REQUEST FOR PROPOSALS

AIR MONITORING AND SOURCE APPORTIONMENT IN UNDERSERVED COMMUNITIES, FRANKLIN COUNTY, OHIO

The Mid-Ohio Regional Planning Commission (MORPC) is requesting proposals from firms to provide professional services for a real time local air quality modeling platform to calculate $PM_{2.5}$ concentrations and source contributions from mobile, area, point, background, and non-road sources in Franklin County, Ohio. The consultant will also integrate air sensor data into an online dashboard that summarizes spatial and temporal findings in a publicly digestible format.

MORPC is a voluntary association of local government communities in the 15-county Central Ohio area. Our organization strives to enhance the quality of life and competitive advantages of Central Ohio by working through local governments and other constituents. A catalyst for change, evidence of MORPC's work is seen every day through planning, programming and services in the areas of housing, transportation, water, land use, economic development, environment, public policy and technology. We assist our local government members by providing innovative solutions for the many challenges facing our growing region.

Consultants interested in being considered must submit a **PDF format copy of their proposal via email** to **bwhetstone@morpc.org** with subject line Air Pollution Modeling and Source Apportionment. Proposals will be received by MORPC until 5:00 PM (ET) on Monday, June 3, 2024.

Submit proposals to:
Brandi Whetstone
bwhetstone@morpc.org

All questions must be submitted in writing to Brandi Whetstone at bwhetstone@morpc.org. No answers will be given over the phone. Written answers, including amendments to the RFP, if necessary, will be posted on MORPC's website. Responses to questions will be posted at http://www.morpc.org/rfps-rfqs/.

The Mid-Ohio Regional Planning Commission in accordance with Title VI of the Civil Rights Act of 1964 and the related nondiscrimination statutes, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, all bidders including disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin, sex, age, disability, low-income status, or limited English proficiency in consideration for an award.

Neither MORPC nor any member agency of the Committee shall be liable for any costs incurred by the consultant in response to this RFP, or any costs incurred in connection with any discussions, correspondence or attendance at interviews or negotiation sessions.

All materials submitted in response to this RFP shall become the property of MORPC and may be returned only at MORPC's option.

All materials received shall be considered public information and shall be open to public inspection.

Contents

I. OVERVIEW/PROJECT BACKGROUND

This is a Request for Proposal to seek a consultant to assist with data collection, monitoring, and modeling of $PM_{2.5}$ air quality data for the Central Ohio region. MORPC began its low-cost air quality monitoring program in 2022 and aims to expand the modeling impact of the project with the consultant's help.

MORPC's neighborhood air quality monitoring project, titled the Community Led Enhanced Air Quality Network (CLEAN), co-created and -led by MORPC and Franklin County Public Health, measures air pollution neighborhood-by-neighborhood in Franklin County. By gathering more data at the local level, this project will help provide a baseline understanding of pollution concentrations comparing across a variety of locations and with regulatory monitors, increase awareness about local air quality and the potential health impacts, and guide the strategies that go into making the region's air healthier and easier to breathe. The project utilizes PurpleAir sensors that collect data on particulate matter ($PM_{2.5}$), temperature, and humidity. Measurements of $PM_{2.5}$ concentrations will be collected with 50-60 sensors placed throughout Franklin County. The specific locations will be chosen with input from a project advisory committee and the consultant, however the locations generally will be selected within zip codes whose residents are more likely to be underserved populations and impacted by poor air quality, as identified through data aggregation. The locations will also be chosen to provide distributed coverage throughout the county. More information is available at www.morpc.org/airquality.

SCOPE OF SERVICES/PROJECT SCOPE/STUDY PURPOSE & APPROACH

The consultant will provide technical services including data collection and analysis, photochemical air modeling, development of a public-facing dashboard, and reporting. The consultant will attend quarterly Project Advisory Committee (PAC) meetings, and with input from the PAC, advise on sensor siting using a data driven approach primarily focused on disadvantaged populations with an elevated risk of health-related outcomes from pollution exposure. The data generated by the sensors and photochemical model will be used to compare pollution levels at established time increments between sensor locations and with Ohio EPA's continuously reporting $PM_{2.5}$ monitors, as well as provide data on pollution patterns and regional source contributors (vehicles, freight, industrial, wildfires, etc.). This data will also inform quarterly and a final report which will include recommendations for reducing exposure and mitigating local sources. Additional tasks are outlined in the scope of services. This data will not be used to characterize the county's air quality for regulatory or attainment purposes.

