A1 – Title Page

Quality Assurance Project Plan

for

Upper Ohio River Valley Monitoring Project

Post-EPA Feedback Date of QAPP Preparation: 1/17/25

<u>Breathe Project, a Program of the Community Foundation for the Alleghenies</u>

<u>Energy Innovation Center</u>

[redacted]

Period of Applicability: September 1, 2023 -- October 1, 2026

Grant or Cooperative agreement [redacted]

EPA Organization Sponsoring the Work: US EPA Mid-Atlantic Region

A2 – Approval Page

Role	Signature: Name & Title	Date
Program Manager/PI	[redacted] ____________________ [redacted] Program Manager/PI	Feb 24, 2025
Project Operations Manager	[redacted] ____________________ [redacted] Project Manager Upper Ohio River Valley Monitoring Project	Feb 24, 2025
Project QA Manager	[redacted] _________________________ [redacted] Clean Air Task Force Project Quality Assurance Manager	Feb 24, 2025
EPA Project Officer (PO)	[redacted] ____________________ [redacted] Environmental Protection Agency Project Officer	Mar 12, 2025
EPA Delegated Approving Official (DAO)	[redacted] _____________________ [redacted] Environmental Protection Agency EPA Regional QA Approving Officer	Mar 11, 2025

A3 – Table of Contents, Document Format, and Document Control

Table of Contents

List of Acronyms

The following table provides definitions for terms relevant to this document.

Term	Definition
COC	Chain of Custody
DQO	Data Quality Objective
ED	Executive Director
EHP	Environmental Health Project
EJ	Environmental Justice
ESDR	Environmental Sensor Data Repository
HAP	Hazardous Air Pollutant
PT	Project Technician
PID	Photoionization Detector
PJM	Project Manager
PM	Program Manager
$PM_{2.5}$	Particulate Matter (2.5 micrometers or less in diameter)
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QM	Quality Manager
QMP	Quality Management Plan
SOP	Standard Operating Procedures
UORV	Upper Ohio River Valley
VOC	Volatile Organic Compound

Statement of Commitment to Quality Assurance and Quality Control

This Quality Assurance Project Plan (QAPP) was developed for the *Upper Ohio River Valley Monitoring Project*. We utilized the EPA Guidance for Quality Assurance Project Plans, EPA Guidance for Choosing a Sampling Design of Environmental Data Collection, the Breathe Project's Quality Management Plan (QMP), and insights gained from trainings delivered by the EPA to develop this QAPP. Data quality is important for all who work on monitoring and data collection projects in order to assess and infer meaning from air monitoring and sampling results. This QAPP seeks to ensure the collection and management of quality data that will effectively meet project goals. The Quality Assurance Manager (QAM) and Project Manager (PJM) for this project will oversee and follow quality assurance procedures detailed in this QAPP to ensure data quality standards are met. They will be given authority over the quality assurance process for this project and provided the resources necessary to effectively conduct this work. The organizations listed in this QAPP are committed to quality management principles and practices in the planning, implementation, and assessment of environmental information operations (EIOs).

A4 – Project Purpose, Problem Definition, and Background

Title of Document	**Date**
Monitoring Chronic and Acute Pollution in the Upper Ohio River Valley (UORV)	9/11/24

The recent buildout of a new petrochemical plant in Beaver County, PA has raised concerns among residents living in the Upper Ohio River Valley about the impact of increased levels of volatile organic compounds (VOCs), hazardous air pollutants (HAPs) and particulate matter on their health. This region has long struggled with poor air quality and increased rates of cancer due to the large industrial presence and its unique topography, which makes it prone to weather inversions that trap pollution close to the ground (University of Pittsburgh Center for Healthy Environments and Communities, 2013). Since beginning operations in 2022, the Pennsylvania Department of Environmental Protection (PA DEP) has issued 15 notices of violation to the newest petrochemical plant due to exceeding state limits for VOCs, nitrogen oxides, and carbon monoxide, as well as violating limits on flaring unwanted gasses (Hurdle, 2023). The plant has also submitted over 75 malfunction reports to the PA DEP since January 2022. It is critical to provide the community with the tools they need to document the impact that the newest contributor has on air quality and health outcomes in the region.

The overall objective of this project is to engage environmental justice community members in the Upper Ohio River Valley in Southwestern PA, who are impacted by ongoing, chronic pollution and acute, episodic polluting events from the regional petrochemical buildout, in community air monitoring activities. By providing residents with real-time information about the quality of their air, they will be empowered to take action to protect themselves and their communities. Our project will utilize several air sampling methods to assess the levels and impact of episodic and chronic emissions in communities neighboring the petrochemical plant, with an emphasis on volatile organic compounds (VOCs) and fine particulate matter ($PM_{2.5}$).

The first component of the project is continuous air monitoring of outdoor $PM_{2.5}$. To conduct continuous $PM_{2.5}$ monitoring, we will install low-cost PurpleAir sensors outside of homes and community spaces to help residents identify patterns and baseline levels of pollution in their region. We aim to install 100 PurpleAir sensors across towns affected by pollution from petrochemical buildout to ensure that we have consistent data on where and when $PM_{2.5}$ levels are highest. We will work closely with community partners to identify PurpleAir hosts located in the target region and will regularly share data from the sensors with community members.

The second component of the project is collecting air samples to quantify and speciate VOCs detected in the air around the petrochemical plants in the region. The primary goal of collecting samples is to provide residents with information on VOC levels when $PM_{2.5}$ levels are particularly high or when concerns about air quality are elevated due to sensory experiences. The secondary goal of sampling is to collect background samples in close proximity to industrial sites to understand the VOC makeup close to pollution sources in the region.

We will use several methods to gather information on VOC levels, which are outlined in further detail in section A5. We will use a combination of the following devices to achieve our goals: a photo-ionization detector (PID) to quantify total VOC's, SUMMA canisters and Tedlar bags for VOC speciation, colorimetric gas detection tubes for real-time information on VOCs during periods with extremely high tVOC counts, and sorbent tubes situated close to PurpleAir sensors to gain a better understanding of the capabilities of PurpleAir tVOC sensors. We are paying particular attention to concentrations of benzene, 1,3-butadiene, n-hexane and formaldehyde because these were identified by one of the major polluters in the region as Chemicals of Potential Concern.

Questions this project will attempt to answer with the monitoring and sampling technology chosen:

PurpleAir Monitors	What trends do local $PM_{2.5}$ levels follow? What factors appear to influence $PM_{2.5}$ levels in the area and do we see localized impacts of facilities of concern?
PID	What is the total VOC level when $PM_{2.5}$ levels are high or community concerns are elevated?
SUMMA Canister/Tedlar Bag and Bucket Sampling	What is the composition (per TO-15 report) of VOCs during periods when community concerns are elevated, $PM_{2.5}$ levels are high, or on a regular day when there doesn't appear to be any episodic pollution event?
Sorbent Tubes	What are the levels of VOCs of concern at homes where PurpleAir sensors are running and how do those levels relate to tVOC counts from PurpleAir sensors?
Colorimetric Gas Detection Tubes	During periods when tVOC is abnormally high, are VOCs of potential concern (formaldehyde, 1,3-butadiene, benzene, and hydrocarbons) found in higher concentration in project geographic area?

Regulatory Program	CFR Section	Description
Clean Air Act	40 CFR Part 50 Sect. 50.7	National primary and secondary ambient air quality standards for $PM_{2.5}$.

Environmental Information Generated from Project	Linkage to Environmental Decisions and Possible Actions

$PM_{2.5}$ and VOC pollution at hyper-local resolution in near real-time in and around the Upper Ohio River Valley. Samples will quantify the concentrations of various pollutants found during episodic events.	The information from continuous monitoring will help the community better understand air quality in the region and make informed decisions based on information accessed through the sensors. Information from episodic sampling will help residents understand which VOCs are in the air and at what concentrations.

Form and Standard

We will assess the data we receive from continuous PurpleAir monitors according to the level and form recommended by the EPA in this table and in this standard. We are focused on understanding whether $PM_{2.5}$ reaches an annual mean averaged over three years of 9 µg/m³ or a 24-hour mean of 35 µg/m³ averaged over three years because these are the National Ambient Air Quality Standards (NAAQS) set by the EPA.

For HAPs, we will utilize the California Office of Environmental Health Hazard Assessment guidelines for reference exposure levels (RELs) as a standard for understanding concentrations of HAPs in the region. We are most interested in RELs for *acute* exposure to HAPs because we are collecting episodic data that will indicate VOC levels at a specific point in time, not over a long period. The table below shows the acute RELs for four of the HAPs we are most interested in understanding. It is important to note however that laboratory analysis will provide information on several HAPs and VOCs not listed here. The exposure averaging time for acute RELs is one hour. The laboratories conducting our analysis will report concentrations in both ppbv and µg/m³. By referencing these standards, we are not drawing conclusions regarding risk associated with exposure to any of them. We are using these numbers as references to interpret the data we receive from the laboratory, not to make recommendations regarding exposure.

Table 1: Chemicals of Concern Units, Averaging Time, and Minimal Risk Levels

Chemical of Concern	Reference Exposure Levels (REL)	Reference Exposure Levels (REL)	Source
	(µg/m³)	(ppm)	
Benzene	27	0.008	CA OEHHA
Formaldehyde	55	0.045	CA OEHHA
n-Hexane	7000*	1.99	CA OEHHA
1,3-butadiene	660	0.298	CA OEHHA

*The CA REL only has levels for chronic exposure.

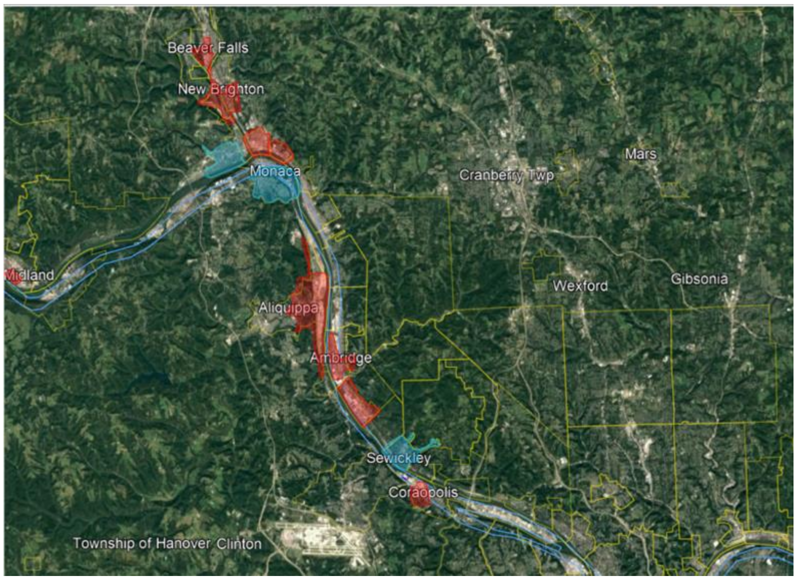

Figure 1: Map of Project Area

A5 – Project Task Description

Project Study Area

This study focuses on communities in southwestern PA: Ambridge, Aliquippa, Beaver Falls, Coraopolis, East Rochester, Freedom, Leetsdale, Midland, New Brighton, Rochester, and adjacent communities of Beaver, Monaca, and Sewickley. These communities are located/situated in Beaver and Allegheny Counties in Southwestern Pennsylvania in the following zip codes: 15003, 15001, 15010, 15108, 15074, 15042, 15003, 15056, 15052, 15059, 15066, 15074, 15009, 15061, and 15143. These communities are highlighted in the following graphic, with red zones corresponding to Environmental Justice communities with high levels of asthma. Appendix 1 shows the community reports developed using EPA's EJ Screen 1.0 tool. These were used to create the table below, which shows the elevated $PM_{2.5}$ and ozone levels, as well as elevated cancer risk in the target communities.

Table 2: EJ indices for communities included in project area

Community	ZIP Code(s)	Population	PA EJ Index PM 2.5 (%ile)	PA EJ Index Ozone (%ile)	PA EJ Index Cancer Risk (%ile)
Ambridge	15003	9004	79	79	79
Aliquippa	15001	6707	85	85	85
Beaver	15009	4334	43	43	42
Beaver Falls	15010	8464	79	79	80
Coraopolis	15108	5488	76	76	75
East Rochester	15074	472	72	72	72
Freedom	15042	1532	73	73	73
Leetsdale	15056	1189	61	62	60
Midland	15059	2918	76	76	76

Monaca	15061	5521	42	42	41
New Brighton	15066	5761	75	75	75
Rochester	15074	3501	77	77	77
Sewickley	15143	3829	39	40	39

Project Activities: Continuous Monitoring, Discrete Sampling, and Data Analysis and Reporting

The project has been divided into two major categories of activities: continuous air quality monitoring and discrete sampling of air in the region. Both of these components will involve community engagement, data collection, data analysis, and data sharing to ensure affected residents are included in the process of air sampling and monitoring. While both activities will occur simultaneously, we will make strategic decisions about when to conduct discrete sampling whereas continuous monitoring will occur throughout the study period across the region.

The proposed timeline is to install 100 PurpleAir sensors throughout the course of the first year of the study and then to conduct discrete sampling on a monthly basis throughout the study period. After the first year, we will focus on data analysis for continuous monitoring to answer the questions proposed above while continuing to conduct discrete sampling as needed and continuing to collect continuous data.

Continuous Monitoring

Purple Air Monitors

Continuous monitoring of $PM_{2.5}$ will occur throughout the study period with a total of 100 PurpleAir monitors installed in homes across the communities identified above. We plan to install 8-10 sensors each month starting in fall 2024 so that all 100 sensors are installed by October 2025. Sensors will run throughout the study period. We will strategically place sensors in areas where there are gaps in air quality monitoring. Information on the criteria for placement of a sensor can be found in Section B2 of this document.

Discrete Sampling

The primary goal of conducting discrete sampling is to respond to community concerns or elevated $PM_{2.5}$ levels by determining which VOCs are in the air and providing residents with that information. We will determine VOC concentration and speciation by collecting air samples when either the community or monitor readings indicate an increase in VOCs or $PM_{2.5}$. The following discrete sampling methods will be used: SUMMA canisters, Tedlar bags, sorbent tubes, and colorimetric gas detection tubes.

We will use both SUMMA canisters and Tedlar bags as collection methods because the laboratory we're working with has indicated that we can only have an unused SUMMA canister in our possession for two weeks at a time. This means there is a chance an episodic polluting event will occur when we do not have a SUMMA canister in our possession. In those instances, we would use a Tedlar bag to collect the sample instead. Having multiple methods for collecting samples allows us to achieve our primary goal of responding quickly to community concerns and providing residents with information. We recognize that the results received through these two collection methods will not be directly comparable because of the different collection intervals and will make note of that when interpreting and sharing results from each method. Figure 2a below shows the process we will follow when deciding whether to collect a discrete air sample. Figure 2b shows the process we will follow when deciding which method to use to collect the sample. These decision trees can also be found in Appendix 23.

