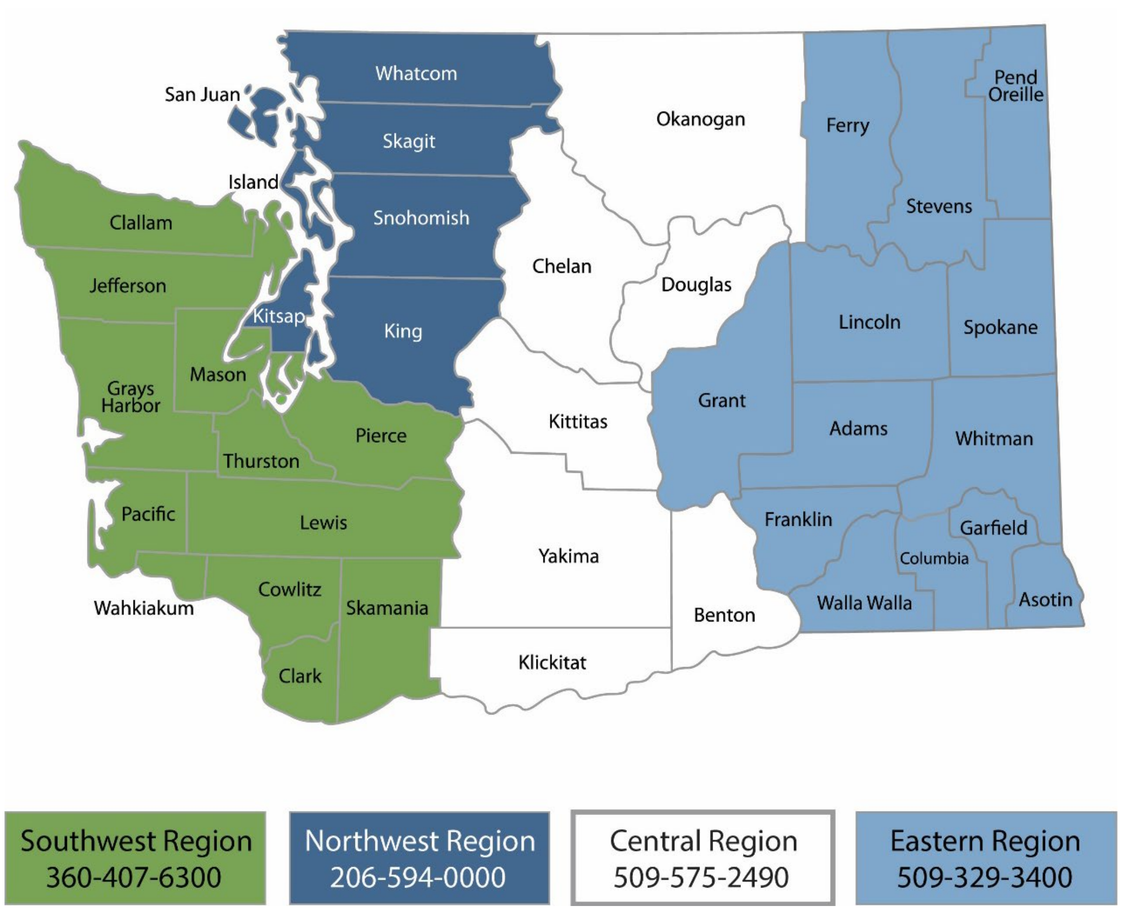
Department of Ecology’s Regional Offices

Map of Counties Served



Region	Counties served	Mailing Address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	PO Box 47775 Olympia, WA 98504	360-407-6300
Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	PO Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
Headquarters	Across Washington	PO Box 46700 Olympia, WA 98504	360-407-6000

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DEPARTMENT OF
ECOLOGY
State of Washington

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Table of Contents

List of Figures and Tables

Figures

Tables

Acronym List

AQS	Air Quality System
COC	Chain of Custody
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
ERG	Eastern Research Group
GC/MS	Gas chromatography mass spectrometry
HAPs	Hazardous air pollutants
HPLC	High performance liquid chromatography
ICP-MS	Inductively coupled plasma mass spectrometry
LIMS	Laboratory Information Management System
MQO	Measurement quality objectives
NATA	National Air Toxics Assessment
NATTS	National Air Toxics Trends Stations
NCore	National Core Monitoring Network
OAQPS	EPA Office of Air Quality Planning and Standards
Pace	Pace Analytical Laboratory
PAHs	Polycyclic aromatic hydrocarbons
PM_{10}	Particle matter less than or equal to 10 micrometers in aerodynamic diameter
QA	Quality assurance
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	Quality control
SOP	Standard Operating Procedure
TSA	Technical System Audit
VOCs	Volatile organic compounds

Executive Summary

The Clean Air Act Amendments of 1990 identified a list of 189 hazardous air pollutants (HAPs) that impose adverse health risks and summoned a strategic control of these air toxics by the U.S. Environmental Protection Agency (EPA). To identify the regions where efforts of HAP reduction should be strengthened and the quantity and type of HAPs be reduced, the National Air Toxics Trends Station (NATTS) Program was established in early 2000s to monitor long-term temporal and spatial trends in the concentrations of air toxic pollutants.

This document presents the Washington Department of Ecology (Ecology) Air Quality Program's Quality Assurance Project Plan (QAPP) for the NATTS program. Ecology supports one single NATTS monitoring station, located at Seattle-Beacon Hill, in Washington State. The site represents conditions in an urban residential neighborhood in the Puget Sound metropolitan area. The project goal of the NATTS Program is to provide long-term trends of quality-assured and representative data in hazardous air pollutants (HAPs) and support efforts in ongoing evaluations of air toxics in the United States. One single Data Quality Objective (DQO) for the NATTS Program is *to be able to detect a 15% difference between two successive 3-year annual mean concentrations (rolling averages) within acceptable levels of decision error.*

This document is divided into four major chapters:

1. **Project Management** provides an overview of project organizations and descriptions. Lists of quality objectives and criteria, pollutant types to be collected, sampling and analytical instrumentation specifications, and training requirement for the NATTS operators are presented. It also summarizes the documentations and records generated in this project.
2. **Data Generation and Acquisition** describes the technical requirements, procedures and considerations involving data collection. Following a logic flow of how data is created, this chapter details how data quality is assured starting from monitoring location, pre- and post-sampling handling, quality control check activities, and ending in data management for how data is archived long after data acquisition.
3. **Assessment and Oversight** explains the assessments implemented in this project plan to evaluate potential impacts on measurement data and network representativeness. Namely, they are performance evaluation, network assessment, and Technical System Audit (TSA). The chapter also identifies individual and organization's responsibilities to report periodic performance measures to the supervisory manager or organization.
4. **Data Validation and Usability** presents the data verification, review, and validation processes on the collected air toxic data, as well as data reconciliation with the DQO of the project.

In the light of maintaining this QAPP as part of the larger scheme of a national monitoring network, we acknowledge that much of the language in this document is adopted directly from EPA's Technical Assistance Document for The National Air Toxics Trends Stations Program (NATTS TAD) and the NATTS Work Plan Template.

1 Project Management

1.1 Distribution List

The following individuals involved in the project will be notified of the QAPP and receive an electronic copy of any revisions or amendments during the project. Revisions and amendments must be approved prior to implementation and distribution.

Table 1: Distribution list

Position	Organization
Ecology Quality Assurance Officer	Ecology, HQ
Air Quality Program Deputy Manager	Ecology, HQ
Technical Support Section Manager	Ecology, HQ
Air Monitoring Coordinator / NATTS Project Manager	Ecology, HQ
Air Monitoring Quality Assurance (QA) Coordinator	Ecology, HQ
NATTS Operator	Ecology, NWRO
EPA Region 10 Air Monitoring Officer	EPA Region 10
EPA Region 10 Air Monitoring Administrator	EPA Region 10

1.2 Revision History

Table 2: Revision history

Year	Author(s)	Action
2004	Stan Rauh	New document
2008	Stan Rauh and John Williamson	Review and minor revision
2012	Stan Rauh and John Williamson	Review and minor revision
2020	Anna Y.C. Tai	Changes throughout document. Updated document structure based on current EPA Air QAPP Guidance (EPA-454/B-18-006, August 2018)
2025	Matthew Bechle	Changes throughout document. Updated document to reflect Air Toxics Technical Assistance Document Rev. 4. (EP-D-013-005)

1.3 Project Organization

Federal, state, and local agencies and tribal nations all have important roles in developing and implementing satisfactory air monitoring programs. As part of the planning effort, the U.S.

Environmental Protection Agency (EPA) is responsible for developing National Ambient Air Quality Standards (NAAQS) and identifying a minimum set of quality check (QC) samples from which to assess data quality. The state and local organizations are responsible for taking this information, developing, and implementing a quality system that will meet the data quality requirements. It is the responsibility of both EPA and the state and local agencies to assess the quality of the data and take corrective action when appropriate. The responsibilities of each organization follow.

1.3.1 Department of Ecology Air Quality Program

The designated Primary Quality Assurance Organization (PQAO) for this project is the Air Quality Program at Washington State Department of Ecology (Ecology). The organizational structure of the Air Quality Program is present in Figure 1 below. Note that the NATTS program is implemented by a subset of Air Quality Program personnel. The lines of reporting for the NATTS project are presented below.