The final scope of services will be developed during a project scoping meeting, but should include at a minimum:

1. System Setup
    a. Review and provide feedback on sensor sites and sensor placement.
        i. Provide consultation to the project team and PAC utilizing a Vulnerability Index Map and data to identify sensor locations within PAC identified target areas.
2. Data Collection & Monitoring

   a. Collect, monitor, and analyze the PurpleAir sensor data gathered at a hyperlocal level.
      i. Automated retrieval of data from the PurpleAir database using a configuration and frequency that is financially sustainable in coordination with the MORPC team.
      ii. Collaborate with MORPC to apply consistent data schema requirements, and data retrieval scripts, to ensure data handling and other processes are consistent.
      iii. Provide monthly excel/csv tables of the sensor data in a format agreed upon with MORPC.
      iv. Perform evaluation of the performance and lifetime of sensor equipment.

3. Modeling
   a. Develop and/or implement hyperlocal time variant $PM_{2.5}$ (photochemical) model to provide insights on $PM_{2.5}$ pollution levels and sources, utilizing the data collected by MORPC's PurpleAir sensors.
   b. Apply modeling tools to identify source contributions incorporating both modeled and measured data to the census tract level.
4. Reporting and Summarizing of Data
   a. Break down findings at time intervals: hourly, hour of the day, daily, days of the week, monthly, quarterly, day or week of year, and annually.
      i. Make available to the public processed $PM_{2.5}$ data via a public cloud file storage platform (e.g. Google Drive, SharePoint, etc.) or another platform mutually acceptable to the contractor and MORPC.
   b. Create a community-focused, multilingual dashboard
      i. Host this resource online, which can be linked to websites and displayed as live air quality screens at identified locations throughout Franklin County. The dashboard should include current $PM_{2.5}$ levels based on agreed upon time intervals, and links to additional resources.
   c. Present findings from in-depth data analysis every 3 months to the project team and the Project Advisory Committee and provide expertise as necessary in meetings.
   d. Provide quarterly reports to fulfill grant requirements.
   e. Advise on the development of educational materials focused on the purpose of air sensors, the sensor data, and any relevant findings that the project team would like to communicate to the public and the PAC.
5. Quality assurance and control
   a. Become familiar with and follow procedures outlined by the approved Quality Assurance Project Plan (**available in Appendix A**).
   b. Complete the ascribed quality processes at an interval agreed upon by MORPC.

PROPOSAL FORMAT

The proposal must address the following items in the following order. Failure of the proposal to respond to a specific requirement may be a basis for elimination from consideration during the comparative evaluation. MORPC reserves the right to accept or reject any or all proposals.

Each consultant shall submit a formal proposal not to exceed FORTY (40) 8.5" x 11" pages (excluding tabs, dividers, etc.) and shall contain the following sections:

A) Cover Letter
B) Organization, Personnel, Experience & Project Management
   a. Consultant's Personnel Profile and Corporate Qualifications
   b. Project Team Availability and Capacity

c. Project organization chart showing key personnel, their relationships and affiliations

C) Consultant's Methodology/Work Plan
D) List and Description of Deliverables
E) Project Schedule
F) Budget or Cost Proposal
G) MORPC Disadvantaged Business Enterprise (DBE) Goal Compliance/Subcontracting

A.) COVER LETTER

The **cover letter** shall be signed by a representative authorized to legally bind the firm, and include:

- Name, telephone number, and e-mail address of a contact person with authority to answer questions regarding the proposal (ideally the day-to-day project manager for this work).
- Name, address, and phone number of a contact person to be notified regarding contractual issues.
- Identification of the firm as a corporation or other legal entity.
- Will meet the MORPC DBE goal and be signed by a representative authorized to legally bind the firm.