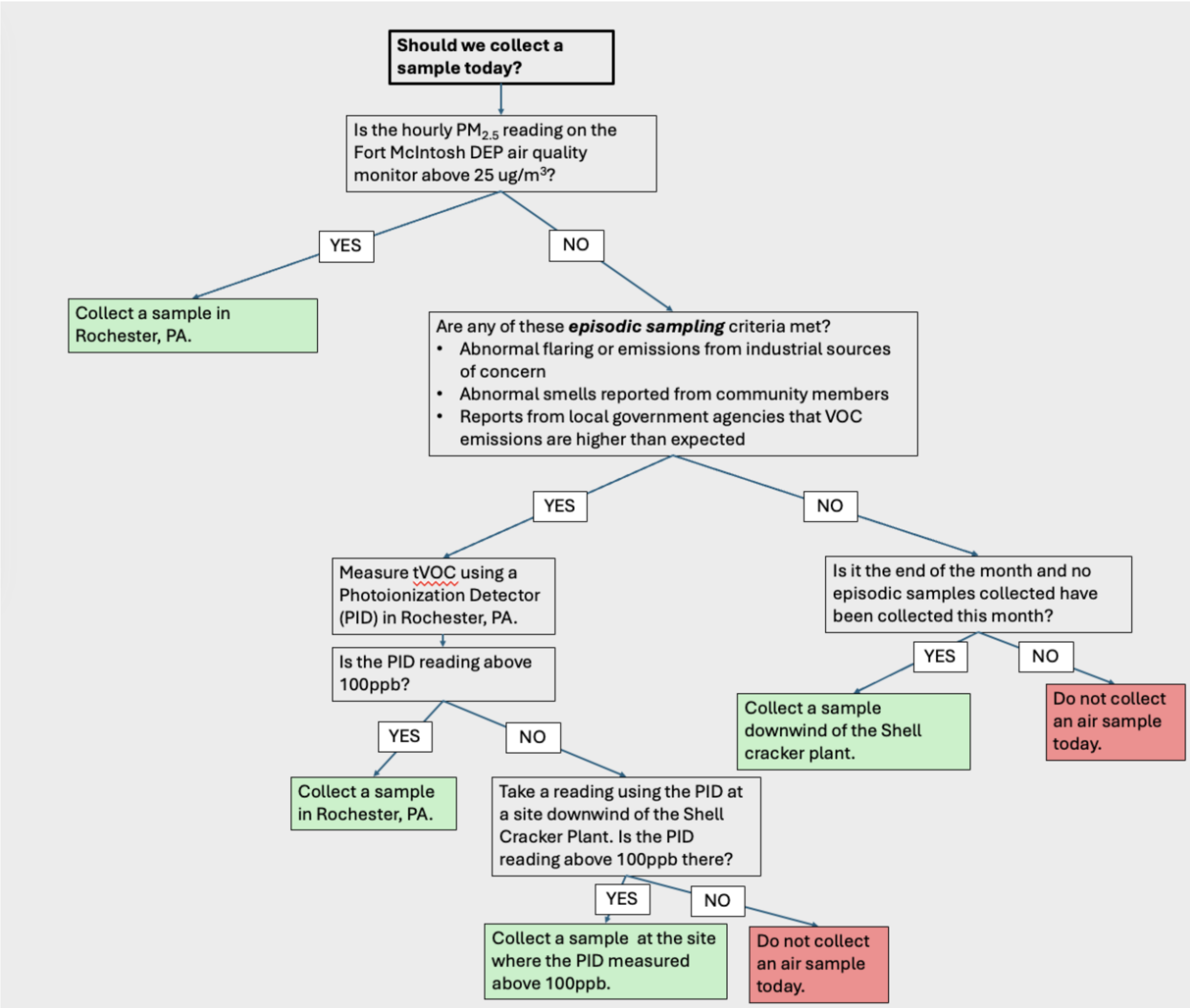

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Figure 2a: Decision tree for when to collect episodic samples

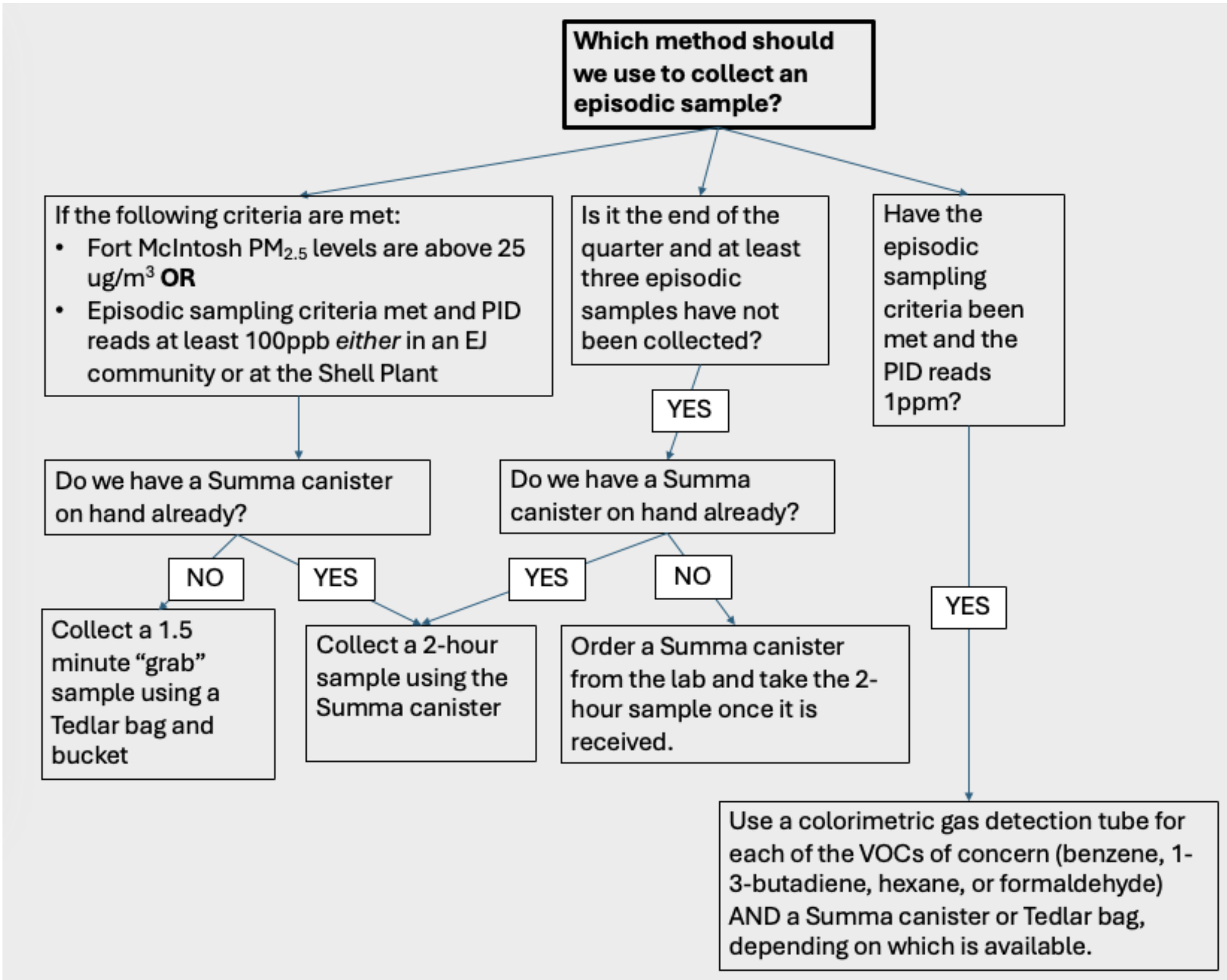


Figure 2b: Decision tree for which method to use in episodic sample collection

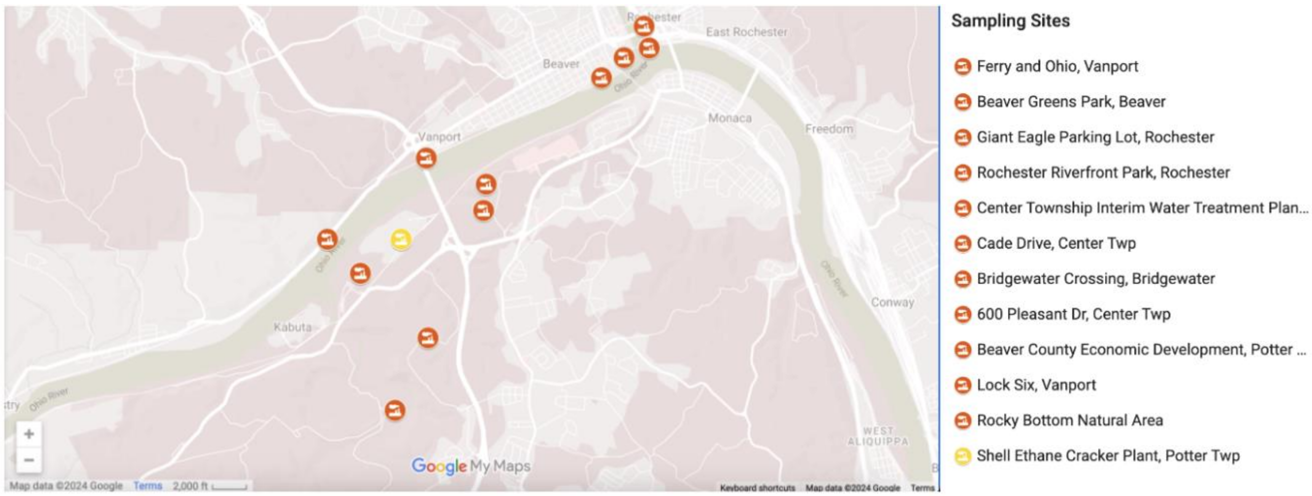


Figure 3: Map of Sampling Locations

Sampling Locations

Figure 3 shows the potential sampling locations once we've made the decision to collect either an episodic or background sample. We will decide which location to collect an episodic and background sample from based on the prevailing wind conditions at the time and site accessibility. These locations were chosen because of their proximity to one of the largest polluters in the region and their proximity to EJ communities. We plan to collect background samples at sites where we have already collected an episodic sample to compare background readings to those taken in response to smell reports or elevated $PM_{2.5}$ levels. These sites are only used for episodic sampling. The Purple Air sensors will be installed across the study area at homes and community spaces of individuals willing to host them.

Sorbent Tubes

In addition to collecting samples in response to episodic polluting events across the study region, we plan to install two pre-conditioned stainless steel sorbent tubes at one house in the region three times a year for two weeks each time. Sorbent tubes could be placed at any of the locations already hosting a Purple Air monitor in the study area outlined in Figure 1. We plan to place sorbent tubes during the fall, spring, and summer each year to capture VOC levels at different points throughout the year. This means we will have data from six sorbent tubes each year.

A6 – Information/Data Quality Objectives and Performance/ Acceptance Criteria

We intend to use this project to inform the public about air quality conditions in the Upper Ohio River Valley, and to increase transparency about possible emissions of concern detected through this exploratory research. The design of the project reflects that exploratory work, and the quality objectives explained in this section are based on this. The approach we've decided to take involves continuous

$PM_{2.5}$ monitoring and discrete sampling to detect and speciate VOCs associated with industrial emissions.

Overall data quality objectives (DQOs) for this project can be defined in terms of the following data quality indicators defined in the EPA Handbook for Citizen Science Quality Assurance and Documentation:

- **Accuracy** is a degree of confidence in a measurement. The smaller the difference between the measurement of a parameter and its "true" or expected value, the more accurate the measurement. Also, the more precise or reproducible the result, the more reliable or accurate the result. Accuracy can be determined by comparing an analysis of a chemical standard to its actual value.
- **Precision** is the ability of a measurement to consistently be reproduced. Repeated measurements are usually used to determine precision. In the case of repeated measurements, one would see how close those measurements agree. Precision is often measured as the relative percent difference or the relative standard deviation.
- **Completeness** is the amount of data that must be collected to achieve the goals and objectives stated for the project. It is determined by comparing the amount of valid, or usable, data you collected to what you originally planned to collect. For the purposes of the performance criteria below, completeness is defined as the total number of data points collected over each deployment for each monitor that meet other performance criteria divided by the maximum number of data points that could be collected
- **Representativeness** is defined as the measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.
- **Comparability** is the qualitative term that expresses the measure of confidence that two or more data sets can contribute to a common analysis. Before pooling data, the comparability of data sets generated at different times or different organizations must be evaluated in order to establish whether two data sets can be considered equivalent in regard to the measurement of a specific variable or groups of variables.
- **Sensitivity** is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest. The term "detection limit" is closely related to sensitivity and is often used synonymously.

The table below shows how each parameter meets the Data Quality Objectives of accuracy, precision and completeness. **For representativeness**, we are installing 100 PurpleAir sensors in communities across Beaver County. With this quantity, it is our goal to get data that represents the air quality status of the county relatively well. We will not be making broad assumptions or policy decisions based on the data from PurpleAir sensors, rather it will allow us to help residents understand air quality patterns across the region.

PurpleAir sensors will measure particles from 0.3 to 10 microns in size in $\mu g/m^3$ every 2 minutes. The EPA Correction Factor will be applied to all data received from PurpleAir sensors, which will ensure that readings are **comparable** to federal reference monitors. The EPA National Ambient Air Quality Standards (NAAQS) will be used to contextualize the readings received from PurpleAir sensors. Additionally, PurpleAir sensors are tested by the company in batches of 20 to ensure that output readings are accurate and in line with the included control devices in each batch. Each batch contains 18 newly manufactured devices and 2 control devices. The new devices are compared to the control devices. Batch testing of sensors involves the use of synthetic smoke to imitate the worsening of air quality. This method of testing ensures devices record similar levels of particulates. However, the goal of this project is not necessarily to produce data that is comparable to reference monitors, rather we aim to fill a gap in air quality information that exists in the Upper Ohio River Valley region and to better understand the overall impact that petrochemical buildout has on air quality.

To ensure accuracy and precision of the PID device, SUMMA canisters, and Tedlar bags, we will complete several checks prior to using them. These checks are detailed in Appendix 36 and section B4 of this document. If the PID passess each of the start-up checks (self-test, pump check, disc check) and has been calibrated within the past six months, we can be certain that the accuracy and precision of the device fall within the range listed in Table 3. Correctly following the quality control steps listed for the SUMMA canister and Tedlar bags will ensure their accuracy and precision, as well.

Because we are looking at broad trends in air quality across the region and not focused as much on specific values, the objective of **sensitivity** does not apply to the data we're collecting.