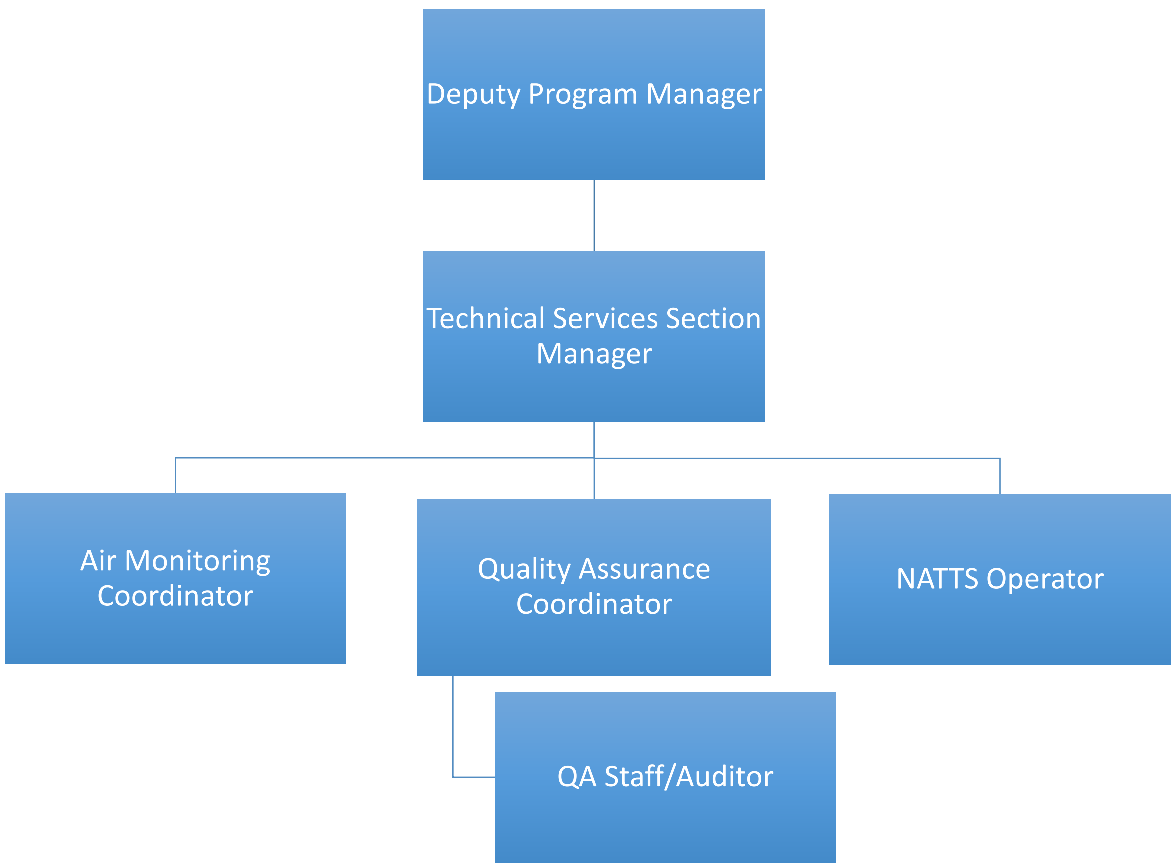

Figure 1: Organization Hierarchy of Ecology's NATTS Program

Deputy Program Manager

- Supervises the Technical Services Section Manager

Technical Services Section Manager

- Supervises the Air Monitoring Coordinator, Quality Assurance Coordinator, and NATTS operator

Air Monitoring Coordinator

- Manages the NATTS project budget
- Identifies air monitoring equipment needs and approves equipment purchases

Quality Assurance Coordinator

- Oversees the implementation of the Air Quality Program's quality system
- Oversees the quality assurance plan of the Gravimetric Analysis Laboratory at Pace

Quality Assurance Staff

- Conduct independent performance audits on the NATTS samplers
- Perform final level NATTS data validation

NATTS Operator

- Maintains and operates the Seattle-Beacon Hill NATTS site

1.3.2 Pace Analytical Laboratory (Pace)

Pace Analytical Laboratory is Ecology's contracted laboratory for gravimetric analysis of particulate matter sample filters.

- Prepares, inspects, and conducts PM_{10} mass concentration gravimetric analysis on low-volume PM_{10} filters as part of NCore PM Coarse measurements (same PM_{10} filters are used for NATTS metals but Eastern Research Group conducts NATTS metals analysis following PM_{10} gravimetric analysis)
- Ships PM_{10} filters (1-in-6) to Eastern Research Group following PM_{10} mass concentration gravimetric analysis

1.3.3 Eastern Research Group (ERG)

Eastern Research Group (ERG), is responsible for the analysis of all Washington State NATTS samples. As the EPA national contract laboratory for NATTS, ERG is approved by EPA to perform all of the following tasks in support of the NATTS program:

- Writes laboratory quality assurance policies, plans, and procedures
- Verifies all laboratory QA activities
- Prepares, certifies, and ships VOC canisters and carbonyl tubes to monitoring sites
- Analyzes VOCs, carbonyls, PAHs, and PM_{10} metals samples
- Assesses and reports data quality
- Validates analytical data (VOCs, carbonyls, PAHs, and PM_{10} metals)
- Conducts inter- and intra-laboratory testing
- Stores and archives laboratory data and documentation

- Delivers periodic electronic data results to key personnel
- Reports results (valid, flagged, and suspect data) to AQS

1.3.4 EPA Office of Air Quality Planning and Standards

EPA's Office of Air Quality Planning and Standards (OAQPS) is the organization charged under the authority of the Clean Air Act (CAA) to protect and enhance the quality of the nation's air resources. OAQPS sets standards for pollutants considered harmful to public health or welfare and, in cooperation with EPA's regional offices and the states, enforces compliance with the standards through State Implementation Plans (SIPs) and regulations controlling emissions from stationary sources. OAQPS evaluates the need to regulate potential air pollutants, especially air toxics and develops national standards; works with state and local agencies and tribal nations (S/L/T) to develop plans for meeting these standards. In addition, OAQPS provides funding for this work, through the CAA Section 103 and 105 funds.

Within the OAQPS Emissions Monitoring and Analysis Division (EMAD), the Monitoring and Quality Assurance Group (MQAG) is responsible for the oversight of the National Air Toxics Trends Stations (NATTS). MQAG has the following responsibilities:

- Ensuring that the methods and procedures used in making air pollution measurements are adequate to meet the programs objectives and that the resulting data are of satisfactory quality.
- Evaluating the performance through Technical Systems Audits (TSAs) of organizations making air pollution measurements.
- Implementing satisfactory quality assurance programs over EPA's Ambient Air Quality Monitoring Network.
- Ensuring that national regional laboratories are available to support toxics and QA programs.
- Rendering technical assistance to the EPA Regional Offices and air pollution monitoring community.

1.3.5 EPA Region 10

EPA regional offices address environmental issues related to the states within their jurisdiction and administer and oversee regulatory and congressionally mandated programs. The major quality assurance responsibilities of EPA's Regional Offices are the coordination of quality assurance matters at the regional level with the state and local agencies. This is accomplished by the designation of EPA Regional Project Officers who are responsible for the technical aspects of the program including:

- Reviewing QAPPs by Regional QA Officers who are delegated the authority by the Regional Administrator to review and approve QAPPs for the state agency.
- Supporting the air toxics audit evaluation program.
- Evaluating quality system performance, through TSAs and network reviews whose frequency is addressed in the Code of Federal Regulations.
- Acting as a liaison by making available the technical and quality assurance information developed by EPA Headquarters and the regional offices to the state and local agencies

including making EPA Headquarters aware of the unmet quality assurance needs of the state and local agencies.

1.4 Problem Definition

1.4.1 Background

EPA provides the following background information about the NATTS program (NATTS TAD):

Hazardous air pollutants (HAPs), or air toxics, are regulated under the Clean Air Act (CAA) as amended in 1990 and include a list of 189 toxic pollutants associated with adverse health effects. Such HAPs are emitted by numerous stationary and mobile sources. The U.S. Environmental Protection Agency (EPA) Government Performance Results Act (GPRA) commitments specify a goal of reducing air toxics emissions by 75% from the 1993 levels to significantly reduce the potential for human health risk.

The National Air Toxics Trends Station (NATTS) Program was developed to fulfill the need for long-term ambient air toxics monitoring data required to assess attainment of GPRA commitments. The NATTS Program was designed to generate data of a known, consistent, and standardized quality sufficient to enable the identification of spatial, and, more importantly, long-term temporal trends in the concentrations of air toxics. The partnership between EPA and the state and local air monitoring agencies is intrinsic to attaining the goal of the NATTS Program to generate high quality data needed to accomplish the end goal of trends detection.

EPA finalized the Integrated Urban Air Toxics Strategy (UATS) in the Federal Register on July 19, 1999. The UATS states that emissions data are needed to quantify the sources of air toxics impacts and aid in the development of control strategies, while ambient data are needed to understand the behavior of air toxics in the atmosphere. Since ambient measurements cannot practically be made everywhere, modeled estimates are needed to extrapolate our knowledge of air toxics impacts into locations without monitors. As such, the National Air Toxics Assessment (NATA) was established as an ongoing comprehensive evaluation of air toxics in the United States. It is a collaborative effort among EPA, state, local and tribal agencies to compile a national emission inventory and use air quality and exposure models to prioritize air toxics, emission sources and location of interest for further study to assess public health risks due to inhalation of air toxics. In 2017, the Air Toxics Screening Assessment, or AirToxScreen, succeeded NATA. EPA updates AirToxScreen annually.

One NATTS site in Washington State has been selected and established at Seattle-Beacon Hill since 2003 (EPA, 2002) and continues to be one of the ongoing 27 air toxics monitoring stations in the national network.

1.4.2 Analytes of Principle Interest

Among the 187 toxic pollutants listed in Section 112 of the CAA, 33 HAPs were identified in the UATS that are thought to have the greatest impact on the public and the environment in urban areas. This subset of 33 HAPs covers a variety of inhalation exposure periods, exposure pathways, and associated adverse health effects. However, the NATTS Program is primarily concerned with traditional inhalation pathway exposures of more ubiquitous HAPs, and is focused on measuring HAPs which have available and cost-effective measurement methods.

As such, 18 of the 33 UATS HAPs were selected as Tier I HAPs that must be measured and reported for the NATTS Program. With the other 42 Tier II HAPs that are highly desired and should be monitored and reported, a total of 60 HAPs have been designated as **Analytes of Principle Interest** for the NATTS Program. Each HAP was categorized to one of the four analyte classes: volatile organic compounds (VOCs), carbonyl compounds (carbonyls), polycyclic aromatic hydrocarbons (PAHs), and PM_{10} metals. A complete list of these HAPs and their corresponding analyte class is summarized in Section 1.5.2.

Since the collection and analysis of samples will also provide data on other compounds, ERG will report values that can be quality assured and accepted by the procedures detailed in its QAPP to the Air Quality System (AQS).

1.5 Project Description

1.5.1 Project Goal

The project goal of the National Air Toxics Trends Station (NATTS) network is to track long-term trends in hazardous air pollutants (HAPs) to support continuous efforts in assessment toward national emission inventory and health risk reduction goals.

This Quality Assurance Project Plan documents the quality assurance (QA) and quality control (QC) activities that are instituted by Ecology to fulfill the NATTS project goal. As the Primary Quality Assurance Organization (PQAO) of the NATTS Program in Washington State, Ecology collects and tracks trends in ambient air toxics concentrations across rolling three-year periods within acceptable levels of decision error by performing the following activities:

- Measure concentrations of the NATTS Tier I (required) and Tier II (highly desired) analytes (Table 1);
- Generate data of sufficiently high and known quality, with methods of sufficient sensitivity to obtain limits of detection at or lower than concentrations at which adverse health effects have been observed; and
- Collect sufficient data to represent the annual average ambient concentrations of air toxics.

The measurement goal of this project is to estimate the concentration, in units of micrograms per cubic meter (ug/m^3) and parts per billion/volume (ppbv) of air toxic compounds of particulates and gases, respectively. This is accomplished by using four individual sampling methods:

- Canister sampler for volatile organic compounds (VOCs);
- Carbonyl sampler with 2, 4-Dinitro-phenyl hydrazine (DNPH) coated cartridges for carbonyl compounds;
- Poly-Urethane Foam (PUF) high volume air sampler for polycyclic aromatic hydrocarbons (PAHs); and
- 47mm PTFE filters housed in FRM MetOne E-Sequential Air Sampler for PM_{10} metals.