The letter shall state that the proposer:

- Has sole and complete responsibility for delivery of the required services.
- Is presently not debarred, suspended, proposed for debarment, declared ineligible or involuntarily excluded from covered transactions by any federal department or agency or the Ohio Department of Transportation.

B.) ORGANIZATION, PERSONNEL, EXPERIENCE & PROJECT MANAGEMENT

CONSULTANT'S PERSONNEL & CORPORATE PROFILE

Specific background information on key individuals who are anticipated to be assigned to the project should be included, most notably the project manager. The background information on these individuals would emphasize their experience relative to project requirements. A statement concerning the recent related experience of persons from your team who will be actively engaged in the proposed effort should also be included. Attach resumes of the project manager and other key personnel to the proposal. A general resume is not a satisfactory substitute for this information.

Identify similar projects undertaken by your firm or proposed team firms a) within Ohio and b) in other states. Document each firm's actual responsibility on the project. Provide appropriate reference(s), name(s) and telephone number(s).

PROJECT TEAM AVAILABILITY & CAPACITY

Identify the location of the office where most of the work is to be performed. Discuss your staff's availability and capacity in the skill classes necessary to accomplish the work contemplated in the work elements as outlined in your technical approach. Specifically, break the staffing down by the number of professionals, technicians, and other specialists and indicate the number of each available for assignment to this project. Provide a list of the firm's present workload relative to capacity and availability to provide the requested services.

The consultant should note that as a condition of the contract the key persons, as defined by MORPC, assigned to the project for its duration must be substantially as represented in the proposal. MORPC reserves the right to cancel the contract and seek damages from the consultant

in the event the consultant fails to provide the key personnel substantially as represented in the proposal.

PROJECT ORGANIZATION CHART SHOWING KEY PERSONNEL, THEIR RELATIONSHIPS AND AFFILIATIONS

This section shall provide an overview of each key personnel working on the project and show their relationship to the firm and their affiliations. It shall identify the firm's/team's principal-in-charge and the day-to-day project manager together with their qualifications as well as a brief outline of the potential roles and qualifications of other key personnel. If subcontracts are utilized, the position in the project team and identity of the sub-contractor shall be stated.

CONSULTANT'S PERSONNEL, CORPORATE PROFILE & PROJECT ORGANIZATION

Specific background information on key individuals who are anticipated to be assigned to the project should be included, most notably the project manager. Identify the location of the office where the majority of the work is to be performed. This section shall also provide an overview of each key personnel working on the project and show their relationship to the firm and their affiliations. Identify any diversity and inclusion efforts the consultant is taking or will take.

C.) CONSULTANT'S METHODOLOGY/WORK PLAN

This section shall indicate the consultant's understanding of the project scope of work, a definition of the scope of the project (including a discussion of the tasks to be performed to accomplish the scope of work), a definition of the final product, and the consultant's approach to the project (including the estimated time of completion for key tasks, phase deliverables, the management organizational chart, and identification of the Committee's roles in the project).

The consultant's proposal shall contain a step-by-step explanation and description of the methodology to be employed and how the methodology addresses MORPC's scope of work. The consultant's proposal shall further contain a detailed level of effort. In addition, please explain any aspect of your method that is unique or innovative.

Also, administrative information, such as the consultant's status reporting procedures and the consultant's approach to effective communication with MORPC personnel and sub-consultants, shall be included.

D.) LIST AND DESCRIPTION OF DELIVERABLES

Through a coordinated effort and collaboration between MORPC, Franklin County Public Health (FCPH) and the consultant, the alignment and achievement of project goals and objectives will be ensured. This will involve the collaborative development, tracking, management, and measurement of relevant project metrics, including inputs, outputs, and outcomes, with detailed documentation provided on the approach and implementation.

The consultant's proposal shall list and describe the deliverables for each identified task that are part of the various steps of the methodology. All materials created and submitted throughout the lifetime of the projects related to the contract shall become the property of MORPC. All materials received shall be considered public information and shall be open to public inspection.