Table 3: Performance Criteria and Data Quality Objectives (DQO) for Air Monitoring Devices:

Parameter	Field QA Method	Averaging Time	Accuracy	Precision	Completeness
PID tVOC (ppbV)	Startup check, disc check, pump check, calibration every 6 months, bump test every 5 uses. Acceptance criteria for accuracy is being determined by the successful completion of a calibration by Pine Environmental every six months. Criteria for passing the calibration can be found in Appendix 44.	15-minute short-term exposure level (STEL)	±25%	±25%	80%

SUMMA Canister VOCs (ppbV and µg/m³)	TO-15 time-tracked samples with lab analysis and duplicate sample collected once/year (See acceptance criteria in Table 11)	2 hours	±30%	±25% for detects above limit of quantitation	80%
Sample Bucket and Tedlar Bag VOCs (µg/m³ and ppbV)	TO-15 samples with lab analysis and duplicate sample collected once/year (See acceptance criteria in Table 11)	1.5 minutes	±25%	±25% for detects above limit of quantitation	80%
Sorbent Tube VOCs (µg/m³)	Method 325B lab analysis and field blanks collected once/year (See acceptance criteria in Table 11)	2 weeks	±30%	±20%	80%
PurpleAir $PM_{2.5}$ (µg/m³)	Real-time $PM_{2.5}$ concentrations based on two collocated PMS6003 laser counters and check prior to deployment in field that monitor reading is in reasonable range	Data are collected every 2 minutes and we'll use 10-minute, hourly, and daily averages during analysis	N/A	±25%	80%
PurpleAir Temperature, pressure, tVOC, and relative humidity (Raw Temperature: degrees Fahrenheit Raw Humidity: % Raw Pressure: mbar VOC: PA tVOC Units)	Post-analysis reasonableness check	Data are collected every two minutes and we'll use 10-minute, hourly, daily, and weekly averages during analysis	NA	NA	80%

A7 – Distribution List

[redacted] Breathe Project, Program Manager, [redacted]
[redacted] - Clean Air Task Force, Quality Assurance Manager, [redacted]
[redacted] - UORV Monitoring Project Project Manager, [redacted]
[redacted] - UORV Monitoring Project, Project Technician, [redacted]
[redacted] - Blue Lens, LLC, Air Monitor Advisor, [redacted]

[redacted] - Krings & Associates, LLC, Data Analysis, [redacted]
[redacted] - Beaver County Marcellus Awareness Community, [redacted]
[redacted] - Beaver County Marcellus Awareness Community, [redacted]
[redacted] - Environmental Health Project, Project Technical Staff, [redacted]
[redacted] - Environmental Health Project, Project Technical Staff, [redacted]
[redacted] - Carnegie Mellon University CREATE Lab, Project Technical Staff, [redacted]
[redacted] - US EPA Region 3, Project Officer, [redacted]
[redacted] - US EPA Region 3, QA Coordinator, [redacted]
[redacted] – US EPA Region 3, QA Coordinator, [redacted]

A8 – Project Organization

The Quality Assurance Manager (QAM) and Project Manager (PJM) for this project will oversee and follow quality assurance procedures detailed in this QAPP to ensure data quality standards are met. They will be given authority over the quality assurance process for this project and provided the resources necessary to effectively conduct this work. The organizations listed in this QAPP are committed to quality management principles and practices in the planning, implementation, and assessment of environmental information operations (EIOs).

Table 4: Individuals involved in quality assurance

Role	Individual in Role, Title, and Name if known in Planning	Describe Roles and Responsibilities	Reporting Relationship
Approval Authority for the QAPP	[redacted] Environmental Protection Agency Project Officer [redacted] Environmental Protection Agency Quality Assurance Coordinator	Review and approve QAPP	N/A
Program Manager (PM)	[redacted] - Breathe Project, Executive Director	Executive Director and the grant recipient. The PM will approve the organization’s QMP and	Reports to EPA Program Manager and Team

		QAPP. PM or delegates will communicate with federal grant managers to meet grant reporting goals.	
Project Manager (PJM)	[redacted] - UORV Monitoring Project Project Manager	PJM is responsible for writing and maintaining the QAPP and QMP. Execution of project operations. PJM will confirm field activities follow the project timeline, oversee grant reporting based on that timeline, facilitate weekly check-ins, and track hours. PJM will send grant reports to the Grant Administrator (GA) as required for submission to the EPA.	Reports Program Manager
Project Technician (PT)	[redacted] - UORV Monitoring Project, Project Technician	Distribution and maintenance of monitoring equipment Will install air monitors and conduct air sampling Will maintain field records. Will contribute to data analysis and communication of findings to the public.	Reports to Project Manager about field activities and strategize to communicate project goals to the public to recruit air monitoring hosts.

Monitoring/ Data Advisors (MDAV)	[redacted] - Blue Lens, LLC, Monitor and Data Advisor [redacted] - Krings & Associates, LLC, Monitor and Data Advisor [redacted] - Beaver County Marcellus Awareness Community, Monitor and Data Advisor [redacted] Environmental Health Project (EHP), Monitor and Data Advisor [redacted] - Environmental Health Project, Monitor and Data Advisor [redacted] - Carnegie Mellon University CREATE Lab, Monitor and Data Advisor	Data collection and data flow Data storage Will train project staff for all field activities and maintain field records. Will contribute to data analysis and communication of findings to the public	Report to Project Manager about data collection, storage, and analysis.
QA Manager (QAM)	[redacted] Clean Air Task Force, Quality Assurance Manager	QAM will be operating independently from the data collection team, assessing the project activities' adherence to the QAPP.	QAM will report to the PM and communicate with to receive data quality reports.
Laboratory Point of Contact (POC)	Pace Analytics, Project Manager, Environmental Sciences	Will conduct laboratory analyses and transmit data to PJM, PT, and MDAV.	Report to PJM and MDAV.
Laboratory Point of Contact (POC	ALS Global, Project Manager USA	Will conduct laboratory analyses and transmit data to PJM, PT, and MDAV.	Report to PJM and MDAV.
Laboratory Point of Contact (POC)	Pine Environmental, Project Manager	Will complete bi-annual calibrations of the PID and complete required corrective actions if PID malfunctions.	Report to PJM and MDAV.
Community Engagement Support	[redacted] Executive Director,	Provides support in connecting us with concerned community	Report to PJM and MDAV.

	Beaver County Marcellus Awareness Community	members and expanding engagement on this project	

A9 - Project Quality Assurance Manager Independence

The Project Quality Assurance Manager (QAM) is independent of environmental information operations. The QAM for this project, [redacted] has subject matter expertise in quality assurance, having worked on similar projects prior to this. Their independence is ensured because they will not be involved in data collection or field operations. Their primary responsibility is to ensure that data are collected according to our QAPP and QMP. They have oversight authority of the project and the ability to assess project compliance with the QAPP.

A10 – Project Organizational Chart and Communications

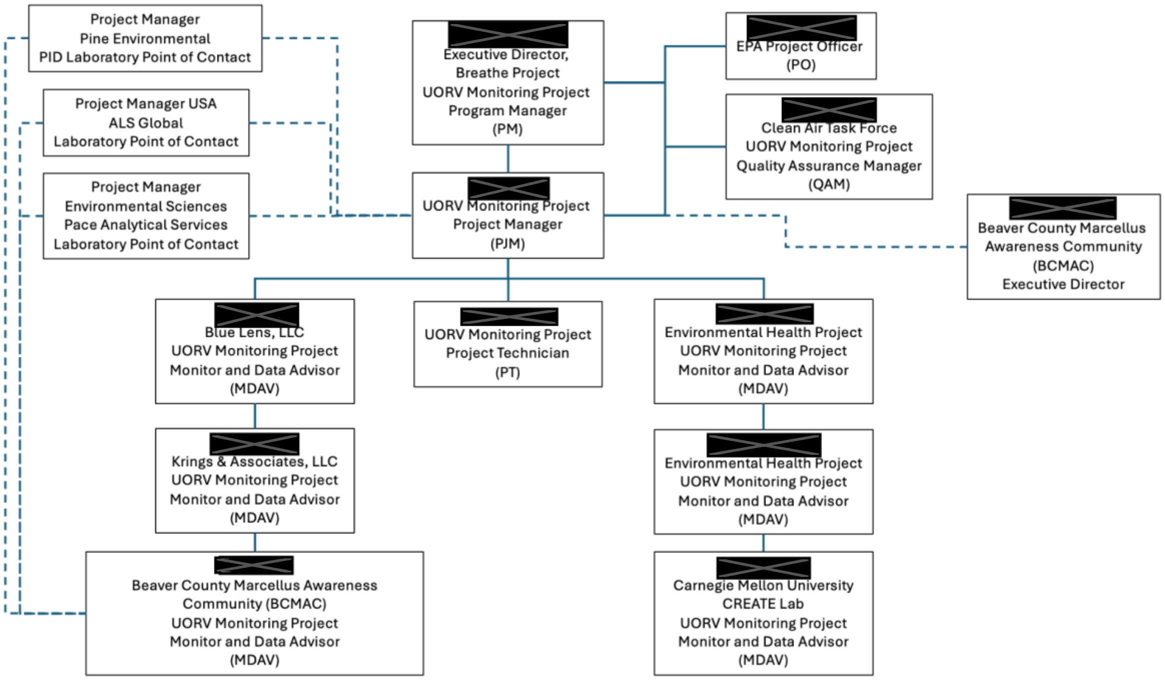


Figure 4: Organizational Chart

Table 5: Communication Methods

Description of Communication	Individual Responsible	Pathway	Mechanism	Procedures including timing
Elevating discrepancies within organization	[redacted] Executive Director, Breathe Project UORV Monitoring Project Program Manager (PM)	via [redacted] UORV Monitoring Project Project Manager (PJM)	Written Communication	Within 24 hours of any incident

Elevating discrepancies within organization with contractors or subcontractors	[redacted] Executive Director, Breathe Project UORV Monitoring Project Program Manager (PM)	via [redacted] UORV Monitoring Project Project Manager (PJM)	Written Communication	Within 24 hours of any incident
QAPP non-conformances	[redacted] Clean Air Task Force UORV Monitoring Project Quality Assurance Manager (QAM)	via PT, PJM, and MDAV to PM	Written Communication	Within 24 hours of any observed occurrence
Process improvement	[redacted] UORV Monitoring Project Project Manager (PJM)	via PT and MDAV to PJM	Written Communication	Continuously
Concurrence and approvals between project personnel	[redacted] UORV Monitoring Project Project Manager (PJM)	via PT and MDAV to PJM	Written Communication	As needed
Concurrence and approvals between contractor and organization responsible for environmental information operations	[redacted] UORV Monitoring Project Project Manager (PJM)	via PT and MDAV to PJM	Written Communication	As needed
Communication with EPA Project Officer and Quality Assurance team regarding questions about project execution.	[redacted] UORV Monitoring Project Project Manager (PJM)	via PT and MDAV to PJM	Written Communication	As needed

Communication with laboratories regarding analysis of discrete air samples.	[redacted] UORV Monitoring Project Project Technician (PT)	via MDAV	Written Communication	As needed

A11 – Personnel Training/Certification

Project Documentation

The completion of applicable training elements (including the review of this QAPP as well as guidance materials, SOPs, field training, EPA method guidelines and device manuals) will be documented and signed off by project staff members. A QAM will be responsible for ensuring training is completed by relevant field personnel and the PJM will document that status using an Air Monitoring Team Training and Preparation Checklist [Appendix 6]. These training checklists will be filled out as training is conducted and a completed copy will be stored in the project's Basecamp platform and a private Google Drive folder.

SUMMA Canisters, Sorbent Tubes, Colorimetric Gas Detection Tubes and Bucket Air Collection Systems

Field staff and community volunteers will undergo training regarding setup, operation, and troubleshooting of the equipment. Field staff will receive guidance in the form of written instructions for operation, with direct phone/remote meeting access and in-person instructions if needed. Discrete sampling will be conducted in accordance with EPA Method guidelines and SOPs provided by EPA certified labs. Anytime a sample is collected using a method listed above, the PT responsible for collecting it is required to complete a form that asks if they completed the necessary training. [Appendix 7]

PurpleAir Monitors

Project team will follow manufacturer instructions and rely on training resources to deploy PurpleAir monitors according to best data quality practices. EHP will provide training on the use of the AirView analytics platform for personnel involved in data analysis. CREATE Lab staff will provide training on the use of EnvironmentalData.org for reviewing monitor data. Staff installing PurpleAir monitors will be required to complete the form in Appendix 8 that verifies they have completed the necessary trainings.

Training success will be documented using a document that is linked to in Appendix 6 that those collecting data must complete certifying they have completed all trainings prior to beginning data collection. Trainings will be developed in Microsoft PowerPoint and can be completed live or a recording can be viewed. The trainings will be reviewed by our quality assurance team to ensure that they are comprehensive. Once someone has completed a training, they will enter that information into the document in Appendix 6. A spreadsheet will be used to track this information.

A12 – Documentation and Records

Table 6: Data Storage and Access

Parameter	Public Data Storage Location(s)	Party Managing Public Data Access	Private Data Storage Location(s)	Party Managing Private Data Access
Sampling Results	Airtable	CREATE Lab	Basecamp folder	EPA Approved Lab
PID Data	Airtable	CREATE Lab	Basecamp folder	PT
PurpleAir	PurpleAir public cloud servers ESDR server	PurpleAir CREATE Lab	AirView server	EHP
Project Training Documentation	N/A	N/A	Basecamp/Google Folder Drive	Breathe Project

Sampling results will be generated by an EPA-approved lab. This data will be emailed via the lab manager to the PJM's and PT's email addresses in Excel format. The Excel files will be uploaded to CREATE Lab's Airtable hub. This Airtable hub will be accessible to all project partners for a minimum of three years and used to archive and retrieve sampling results for data report generation. Discrete sampling results will have an associated chain of custody (COC) form that will be filled out by the field staff who deploy and collect each SUMMA canister, Tedlar bag, or sorbent tube. CoC forms for the two labs we're working with can be found in the Appendix. The CoC document will be completed according to the SOP provided by the EPA-approved lab and verified by a lab representative upon receipt of a sample. Any deviation from this SOP will be reported to PJM by the Lab Representative (LR). The CoC will be sent to the lab with the sample and a digital version will be stored on Google Drive and Basecamp. The PT will fill out the Sampling Collection Form [Appendix 7] when an air sample is collected and shipped to the designated lab for analysis.

PurpleAir data will be stored on PurpleAir's public cloud servers, accessible at https://map.purpleair.com and via the PurpleAir API. PurpleAir data will be backed up on CREATE Lab's ESDR servers, accessible at environmentaldata.org. Processed PurpleAir data will also be stored on EHP's AirView servers.

Project documentation including log sheets, forms, training verification, and quality control information will be stored on Google Drive and any hard copies will be stored in a locked filing cabinet in the project office. Once QAPP is approved by EPA, all project partners will receive updated, approved copies of the QAPP via email and stored in Basecamp.

Group B: Data Generation and Acquisition

B1 – Identification of Project Environmental Information Operations

We will use continuous monitoring equipment (PurpleAir sensors), equipment to measure tVOC concentration during episodic events (PID), and equipment to collect samples and speciate VOCs in the environment (Tedlar bags using the bucket method, SUMMA canisters, colorimetric gas detection tubes, and sorbent tubes).

PurpleAir sensors will be used to collect information at a 2-minute interval on a continuous basis throughout the study period on $PM_{2.5}$ concentrations, VOC concentrations, temperature, and humidity.

Photoionization Detectors (PID) will be used to collect information approximately once to twice per month throughout the study period on unspeciated total VOC concentrations.