1.5.2 List of Pollutants

The main data to be collected and reported in the project is the concentration of air toxic compounds of particulates and gases, in units of micrograms per cubic meter ($\mu g/m^3$) and parts per billion/volume (ppbv), respectively. This is accomplished by using the EPA Compendium Methods for designated for each specific pollutant class. Table 3 summarizes the HAPs and their corresponding analyte class. Supplemental information including operator quality control (QC) results, quality assurance (QA) assessment results, and site metadata is also collected and retained by Ecology.

Table 3: List of Analytes of Principle Interest

Hazardous Air Pollutant (HAP)	Analyte Class	Tier
acrolein	VOC	I
tetrachloroethylene	VOC	I
benzene	VOC	I
carbon tetrachloride	VOC	I
chloroform	VOC	I
ethylene oxide	VOC	I
trichloroethylene	VOC	I
1,3-butadiene	VOC	I
vinyl chloride	VOC	I
formaldehyde	Carbonyl	I
acetaldehyde	Carbonyl	I
naphthalene	PAH	I
benzo(a)pyrene	PAH	I
nickel	PM_{10} Metal	I
arsenic	PM_{10} Metal	I
cadmium	PM_{10} Metal	I
manganese	PM_{10} Metal	I
beryllium	PM_{10} Metal	I
lead	PM_{10} Metal	I
acetonitrile	VOC	II

Hazardous Air Pollutant (HAP)	Analyte Class	Tier
acrylonitrile	VOC	II
bromoform	VOC	II
carbon disulfide	VOC	II
chlorobenzene	VOC	II
chloroprene	VOC	II
p-dichlorobenzene	VOC	II
cis-1,3-dichloropropene	VOC	II
trans-1,3-dichloropropene	VOC	II
ethyl acrylate	VOC	II
ethyl benzene	VOC	II
hexachloro-1,3-butadiene	VOC	II
methyl ethyl ketone	VOC	II
methyl isobutyl ketone	VOC	II
methyl methacrylate	VOC	II
methyl tert-butyl ether	VOC	II
methylene chloride	VOC	II
styrene	VOC	II

Hazardous Air Pollutant (HAP)	Analyte Class	Tier
1,1,2,2-tetrachloroethane	VOC	II
toluene	VOC	II
1,1,2-trichloroethane	VOC	II
1,2,4-trichlorobenzene	VOC	II
m&p-xylenes	VOC	II
o-xylene	VOC	II
acenaphthene	PAH	II
acenaphthylene	PAH	II
anthracene	PAH	II
benz(a)anthracene	PAH	II
benzo(b)fluoranthene	PAH	II
benzo(e)pyrene	PAH	II

Hazardous Air Pollutant (HAP)	Analyte Class	Tier
benzo(k)fluoranthene	PAH	II
chrysene	PAH	II
dibenz(a,h)anthracene	PAH	II
fluoranthene	PAH	II
fluorene	PAH	II
indeno(1,2,3-cd)pyrene	PAH	II
phenanthrene	PAH	II
pyrene	PAH	II
antimony	PM_{10} Metal	II
chromium	PM_{10} Metal	II
cobalt	PM_{10} Metal	II
selenium	PM_{10} Metal	II

1.5.3 Equipment Requirements

Table 4 through Table 7 summarize the critical sampler design and performance requirements for each analyte class.

Table 4: Design and performance specifications for VOCs canister sampler

Category	Specification Area	Acceptance Criteria
Filter Design	Medium	2-µm pore size sintered stainless steel particulate filter
Sampler Design	Size	6 liters spherical
	Medium	Passivated SUMMA® electro-polished stainless steel container
	Max pressure	30 psig
	Max pressure drop	14 psig
	Collection efficiency	99 %
	Lower detection limit	Compound specific, usually > 0.1 ppbv
Sampler Performance	Sample flow rate	7 cc/min
	Flow regulation	1.0 cc/min
	Flow rate precision	± 10 %
	Flow rate accuracy	± 10 %
	External leakage	Vendor specs
	Internal leakage	Vendor specs
	Clock	± 5 min accuracy of reference time (GPS, cell phone)

Table 5: Design and performance specifications for carbonyl sampler

Category	Specification	Acceptance Criteria
Filter Design	Size	360 mg short body
	Medium	2,4-Dinitro-phenyl hydrazine (DNPH) coated silica gel
Sampler Performance	Sample flow rate	1 lpm at standard conditions
	Flow regulation	1 cc/min
	Flow rate precision	± 10 %
	Flow rate accuracy	± 10 %
	External leakage	Vendor specs
	Internal leakage	Vendor specs
	Clock/timer	± 5 min accuracy of reference time (GPS, cell phone)

Table 6: Design and performance specifications for PAHs sampler

Category	Specification	Acceptance Criteria
Sampler Design	Size, PUF	60 mm diameter
	Medium, PUF	Polyether type (0.022 g/cm^3)
Filter Design	Size	110 mm diameter
	Medium	Top chamber: PTFE particulate filter Lower chamber: Styrene-divinylbenzene polymer resin sorbent (XAD-2 or equivalent)
Sampler Performance	Power	960 watts/110VAC
	Flow rate	200–350 m^3/min
	Clock/timer	± 5 min accuracy for digital timer and ± 15 min accuracy for mechanical timer of reference time (GPS, cell phone)

Table 7: Design and performance specifications for low-volume PM_{10} metals sampler

Category	Specification	Acceptance Criteria
Filter Design	Size	47-mm diameter, 2-µm pore size
	Medium	PTFE filter
Sampler Performance	Design flow rate	16.67 L/min (lpm) in local conditions
	Flow rate accuracy	± 4% of the transfer standard or ± 5% of the design flow rate
	Leak check	<5.1 mmHg after 3.4 min
	Clock	± 1 min accuracy of reference time (GPS, cell phone)

1.5.4 Field Activities

Table 8 summarizes the samplers Ecology uses for each pollutant class and their sampling schedule in accordance with the equipment requirements listed in the previous section and in EPA's Technical Assistance Document (TAD) for the NATTS Program (EPA, 2016), which will be referred as NATTS TAD hereafter. See Section 2.5 in this QAPP for further descriptions on field quality control activities.

Table 8: Sampling instruments and schedule

Analyte Class	Instrument	Schedule
VOCs	Xonteck* Model 901 Canister Sampler	1 in 6 days
Carbonyls	ATEC Model 8000 Carbonyl Sampler XonTech* Model 925 Carbonyl Sampler	1 in 6 days
PAHs	Tisch Environmental TE-1000 PUF Poly-Urethane Foam High Volume Air Sampler	1 in 6 days
PM_{10} metals	MetOne E-Sequential FRM Sampler	1 in 6 days

Note: Xonteck, Inc. and XonTech, Inc. refer to the same company and are used interchangeably

1.5.5 Laboratory Activities

All laboratory activities in support of the monitoring related to VOCs, carbonyls, and PAHs are provided by EPA's national contract laboratory, Eastern Research Group (ERG). ERG prepares samples, ships them to the operator at Ecology NWRO, and receives the exposed samples. ERG also performs post-sampling data analysis, data validation and submits the validated data to AQS. See ERG's Quality Assurance Project Plan in Support of EPA National Monitoring Programs (referred as ERG's QAPP hereafter) for a detailed description of ERG's laboratory quality system for the NATTS Program.

Ecology has been given permission by EPA Region 10 to collect NATTS metals samples using its MetOne E-Sequential FRM Sampler that is also used to sample for PM_{10} as part of the collocated State and Local Air Monitoring Stations (SLAMS) Network $PM_{10-2.5}$ monitoring. The 47 mm filters and magazines are prepared by Pace Analytical Laboratory (Pace). After Pace receives the exposed samples and performs gravimetric analysis for the PM_{10} mass concentration, samples (1 in 6 days) are then shipped to ERG for chemical characterization of NATTS metals. ERG also validates the laboratory NATTS metals data and submits it to AQS.

Pre-sampling Preparation

- **VOCs –** Sampling canisters purchased from commercial suppliers will be sent to ERG for cleaning and evacuation prior to field deployment. Cleaning and certification procedures are performed in accordance with ERG's SOP for Sample Canister Cleaning (ERG-MOR-062). Canisters are shipped in secured boxes via United Parcel Service of America (UPS). Canisters are stored at ERG when waiting to be analyzed and after cleaning prior to field deployment. In the field, pressure measurements prior to and following sample collection are made to check sample integrity. Post-sampling canister pressures are confirmed when the canisters arrive at ERG.
- **Carbonyls –** Silica cartridges pre-coated with DNPH are shipped by the vendor directly to ERG. Each cartridge is individually wrapped and marked with a lot number. Three cartridges from each lot are shipped to ERG for certification. Formaldehyde and acetaldehyde levels on the blank cartridges must be below levels described in method TO-11A. After deployment in the field samplers, the exposed cartridges are capped and shipped to ERG for analysis.

- **PAHs –** PUF filters and their associated sample cartridges are prepared by ERG based on EPA Compendium Method TO-13A & ASTM D6209-13 and more specifically as described in ERG's standard quality control procedures in their SOP for PAHs (ERG-MOR-049).
- **PM_{10} –** 47mm PTFE filters for use in PM_{10} samplers are shipped by the vendor to Pace and then onto ERG for post-sampling analysis. Pace technician visually inspects each filter for defects prior to use. See Pace's SOP for specific calibration and quality assurance protocols.

Shipping/Receiving

- **VOCs, carbonyls, and PAHs** – Shipment of PUF filters and cartridges, VOC canisters and carbonyl cartridges between the ERG analytical laboratory and NWRO is accomplished via UPS Priority Overnight Delivery. Samples collected in the field are labeled individually with identification numbers and recorded in the chain of custody (COC) forms. Each COC form for VOC, carbonyl and PAH samples consists of 3 carbonless copy papers. One copy (pink) is archived and stored in secured file boxes at NWRO for site records. The remaining two copies (yellow and white) accompany each sample during transit. Upon arrival at ERG, samples are logged in and stored for analysis and COC forms are checked, scanned and stored on ERG's Laboratory Information Management System (LIMS) per ERG's SOP for Sample Receipt at the ERG Chemistry Laboratory (ERG-MOR-045) and SOP for Sample Login to the LIMS (ERG-MOR-079).
- **PM_{10} –** Shipments of PM_{10} samples from Pace to NWRO and from Pace to ERG are accomplished via Federal Express (FedEx) Priority Overnight Delivery. Filter ID and sample date for individual samples collected in the field are recorded by NWRO operator in one single COC form, which accompanies the samples during transit, as well as on individual bags holding each filter. Pace technician ships the PM_{10} samples to ERG on a quarterly basis for ICP-MS analysis and provides email reminders to both NWRO operator and ERG prior to shipping.