E.) PROJECT SCHEDULE

Included as part of the proposal, the proposer shall provide a schedule identifying all tasks and sub-tasks, all deliverables, and time in the scope of work. The project should be completed by June 30, 2026. If the consultant believes this will adversely affect the quality of the project, the consultant should explain why.

Key dates/time period	Event
July 2024	Estimated start date & orientation meeting.
August 2024	Advise the deployment of low-cost $PM_{2.5}$ PurpleAir sensor locations and sites, with deployment of sensors completed by MORPC/FCPH by end of August/early September. Quality assurance and quality control processes documentation submitted. Preparation of source apportionment model; begin $PM_{2.5}$ data collection from PurpleAir sensors and identify source contributions (ongoing through duration of project).
September 2024	Present at Project Advisory Committee meeting (date TBD). Provide input on educational materials. Quarterly summary of activities due.
October 2024	Multilingual Air Quality Analysis Dashboard (AQAD) goes live, preferably via ArcGIS Online.
December 2024	Participate in Project Advisory Committee meeting (date TBD). Quarterly summary of activities due.
January 2025	Calculations of confidence and lifetime of sensors begin.
February 2025	Six-month technical report due end of month.
Ongoing in Spring/Summer 2025	Support community outreach and engagement, as needed, with MORPC/FCPH.
March 2025	Present at Project Advisory Committee meeting (date TBD). Quarterly summary of activities due.
June 2025	Participate in Project Advisory Committee meeting (date TBD). Quarterly summary of activities due.
August 2025	Six-month technical report due end of month.
September 2025	Participate in Project Advisory Committee meeting (date TBD). Quarterly summary of activities due.
December 2025	Participate in Project Advisory Committee meeting (date TBD). Quarterly summary of activities due.

January/February 2026	Conclude 18-month $PM_{2.5}$ data collection period; begin analysis of this data and patterns.
February – March 2026	Determine agreed upon format for the final analysis and report.
March 2026	Participate in Project Advisory Committee meeting (date TBD). Quarterly summary of activities due.
April 2026	Meet with project team to review status of final analysis and report to solicit input. Incorporate best practices and recommendations in the final draft from MORPC and FCPH team.
May 2026	Submit final analysis and report draft to project team for review; meet with project team to present the final report. Finalize report by end of May.
June 2026	Present to Project Advisory Committee meeting (date TBD). Quarterly summary of activities due. Analysis of confidence and lifetime of sensors due, incorporated into final quarterly activities report.
June 30, 2026	Contract ends; final deliverables due.

F.) BUDGET OR COST PROPOSAL

The expected budget for this task should not exceed $221,000. Additionally, MORPC will provide the following services for the project, including:

- project and contract management
- data and GIS support
- public involvement (facilitation assistance and facility use)
- website hosting

The proposer should be aware that the project is funded with U.S. EPA funds and will be subject to all the requirements thereby imposed.

The proposer should be aware that it is the goal of MORPC to process and pay properly prepared and submitted invoices within 60 days, although that is not guaranteed. Improperly prepared and submitted invoices will be returned and will consequently not be processed and paid within the 60-day goal. Proof of payment will be required for all charges included on invoices.

PROCUREMENT PROCESS

RFP TIMELINE

The schedule for the RFP is given below. Dates are tentative and may be modified by MORPC as necessary.

Key Date	Event
May 6, 2024	Proposal is posted on MORPC website for interested parties to retrieve at 9:00 a.m.
June 3, 2024	Completed proposals due to MORPC by 5:00 p.m.
June 3 - June 14, 2024	Evaluations of proposals.
June 13, 2024	MORPC Board meeting to approve resolution for contractor work.
June 17 – June 21, 2024	Oral presentations at MORPC, if required.
June 24, 2024	Evaluation Committee makes recommendation and informs consultant.
June 25, 2024	Contract preparation begins.
July 19, 2024	Contract finalized.
July 22-26, 2024	Project begins with orientation meeting.