SUMMA canisters will be used to collect information approximately once to twice per month throughout the study period to determine speciated VOC concentrations in the project area. The SUMMA canister will be used to collect samples over a two-hour time period. Appendix 26 outlines the decisions that will be made to determine which method of sampling to use.

Tedlar bags will be used to collect information when a SUMMA canister is not available to determine speciated VOC concentrations in the project area. The Tedlar bag will be used to collect “grab” samples, which take approximately 1.5 minutes and will give us an indication of the type of VOCs in the air during a single point in time.

Sorbent tubes will collect information approximately three times each year throughout the study period. One tube will be placed next to a PurpleAir sensor for two weeks and we will compare VOC concentrations to the values reported from the tVOC sensor.

Colorimetric gas detection tubes will be used during incidents when tVOC levels are extremely high, reading at least 1 ppm. During these incidents, we will use these tubes to get immediate results on the speciation of VOCs in the air.

The table below shows the list of environmental information operations that will be conducted and how they meet the performance and acceptance criteria described in Section A.

Table 7: Environmental Information Operations and DQO

Environmental Information Operation	Frequency	Description of how the EIO will satisfy the project purpose	Description of how the EIO will satisfy the data quality objectives
Continuous regional $PM_{2.5}$ monitoring with PurpleAir (PA) monitors	On a continuous basis throughout study period	PA monitors will enable heightened community awareness of particle pollution conditions	100 PA monitors will be factory-calibrated and periodically assessed by the maintenance team to

		and provide information on pollution trends in the region.	ensure operations within suitable ranges.
Episodic PID Measurements	1-2 times/month	PID measurement will be used to ascertain VOC levels and assist in deciding if additional sampling is warranted	PID instrument(s) will be factory calibrated and checks outlined in sections B4-6 explain QA measures that will be taken. PID monitors will give a numeric value for the tVOCs in ppb during an episodic event.
Air Sampling with SUMMA canister using TO-15 analysis method	1-2 times/month	Air sampling will be used to speciate VOCs in the air either when the PID reads above 100 ppb, the Fort McIntosh monitor reads above 25 µg/m³, or to collect a background sample.	SUMMA canister samples will be taken following the manufacturer instructions and analyzed at a certified third party lab.
Air sampling with Tedlar bag using TO-15 analysis method	1-2 times/month	Air sampling will be used to speciate VOCs in the air either when the PID reads above 100 ppb, the Fort McIntosh monitor reads above 25 µg/m³, or to collect a background sample. Bucket sampling will be done when a SUMMA canister is not available to ensure we can respond to episodes of high pollution within 24 hours.	Bucket samples will be taken using Tedlar bags following the manufacturer instructions and EPA methods and analyzed at a certified third party lab.
Sorbent Tube VOC Sampling	3 times/year throughout study period	Sorbent tubes will be used to understand concentration and speciation of VOCs at people's homes and to compare VOC concentrations found in sorbent tubes to the tVOC recorded on PurpleAir sensors.	Sorbent tubes will be used following manufacturer instructions and EPA methods and results will be analyzed by a certified third party lab.
Episodic colorimetric gas detection tube sampling	Up to 5 times throughout study period	Colorimetric gas detection tubes will be used to speciate VOCs during periods when the PID reports a high concentration of tVOC.	Colorimetric gas detection tubes will be used following manufacturer instructions and EPA methods. Analysis happens based on the color of the tube once the sample was taken so PT will be trained in interpreting those colors.

B2 – Methods for Environmental Information Acquisition

Every time a sample is collected using a SUMMA canister, Tedlar bag, or sorbent tube, or a measurement is taken with the PID, or a new PurpleAir sensor is installed, **the project technician is required to complete this form**.

Table 8: Episodic Sampling Methods and SOPs

Episodic				
Pollutant to be Measured	**Method**	**Collection/ Analysis**	**Procedures**	**Laboratory**
VOCs	PID	Usage	ppbRAE 3000 User Manual	Pine Environmental
TO-15 compounds	SUMMA canister	Collection	Eurofins Guide to SUMMA Canister Sampling EPA SUMMA Canister Sampling Method	ALS Environmental
		Analysis	EPA Method TO-15	
TO-15 compounds	Sample Bucket w/ Tedlar bag	Collection	Bucket Brigade Method SOP	Pace Analytic
		Analysis	EPA Method TO-15	
Selected VOCs	Colorimetric Gas Detection Tubes	Collection and Analysis	Colorimetric Gas Detection Tube Handbook - separate SOP for analysis is not necessary because analysis occurs by visually examining the color of the tube	N/A

			after a sample has been collected with all necessary steps outlined in the handbook above	

* Modifying method 325a to meet our needs. We are not using sorbent tubes for fenceline monitoring so we are disregarding Section 8.2 used to determine sampling locations and 8.3 about siting meteorological stations nearby.

Continuous and Periodic Monitoring			
Pollutant to be Measured	**Method**	**Periodic/Continuous Monitoring**	**Documentation**
$PM_{2.5}$	PurpleAir	Continuous Monitoring	Method is continuous and automated per the PurpleAir design, using Plantower PMS6003 laser counters.
		Installation	PurpleAir Installation Checklist Sensor Wifi and Registration EPA Guide to Siting and Installing Air Sensors
Selected VOCs	Sorbent Tubes collocated with PurpleAir sensors for one to two weeks	Periodic Monitoring	EPA Method 325A*
		Analysis - conducted at ALS Environmental with tubes procured from Markes International	EPA Method 325B for all VOCs of interest

Table 9: Continuous and Periodic Sampling Methods and SOPs

Criteria for Sensor Placement or Sample Collection

Continuous Monitoring
Critical Information: date, time, $PM_{2.5}$ µg/m³
Helpful Information: temperature, humidity, pressure, uncalibrated VOC information. Wind direction and wind speed may be gathered from public sources.

Continuous monitoring will occur through the utilization of 100 PurpleAir monitors, each with twin PMS6003 particulate sensors and single BME688 gas sensors. These will be used for continuous air monitoring of $PM_{2.5}$ in the target region. We may use PurpleAir Flex and Zen models interchangeably in this project, rooted in our understanding that their sensing hardware is identical.

We plan to install PurpleAir monitors throughout the target region, with particular emphasis on environmental justice areas and those impacted by local pollution sources, particularly those that currently do not have such monitors in place. Target locations for monitor placement include but are not exclusive to Ambridge, Aliquippa, Beaver Falls, Coraopolis, East Rochester, Freedom, Leetsdale, Midland, New Brighton, Rochester, and adjacent communities of Beaver, Monaca, and Sewickley. Air pollution conditions vary widely across the Upper Ohio River valley. This necessitates the placement of many monitors to properly understand hyper-local pollution risk. Host site candidate identification will be accomplished with the help of the grantee organizations, community advisory committee, and their networks. A project description including host requirements will be created and regularly shared through affiliated networks to connect with host candidates. Interested host locations will be checked against a map of pre-existing installations and undergo a review of the location's suitability for hosting a monitor.

Sorbent Tube Placement
In addition to conducting continuous monitoring using PurpleAir sensors, we plan to install a sorbent tube at select PurpleAir host sites for two weeks at a time. We aim to install sorbent tubes at a host site three times each year throughout the study period. We will utilize sorbent tubes to detect the VOCs outlined in Table 3 in Appendix 32, with particular attention paid to benzene, toluene, ethylbenzene, and xylene (BTEX). Results from the sorbent tubes will help us understand which VOCs residents are being exposed to near their homes and whether the tVOC monitor in PurpleAir monitors might be useful in alerting residents of high levels of these VOCs. We are doing this because the VOC sensor in the PurpleAir monitors is experimental, so this will help us understand which VOCs it is able to detect. We will follow EPA method 325A/B for detection of VOCs. The location of sorbent tube installation will depend on which Purple Air host sites agree to host a sorbent tube. They will only be placed at homes located in the study area outlined in Figure 1.

Eligibility Criteria
To be eligible to host either a PurpleAir sensor or a sorbent tube, we utilized the [EPA Guide to Siting and Installing Air Sensors] to develop the following criteria:

- Resident must live in one of the thirteen communities included in the table in section A5
- Resident must have an accessible outdoor power source
- Resident must give explicit permission for our project technicians to mount the sensor on their property
- The property must maintain a consistent WiFi signal so that data can continuously be uploaded to the server
- The sensor should be sited:
    - Away from any hyperlocal sources of pollution such as building exhausts or grills
    - 3-6 feet above the ground with free flowing air beneath the sensor

PurpleAir monitors report $PM_{2.5}$ levels continuously at approximately 2-minute intervals. These values are captured in the ESDR system hosted by the CREATE Lab at CMU and available for public viewing and downloading at EnvironmentalData.org. Humidity, pressure, VOC, and temperature levels are also recorded.

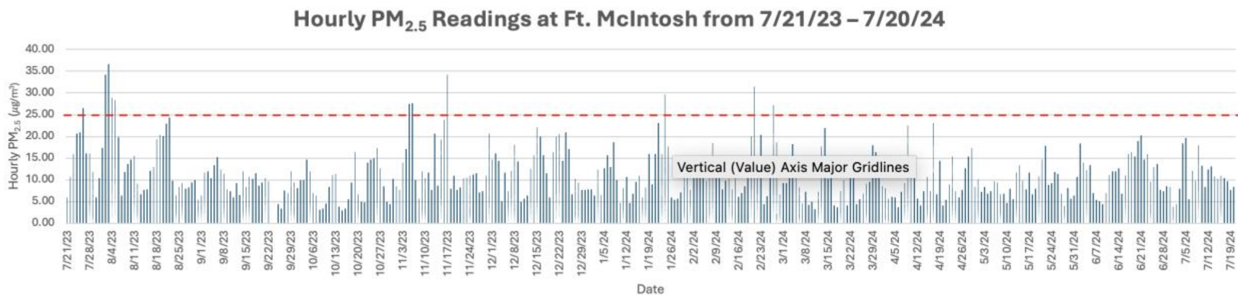
Episodic Monitoring

Critical Information: date, time, sample type, compound ID, results reported in $\mu g/m^3$, ppbV, or ppmV, sample duration, sample flow rate (when applicable), chain of custody details.

Helpful Information: wind direction and wind speed at time of sample. Handheld VOC reading at time of sample. Name of lab, date received by lab, submitter, project ID.

Episodic monitoring is intended to document polluting events with abnormal conditions using SUMMA canisters, bucket systems pulling air into Tedlar bags, colorimetric gas detection tubes, and PID sensors. Appendix 26 provides an overview of what will trigger the decision to collect a sample as well as the decision of which method to use for collection. The goal of these criteria is to ensure that discrete sampling occurs approximately 45 times throughout the study period. As we approach the end of each month, we will collect a “background” sample if the criteria have not been met for an episodic sample collection over the course of the month. The goal is to collect samples at least once every month during times when polluting events are reported by the community or when $PM_{2.5}$ levels are above 25 $\mu g/m^3$ on the Fort McIntosh Federal Equivalent Monitor (FEM).

The justification for collecting a sample when the monitor reaches 25 $\mu g/m^3$ is based on a year’s worth of data from the Fort McIntosh FEM. Figure 5 below shows the number of days that the monitor recorded an hourly average above 25 $\mu g/m^3$. Because our goal is to collect a sample on a monthly basis, this threshold is reasonable to achieve that goal. We are utilizing data from the Fort McIntosh FEM because of its close proximity to an industrial plant of concern, as can be seen in Figure 5.



Value	Frequency	# of unique days
≥30 $\mu g/m^3$	20	4
25 – 30 $\mu g/m^3$	32	11
20 – 25 $\mu g/m^3$	60	29

Figure 5: Annual data from Fort McIntosh FEM in Beaver County with the red dot indicating the monitor's location and the red circle showing an industrial plant of concern.

Trigger: Reports from community of abnormal pollution

There are several incidents that may initially trigger the process to commence discrete sampling using the PID. Based on previous experiences with the petrochemical plant in the region, we anticipate there will be an event that triggers the use of the PID every two weeks. The criteria that may trigger this are:

- Abnormal smells reported from an individual, business, or organization within the study area.
- Abnormal flaring or emissions from industrial sites of concern observed using camera footage or a report from a resident.
- Report from the Pennsylvania Department of Environmental Protection, other local government agency, or polluter that VOC emissions are higher than usual or expected to be higher during a certain time period.

If any of these occur, the PT will go to a designated location in Rochester, PA to run the PID for 15 minutes. We've chosen Rochester, PA as the ideal location for sampling because of its proximity to an industrial source of concern and its status as an EJ community. By conducting sampling in Rochester, PA on a regular basis, we will gain an understanding of how days with high $PM_{2.5}$ readings or days when the plant appears to be releasing more pollutants impact an EJ community located near several industrial sources. Figure 3 shows a map of sampling locations that will be used, including two sites in Rochester, PA. We plan to primarily use the Rochester Riverfront Park as our sampling location in that town.

If the reading on the PID is above 100 ppb at the riverfront park, the PT will collect a sample from that location. If the PID reading is below 100 ppb, the PT will go to a location downwind from the plant of concern and run the PID again. Figure 3 shows potential sampling locations, with the site in Vanport, PA serving as the primary sampling location. If the PID reads above 100 ppb, a sample will be taken there. If it's below 100 ppb, a sample will not be taken that day.

Trigger: $PM_{2.5}$ reading of 25µg/m³ or higher at the Fort McIntosh FEM located in Beaver

A reading at the Fort McIntosh FEM of 25µg/m³ will immediately trigger sample collection. We are accessing data from the Fort McIntosh sensor through AirNow, which can have a 1-2 hour delay in data reporting, which means our sampling decision will be based on data from the previous hour. Data from AirNow are reported in GMT-5. To ensure we are prepared for sample collection when the Fort McIntosh monitor hits 25µg/m³, we will pay close attention to state and local air quality forecasts, periods when the Ft. McIntosh monitor crosses a 20µg/m³ threshold, and elevated hourly averages across the existing PurpleAir network.

The goal of collecting a sample when the $PM_{2.5}$ reading is this high is to understand the relationship between increased $PM_{2.5}$ levels and VOC levels. In this region, $PM_{2.5}$ levels are often elevated due to atmospheric conditions and weather patterns such as inversions, which trap a layer of cool air close to the ground. Inversions also trap pollutants such as $PM_{2.5}$ and VOCs close to the ground, meaning that there might be a relationship between days when $PM_{2.5}$ is high and VOCs are high. Collecting samples during these periods will help us understand this relationship better. We plan to collect a sample in Rochester, PA each time for the first year of the study in an effort to understand VOC concentration and speciation in an EJ community close to the plant of concern. Figure 6 below shows that Rochester, PA is one of the communities that may be more impacted by pollution from the cracker plant.