Post-Sampling

- **VOCs –** VOC analysis is performed at ERG using the EPA Compendium Method TO-15: Determination of Volatile organic Compounds (VOCs) in Air Collected In Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS) and ERG's SOP for the Concurrent GC/FID/MS Analysis of Canister Air Toxics Samples using Method TO-15A (ERG-MOR-005).
- **Carbonyls –** The DNPH derivatives of formaldehyde and acetaldehyde are eluted from the carbonyl cartridges and analyzed as described in EPA's Compendium Method TO-11A: "Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC), and more specifically ERG's SOP for Preparing, Extracting, and Analyzing DNPH Carbonyl Cartridges by Method TO-11A (ERG-MOR-024).
- **PAHs –** PAH analysis is performed as described in EPA's Compendium Method TO-13A: Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS), and more specifically ERG's SOP for

Analysis of PAHs using Method TO-13A & ASTM D6209-13 (ERG-MOR-049). The hold time for extraction is 14 days after sampling and for analysis is 40 days after extraction.

- **PM_{10} filters –** Upon arrival at ERG, each filter is logged in and examined for physical defects. Filters then are cut into strips in preparation for metals analysis. All handling, cutting, and metals analysis are performed as described in the EPA's Compendium Method IO-3.5: Determination of Metals in Ambient Particulate Matter Using Inductively Coupled Plasma Mass Spectrometry (ICP-MS), and more specifically ERG's 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 (ERG-MOR-095).
- **Data Management and Validation** – ERG will provide the post analysis data management and validation. Data management (recording, transformation, transmittal, reduction, summary, tracking, storage and retrieval) and validation (review, verification, and analysis) will be performed using the protocols specified in ERG's QAPP.
- **Data Reporting** – ERG will submit the resulting data and associated quality assurance information to EPA's Air Quality System (AQS) no later than 120 days following the end of each calendar quarter. ERG will submit data as is, including values below the calculated MDL.

1.5.6 Assessment Activities

Various organizations perform thorough assessments on the quality systems of different agencies to evaluate the effectiveness of the air toxics monitoring in Washington State. The assessment activities involved in the project are summarized in Table 9, which may include, but are not limited to, Technical System Audits (TSAs), Instrument Performance Audits (IPAs), Performance Evaluations (PEs), and peer reviews. All assessment activities are crucial to ensure an air toxic monitoring system of consistent and adequate quality not only within Washington State but across the nation.

Network-wide data analysis is performed by OAQPS to ascertain the size and features of a national trend network that will satisfy the program goals. Ecology continues to provide maintenance, monitoring and performance evaluation support to the NATTS Program at its Beacon Hill NCore station in Seattle, as agreed and funded through the Section 103 funds received from EPA Region 10.

Table 9: Assessment schedule

Agency	Type of Assessment	Agency Assessed	Frequency
NAREL (National Analytical Radiation Environmental Laboratory)	TSAs and PEs, round robin inter-laboratory samples	ERG	Annually
OAQPS	TSAs	NAREL, ERG, EPA Regional and Ecology	As needed by OAQPS determination
OAQPS	Network Reviews	Ecology	Once every 5 years
EPA Region 10	TSAs and IPAs	Ecology	Once every 3 years
Ecology	Standard Operating Procedure Reviews	Ecology	Once every 3 years
Ecology	PEs (audits)	Ecology	Annually

1.6 Quality Objectives and Criteria

1.6.1 Data Quality Objective (DQO) Overview

As established by EPA for the NATTS Program, the only Data Quality Objective (DQO) for this air toxics monitoring project is:

> **To be able to detect a 15% difference between two successive 3-year annual mean concentrations (rolling averages) within acceptable levels of decision error.**

The formal process of establishing the DQOs is described in EPA's *Guidance on Systematic Planning Using the DQO Process* (EPA, 2006). It provides a general framework for ensuring that the data collected meet the needs of the intended decision makers and data users.

1.6.2 Measurement Quality Objectives (MQOs) and Data Quality Indicators (DQIs)

In order to ensure comparable data among monitoring sites, consistency is a necessary component for the NATTS Program. Inherently, such consistency needs to be reflected in a standardized set of Measurement Quality Objectives (MQOs), field and laboratory operations, specific acceptance criteria for individual monitoring methods, and stability for the selected site to collect data over the required period of time.

Ecology implements the MQOs described in the following sections to attain the DQO of the NATTS Program.

Representativeness

Representativeness is a measure of degree to which collected data represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition (ANSI/ASQC, 1994). Components such as sampling design and siting are crucial in ensuring data collected are reliable and defensible to represent the area under study. In NATTS monitoring, sampling frequency must occur every 6 days per national sampling calendar over 24 ± 1 hours, beginning and ending at midnight in local standard time (i.e. Pacific Standard Time in Washington).

Completeness

Completeness is defined as a measure in percentage of which data is collected and validated at a given site over a calendar year. A minimum number of valid data points is necessary to perform meaningful data analysis and compare data among monitoring sites. The MQO for completeness requires at least (≥) 85% of the annual samples be valid and reported. Make-up samples should be collected when sample results are invalid and completeness are projected to not meeting the MQO for the calendar year.

A make-up sample should be collected as close to the original sampling schedule as possible and preferably before the next sampling date. If not feasible, the make-up sample should be collected within 30 days of the original invalid sampling date, or the least preferably, but acceptable, within the same calendar year.

Precision (CV %)

Precision is a measure of reproducibility of a data population to ensure concentration results are within an acceptable uncertainty. The MQO for the network precision is calculated based on at least one year of data, and a coefficient of variance (CV) of ≤ 15% must be met.

Bias

Bias or systematic error is a measure of the difference between a measurement ("indicated") and a true or accepted ("actual") value. Bias may be attributed to data collection or the data analysis process. Laboratory bias is assessed through the NATTS proficiency testing (PT) program, in which all the analytes selected for PT must be within ± 25% of the assigned target value (defined as the NATTS laboratory average). Field bias is largely assessed based on the flow rate of the samplers. Table 10 summarizes the acceptance limits of the indicated flow rates from a flow transfer standard or design flow rate for each pollutant class. Note that as the sampling method for VOCs involves collecting whole air into a canister using negative vacuum, a constant flow rate over the entire 24-hour sampling period is of greater importance than its accuracy.

Table 10: Acceptance limits of flow rates

Pollutant Class	Flow transfer standard	Design flow rate
Carbonyl	± 10%	± 10%
PAH	± 10%	± 10%
PM_{10} metal (low volume)	± 4%	± 5%

Sensitivity

Sensitivity of the samplers is important to be aware of to prevent misinterpretation of the data collected. As the ambient air toxics concentrations decrease, sensitivity in the sampling method is expected to increase as well. The method detection limit (MDL) MQO has been established for each of the NATTS Tier I core analytes. Refer to the annual NATTS network workplan template, available on the virtual Ambient Monitoring Technology Information Center (AMTIC), for the latest MDL MQO values.

1.7 Training

Air monitoring personnel are recruited and screened to ensure they are experienced and qualified to safely and adequately perform all job functions. All Ecology air monitoring operators are classified at the Environmental Specialist 4 (professional level) to ensure that they have the necessary education and skills to perform all aspects of air monitoring and are required to demonstrate proficiency, typically through the use of a training plan or guide. An example of a training plan for an ambient air monitoring operator is presented below.

Table 11: Example of an Ecology Air Monitoring Operator Training Plan

Training elements and activities to be performed/learned	**Date Completed**
Read and become familiar with Ecology's Quality Assurance Plan and instrument standard operating procedures (SOPs)	
Read and become familiar with federal 40 CFR Parts 58, appendices A, D, and E and Quality Assurance Handbooks Volumes II and IV	
Job-shadow NWRO NATTS and trace-gas operator. Accompany them on as many trips into the field as it takes to feel comfortable completing all of the following tasks: Perform air toxics quality control (QC) checks (recommend X 4) Perform manual nephelometer QC checks (recommend X 4) Perform four ozone manual QC checks (recommend X 4). Collect, document, and ship National Air Toxics Trends Site (NATTS) air toxics samples (recommend X 4)	
Work with NWRO NATTS and trace-gas operator and other staff to learn these – your primary areas of responsibility: Visit the NWRO sites you will operate. Do the following activities at the above locations and become proficient in these areas: Perform meteorological quality control (QC) checks Perform manual nephelometer QC checks Perform ozone manual QC checks	

Training elements and activities to be performed/learned	Date Completed
Perform filter-based $PM_{2.5}$ or PM_{10} QC checks Perform CO and NO_2 manual quality control checks Perform routine maintenance, clean parts, replace batteries and change filters. Collect, document, and ship Federal Reference Method (FRM) $PM_{2.5}$ samples. Collect, document, and ship speciation samples.	
Job-shadow NWRO's speciation and near-road operator. Accompany them on as many trips into the field as it takes to become proficient in all of the following tasks: Visit the NWRO monitoring sites they operate Cross-train with them by doing the following activities: Perform meteorological quality control (QC) checks Perform nephelometer QC checks Perform $PM_{2.5}$ Chemical Speciation Network QC checks Perform ozone manual QC checks Perform filter-based $PM_{2.5}$ or PM_{10} QC checks Perform CO and NO_2 manual quality control checks Perform BAM 1020 QC checks and perform routine maintenance Collect, document, and ship at least four Federal Reference Method (FRM) $PM_{2.5}$ samples. Collect, document, and ship speciation samples	
Job-shadow the SWRO operator. Accompany them to the Tacoma-S. 36th St. site in Tacoma: Cross-train with them by doing the following activities: Perform BAM 1020 QC checks (recommend X 2). Perform DART review	
Late spring/early summer, job-shadow ERO $PM_{2.5}$ and ozone operator. Accompany them on trips into the field to complete the following tasks: Accompany them to the following sites in central Washington: Wenatchee Ellensburg Cross-train with him/her by doing the following activities: Perform meteorological quality control (QC) checks Perform manual nephelometer QC checks	

Training elements and activities to be performed/learned	Date Completed
Coordinate with Calibration & Repair Lab staff for a day-long visit to the Calibration & Repair Lab: Train with them on: M903 nephelometer operations, calibration, and maintenance Beta Attenuation Monitor 1020 PM2.5 monitor operations and maintenance Ultrasonic meteorological sensor operation and recertification process Flow and temperature standard verification processes Ozone operations and maintenance (This will be a big part of what you'll be doing.) f. Multi-gas calibrator operations and maintenance	
Train with Quality Assurance staff: Meet with Quality Assurance Coordinator (QAC) to learn: Quality system requirements overview Documentation Level 1 data review processes Coordinate with the QAC and QA staff to accompany them on audit trips. Include met, ozone and BAM audits. Two audit trips with QA staff conducting field audits Learn the gaseous auditing process Evaluate the two air monitoring sites for accordance with 40 CFR 58, Appendix E siting and adherence to federal regulations and monitoring objectives. One audit trip with QA staff conducting field audits. Evaluate the air monitoring site for accordance with 40 CFR 58, Appendix E siting and adherence to federal regulations and monitoring objectives.	
Coordinate with the SWRO & Air Quality Operations Supervisor to meet with Telemetry Specialist and AQS Coordinator at HQ: Learn what the Telemetry Specialist does for site communications and data polling, data logger configuration, modems and channel set up. Learn what the AQS Coordinator does to submit data to EPA. Learn how to enter data in SIMS	
Use Excel, R, or other statistical software to analyze and visually present air quality data collected from NWRO.	
Become proficient with the EnvistaARM software: Learn how to run a variety of reports to analyze and conduct level 1 data review	