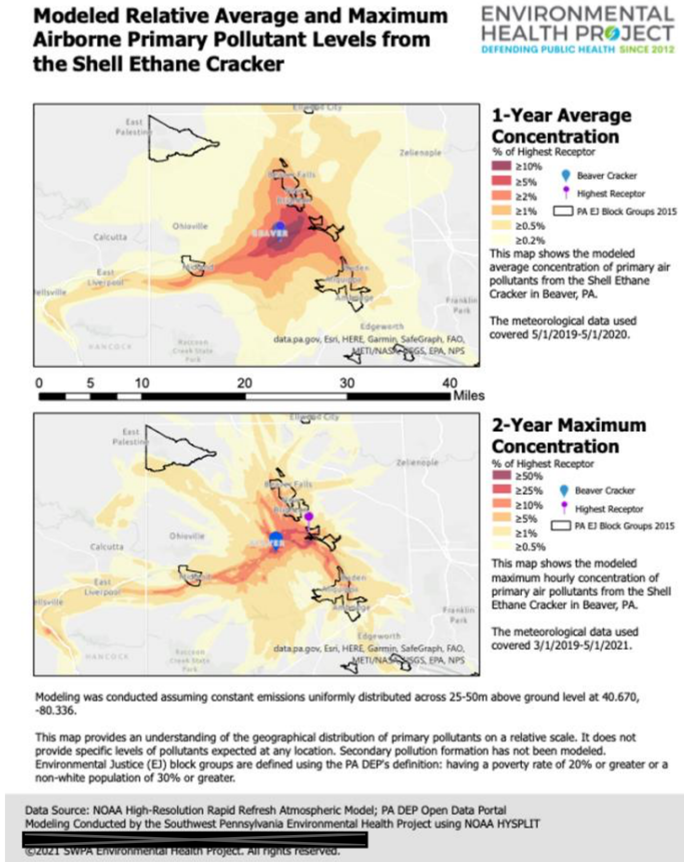


Figure 6: Communities Impacted by Pollution from Cracker Plant Model

Response: Episodic Sampling with SUMMA Canister

Once the criteria have been met to collect a sample, either by a high PID reading or a high reading at Fort McIntosh, we will proceed with sample collection using either a SUMMA canister or a Tedlar bag. If we have a SUMMA canister on hand, we will move forward with collecting a 2-hour sample with the SUMMA canister. The reason for collecting a 2-hour sample is that we often might detect a spike in VOCs, but it could take several hours before that spike hits its peak concentration. By collecting a sample for two hours, we're more likely to capture VOCs when they're at their highest concentration. The SUMMA canister will arrive from the lab with a calibrated orifice set to collect a sample over a two hour period. The table below shows the steps that will be taken prior to collecting a sample with a SUMMA canister. Appendix 36 outlines the quality control checks that will be performed prior to, during, and after collecting a sample with the SUMMA canister. Table 10a below also outlines the key steps to be taken when collecting a sample with a SUMMA canister. The setup will look like the example in Appendix 35.

Table 10a: Assessments When Using SUMMA Canister

Assessment	Expected Values	Corrective Action
Inspect SUMMA canister upon receipt from laboratory and prior to beginning sampling.	No visible damage to the outside of the SUMMA canister or to the pressure assembly.	If there is visible damage to either piece of equipment, it should be returned to the laboratory.
Attach the pressure assembly to the SUMMA canister and conduct a leak check by opening the valve between the pressure assembly and canister. Record the initial value and the time.	The pressure assembly gauge should read approximately -14.3 psi or -28.6 Hg and should remain at that level after remaining open for 2-3 minutes.	If it does not remain at that level, it needs to be tightened with a wrench to ensure there is no leak between the canister and the pressure assembly.
Open the top of the pressure assembly to begin collecting air samples. Closely monitor the pressure gauge.	The pressure assembly should be set ahead of time by the laboratory to decrease in pressure over the course of 2 hours. It should not drop below approximately -3 Hg. Sample collection is complete once it hits that level.	If it drops to -3psi before the 2-hour sample is complete, the canister should be sealed and the time of completion should be noted. The laboratory should be informed of the length of sample collection.

Response: Episodic Sampling with Tedlar Bag and Bucket

If we do not have a SUMMA canister on hand, we will use the Tedlar bag and bucket method to collect a "grab" sample when the episodic sampling criteria are met. Because we rent SUMMA canisters from the laboratory for two weeks at a time, there is a chance we will not always have one. In those instances, we will take a 1.5 minute sample using the Tedlar bag. We will collect the sample until the Tedlar bag is inflated to the level shown in Appendix 42. Appendix 36 outlines the quality control checks that will be performed prior to, during, and after collecting a sample with the Tedlar bag.

Table 10b: Assessments When Collecting Sample With Tedlar Bag

Assessment	Expected Values	Corrective Action
Check the link between the stem of the Tedlar bag and the screw on the bucket lid. This needs to be tight, which means a ferrule ring needs to be snug along the closure point.	We will know the connection is not tight enough if the bag falls off when we attempt to connect it to the bucket.	The ring needs to be replaced if the connection is not tight enough or every two uses of the bucket.

Before closing the bucket fully, rotate the black part of the plastic seal on the Tedlar bag. This opens the valve on the bag, allowing air to flow into it. Attach the Tygon tube with the cotton ball on one end to the silver metal screw and connect the vacuum pump to the opening of the tube. Turn the vacuum pump on to begin sucking air out of the bucket.	The Tedlar bag should begin inflating once the pump has been turned on.	If the bag is not inflating, turn off the pump to check that the seals on each part of the bucket are tight enough.
Once sampling is complete and when removing the bag from the bucket, make sure it doesn't get punctured.	The bag should remain inflated as it is removed from the bucket.	If the bag begins to deflate, it is likely punctured and the sample is compromised. Dispose of the bag and begin the sampling process again.

Response: Colorimetric Gas Detection Tubes

The goal of utilizing the colorimetric gas detection tubes is to detect high concentrations of VOCs in the air, with a specific focus on detecting formaldehyde. The four compounds that the tubes can detect are: benzene, formaldehyde, 1-3-butadiene, and hydrocarbons. We will only use these tubes when the PID reads above 1 ppm, indicating a serious polluting event. While we cannot be certain how frequently this will occur, based on past PID readings, we do not anticipate using the colorimetric gas detection tubes more than five times throughout the study period. Appendix 22 outlines the steps that will be taken when utilizing the gas detection tubes. The tubes are only sensitive enough to detect VOCs when they reach levels of ppm, which is why these are reserved for those instances. In addition to using the tubes during these polluting events, we will also collect a sample with a SUMMA canister or Tedlar bag.

After the first year of the project period, if we have not yet used the colorimetric gas detection tubes, we will lower the threshold for their use. At that point, if we get a 500ppb reading on the PID, we will move to a downwind location as close to the Shell cracker plant as possible and use the tubes to see if they change color even slightly, indicating that it is the compound we suspect. We will do this because if the PID reads 500ppb, there is a chance this is due to pollution from the Shell plant so we would want to get closer to the source before using the colorimetric gas detection tubes. This provides us with the highest likelihood of collecting a sample in a place with a high enough VOC concentration for it to be detected.

Response: Background Sampling

Background samples will be collected on a regular basis to understand VOC concentration on days when the episodic sampling criteria are not met. To meet this goal, an upwind and downwind background sample will be collected every quarter. Additionally, the Project Manager will meet with the Field Technician(s) monthly to review the number of episodic samples that have been collected. If one has not been collected during the previous month, a background sample will be collected to measure pollution downwind from the plant. The team will determine a sample collection location based on predominant wind on sampling day to make sure our sample includes emissions from the source. We plan to collect background samples using SUMMA canisters because we will have time to order them from the lab and then collect the sample. The field team will make note of prevailing wind conditions, inversion status, and other meteorological factors when collecting samples.

Halfway through the study period, we will assess the number of samples that have been collected and whether we are on track to collect the target number by the end of the study period. If needed, we will lower the PID value or Fort McIntosh $PM_{2.5}$ value that triggers episodic sampling and proceed accordingly. If we have collected more samples than anticipated, we will not adjust our threshold because the threshold was set based on when we are most concerned about exposure to pollutants.

Timeframe for Analyzing Discrete Samples

An important component of discrete sampling is efficient laboratory analysis of air samples. This requires establishing a clear chain of command, ensuring that samples are analyzed within 20 days of acquisition, and ensuring the laboratory meets EPA quality standards. Laboratory quality can be assured in Appendices 23 and 24, which links to quality assurance documents from the laboratories we plan to use. We are partnering with two different laboratories that can process samples collected via the methods outlined in this document. Samples from SUMMA canisters, sorbent tubes, and bucket sampling will be sent to the lab within three days. Once the sample has arrived at the lab, it will be processed and results shared with project staff within one month.

Existing Information

For this project, we also plan to utilize information from several sources that will not be collected by our team during the study period. Sources of existing information are:

- Publicly available data from PurpleAir sensors that have been installed across Beaver County by other organizations or individuals. We will only utilize data from sensors that have been installed by or are somehow connected to one of our partners in the region so we can verify the sensor is installed correctly at an outdoor location. We will access this data through ESDR, which pulls data on a regular basis and is the same platform we're using for the sensors we install.
- Publicly available air quality visuals provided by the EPA through the Fire and Smoke Map. This video provides information from the EPA on how they decide which PurpleAir sensors to include on the map. Their quality assurance standards match ours, removing sensors that have poor agreement between A & B channels or sensors that suggest failure, indoor readings, or incorrect location on map. Additionally, they apply the EPA correction factor which we do with our data.

- For real time weather data, we will rely on data from the National Weather Service (NWS), which comes from a monitoring station located at Beaver County Airport. For analysis at a later date we will use the weather data incorporated into AirView from the closest NWS monitoring station.
- Real time information on wind direction and speed will be accessed using the aviation weather report taken at the Beaver County Airport which will give a general overview of the direction in which the wind is blowing. They compute forecasts four times a day utilizing the GFS Model and predictions can be made in time steps of three hours up to ten days in the future.

B3 – Integrity of Environmental Information

The Project Technician is responsible for ensuring the sample is collected following the steps outlined below. The PT is responsible for understanding how samples should be handled and how to complete the appropriate forms following sample collection. Below are the specifications of sample handling for each method. Quality Assurance activities are also outlined in more detail in Appendix 36.

Table 10c: Sample Handling and Chain of Custody

SUMMA Canister	
Sample Handling	• The SUMMA canister will arrive with a pressure assembly that will need to be attached to the canister. The laboratory will set the calibrated orifice to collect a 2-hour sample with a flow rate set by the laboratory according to standard atmospheric conditions. We will verify this by completing a pressure check and leak check prior to beginning sampling. • ALS Laboratory sends their SUMMA canisters with a vacuum of -14.3 psi or -28.6 Hg so this value should be read and recorded upon attaching the pressure assembly. • PT will ensure that the canister is free from external evidence of contamination or damage. • Handle the canister with clean hands and avoid any contact with connection points to prevent contamination. • After sampling, seal the canister tightly to prevent leakage. Transport the canister to the laboratory as soon as possible. Use proper packaging to avoid damage during transport. • Store the canister in a cool, dark place if immediate analysis is not possible.
Chain of Custody	**Laboratory: ALS Laboratories, Simi Valley, California** ALS Laboratory will be used for analysis of samples collected using Summa canisters. Their Chain of Custody Form, QA certificate, internal form for completion, and SOP for SUMMA analysis can be found below: Appendix 7: Internal Air Sampling Event Form Appendix 22: ALS Lab QA Appendix 25: ALS SUMMA Analysis

	Appendix 27: ALS Chain of Custody Form - California
Tedlar Bag	
Sample Handling	• PT will use clean, unused Tedlar bags to avoid contamination and ensure they are free from any residues or defects. They will be stored prior to use in a clean environment to prevent exposure to potential contaminants. • PT will handle the Tedlar bags with clean hands to avoid transferring contaminants from hands and avoid touching attachment points on the bag. • PT will be careful to avoid overinflating the bag to prevent it from rupturing • After sampling, PT will securely seal the bag and promptly transport it to a laboratory, working to keep it in the upright position away from anything that could puncture it in a clean, cool environment. • See Appendix 36 for details on sample collection processes
Chain of Custody	**Laboratory: Pace Analytics** PT will transport the Tedlar bag directly to the laboratory after completing the label and Chain of Custody form and the form required for our internal records. Chain of Custody Form, SOP for TO-15 analysis, Pace QA assurance, internal form for completion, and sample handling SOP can be found below: Appendix 12: Air CoC Pace Lab Appendix 21: Pace Lab QA Appendix 38: Pace Analytics TO-15 Appendix 39: Pace Analytics Sample Handling Appendix 7: Internal Air Sampling Event Form
Sorbent Tube	
Sample Handling	• PT will ensure that the tube has been pre-conditioned and is free from damages or defects upon removing the packaging • PT will follow Method 325A instructions by protecting the sorbent tubes from "rain and excessive wind velocity by placing them under the type of protective hood described in Section 6.1.3 or equivalent." A description of the protective hood can be found in Appendix 46.
Chain of Custody	**Laboratory: ALS Laboratories, Simi Valley, California** ALS Laboratory will be used for analysis of samples collected using sorbent tubes. Their Chain of Custody Form, QA certificate, internal air sampling event form, and SOP for SUMMA analysis can be found below: Appendix 22: ALS Lab QA Appendix 32: ALS 325b SOP Appendix 28: ALS Sorbent Tube Chain of Custody Appendix 7: Internal Air Sampling Event Form
Colorimetric Gas Detection Tube	

Sample Handling	- PT will ensure that the tube has been pre-conditioned and is free from damages or defects upon removing the packaging - PT will calibrate the sampling pump and flow meters to ensure accurate flow rates through the gas detection tube. - PT will ensure that the sampling environment is stable, avoiding extreme temperatures or other conditions that might affect the sample or sorbent material.
Chain of Custody	Upon collecting a sample using the colorimetric gas detection tube, the PT will complete the form in Appendix 7 below and will dispose of used tube according to local regulations: Appendix 7: Internal Air Sampling Event Form

Transmitting Episodic Monitoring Data

We are developing an Airtable data system to store results from samples analyzed at the lab, which will create a foundation for data-driven analysis of sample results.

Continuous PurpleAir monitor data are sent to the PurpleAir data system approximately every two minutes. From there it is gathered by the Environmental Sensor Data Repository (ESDR) (https://environmentaldata.org/). Backups of raw data streams will be maintained at the ESDR at the CREATE Lab at Carnegie Mellon University.

Table 10d: Sample Chain of Custody

Activity	Name/Organization	Contact Information
	Sample Collection, Packaging & Shipment	
Sample Collection	Project Technician - [redacted] and MDAV - [redacted]	[redacted]
Sample Packaging	Project Technician - [redacted] and MDAV - [redacted]	[redacted]
Coordination of Shipment	Project Technician - [redacted] and MDAV - [redacted]	[redacted]
	Sample Receipt & Analysis	
Sample Receipt	ALS Laboratory or Pace Analytics depending on the method. They will follow SOPs outlined in the Appendices.	
Sample Custody & Storage		
Sample Preparation		

Sample Analysis	

When samples are collected, packaged and shipped, the project technician will complete a field log documenting the date and time the sample was collected and will reference the SOPs linked to in Section B2 below with regards to packaging and shipping the samples.

B4 – Quality Control

Below is a table with an overview of the QC activities that will be taken in the field prior to, during, and after sample collection to ensure the data meets QAPP standards. This table provides a summary of assessments for each device. For detailed information on the checks and corrective actions that will be taken each time a check is completed, refer to Appendix 41: Quality Assurance Activities.

Table 11: Field Quality Control Assessments and Corrective Actions

Assessment Type	Frequency	Performing Assessment	Response to Assessment Findings	Identifying and Implementing Corrective Actions	Monitoring Effectiveness of Corrective Actions
Duplicate samples collected w/ SUMMA canister and Tedlar bag	Once per year for SUMMA and once per year for Tedlar	MDAV, PT, or PJM	Proper procedures will be followed to collect a duplicate sample with the SUMMA canister once per year and the Tedlar bag once per year and send it to the laboratory for analysis.	If there is greater than a 25.1% difference in the results from duplicate samples, PJM will work with the lab to identify differences in collection methods or analysis methods that might be the cause of this. Corrective actions will either be better field QC to ensure the proper steps are followed for checking canisters prior to use or laboratory QC where the lab will ensure they are following proper procedures.	If a duplicate sample reports different results, duplicate samples will be collected on a regular basis until we are sure that sample integrity is guaranteed.
Continuous Monitor Pre-Deployment Check	Prior to field deployment	MDAV, PT, and PJM	Monitors will run alongside one another and a reference Purple Air for at least 1 week prior to deployment in the field. Data from this will be reviewed to ensure all sensors are reporting similar values.	If hourly average readings are greater than 25% different between Purple Air monitor and rPA, we will contact Purple Air to request replacement monitor or make note of differences if replacement is not warranted.	Sensor reporting differences will be monitored once it's in the field to determine if differences in readings persist or grow larger.
Automated Continuous Monitor Check	Daily	Project Technical Staff, EHP	Every morning, EHP's automated system will email PT and PJM if data has not been received from a given continuous monitor for at least 24 hours, noting the monitors	PT will determine root cause of the monitor downtime through investigation of the data pipeline, outreach to monitor hosts, and/or visiting the monitoring site. PT	Data will be reviewed and compared against the applicable total completeness DQOs to determine if uptime is properly

			not reporting and the total downtime.	will take pertinent corrective action within 1 week, including but not limited to changing power source, updating WiFi credentials or cell network setting, or monitor replacement.	maintained in monthly data review reports to QAM.
Continuous Monitor Data Review	Monthly	Project Technician	On a regular schedule, PT will utilize the EHP AirView quality assurance dashboard in Appendix 11. Using this tool, PT will review data flagged from PurpleAir monitor for the reasons outlined in B5.	PT will determine how to qualify flagged data based on analysis of the reasons for the flags and additional data available in the quality assurance dashboard. All data will be retained and review actions recorded and tracked.	Retained data will be reviewed and compared against the applicable completeness, accuracy, and precision DQOs in monthly data review reports to QAM.
Field Blank for sorbent tubes	Once per year	Project Technician	Lab will analyze field blanks alongside samples collected in the field to ensure integrity.	We will report both the values of the field blank and the sample and note that the samples may have been contaminated if the field blank contains greater than one-third of the measured target analyte, in accordance with method 325B. We will flag data using the codes in Table 12c with a note that the associated results are estimated and likely to be biased high due to field blank background.	Collecting a field blank each year will help to ensure that recorded VOCs are coming from the local environment.

Table 12a: Data Accuracy, Precision, and Completeness

<table>
<tr><th colspan="4">Laboratory QC SUMMA Canister</th></tr>
<tr><td></td><td>Range</td><td>Method</td><td>Procedures and Formulas for QC</td></tr>
<tr><td>Accuracy</td><td>±30%</td><td rowspan="3">TO-15 two-hour time-integrated samples with duplicate lab analysis. Duplicate field criteria for precision are the same as the laboratory's criteria.</td><td>$Accuracy = \%D = \frac{RRF_c - \underline{RRF_i}}{\underline{RRF_i}} \cdot 100$ where:
RRF_c = RRF of the compound in the continuing calibration standard.
$\underline{RRF_i}$ = Mean RRF of the compound in the most recent initial calibration.

For all analytes.</td></tr>
<tr><td>Precision</td><td>±25% for detects above limit of quantitation</td><td>Precision = $\frac{|x_1 - x_2|}{\underline{x}} \cdot 100$ where:
x_1 = First measurement value
x_2 = Second measurement value
$\underline{x}$ = Average of the two values
For all analytes.</td></tr>
<tr><td>Completeness</td><td>80%</td><td>$Completeness = \frac{n_v}{n_c}$ where:
n_v = number of valid TO-15 analyses returned
n_c = number of SUMMA canisters triggered</td></tr>
<tr><th colspan="4">Field QC PurpleAir $PM_{2.5}$ Monitors</th></tr>
<tr><td></td><td>Range</td><td>Method</td><td>Procedures and Formulas for QC</td></tr>
<tr><td>Accuracy</td><td>N/A</td><td rowspan="2">Real-time $PM_{2.5}$ concentrations based on two collocated PMS6003 laser counters. Monitors will run alongside one another prior to deployment in</td><td>Accuracy will not be evaluated for PurpleAir monitors due to their use as community education tools.</td></tr>
<tr><td>Precision</td><td>±25%</td><td>$$Precision = \frac{1}{n_j} \cdot \sum_{i=1}^{n_j} |d_i|$$
d_i = % difference between co-located sensors for reading *i*
n_j = number of sensor reading pairs</td></tr>
</table>

		the field to determine if measurements fall within a reasonable range of one another.	Every outdoor-capable PurpleAir device contains two laser counters that produce individual measurements that can be compared to each other. Comparing the R^2 of these channels allows you to assess if a counter might be experiencing issues, or if the sensors are drifting in readings apart from each other. In relation to sensor drift, the laser counters do have a maximum consistency error, which is described by the device manufacturer, Plantower, as ±10µg/m³ when readings are between 0 and 100 µg/m³ and ±10% when readings are between 100 and 500 µg/m³.
Completeness	80%		$Completeness = \frac{1}{n} \cdot \sum_{t=1}^{n} \quad f(t)$ where: n = number of time periods t in study period, can be calculated as $\frac{(end\ time - start\ time)}{measurement\ frequency}$. $f(t) = \begin{cases} 1 & if\ time\ t\ returned\ valid\ data \\ 0 & otherwise \end{cases}$ Time periods are determined to have returned valid data when PurpleAir data are collected and were not flagged by EHP's AirView system, or when flagged data were reviewed and approved by applicable project staff. PurpleAir data can be flagged for the following reasons: ● Sparse: ● Outside sensor range: ● Outside operating temperature: ● Outside operating humidity: ● Co-located sensor disagreement:
Laboratory QC Method 325A/B Sorbent Tubes			
	Range	Method	Procedures and Formulas for QC
Accuracy	±30%	Passive two-week sample collection with duplicate lab analysis and field blank	$Accuracy\ =\ \%D = \frac{RF - RF_c}{\underline{RF}} \cdot 100$ where: RF_c = RF from continuing calibration $\underline{RF}$ = Average RF from initial calibration For all analytes. See Enthalpy SOP-222 page 13 [Attachment 2] for more information.

Precision	±30%		Precision = $\%RSD = 100\left(\frac{SD}{\underline{RF}}\right)$ where: SD = Standard deviation $\underline{RF}$ = average response factor For all analytes.
Completeness	80%		$Completeness = \frac{1}{n} \cdot \sum_{t=1}^{n} f(t)$ where: n = number of time periods *t* in study period, can be calculated as $\frac{(end\ time - start\ time)}{measurement\ frequency}$. $f(t) = \begin{cases} 1 & if\ time\ t\ returned\ valid\ data \\ 0 & otherwise \end{cases}$ Time periods are determined to have returned valid data when all COC processes are correctly followed.
Field QC PID			
	Range	Method	Procedures and Formulas for QC
Accuracy	±25%	Startup check, disc check, pump check, bump test every 5 uses.	$Accuracy = \frac{1}{n} \cdot \frac{\sum_{i=1}^{n} (PID - Cal)}{Cal} \cdot 100$ PID_i = the reading from the PID sensor for period *i* Cal = the ppb value associated with the calibration gas n = number of PID readings collected during calibration
Precision	±25%		$Precision = \frac{1}{n} \cdot \sum_{i=1}^{n} \frac{\lvert PID_i - Cal \rvert}{Cal} \cdot 100$ where: PID_i = the reading from the PID sensor for period *i* Cal = the ppb value associated with the calibration gas n = number of PID readings collected during calibration
Completeness	80%		When using the PID device, we aim for 80% completeness, meaning that 80% of attempts to use the device are successful.
Laboratory QC Bucket Collection w/ Tedlar Bag			

	Range	Method	Procedures and Formulas for QC
Accuracy	±30%	TO-15 sample method with duplicate lab analysis	Same as SUMMA above, adjust for Tedlar bag SOP if applicable
Precision	±20%		Same as SUMMA above.
Completeness	80%		$Completeness = \frac{n_v}{n_c}$ where: n_v = number of valid TO-15 analyses returned n_c = number of samples collected
Field QC Colorimetric Gas Detection Tubes			
	Range	Method	Procedures and Formulas for QC
Accuracy	10-25% depending on VOC (20% for formaldehyde)	Follow manufacturer instructions for use to detect high concentrations of specific VOCs in the air. No additional steps will be taken in the field to ensure QC because QC occurs upon manufacturing. QC criteria from Honeywell can be found in Appendix 20.	Honeywell tests five tubes and calculates the standard deviation from the standard gas value.
Precision	10-20% depending on VOC (20% for formaldehyde)		Honeywell determines precision by testing five tubes and taking the standard deviation from the average value of the five measurements.
Completeness	80%		When using the colorimetric gas detection tubes, we aim for 80% completeness, meaning that 80% of attempts to use the equipment are successful.

Completeness, precision, and accuracy will be assessed by both the laboratories we use to analyze samples collected using TO-15 and 325A methods and the field team collecting the sample. The lab will be responsible for quality control techniques used in sample analysis. For TO-15 SUMMA canister field QC, PT will ensure a relatively constant flow rate and record the flow rate along with the canister pressure before and after sampling. This will be recorded in the Sample Collection Form. Any issues with the housing or flow rate will be documented in the Maintenance and Troubleshooting Form [Appendix 14]. If QC interference is found during the checks conducted on any of the equipment, the affected sample will be discarded and corrective actions will be taken to ensure the equipment is in working order next time a sample is collected.

We did not include accuracy, precision, or completeness for Purple Air tVOC sensor because it is experimental so we're not reporting results from the tVOC sensor to the public and we have no way to verify its accuracy or precision.

Data from PurpleAir sensors can be flagged with the following codes that necessitate further review for qualification or omission. Codes assigned by AirView are assessed and reported on the 15-minute time scale.

Table 12b: Quality Control Codes for PurpleAir Data

Code	Description	Applicable Devices
"sparse"	Fewer than half of expected data points in a 15-minute span	PurpleAir
"temperature"	Reading was taken when sensor was outside the recommended operational temperature	PurpleAir
"humidity"	Reading was taken when sensor was outside the recommended operational relative humidity	PurpleAir
"range"	Reported reading is beyond the sensors specified output range	PurpleAir
"agree"	Two co-located sensors disagree significantly on their output	PurpleAir

PurpleAir Code Definitions

$$sparse = \begin{cases} 1, & n \leq 4 \\ 0, & otherwise \end{cases}$$

where n = number of readings in a 15-minute span

$$temperature = \begin{cases} 1, & t < 14°\,F \mid t\ > 140°\,F \\ 0, & otherwise \end{cases}$$

where t = average temperature returned in a 15-minute span

$$humidity = \begin{cases} 1, & h < 0\% \mid h\ > 99\% \\ 0, & otherwise \end{cases}$$

where h = average humidity returned in a 15-minute span

$$range = \begin{cases} 1, & x < 0\ \mu g/m^3 \mid x\ > 500\ \mu g/m^3 \\ 0, & otherwise \end{cases}$$

where x = average $PM_{2.5}$ reading returned in a 15-minute span

$$agree = \begin{cases} 1, & (p < 0.001\ \wedge d > 10)\ \vee (x < 100 \wedge d > 20) \vee (d > 100) \\ 0, & otherwise \end{cases}$$

where p = p-value of a two-sample t-test of readings from the two colocated sensors taken during a 15-minute span

d = difference between the average readings from the two colocated sensors taken during a 15-minute span

x = average $PM_{2.5}$ reading returned in a 15-minute span

A system for review has been developed by the Environmental Health Project and quality control reports will be provided on a regular basis, similar to the one seen in Appendix 8 and additional information on corrective actions if equipment is not meeting quality assurance standards can be found in Section C1. If data from a particular sense are flagged, this will prompt a review from the field team and outreach to the sensor host. The issue will be investigated and resolved by either ordering new parts for the monitor or ordering a new monitor altogether.

Table 12c below shows the codes we've developed for when reviewing episodic sampling results. These codes will be applied upon the final data validation step before publicly sharing any results.

Code	**Meaning**	**Examples**
0	Invalid	Major error(s) occurred in either field QC and laboratory QC procedures (e.g. negative pressure reported when sample was collected is not the same when it arrives at the lab, if SUMMA canister doesn't hold pressure after processing the sample, or if during the process of withdrawing sample, the lab detects an error) and note is made explaining the error. Major errors include any error that affects the integrity of the measurement.
1	Flag	Minor error (e.g. missing signature) occurred in either field QC and laboratory QC procedures and note is made explaining the error.
2	Valid	All Field QC and Laboratory QC procedures were followed.

Table 12c: Data Validation Codes for Episodic Sampling

B5 – Instruments/Equipment Calibration, Testing, Inspection, and Maintenance

Continuous Monitors Inspection Prior to Deployment

After the PurpleAir monitors arrive from the manufacturer and prior to installation at a host site, the project technician will plug the devices in to ensure they are able to power up. We will receive PurpleAir sensors in batches of 10-15 and will plug all of them in simultaneously to run for at least seven days prior to deployment in the field. We will install them next to a PurpleAir sensor that has already been running and reporting $PM_{2.5}$ readings similar to other sensors in the region, which we call the "reference PurpleAir (rPA)". The goal of running the sensors alongside one another and alongside the rPA is to identify any sensors that have median hourly $PM_{2.5}$, humidity, or temperature readings that are more than approximately 25% higher or lower than the rPA. If we identify a monitor where this is the case, we will order replacement sensors directly from PurpleAir. During this process, we are also looking out for monitors in which the A and B sensors are not in agreement. If this is the case, we will also order new sensors. Because the laser counters used in PurpleAir sensors come factory calibrated, the field team is operating on the assumption that as long as they report similar values for the week(s) in which they are running alongside one another, they are properly calibrated and ready to be deployed into the field. The goal of this is not to calibrate the sensors to a federal standard, but rather to ensure that the readings we're receiving from the sensors are reasonable and aligned with one another.

Once the equipment arrives, it will be recorded in this spreadsheet and the project technician will be sure to regularly check on the equipment, ensuring it is securely stored in the office space. Monitors regularly reporting outside manufacturer specifications (including sensor pair percent match where applicable) or not meeting the above DQOs will be programmatically flagged for repair or replacement. PT will attempt a field repair of PurpleAir monitors according to manufacturer instructions. If a repair is not possible or does not resolve the issue, a replacement device will be deployed. We will purchase spare parts directly from PurpleAir as needed and anticipate delivery and replacement of parts within one month based on past experiences with PurpleAir.