Training elements and activities to be performed/learned	Date Completed
Station reports (1-hour and 1-minute) Group reports (comparability of like-monitors) Calibration reports Log book reports Diagnostics reports Learn how to make new log book entries	
Become proficient with Envidas Ultimate data loggers and software tools to: Review calibration results Make logbook entries Disable channels Run reports for raw data and diagnostic data Review configurations of data channels, calibration sequences, and diagnostic information	

In addition to the basic training for becoming an Ecology air monitoring operator, NATTS program-specific air monitoring training is also required of NATTS personnel and consists of a combination of completion of available online air monitoring courses, in-person workshops and conferences, reading of EPA and Ecology NATTS quality system documents, and on-the-job training with highly experienced air toxics monitoring personnel. Supervisors are responsible for ensuring that air monitoring staff have the adequate education, skills, and training to perform all aspects and duties of their jobs.

At a minimum, prior to conducting air toxics sampling, all Ecology air toxics monitoring personnel are required to:

- Complete all available EPA online air toxics training
- Read the most current version of the EPA's NATTS Technical Assistance Document
- Read this Quality Assurance Project Plan and the associated Air Toxics Operating Procedure
- Read Ecology's Washington Ambient Air Monitoring Quality Assurance Plan and SOPs
- Receive on-the-job training with a highly experienced air toxics monitoring operator

The supervisor is responsible for tracking and ensuring these activities are completed prior to any operational activities by the personnel.

EPA also provides workshops and courses, both online and in-person. Additional training tailored for the NATTS program is offered during the National Ambient Air Monitoring Conferences All new air toxics monitoring personnel will attend these conferences and the NATTS-specific workshops as resources allow.

Operators may be required to take additional training as needed in order to stay current over time as the NATTS program changes.

1.8 Documentation and Records

Ecology's Washington Ambient Air Monitoring Quality Assurance Plan (QAP) describes the standard documentation and records handling and retention procedures. ERG's Quality Assurance Project Plan (QAPP) describes data management, recording, validation, transformation, transmittal, reduction, summary, tracking, storage and retrieval protocols for the laboratory's NATTS program. ERG submits air toxics results to EPA's AQS no later than 120 days following the end of each calendar quarter of data collection.

Per EPA's retention time requirement for all NATTS data and records, Ecology must keep the original documents and records on file for a minimum of six years. A 6-year retention period is deemed necessary to ensure all records generated during two successive three-year periods of air toxic monitoring are accessible after data collection. Documentation will be retained such that all operation, laboratory and quality assurance activities during the retention period can be verified.

As described in Ecology's QAP, documents are version-controlled and the most currently approved versions of QAPP, standard operating procedures (SOP), quality control (QC) forms and quality assurance (QA) forms are distributed to relevant individuals. These forms are retained electronically by the Quality Assurance Coordinator in a secured computer network location that is backed up regularly. Hard copies of Run Data Sheets and chain of custody (COC) forms for PM_{10} metals are archived by Pace technician in a secured filing location at Pace. Individual carbonless paper copies (pink) of COC forms for VOC, carbonyl and PAH sample are archived and stored in secured file boxes at NWRO for site records. The remaining two copies (yellow and white) accompany each sample during transit to ERG. Electronic logbook entries made by operators or QA personnel will be retained in Ecology's central database through the Data Acquisition System.

2. Data Generation and Acquisition

2.1. Network Design

2.1.1. Overview

OAQPS, in conjunction with the EPA Regional Offices and State, Local, Tribal (SLT) air pollution control agencies, developed the NATTS network. The network is comprised of 25 ambient air monitoring stations targeting 21 urban and 4 rural locations that are representative of different parts of the country. NATTS monitoring was established at neighborhood-scale sites with pre-existing $PM_{2.5}$ speciation sampling. Ecology is currently monitoring ambient air toxic concentrations at one urban location at Seattle Beacon Hill (AQS ID: 53-033-0080). The network objectives can be found in Section 1.6 and sampling schedule in Section 1.5.4.

2.1.2. Sampling Location

The single NATTS site in Washington is located at Jefferson Park in the Beacon Hill neighborhood of Seattle. The site is in an area of high population density that represents conditions in an urban residential neighborhood in the Puget Sound metropolitan area. The site is centrally located within the Seattle urban area. The nearest road (Beacon Hill Avenue) is approximately 150 m to the east and interstate highway (I-5) approximately 1 km to the west of the station. The station is situated within Jefferson Park and surrounded by a community center, a golf course, a middle school and residential neighborhoods. It is about 100 meters above sea level. The hill is part of a larger ridge defining the eastern edge of an area of light industry including a major seaport, an airport and warehousing and trucking activity about 4 to 10 km west of the site. Interstate freeways and arterial roads carrying large amounts of traffic are closely situated 1 km northwest of the site. The site is considered representative of 24-hour average $PM_{2.5}$ levels within a 20 km radius (Goswami et al., 2002). The prevailing winds at the monitoring site are from the south (22%), southeast (17%), northwest (14%) and northeast (13%). The highest wind speeds (upper 25%) are typically from the south.

The Beacon Hill monitoring station was originally selected to provide maximum neighborhood/urban scale NO_x concentrations to compare to the annual NO_2 standard. It is also used to evaluate ozone precursors as part of the National Core multipollutant network (NCore). The parameters currently measured at this site include VOCs, carbonyls, PAHs, PM_{10} metals, $PM_{10-2.5}$, $PM_{2.5}$, speciated $PM_{2.5}$, trace-level carbon monoxide (CO), trace-level oxides of nitrogen (NO_y/NO/NO_y-NO/NO_2), ozone (O_3), trace-level sulfur dioxide (SO_2), area-wide NO_2, and Photochemical Assessment Monitoring Station parameter including hourly-VOC and enhanced meteorological parameters. In addition, an Interagency Monitoring of Protected Visual Environments (IMPROVE) sampler is also being operated at this site.

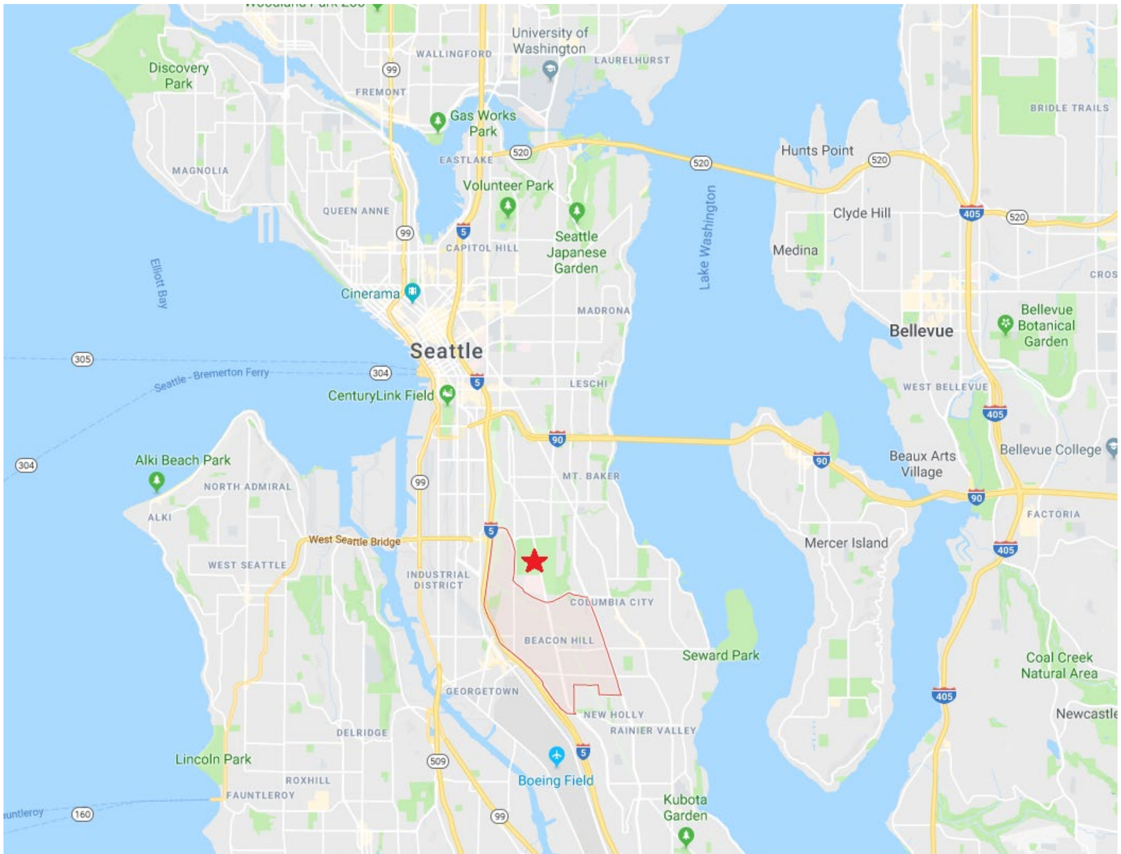

Figure 2: Seattle Beacon Hill (outlined) and monitoring location (starred).

Figure 3: Satellite view of Seattle Beacon Hill's location.

2.2. Sampling Methods

2.2.1. Sample Collection and Preparation

NATTS requires all four pollutant classes to be determined in appropriate concentrations ($\mu g/m^3$or ppbv) using the following EPA Compendium Methods:

- TO-15A: Volatile organic compounds (VOCs)
- TO-11A: Carbonyls
- TO-13A/ASTM D6209: Polycyclic aromatic hydrocarbons (PAHs)
- IO-3.5: PM_{10} metals

Refer to Table 3 for the list of HAPs that will be collected.

The sampling frequency for VOCs, carbonyls, PAHs and PM_{10} metals is once every 6 days for a 24-hour duration beginning and ending at midnight in local standard time. This will yield about 61 sampling days per year for determination of the air toxic compounds. In addition, there will be about 6 duplicate sampling days for VOCs, carbonyls and PAHs. There will also be a monthly field blank for carbonyls, PAHs, and PM_{10} metals.