Reference Purple Air (rPA) Drift

Because we plan to compare the Purple Air monitors we're deploying to reference monitors upon receipt, we have developed a plan to determine if the rPA readings have drifted over time. We will run the rPA continuously for three weeks prior to placing new monitors beside it. During this time, we will compare the hourly $PM_{2.5}$ readings of rPA to the closest FEM during the same time period. After three weeks, we will assess the accuracy and precision of the rPA. We will do this by getting a three-week average of the hourly $PM_{2.5}$ readings from the rPA and comparing that to the three-week average of the hourly FEM readings. Every six months, we will compare another three-week period of readings between the rPA and the FEM. If the difference in the averages of the two monitors has changed by 30% or more, we will replace the rPA with a new one.

Equipment Storage and Cleaning

All equipment will be stored in a dry, temperature-controlled environment. When possible, the sampling equipment will remain in its original packaging until it's ready to be used. We will not use cleaning products such as isopropyl alcohol on any of the equipment and will avoid using markers with VOCs near the equipment.

Equipment	Storage and Cleaning Specifications
Tedlar bags, bucket, pump, and ancillary supplies	No cleaning products will be used on the surface of these materials and they will all be stored in a clean, dry environment.
SUMMA canisters	SUMMA canisters will arrive from the laboratory in a box with the pressure assembly ready for a sample to be collected. If there is a delay between delivery and sample collection, the canister and assembly will be stored in an upright position.
Sorbent tubes	One-time use, remain sealed in their original box until we arrive at the host site and uncap them.
Colorimetric Gas Detection Tubes	One-time use, remain sealed in their original box until we arrive at the sampling site and uncap them.
PID	Stored in its protective container at all times and transported in the container. Humidity discs are wrapped in plastic and stored in a plastic bag.

Continuous Monitor Troubleshooting

PurpleAir monitors will occasionally go offline for a variety of reasons including but not limited to:

- Power outage
- Wifi credential changes
- GFI or other breaker trip
- Water or other damage to equipment
- Bugs or debris

The public PurpleAir map makes it easy to see when monitors go offline and they can be checked periodically for issues. The dual-sensor feature of each PurpleAir monitor allows for quick cross-checking of sensors within each device. The EHP AirView app also has functionality enabling automatic emails to be generated when monitors on a list go offline. We may leverage this functionality as well. Once a monitor is determined to be offline for or reporting questionable data for 24 hours, the team will check with the monitor host to eliminate easily correctable power/GFI issues. If these do not address the issue then a site visit may be necessary to update the wifi information, repair, replace, or relocate a monitor. This form will be completed anytime a maintenance visit is required to ensure documentation of issues that arise with sensors. Additionally, we have developed a protocol for steps the Project Technician should take when a sensor goes offline that can be accessed here.

If host sites for PurpleAir monitors become inaccessible, we will attempt to collect the equipment and place it at a new site with comparable siting qualifications. If equipment is unretrievable we will make best efforts to connect with site owners to facilitate equipment retrieval. Lost or stolen equipment may be replaced with newly purchased equipment as budgets allow.

If a monitor or associated equipment is broken or damaged, the project technician will repair/replace on-site if possible, otherwise replace with back-up monitor until repair is achieved and swapped back into place. A form will be completed when maintenance is required.

If real-time data are outside of the expected range, the project technician will contact the monitor host to determine potential causes and work with those managing ESDR to flag data and make decisions regarding how to handle data outside of the expected range.

At the end of the study period, we will conduct an analysis to determine whether the sensor readings have drifted over the course of several years by comparing the readings to other sensors in the region, including the FEM at Fort McIntosh in Beaver, PA. The goal of this will be to understand whether the monitors have remained accurate and precise throughout the course of the project.

Discrete Sample Collection

Prior to going out into the field to collect samples, the project technician will conduct a physical inspection to ensure all components of the sampling device(s) are in order. They must be sure to identify any visual contaminants and clean or replace devices as necessary. For the PID, the PT will ensure that electrical components of the sampling equipment power on and check for battery levels (if applicable). All equipment will be stored in a clean and dry environment according to manufacturer specifications. We plan to rent SUMMA canisters and sorbent tubes from the laboratory on an as needed basis so any calibration or maintenance checks will be done by the manufacturer prior to shipment. Upon arrival at our worksite, we will inspect the equipment to make sure it meets the manufacturer's specifications. For the Tedlar bag and bucket method, we will inspect the Tedlar bag prior to going into the field to ensure it is not damaged or contaminated. We will also need to check the seal between the bag and lid of the bucket to make sure it is tightly sealed. We will have replacement ferrule rings on hand if the seal is not tight.

Discrete Sample Troubleshooting

Issues that may arise with the devices we're using for discrete sample collection include:

- Sampling equipment failure or damage, especially for the PID
- Sample contamination due to a broken Tedlar bag
- Loss of paperwork for chain of custody
- Loss of sample in transit to lab
- Failed pressure or leak checks upon receiving the SUMMA canister
- Failed pump when collecting a sample using the colorimetric gas detection tube
- Broken seal on sorbent tubes or colorimetric gas detection tubes prior to use

When problems occur with the PurpleAir sensors, sorbent tubes, SUMMA canister, Tedlar bags, or PID, they will be documented via this form with relevant date/time/conditions and the resolution of the problem, then emailed to team leadership for team assessment of corrective actions if any are still required at that time. Regular maintenance of equipment for VOC sampling includes verifying flow rate and collecting duplicate samples for SUMMA canisters and Tedlar bags twice a year. Any issues with equipment will immediately be communicated to the project manager within 48 hours and the appropriate steps will be taken to resolve equipment issues. The steps outlined in section B3 show the measures that will be taken to ensure quality assurance in the field for each sampling method. Below is a table that outlines the corrective actions that will be taken if issues are identified with the equipment. Appendix 36 provides more detail on each of these assessments and corrective actions.

Table 13: Maintenance and Calibration of Episodic and Continuous Sampling Equipment

Maintenance/Calibration				
Equipment Type	**Assessment**	**Corrective Action**	**Frequency**	**Performing Assessment**
PID Appendix 3: Photo-ionization Detector Operations and Appendix 36: Quality Assurance Activities	Bump tested every five times we use it or as needed and every 6 months, we will send the PID to Pine Environment for a 2-part calibration (Appendix 18). Appendix 19 is an example of the report we receive each time a calibration is performed.	If the PID fails the bump test, it needs to be sent to Pine Environment for repairs.	Every five times bump test; every 6 months calibration	Project Technician or MDAV
	Start-up tests: self-check, test to see if pump is working, test to see if disc is absorbing humidity. Appendix 36 details the checks that are performed each time the PID is used.	Device needs to be sent to Pine Environmental if it fails self-check or pump test. If the disc fails, it should be replaced with equipment we have and re-tested. If it still fails, it needs to be sent to Pine Environmental for repairs.	Every time it's used	Project Technician or MDAV
SUMMA Canister Pressure and Leak Check Appendix 36: Quality Assurance Activities	Leak Check	Ensure that the screws are tight on the valve, being careful not to cross-thread and over tighten the connection.Return canister to lab and request new one if issue is unresolvable	Every time the canister is used	Project Technician or MDAV
	Pressure Check	Refer to manufacturer instructions for troubleshooting and follow steps outlined in their guide	Every time the canister is used	Project Technician or MDAV
	Visible damage to SUMMA canister	Return the canister to the lab and request a new one.	Every time the canister is used	Project Technician or MDAV
PurpleAir	Upon delivery, each PurpleAir	If the readings are	As sensors	Project

Monitors	monitor should be plugged in and run alongside other monitors to ensure readings are reasonable and the monitor can connect to power and Wifi.	more than 25% different than the reference PurpleAir, new sensors should be ordered to replace the ones in the monitor.	arrive	Technician or MDAV
	Monitor appears to be offline	Conduct house visit to ensure monitor is connected to power and internet	As needed	Project Technician or MDAV
	Disagreement between A and B sensors in one monitor	Conduct house visit and check sensors to see if there is a visible interference with one or both of the sensors.	As needed	Project Technician or MDAV
	Issue identified after home visit that is unresolvable in the field	Replace one or both sensors in the monitor	As needed	Project Technician or MDAV
Sorbent Tubes Appendix 36: Quality Assurance Activities	Upon receipt, inspect each sorbent tube for damage or defects. Verify the integrity of the tube and its fittings.	If visible damage is noticed, the sorbent tubes should be returned to the manufacturer.	As needed	Project Technician or MDAV
	Check whether sorbent tube has been compromised while installed in the field	PT will inform PJM and the lab will be informed via the COC form. Meeting will be convened to determine how this affects interpretation of results from the lab.	Upon retrieving the sorbent tube from the field	Project Technician
Bucket Collection with Tedlar Bags Appendix 36: Quality Assurance Activities	Project technician is responsible for inspecting Tedlar bags upon receipt for damage or defects. PT is also responsible for ensuring the pump and all parts associated with it that are used in the bucket collection method are in working order.	If there is a hole in the Tedlar bag or it appears damaged, the bag should be disposed of and replaced with a new one. If equipment is not working, it needs to be replaced.	Before a sample is collected or once a month	Project Technician

Colorimetric Gas Detection Tubes Appendix 36: Quality Assurance Activities	The gas tubes are factory-calibrated at Honeywell according to the steps outlined in Appendix 20. They test at least five tubes against one another prior to packaging and calculate the average standard deviation from the standard gas value. Project Technician is responsible for inspecting gas detection tubes prior to use for damages or defects. PT is also responsible for ensuring that the pump and all parts associated with the method are in working order prior to deploying into the field. PT should ensure that the pump is calibrated to the appropriate flow rate for the target VOC.	If a tube is damaged or expired, discard it and use a new, intact tube. Properly store tubes according to the manufacturer's recommendations to prevent damage.	Upon opening the packaging	Project Technician

B6 – Inspection/Acceptance of Supplies and Services

The Project Manager, MDAV, and PT responsible for ordering, receiving, deploying, and retrieving equipment will record the monitor or sampling equipment serial number and/or ID number in the spreadsheet in Appendix 10 to track the equipment's location from ordering through deployment and decommissioning. The Quality Manager is responsible for ordering all equipment and supplies and the Project Technician is responsible for receiving, deploying, and retrieving all equipment and supplies. Ancillary supplies required for successful installation of PurpleAir monitors and sample collection can be found in Appendix 9. Each of these supplies will be inspected when it arrives at the office for any notable issues that are divergent from how it was manufactured. SUMMA canisters will be rented from the laboratory and sorbent tubes will only be used once before being sent back to the laboratory where they follow the appropriate cleaning and maintenance procedures. Additionally, the PID will be sent to Pine Environmental every six months to be calibrated.

Table 14: Supply Inspection and Acceptance

Supplies that may directly or indirectly affect the quality of the data	**Describe or reference the procedures for how supplies and services are inspected and accepted**	**Individual Responsible for Inspecting and Accepting Project Supplies**

SUMMA canisters	Check received inventory against order. Visually inspect for defects. Conduct pressure check and leak test prior to collecting sample.	Project Technician
Tedlar bag, bucket, vacuum pump, tygon tubing, screws, and washers	Check received inventory against order. Visually inspect for defects. Defects include punctured Tedlar bag, missing components of the bucket including the ferrule ring or the screws attached to the lid. Each time the bucket is used, it should be checked to ensure it has all necessary components. The pump used to remove air and the tubing should also be visually inspected and turned on prior to use.	
10 ppm isobutylene for PID bump test	Check received inventory against order. Visually inspect for defects or leakage. Ensure the isobutylene has a Certificate of Analysis (COA) showing that it has been tested and contains the proper amount of isobutylene. The COA can be found in Appendix 45.	
PurpleAir sensors	Test whether PurpleAir device turns on and produces wifi signal.	
Sorbent Tubes	Check received inventory against order. Visually inspect for defects. Tubes should be sealed completely with lids tightly on to ensure no contamination.	
Colorimetric Gas Detection Tubes and pump	Check received inventory against order. Visually inspect for defects. Tubes should be sealed completely with lids tightly on to ensure no contamination.	

B7 – Environmental Information Management

Type of Data	Generation	Storage
PurpleAir $PM_{2.5}$ Data	Data are gathered on the device continuously from the date/time of installation. Transmitted to PurpleAir cloud every 2 minutes.	PurpleAir Data will be automatically uploaded to the PurpleAir cloud storage via home wifi connection. CREATE Lab Project Technical Staff will collect the data and store it in ESDR.
PID Data	The PID provides real-time readings of total VOC concentrations in parts per billion (ppb). We will run the PID for at least 15 minutes during sampling to ensure we get a 15-minute average.	The instrument stores the measured gas concentration at the end of every sample period (when data logging is enabled). In addition, the following information is stored: user ID, site ID, serial number, last calibration date, and alarm limits. All data are retained (even after the unit is turned off) in non-volatile memory so that it can be down- loaded at a later time to a PC. The maximum time for one event is 24 hours or 28,800 points. If an event exceeds 24 hours, a new event is automatically created. We will upload data from the PID to the Project Technician's laptop every two months and that data will be saved in Basecamp.
Discrete Sample Collection	Sampling information will be recorded in the form found in Appendix 7 and pictures will be taken of sample setup. Details may also be recorded in a field notebook if access to a mobile device or internet is unreliable in the field. If recorded in a field notebook, the page will be scanned and uploaded to Basecamp.	Laboratory analysis of the VOCs will be conducted. The results from that analysis will be posted in AirTable and can be accessed by project staff. Reports from this Airtable hub will be accessible to all project partners for a minimum of three years and used to archive and retrieve sampling results for data report generation.

Table 15a: Generating and Storing Data

Record Keeping

Episodic Monitoring

While the project technician is out in the field, they will complete the form in Appendix 7 outlining time, location, and reason for sampling. Relevant sampling details will also be captured in field notebook and then scanned/photographed after each outing is completed. Resultant images will be uploaded to

Basecamp. Basecamp is a platform designed for collaboration among team members. In order to access this project's Basecamp platform, the PJM needs to add an individual's email address and contact information. Access can be removed and the participant will no longer be able to see anything posted on Basecamp. This is a secure way to share files and communicate with project members.

Data from handheld monitor or lab-generated reports will be entered into Airtable database maintained by the CREATE Lab. The Google Form in Appendix 7 will also be used to track reasons for sampling, location of sample collection, sample time, and sample date. We will also use this form to track any factors that might influence the results of the lab analysis such as an idling car or wildfires. These will be helpful to know in order to interpret the results provided by the laboratory. To ensure that data are properly entered into the Airtable database, the original document will be scanned and a PDF will be saved to Basecamp. This will ensure that no errors are made during data entry and any errors that are made can be corrected.

Continuous Monitoring
Essential PurpleAir records (i.e. installation location, purchase date, and registration date/time) will be collected using a Google Form and stored in a Google spreadsheet. PT will review the PurpleAir Installation Checklist prior to completing an initial installation.

Table 15b: Data Reviewing, Reporting, and Archiving

Reviewing	Reporting	Archiving
Data that doesn't meet DQOs will be reviewed and rejected before moving on to summarization/ analysis by the QAM using Airview (see example Airview Quality Assurance Report in Appendix 9).	Quarterly data summaries and webinars for residents of target ZIP codes.	Data will be stored in ESDR in perpetuity

Group C: Assessment and Oversight

C1 – Assessments & Response Actions

The Quality Assurance team must regularly conduct assessments to ensure that usable environmental information is being collected. This requires verifying the data by ensuring equipment is properly stored and used in addition to making sure that information is stored securely in the places outlined in this document and not outside of those locations. The Quality Assurance team must also validate the data by reviewing it as it is received from the laboratory and EHP to make decisions about whether to qualify or omit certain pieces of data.

Table 16 below outlines the assessments that will be done on a periodic basis of the data coming in from continuous monitoring and episodic sampling as well as assessments of project team members. These assessments are separate from the ones done on a regular basis prior to sampling or daily to ensure PurpleAir monitors are functioning properly. The Data Quality Assessments will be used to adjust our sampling thresholds as needed if we find that thresholds are not being met or are being met too frequently for the number of samples we aim to collect in a project period.

The Project Manager is responsible for ensuring that equipment meets the quality standards outlined in this QAPP. The QAM is responsible for deciding whether data we collect are valid given the parameters outlined in the QAPP. The assessments outlined in Table 16 will be important tools when making the ultimate decision of whether data from the project are acceptable. That responsibility lies with the Quality Assurance Manager in consultation with the Monitor and Data Advisors (MDAV), Project Technician, Program Manager, and Project Manager.

Table 16: Assessment and Corrective Action

Type of Assessment	Frequency	Performing Assessment	Response to Assessment Findings	Individual Responsible for Corrective Action
Data Quality Assessment Continuous PurpleAir $PM_{2.5}$ Monitors	As data are reported through EHP	Quality Assurance Manager	Project Technician and Project Manager	Project Manager
Data Quality Assessment Episodic Monitorings	As data are reported by analytical laboratory	Quality Assurance Manager	Project Technician, MDAV, and Project Manager	Project Technician, MDAV, and Project Manager
Readiness to sample	After training	Project Manager, MDAV, Project Technician	Project Technician	Project Manager
Readiness to install	Upon request	Project Manager, MDAV, Project Technician	Project Technician	Project Manager
Review of calibration reports for PID	Semi-annually	Project Technician and MDAV	Project Manager	Project Manager
Performance evaluations	Semi-annually	Program Manager	Project Manager, Project QA Manager, Project Technician	Project Manager, Project QA Manager, Project Technician
Management reviews	Semi-annually	Program Manager	Project Manager, Project QA	Project Manager, Project QA

			Manager, Project Technician	Manager, Project Technician
Peer reviews	Semi-annually	Project Manager, Project Technician, Project QA Manager	Project Manager, Project Technician, Project QA Manager	Project Manager, Project Technician, Project QA Manager
Data storage reviews	Semi-annually	Project Manager	Program Manager	Quality Assurance Manager
Equipment storage and inventory reviews	Semi-annually	Project Technician	Project Manager	Project Manager

C2 – Oversight and Reports to Management

Table 17: Quality Control Oversight

Type of Report	Frequency	Method for Report Transmission	Responsible for Report Transmission	Report Recipients and Organization	Approval Frequency
PurpleAir Installation	Concurrent with every monitor deployment	Installation Form	Project Technician, Breathe Project	Project Manager, Breathe Project	Within one week of receipt
PurpleAir Maintenance	Anytime a sensor is offline and a corrective action is needed	Maintenance Form	Project Technician, Breathe Project	Project Manager, Breathe Project	Within one week of receipt
Sampling Collection Reports	Concurrent with every sample collected	Sample Collection Form	Project Technician, Breathe Project	Project Manager, Breathe Project	Within one week of receipt
Sampling Collection Equipment Issues	Anytime an issue is found with any of the equipment and a corrective action is needed	Maintenance Form	Project Technician, Breathe Project	Project Manager, Breathe Project	Within one week of receipt
Continuous Monitor Status Reports	Monthly	via email	EHP MDAV	Project Manager, Breathe Project	Within one week of receipt

Quarterly Progress Report	Quarterly	via email	Project Manager, Breathe Project	EPA Project Officer	Within one week of receipt
Final QA Report	Upon project completion	via email	QAM, QM	EPA Project Officer	Within one week of receipt

Group D: Data Validation and Usability

D1 – Environmental Information Review

The Project Manager is responsible for overseeing field QA activities and for reviewing reports from laboratories that confirm the proper QA procedures were followed. Appendices 27 and 28 show the qualifying codes used by the laboratories in their sample reports they'll provide to us. We plan to utilize EPA Qualifiers as well as the codes in Table 12c when reporting results from episodic sampling. In the form we're completing when we collect samples, we'll make note of any external factors that could have influenced sensor readings. If we identify an activity that might have influenced the results that's not included in the EPA Qualifier code list, we will provide details in the field notes section of the form. If the Project Manager identifies that QA procedures were not followed during sample collection or if the laboratory reports that they did not follow their QA procedures, a meeting will be convened with the quality assurance team to make a decision on whether to qualify the data when reporting it. The final determination will be made by the QAM with support from the MDAV, PT, and PJM. Below is an outline of the steps that will be taken to ensure that data are verified and valid prior to reporting results to the public.

Table 18: Data Review

Instrument	Laboratory or Field	Review	Verification	Validation

TO-15, TO-11, 325A/B, Colorimetric Gas Detection Tube Samples	Field	Upon sample collection, the PT will ensure that proper conditions were met and QC protocols were followed during collection.	Each sample must be uniquely identified and accompanied by a valid and legible COC form. Prior to shipment to laboratory or reporting results, PT will make sure that all equipment was functioning properly and that field conditions were appropriate for use of the specified method. PJM will collect samples with PT and MDAV at least once every six months to ensure proper protocol is being followed.	Every six months, the QAM will review the equipment storage protocols and technique for collecting samples. QAM will also review the samples collected against the DQO outlined in Table 3 to ensure the data we're collecting meets the accuracy, precision, and completeness expectations.
TO-15, TO-11, 325A/B	Laboratory	Upon receipt of the sample, lab will follow QA procedures to check that the sample has not been compromised	Each sample must be accompanied by documentation from the laboratory that the sample met all requirements for handling and hold times, and that analysis equipment was properly calibrated and maintained for the associated sample.	Validation will occur every six months by QAM. This will involve reviewing the results received from the laboratory and comparing them to PID readings from that period to ensure they are in the normal range, ensuring that the laboratory results show they followed their QA procedures, reviewing the lab results for spiked samples and blanks, and investigating any anomalies.

PID	Field	As outlined in B4	Conformance to requirements during PID deployment according to the user manual and the checks outlined in Appendix 36. PJM will accompany PT and MDAV every six months at least to ensure proper protocols are being followed in the field.	Data will be validated by the QAM through a quarterly review of readings from the PID. If any readings are out of the normal range, the quality assurance team will meet to discuss whether to qualify or omit that data depending on the factors that might have influenced them.
$PM_{2.5}$ data from PurpleAir	Field	As outlined in B4	PT will confirm that there was conformance to requirements during PurpleAir deployment including 270° unobstructed sensor inlet, sensor location >2m above ground-level, and located > 10m from on-site emissions sources, e.g. dryer vents, sewer vents, or generators.	Data will be validated using the AirView QA console. This system flags data for review for five possible reasons: sparse, outside sensor range, outside operating temperature, outside operating humidity, and co-located sensor disagreement, further codes and definitions outlined in B5. Readings with any flag will be compared to nearby readings alongside temperature and humidity data to either retain or discard for final analysis.

In Table 19 below, we describe verification, validation, and data dissemination processes. While these are included in the same table, the verification and validation processes are Data Quality Assessments (DQA) that determine whether QA meets or fails the project data quality objectives as a whole. The results of the DQA make the determination of data usability and may help lead changes in the study design or interpretation of the data. Dissemination is the process through which data are are reported on internally.

Table 19: Verification and Validation of Data

Field QC for TO-15, 325A/B Samples				
	Process	**Acceptance**	**Resolution of**	**Responsibility**

		Criteria	Data Issues	
Verification	PJM will review forms completed by PT and MDAV to ensure that all necessary steps were taken prior to, during, and after sampling.	The PJM would accept the data if all collection steps match what is outlined in the QAPP and appropriate corrective actions were taken when needed.	If the PJM or QAM identify that the appropriate steps were not followed when collecting the sample, they will notify the QAM and PM to convene a meeting and make a decision about whether to accept the data.	MDAV, PT, and PJM
Validation	QAM will review results reported from the laboratory to ensure their QA procedures were followed.	QAM will accept the data if it meets the DQOs outlined in A6 and all values are in the normal range.		QAM
Data Dissemination	Via Google Form reports and emails for internal use			
Laboratory QC TO-15, 325A/B Samples				
	Process	**Acceptance Criteria**	**Resolution of Data Issues**	**Responsibility**
Verification	EPA certified lab will develop a report that outlines results from their QA/QC procedures as well as results from samples we provided.	All receipt and custody information matches SOP requirements. Siting requirements met and documented.	The PJM and quality assurance team will review reports shared from the laboratory to identify any qualified data and decide how findings from that data should be presented to the public.	Staff, EPA-certified lab
Validation	QAM will review results reported from the laboratory to ensure their QA procedures were	DQOs from A6 met.		QAM

	followed and all values are in the normal range.			
Data Dissemination	Via data review reports			
tVOC data from PID				
	Process	**Acceptance Criteria**	**Resolution of Data Issues**	**Responsibility**
Verification	Verification will be done by ensuring that each of the QC field activity measures were taken prior to collecting a sample.	PJM will review sample collection form to ensure proper procedures were followed.	If the PJM identifies that the appropriate steps were not followed when collecting the sample, they will notify the QAM and PM to convene a meeting and make a decision about whether to accept the data.	PT, Breathe Project
Validation	Validation to be completed by QAM after collection to ensure readings are in line with what is considered normal range.	PJM will review readings to confirm DQOs in A6 are met.		QAM
Data Dissemination	Via data review reports			
$PM_{2.5}$ data from PurpleAir				
	Process	**Acceptance Criteria**	**Resolution of Data Issues**	**Responsibility**
Verification	Verification to be completed by installation quality forms and on-site monitor check forms.	Siting requirements met and maintained.	If the PJM identifies that the appropriate steps were not followed when installing the sensor, they will notify the QAM and PM to convene a meeting and make a decision about whether to accept the data.	PT, Breathe Project
Validation	Validation to be completed through use of EHP AirView QA console [Appendix 8].	DQOs from A6 met.		

Data Dissemination	Via data review reports			

D2 – Useability Determination

The Quality Assurance Manager (QAM) will ultimately be responsible for determining the useability of data collected throughout the study period by reviewing and validating it against the project's defined DQOs. Table 21 shows the timeline for reviewing and approving data received through each of the methods used for data collection. The PJM will ensure that the study team follows proper procedures when the equipment is initially received, ensuring that maintenance is done on each piece of equipment according to procedures outlined in sections B and C, and following the appropriate procedures when sample collection occurs. Additionally, sample integrity must be maintained from sample collection through shipment to and processing at the laboratory. Reviews of data will be completed on a regular basis according to the timeline below to determine which pieces of information can be used and which should be qualified. We will only omit data if proper collection or analysis procedures were not followed.

Table 20: Timeline for Verifying and Validating Data

Method	Item for Review	Review Timeline	Reports from Review
Episodic Sampling (TO-15, TO-11, 325A/B)	Field collection procedures	Every two months	All reports will be stored in the spreadsheet found in Appendix 41: Useability Determination
	Equipment storage	Quarterly	
	Laboratory analysis data review	Bi-annually	
PID	Data Review	Quarterly	
	Sample collection process review	Every two months	
PurpleAir	Data review	Monthly	
	Installation process review	Every two months	
Colorimetric Gas Detection Tubes	Equipment storage	Quarterly	
	Sample collection process review	Bi-annually	

For continuous data, the AirView QA portal will be an important tool in flagging data and determining whether it is usable. AirTable will be used to verify and validate data from episodic and background sampling. Table 21 below shows the codes that will be used to qualify data once we've received it from the lab. Limitations of both continuous data and episodic sampling information will be communicated within reports shared with the community by outlining the steps we took to ensure accurate, precise, and complete data while being clear about the limitations presented by the equipment used. Table 22 shows the limitations of each method. If the PJM suspects that samples were not collected in accordance with the QAPP, a meeting will be convened with the Quality Assurance team to determine whether the data should still be reported out.

Code	Meaning	Examples
0	Invalid	Major error(s) occurred in either field QC and laboratory QC procedures (e.g. negative pressure reported when sample was collected is not the same when it arrives at the lab, if Summa doesn't hold pressure after processing the sample, during process of withdrawing sample, the lab detects an error) and note is made explaining the error. Major errors include any error that affects the integrity of the measurement.
1	Flag	Minor error (e.g. missing signature) occurred in either field QC and laboratory QC procedures and note is made explaining the error.
2	Valid	All Field QC and Laboratory QC procedures were followed.

Table 21: Data Validation Codes

Table 22: Method Limitations

Method	Limitations
TO-15 w/ SUMMA Canister	Sensitivity can vary depending on the specific compound and the quality of the equipment used. The TO-15 has higher detection limits for some VOCs, which might not be suitable for detecting very low concentrations of the VOCs we're interested in. Additionally, this method requires rental of equipment from the laboratory, meaning there might be a delay between when we request the equipment and when we are actually able to take a sample. Accuracy and precision limitations include field QC activities being limited by budget constraints.
TO-15 w/ Tedlar Bag	In addition to limitations written above with the TO-15 method, the stability of a sample collected using a Tedlar bag can be compromised over time, meaning

	we need to quickly get it to the lab after sample collection within 24 hours. Additionally, this sample is collected over a period of several minutes, meaning what is captured during that small time period might not represent what's in the air over a longer period of time.
325a/b	Detection limits and low sensitivity to certain VOCs. Sorbent tubes are affected by weather such as precipitation, high wind, or low temperatures, which can impact the rate of VOC uptake.
Colorimetric Gas Detection Tubes	Limited detection range means we might not detect a VOC that the tube is not designed for and low sensitivity means we will only detect VOCs once they reach concentrations greater than 1 ppm. Temperature and humidity can impact the effectiveness of the tube. PT needs specific training in order to correctly interpret the results of the tube.
PID	Limited detection range and sensitivity and there may be calibration drift over time, which requires conducting calibration on a regular basis.
PurpleAir $PM_{2.5}$	While sensors are relatively accurate, they do not provide laboratory-grade readings. Environmental factors can influence their accuracy and sensors may experience drift over time.

Appendices

References

Hurdle, J. (2023, February 3). Advocates issue intent to sue Shell's new petrochemical plant for emissions violations. *Public Source*. https://www.publicsource.org/intent-sue-shell-petrochemical-plant-cracker-emissions-violations-beaver/

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