For VOCs, carbonyls and PAHs, sample medium preparation involves conditioning and pre-weighing sample filters and cleaning the canisters to minimize sample contamination. ERG's Quality Assurance Project Plan (QAPP) describes these laboratory activities. For PM_{10} sample filters, Pace is responsible for preparing sample filters and shipping the canisters of unexposed filters to NWRO operators. For a detailed description of filter preparation, refer to Pace's Standard Operating Procedure for Gravimetric Analysis of $PM_{2.5}$ Fine Particulate Air Filters, Federal Register, 40 CFR 50, Appendix L, referred as Gravimetric Analysis SOP hereafter.

2.2.2. Sample Installation

Station operators must follow the SOPs for installation, operation, and maintenance for each sampling method. Table 12 summarizes the most current published SOPs involved with the air toxic pollutants monitoring.

Table 12: List of the most current NATTS-related SOPs

Ecology SOP Title	Date	Publication Number
Air Toxics Operating Procedure	June 2025	18-02-012
$PM_{2.5}$ and PM_{10} Met One Instruments E-Sequential Standard Operating Procedure	Published May 2025	25-02-016 v1

2.2.3. Sampling Measurement System & Corrective Actions

Corrective action measures will be taken to ensure data quality objective is attained. Table 13 summarizes a list of common issues found during installation, quality control check and sample retrieval. Note that these issues pertain to Ecology NWRO (field) and Pace (lab) activities. NATTS operator and Pace technician must report to the Quality Assurance Coordinator upon the completion of corrective actions. Procedures of corrective actions on other sample measurement findings should be followed in accordance with the appropriate QAPP and SOPs, namely, those listed in Section 2.2.1 and Table 12.

Table 13: Common problems in measurement system and corrective actions

Item	Problem	Action	Responsible party
Pre/post filter inspection	Pinholes/tears and visual defects	Void sample; document in the analysis report	Laboratory
Flow rates	Flow rate marginal to acceptance limit	Document in the datasheets; flag data	Field operator
PM_{10}, PAH or carbonyl sample flow rate exceeds limit	Leak in sampling train or flow out of calibration	Document in the log book and datasheets; recalibrate; flag data	Field operator
VOC sampler leak test failure	Canister won't hold pressure	Document in the log book and datasheet; inspect connections; flag data	Field operator
Elapsed time > ± 10 min/day or scheduled sample didn't run	Check programming; verify if power outage	Document in the log book and datasheet; reprogram; flag data	Field operator; laboratory

2.3. Sample Handling and Custody

VOC, carbonyl and PAH samples must be collected within three days following sample collection and be shipped from the NWRO to ERG as soon as feasible. PM_{10} samples will first be shipped from NWRO to PACE laboratory for gravimetric analysis and the 1-in-6 samples will be subsequently shipped to ERG for ICP-MS analysis. PM_{10} samples must be analyzed within 180 days after sampling collection. Chain of Custody forms were established to document sample conditions during lab pre-sampling, field installation, field recovery, and upon lab recovery. A sample of the air toxics chain of custody form can be found in Ecology's Air Toxics Operating Procedure for VOCs, carbonyls and PAHs. For PM_{10} filters, Chain of Custody forms for each cooler containing samples as well as electronic Run Data Sheets for each individual sample filter are utilized. Samples of both forms can be found in PACE laboratory's Gravimetric Analysis SOP and Ecology's $PM_{2.5}$ and PM_{10} Sequential Sampler SOP.

2.4. Analytical Methods

Analytical methods used for each suite of air toxics parameters are as followed:

- VOCs: EPA Compendium Method TO-15A.
- Carbonyl compounds: EPA Compendium Method TO-11A.
- PAHs: EPA Compendium Method TO-13A.
- Metals on PM_{10} filters: EPA Compendium Method IO-3.5 via ICP-MS.

All of the QA/QC requirements of the methods specified above shall be followed throughout the sample collection and analysis process of this program. All laboratory analyses will be performed by ERG.

2.5. Field Quality Control (QC) Activities

The quality control procedures specified in EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Volumes II will be utilized to check the quality of the data. Station operators are responsible for documenting the results of quality control (QC) checks on the Air Toxics Quality Control Check Form. An example of the form can be found in Appendix A. Operators must also document a summary of the quality control activities in the electronic station logbook. All field reference standards used to verify or calibrate field samplers must be certified NIST-traceable.

The quality control checks for the laboratory analytical instrumentation will be performed by ERG in accordance with ERG's QAPP. The minimum required frequencies, acceptance limits, and corrective actions associated with the field operations are presented in Table 14 through Table 18.

Table 14: QC checks for VOC sampler

Procedure	**Required Frequency**	**Acceptance Limit**	**Corrective Action**
Leak check	Before every sampling event	Should be close to 0.0 in-Hg (< 0.5 in-Hg)	Identify leak and correct problem, flag data
Time clock	Before every sampling event	± 5 minutes of the reference time	Adjust time clock, note on data sheet
Flow check	Every 30 days	± 10%	Calibrate, flag data
Flow calibration	Initially or if flow exceeds limit	± 10% (one-point) or ± 5% (multi-point)	Calibrate
Pressure gauge check,	Annual	± 0.5 psi of the certified standard.	Adjust gauge
Sampler Certification	Annual	Within certification due date	Send equipment back to ERG for re-certification
Clean/replace tubing to manifold, replace sintered particulate filter	Annual	N/A	N/A

Table 15: QC checks for carbonyl sampler

Procedure	Required Frequency	Acceptance Limit	Corrective Action
Leak check	Before every sampling event	Vendor specific	Identify leak and correct problem, flag data
Time clock	Before every sampling event	± 5 minutes of the reference time	Adjust time clock, note on data sheet
Flow check	Every 30 days	± 10%	Calibrate, flag data
Sampler Certification	Annual	Within certification due date	Send equipment back to ERG for re-certification
Replace ozone denuder	Annual	N/A	N/A
Clean/replace tubing to manifold	Annual	N/A	N/A

Table 16: QC checks for PAH sampler

Procedure	Required Frequency	Acceptance Limit	Corrective Action
Inspect electrical connections, check timers	Weekly	± 5 min (digital timer) and ± 15 min (mechanical timer) of reference time	Adjust time clock, note on data sheet
Flow check	Every 30 days	± 10%	Calibrate, flag data
Flow calibration	Initially, after motor maintenance, or if flow exceeds limit	± 10%	Calibrate
Clean sampling head, inspect gaskets	Every 30 days	N/A	N/A
Siting Verification	Annual	Neighborhood scale siting criteria	Notify Air Monitoring Coordinator if siting no long meets requirements
Calibration orifice certification	Annual	Within certification due date	Send orifice back to vendor for re-certification

Table 17: QC checks for PM_{10} (low volume) sampler

Procedure	Required Frequency	Acceptance Limit	Corrective Action
Leak check	Every 30 days	Leak: <5.1 mmHg pressure loss over 3.4 min	Identify leak and correct problem, note on data sheet
Flow check	Every 30 days	± 4% of the transfer standard or ± 5% of the design flow rate	Calibrate, note on data sheet
Time clock	Every 30 days	± 2 min of the reference time	Adjust time clock, note on data sheet
Temperature check	Every 30 days	< ± 2.1°C	Calibrate, note on data sheet
Pressure check	Every 30 days	< ± 10.1 mmHg	Calibrate, note on data sheet
Flow calibration	Initially or if flow exceeds limit	see flow check	Calibrate, note on data sheet
Temperature and pressure calibration	Initially, then annually	see temperature and pressure checks	Calibrate

Table 18: QC checks for meteorological sensors

Procedure	Required Frequency	Acceptance Limit	Corrective Action
Anemometer alignment	Every 90 days	± 2°	Adjust alignment, note in the QC form*
Temperature check	Every 90 days	± 0.9 °F	Calibrate, note in the QC form*
Pressure check	Every 90 days	± 3 hPa	Calibrate, note in the QC form*
Inspect sensors for integrity and cleanliness	Every 90 days	N/A	Clean as needed

* The QC form refers to the meteorological QC check form, but will not be discussed further in this QAPP.

2.6. Instrument Testing, Inspection, and Maintenance

The Air Monitoring Coordinator is responsible for identifying air monitoring equipment needs and approving equipment purchases. The following protocol is used in procurement of air monitoring equipment:

- Equipment evaluation and selection. Prior to purchase, the equipment's performance will be evaluated and other users queried in regard to the performance, dependability and ease of operation.
- Purchase specifications. The purchase contract will state the performance specifications that insure only equipment of the desired quality is obtained, require a one year warranty, and indicate payment will not be made until the equipment has passed an acceptance test.
- Acceptance Testing. Prior to payment, the equipment will be tested to ensure that it meets the requirements listed in the purchase specifications. For analyzers, the minimum test consists of checking zero drift, span drift, voltage stability, temperature stability, and linearity.

After obtaining the equipment, operators conducts a full initial quality control (QC) checks by performing the following tasks:

- Inspect the integrity of the instruments and spare parts shipped from the manufacturers.
- Verify test functions on the inspection sheet accompanied with the instruments from the manufacturers.
- Perform calibrations as needed, using certified NIST-traceable reference standards.
- Record the initial as-found/as-left QC results and submit to QA Coordinator

Operators are also responsible for preventive and remedial maintenance at the frequencies described in Section 2.5, Ecology's Air Toxics Operating Procedure and in conjunction with the instructions in the instrument manufacturers' manuals. Major maintenance and repair on air toxics sampling equipment is performed by Ecology's Calibration and Repair Laboratory personnel or the equipment manufacturer.

2.7. Instrument Calibration and Frequency

2.7.1. Operational Standards

Instruments used in the field are calibrated at the required frequency described in Ecology's Air Toxics Operating Procedure and summarized in Section 2.6 of this QAPP.

2.7.2. Analytical Equipment

Analytical instruments, including GC/MS for VOCs analysis, HPLC for carbonyls analysis, ICP-MS for metals analysis and GC/MS for PAHs analysis, must meet the minimum calibration frequency and acceptable limit criteria set forth in EPA's NATTS TAD.

Table 19, adopted from EPA's NATTS TAD Table 3.3-1, summarizes the required calibration frequency of each analytical equipment.

Table 19: Required calibration frequency for analytical equipment (EPA NATTS TAD)

Instrument	Required Calibration Frequency
GC/MS for VOCs analysis	• Initially; • Following failed continuing calibration verification (CCV) check; • Following failed bromofluorobenzene (BFB) tuning check; or when • Maintenance performed on the instrument impacts calibration response
HPLC for carbonyls analysis	• Initially; • Following failed continuing calibration verification (CCV) check; or when • Maintenance performed on the instrument impacts calibration response
GC/MS for PAHs analysis	• Initially; • Following failed continuing calibration verification (CCV) check; • Following failed decafluorotriphenylphosphine (DFTPP) tuning check; or when • Maintenance performed on the instrument impacts calibration response
ICP-MS for metals analysis	Each day of analysis

In addition to the required calibrations, the analytical systems must pass calibration verification checks to verify bias are within the acceptable limits as part of the laboratory quality control procedures. ERG have established laboratory standard procedures, as listed below, for each of the analytical instruments to ensure adequate equipment performance at ERG:

- ERG-MOR-005: VOC analysis by GC/FID/MS using Method TO-15A
- ERG-MOR-024: carbonyl analytic by HPLC system using Method TO-11A
- ERG-MOR-049: PAH analysis by GC/MS using Method TO-13A
- ERG-MOR-095: metal analysis by ICP-MS using Method IO-3.5

While ERG is the EPA-contracted laboratory for NATTS sample analysis, it should be noted that the GC/MS systems for VOC and PAH analyses and the HPLC analytical system for carbonyl compounds at ERG are maintained under a contracted service agreement. ERG technician performs minor maintenance activities such as, but not limited to, filament changes and source cleaning on an as-needed basis on the analytical systems following the ERG SOPs.

2.8. Acceptance Requirements for Supplies

Critical supplies needed in data sampling for the NATTS are listed in Section 0. Station operators should order necessary consumables such as fitting and tubing lines as needed following the SOPs listed in Table 12. For critical supplies and consumables used during sample analysis, see ERG's QAPP for detailed descriptions and requirements.

2.9. Data Management

This section addresses data management procedures used in support of the NATTS monitoring program. Section 2.9.1 discusses data management related to operational performance, such as quality control check results and performance evaluations performed by Ecology personnel. Section 2.9.2 describes the general data management processes ERG follows in its QAPP, as ERG performs most of the data validation and analysis, prepares the summary report and archives all data analysis results (raw and processed). Refer to ERG's QAPP for a description of data management.

2.9.1. Field Data Management

Station operators are responsible for completing a monthly Air Toxic Quality Control (QC) Check Form and documenting key operational and maintenance activities in the electronic logbook. Table 20 summarizes the QC activities which operators shall record in the QC check form and electronic logbook.

Table 20: Minimum documentation requirement during field operations

Information	Quality Control Check Form	Electronic Logbook
Station name	Yes	Yes (auto-generated)
Date and time (in PST)	Yes	Yes (auto-generated)
Station AQS ID	Yes	Yes (auto-generated)
Operator name	Yes	Yes
Instrument identification	Yes	Yes
Parameter (VOCs, PAHs or carbonyls)	Yes	Yes
NIST-traceable standards (temperature, pressure, flow rate) used	Yes	No
Ambient conditions (temperature and pressure)	Yes	No
Leak check	Yes	Yes (pass or fail)
Flow rate check	Yes	Yes (pass or fail)
Additional information (e.g. station power outage, lawn mowing observed outside the station, etc.)	Yes	Yes

The QC check form must be submitted to the Air Quality Program QA Coordinator no later than 10 days after the end of the sampling month. QC forms are archived electronically in secured computer network locations with permission-restricted access. The electronic logbook is stored in the password-secured station data logger as well as in Ecology's central data acquisition system (SQL server). Performance evaluations (audits) are conducted by QA personnel on the sampling instruments annually and the results are documented on electronic forms that are stored, archived, and backed-up in the same fashion as the QC check forms.

2.9.2. Laboratory Data Management

ERG provides post-analysis data management and validation of all NATTS parameters, as well as the final data submission to AQS. The ERG QAPP describes the data management operations used for NATTS data, with an overview of the mathematical operations and analyses performed on raw data. These operations are presented in summary below. Data management and data validation are performed using the protocols specified in ERG's QAPP.

- **Date Recording and Retention** – Data entry, validation, and verification functions are all integrated in the ERG Laboratory Information Management System (LIMS) database. The procedures for providing all laboratory notebook information and subsequent data entry are provided in ERG-MOR-039, Procedures for Maintaining Laboratory Notebooks. Raw data sheets are retained on file at ERG for a minimum of five years after the close of the contract, and are readily available for audits and data verification activities. After five years, hardcopy records and computer backup media are disposed.
- **Data Validation** – Data validation is a combination of evaluating the quality of the field operations and of checking data processing operations for compliance with requirements

and protocols. Data validation will identify problems in either of these areas. Once problems are identified, the data will be corrected or invalidated before they can be submitted to EPA's AQS, and corrective actions will be taken for field or laboratory operators. For more information on data validation refer to Section 4.

- **Data Transformation** – Calculations for transforming raw data from measured units to final concentrations use standardized procedures listed in ERG's individual SOPs. All data are double checked to ensure there are no incorrect transformations. In addition, all new spreadsheets go through peer review to ensure that all data submitted are accurate. The peer reviewer uses hand calculations and visual verification to review all data reported to EPA and Ecology are valid. Specific procedures as outlined in ERG-MOR-057, and separate SOPs for Developing, Documenting, and Evaluating the Accuracy of Spreadsheet Data are presented in ERG-MOR-017.
- **Data Reduction and Summary** – Data reduction processes involve aggregating and summarizing results so that they can be understood and interpreted in different ways. Examples of data summaries include average concentration; accuracy, bias, and precision statistics; and data completeness reports based on numbers of valid samples collected during a specified period.
- **Data Transmittal and Reporting** – 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 onto a data entry form for keying into a computer file and electronic transfer of data over a computer network. Each individual SOP listed in ERG's QAPP Appendix C discusses the procedures for determining the calculations of concentrations as well as data entry. ERG reports all ambient air quality data and information to EPA's AQS database. Such air quality data and information are fully screened, validated and submitted directly to the AQS via electronic transmission, in the format of the AQS and in accordance with the annual schedule. ERG submits the resulting data and associated quality assurance information to the AQS no later than 120 days following the end of each calendar quarter. ERG submits data as is, including values below the calculated MDL.
- **Data Tracking** – The ERG LIMS database contains the necessary input functions and reports appropriate to track and account for the whereabouts of specific samples during processing operations. When the laboratory initially receives the unexposed samples from vendors, sample information is recorded in the database, including sample receipt (by work order), canister number (VOC only) and filter package (filter numbers in each package are recorded) for the laboratory. When the samples are delivered back to the laboratory for data analysis, the package is inspected for integrity and the receipt and contents logged. Storage locations for each sample are also recorded, i.e., carbonyl tubes, XAD resin, and PUF are stored in separate refrigerators, metal filters are stored in the ICP-MS laboratory, and canisters are stored in the Air Toxics Laboratory.
- **Data Storage and Retrieval** – ERG's QAPP includes a thorough list of data archival policies and procedures of data storage and retrieval. All data will be stored on the ERG LIMS server. Security of the data in the database is ensured by password protection on the database and network, regular password change, logging of all incoming communication sessions, and storage of media in locked, restricted access areas.

3. Assessment and Oversight

3.1. Assessment and Response Actions

An assessment is as an evaluation process used to measure the performance or effectiveness of the quality system, the establishment of the monitoring network and sites, and various measurement phases of the data operation. The following assessments are implemented for this project plan by Ecology, ERG, or EPA to evaluate potential impacts on measurement data and network representativeness.

3.1.1. Ecology Performance Evaluations

Ecology's QA personnel conduct performance evaluations (audits) annually on all sampling instruments in the NATTS program. Shelter conditions are also assessed during audits to ensure conformance of siting and measurement requirements. Auditors complete an audit result form and provide the completed form containing the audits results to the station operator(s) and alert the operator of any major findings (e.g. flow rate failure) or concerns regarding the operation system that might impact data quality. The audit result forms are stored and archived electronically in secured computer network folders with permission-restricted access.

3.1.2. Network Assessment

As the NATTS program aims to establish a comprehensive air toxic network across the nation, monitoring stations were carefully selected for collecting long term trends data. EPA conducts periodic review and assessment of the NATTS network to ensure that the data it provides meets the goals and objectives of the NATTS program, and to determine how it should be modified to improve network coverage and quality. EPA conducted its most recent (3rd) NATTS network assessment in 2021 and is in the final stages of the 4^{th} network assessment.

3.1.3. Technical Systems Audit (TSA)

A Technical System Assessment or Audit (TSA) is a systematic on-site qualitative audit, where facilities, equipment, personnel, training, procedures, and record keeping are examined for conformance to the QAPP and SOPs. EPA Region 10 implements the TSA either as a team or as an individual auditor every three years, though the NATTS program is not audited during the every third year TSAs. The most recent TSA of the NATTS program at Seattle-Beacon Hill occurred in April 2024. TSAs are typically focused on field (handling, sampling, and shipping), laboratory (handling, shipping, receiving, weighing, reporting, archiving, and associated QA/QC) and data management (information collection, flagging, and security). Instrument Performance Audits (IPAs) on sampling instruments at selected sites may also be conducted by the audit team as part of the TSA activities.

During a TSA of the NATTS program, key personnel with responsibilities related to the NATTS monitoring activities are interviewed. The audit team prepares a written summary report of findings, concerns and observations in order of their potential impact on data quality and provides recommendations on the specific areas of concerns.

If Ecology has written comments or questions concerning the audit report, the EPA audit team reviews and incorporates them as appropriate, and subsequently prepares and resubmits a report in final form within thirty (30) days of receipt of the written comments. When a final report is produced, it typically includes an agreed-upon schedule for corrective action implementation.

3.2. Reports to Management

Station operators submit monthly QC check forms to the Air Quality Program QA Coordinator as part of the routine QC operation activities. Following an audit, QA staff provides the station operator, Air Monitoring Coordinator, and QA Coordinator with an electronic copy of the audit results via email. In addition, Ecology station operators and QA staff should report to their direct supervisor whenever they observe major issues that may compromise data quality during their operational or quality assurance activities. Corrective actions should be recommended and implemented to prevent monitoring data from further deviating beyond acceptable uncertainties.

Ecology is required to meet the 85% minimum data recovery requirement defined by EPA as a grant condition for federal NATTS funding. Ecology reports to EPA annually whether the 85% data recovery requirement was met for the prior year and, if it was not met, provides a reason why each monitor did not meet this requirement.

ERG laboratory prepares and submits an annual Air Toxics Report to EPA that describes data quality information and assessment for each air toxic pollutant monitored in the network. The annual report documents the statistical analysis, audits that were performed during the study period, quality for the measurement data, and how the objectives for the program were met.

4. Data Validation and Usability

4.1. Data Verification and Validation

The responsibility for data verification and validation is shared among individuals in organizations listed in this project. Verification is defined as confirmation, through provision of objective evidence, that specified requirements have been fulfilled. Validation is defined as confirmation, through provision of objective evidence, that the particular requirements for a specific *intended use* are fulfilled. Both involve a thorough process of data review.
Upon retrieving exposed samples, the NATTS operator performs a preliminary screening of field sampling information and verifies the integrity of the collected samples and instrument responses. As the national contract laboratory for the NATTS program, ERG receives the samples and performs data verification and validation based on the EPA Compendium Method for individual analytes. Four categories (critical, MQO, operational and practical) are assigned to each parameter in order of decreasing impact on collected data. See ERG's QAPP or EPA's NATTS TAD Section 7 for the validation tables of individual Compendium Methods.

After the data validation, ERG prepares data analysis reports and Quality Control (QC) data and sends them electronically to the NATTS operator and Ecology's QA Coordinator, Ecology's NATTS Coordinator, as well as the EPA Region 10 QA Coordinator and the EPA NATTS project manager. A QC report consisting of laboratory control charts is also provided electronically to the individuals mentioned above on a quarterly basis per EPA's contract with ERG. Ecology's QA personnel performs a secondary review on the data analysis report and laboratory QC data received from ERG, as well as the QC check results from the station operator.

4.2. Verification and Validation Methods

At the time of sample retrieval, the NATTS operator conducts an initial data screening to verify the instrument is calibrated and the sampling system is within the acceptable limits based on field quality control criteria described in Section 2.5. Note that these criteria were extracted from the EPA Compendium Methods for each sampled pollutant class in NATTS TAD Tables 7.1–7.4. The NATTS operator documents operational observations on the QC check forms and the chain of custody forms (COC). The COC is submitted to ERG along with the samples.

ERG performs a series of data verifications and validation after receiving the sample batch. The following paragraphs summarize the process ERG conducts to ensure that the data collected and analyzed comply with the Compendium Methods before submitting the data to EPA's AQS.

After a reporting batch is completed, a thorough review of the raw data is conducted for completeness and manual and electronic data entry accuracy. For the chromatographic 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 are reviewed for outliers and compliance with acceptance criteria. Outliers and data not meeting acceptance criteria are flagged accordingly. All flagged data will be verified to ensure that the values are entered correctly. Records of invalid data will include a brief summary of why the sample was invalidated along with the associated flags.

During the laboratorial analysis, the laboratory analyst performs sample inspection and may invalidate a sample or measurement based on the EPA Compendium Methods and weight of evidence as appropriate. COC are also be examined for possible problems. Filters flagged for obvious contamination, damage, or field accidents are examined immediately. Final data validation is performed during data analysis by ERG using software developed to perform statistical tests to understand the characteristics of the data set, such as tests for linearity, slope, intercept or correlation coefficient.

4.3. Reconciliation with Data Quality Objective

The air toxics monitoring data collected in this project is reconciled with one single Data Quality Objective (DQO) for the NATTS Program, as stated in Section 1.6.1:

> **To be able to detect a 15% difference between two successive 3-year annual mean concentrations (rolling averages) within acceptable levels of decision error.**

The Data Quality Assessment (DQA) developed by EPA is used to determine whether the monitors and laboratory analyses are producing data that comply with such stated goals. It is thoroughly described in EPA's Guidance for Data Quality Assessment (QA/G-9, July 2000). The DQA process follows statistical routines and consists of the following five steps:

1. Review the DQOs and sampling design;
2. Conduct qualitative data review;
3. Select the statistical test;
4. Verify the assumptions of the statistical test
5. Draw conclusions and formulate action plans

OAQPS performs the Data Quality Assessment on the collected data in the NATTS Program from a national perspective. Therefore, Ecology relies on OAQPS to perform the quality assessment of NATTS at Seattle-Beacon Hill. A significant decrease (15% or more) between two successive three-year annual mean concentration levels suggests the identification of successful reduction strategies. Recommendations may be provided to ensure continuous data collection with adequate data quality. On the other hand, an insignificant decrease (decreases of less than 15%) or increase warrants a thorough review of the network design and its effectiveness. It should be aimed for air toxics monitoring network improvement in order to achieve the DQO during the next round of evaluation. As the PQAO of the NATTS Program in Washington State, Ecology relies on OAQPS to provide clear corrective measures and recommendations to be practically implemented in its air toxic monitoring network.

References

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Appendix: QC/QA Sample Forms

Washington State Department of Ecology
VOC Sampler Quality Control Check Form

Revised 011620

AQS ID	53-033-0080	Date	
Location	Seattle-Beacon Hill	Operator	
QC Start Time	PST	QC Stop Time	PST
Sampler Model No. (Primary)		Primary Tag #	
Sampler Model No. (Duplicate)		Duplicate Tag #	
Sintered filter changed (Primary)			
Sintered filter changed (Duplicate)			

Standards	
Temperature	
Manufacturer	
Model and Serial No.	
Certification Date	
Pressure	
Manufacturer	
Model and Serial No.	
Certification Date	
Flow	
Manufacturer	
Model and Serial No.	
Certification Date	

Site Conditions			
Room Temperature (°C)		Barometric Pressure	mm Hg
Room Temperature (K)		Primary Box Temp	°C
		Duplicate Box Temp	°C

Leak Check Test	
Primary	
Duplicate	

Flow Check - Optional

Sampler	Actual Flow (ccm)	Indicated Flow (sccm)	% Diff
Primary			%
Duplicate			%

*Flow check passes if % difference is within 20%

Comments:

QC Result:

Figure 4: QC check form for VOC sampler

Revised 060321

AQS ID	53-033-0080	Date	
Location	Seattle-Beacon Hill	Operator	
Primary Tag #		QC Start Time	PST
Sampler Model No.		QC Stop Time	PST
KI Denuder Change Date			

Standards	
Temperature	
Manufacturer	
Model and Serial No.	
Certification Date	
Pressure	
Manufacturer	
Model and Serial No.	
Certification Date	
Flow	
Manufacturer	
Model and Serial No.	
Certification Date	

Clock Verification	
Sampler time	
Reference time	
Sampler time adjusted?	

Site Conditions	
Room Temperature	°C
Barometric Pressure	mm Hg

Leak Check Test	
Channel 1	
Channel 2	
Channel 3	

Flow Check

Channel	Actual Flow (ccm)	Indicated Flow (ccm)	% Diff
1			%
2			%
3			%

*Flow check passes if % difference is within 10%

Comments:

Figure 5: QC check form for carbonyl sampler

Washington State Department of Ecology
PAH Sampler Quality Control Check Form

Revised 01 16 20

AQS ID	53-033-0080	Date	
Location	Seattle-Beacon Hill	Operator	
Sampler ID		QC Start Time	PST
Sampler Model No.	Tisch TE-1000 PUF	QC Stop Time	PST
Flow Std. (Orifice) Mfg.	Tisch	Primary or Collocated	Primary
Orifice ID		Orifice Cert. Date	
Orifice Slope (m)		Orifice Intercept (b)	
Sampler Slope (m)		Sampler Intercept (b)	

Ambient Temperature (°C)	
Ambient Temperature (K)	
Barometric Pressure (mm Hg)	

Flow Check	
ΔH_2O	Magnehelic Reading

Calculated Flow		
Actual (m^3/min)	Indicated (m^3/min)	%Difference

*Flow check passes if % difference is within 10%

Comments:

QC Result:

Figure 6: QC check form for PAH sampler

Washington State Department of Ecology Toxics Instrument Performance Evaluation

Revised 011620

AQS ID		Date	
Location		Auditor	
Audit Start Time	PST	Audit Stop Time	PST
Sampler Model No.		Primary Tag #	
Transfer Std. Manf.		Co-located Tag #	
Orifice/Cell No.		Certification Due Date	
Orifice Slope (m)		Orifice Intercept (b)	

Temperature and Pressure

Temperature Device		Pressure Device	
Manufacturer		Manufacturer	
Model and Serial No.		Model and Serial No.	
Certification Date		Certification Date	

Ambient Temperature (Ta)	°C	Barometric Pressure (Pa)	mm/Hg
Ambient Temperature Kelvin		Primary Box Temp	°C
KI Denuder installed/intact? (only applies to Carbonyls)		Co-located Box Temp	°C

Leak Check Test

Channel A (Primary)	Pass/Fail:	Δ Press.	
Channel B (Co-loc.)	Pass/Fail:	Δ Press.	

Channel/Sampler	Audit Flow Actual (sccm)	Indicated Flow (sccm)	% Difference
Channel A (Primary)			%
Channel B (Co-loc.)			%

Flow Rate Difference Acceptance Criteria	
Xontech 901/910PC VOC	±10 %
Xontech 925 Carbonyl	±10 %

Comments:

Audit Result:

Figure 7: Audit form for VOC and carbonyl samplers

Washington State Department of Ecology
Toxic PUF Sampler Performance Evaluation Results

Revised 03122020

AQS ID		Date	
Location		Auditor	
Audit Start Time	PST	Audit Stop Time	PST
Sampler Model No.		Sampler Serial No.	
Transfer Std. Manf.	Tisch	Primary or Collocated	
Orifice/Cell No.	TE-5040A/SN 0391	Certification Date	4/23/2019
Orifice Slope (m)	9.54151	Orifice Intercept (b)	-0.03801
Act. Ambient Temp.	K	Act. Barometric Pres.	Atms

Temperature and Pressure Audit

Temperature Audit Device		Pressure Audit Device	
Manufacturer		Manufacturer	
Model and Serial No.		Model and Serial No.	
Certification Date		Certification Date	

Ambient Temperature	Act:	°C	Filter Temperature	Act:	°C

Barometric Pressure	Act:	mm/Hg

Flow Audit

ΔH_2O	Magnehelic Reading

Calculated Audit Flow (L/min) (Actual)	Sampler Response (L/min) (Indicated) (±10%)

External Leak Check (<25 mmHg)	Internal Leak Check (<140 mmHg)
Pass/Fail:	Pass or Fail:

Acceptance Criteria

Sampler Flow
Percent Difference ______ ±10%

Comments:

Audit Result:

Figure 8: Audit form for PAH sampler

Met One E-Sequential Performance Audit Form

AQS No.		Date	
Location		Auditor	
Sampler Model No.	PM10 E-Sequential	Audit Start Time	PST
Sampler Serial No.		Audit Stop Time	PST
State Tag No.			

Performance Evaluation Results

Reference Standards

	Serial Number	Model	Certification Due
Flow			
Temperature			
Pressure			

As-Found Leak Check

Flow		mmHg
Pass/Fail		

As-Left Leak Check

Flow		mmHg
Pass/Fail		

Temperature

Actual		°C
Indicated		°C
Diff (±2ºC)		°C

Pressure

Actual		mmHg
Indicated		mmHg
Diff (±10mmHg)		mmHg

Filter Temperature

Actual		°C
Indicated		°C
Diff (±2ºC)		°C

Diagnostic Checks

Inlet head clean?	
±1 min of logger?	
E-Seq software version	

Flow Audit

	Flow Rate (LPM)		% Diff (±4%)
	Actual	Indicated	
Flow (16.7 LPM)			
Design Flow Difference (±5%)			

Audit Result:

Comments:

Revised 8/11/2024

Figure 9: Audit form for the MetOne Instruments E-Sequential FRM Sampler