The selection of the project consultant will follow a multi-step process. The first step will be an evaluation of the written proposals using the criteria listed below.

EVALUATION CRITERIA

The evaluation criteria are as follows:

1. **General Quality & Adequacy of Response (5%)**
    a. Completeness and thoroughness
    b. Responsiveness to terms and conditions
    c. Overall impression
2. **Organization, Personnel, Experience & Project Management (40%)**
    a. Qualifications and experience of proposed personnel, including project manager
    b. Relevant knowledge, skills & experience with the project
    c. Experience working with similar clients
    d. Demonstrated capacity to do the work
    e. Study Area Understanding/Local Presence:
        i. Familiarity with the study area's characteristics
        ii. Familiarity with the study area's economy, culture, and environment
        iii. Capacity to locally coordinate and administer the project
3. **Technical Approach & Work Plan (40%)**
    a. Clarity and organization in concept development
    b. Quality and quantity of services to be rendered
    c. Approach to study, including the ability to derive creative solutions. Clear description of elements of the work plan:
    d. Addresses expected outcomes:
        i. Identifies who will do the work
        ii. Includes realistic & sufficient timelines
        iii. Includes reasonable & useful reporting timelines
    e. Specialized experience relevant to the work scope
4. **Cost/Budget (15%)**
    a. Clarity of budget and congruence with RFP and proposed scope of work
    b. Cost

EVALUATION COMMITTEE

The Committee will conduct the evaluation of proposals and reserves the right to reject any and all proposals in whole or in part received in response to this request. The Committee may waive minor defects which are not material when no prejudice will result to the rights of any other consultants or to the public.

The second step would include oral presentations. Depending upon the relative merits of the proposals, two or three of the consultants will be invited to give an oral presentation and respond to questions from an interview panel. The second step may be waived if the Committee finds from the evaluation in the first step that one team is clearly more qualified to perform the study than the other teams.

ORAL PRESENTATIONS

At MORPC's option, the consultant may be required to make a live summarization of its proposal in Columbus. If presentations are necessary, MORPC will contact the consultant's authorized representative to schedule the time, date, and location of the presentation. The presentation will be within two weeks of notification. Total time of the presentation shall be limited to 45 minutes, with an additional 15 minutes reserved for questions and answers. The proposed project manager shall attend and deliver the presentation. A few other key personnel should be present to assist in the presentation and discussion. Key personnel shall have been specifically listed in the consultant's proposal as part of the project team.

The purpose of the presentation is to provide clarification of information presented in the written proposal. The presentation will be given to the Committee. The presentation will focus on the consultant's project understanding and project approach. All information detailed in the presentation shall have been originally incorporated in the submitted written proposal. The consultant must explain how the expertise of the proposed team will be applied to satisfy the RFP requirements and accomplish the feasibility study.

If presentations are requested, the consultant must comply at no cost or obligation to MORPC. A consultant's refusal to make a presentation as described shall result in the consultant's proposal being rejected from consideration for the project.

SELECTION AND NEGOTIATIONS

Based on the evaluation of the proposals, the most qualified consultant will be selected. If negotiation with the highest ranked consultant fails to result in a mutually acceptable agreement, MORPC will notify that firm in writing of the termination of negotiations. The next highest ranked consultant, as determined by the earlier technical proposal evaluation, will then be invited to enter into negotiations with MORPC. If negotiations again fail, the same procedure shall be followed, with each next most qualified firm until a contract has been negotiated. If the remaining proposals are considered not to be qualified, the notification and selection processes will be repeated.

ADMINISTRATIVE & ORGANIZATIONAL ELEMENTS

STUDY ORGANIZATION

The technical components of the study will be prepared by a consultant to be selected through the RFP process. The consultant will work with the Project Manager of MORPC to coordinate routine exchange of data and overall project supervision. Technical components of the study will be regularly presented to the Committee members whose roles are to review and confirm the results.

Role of MORPC
MORPC will manage the entire study. MORPC conducts the RFP process and will, together with the Committee, select the consultant to perform the study as described in this scope. MORPC will also provide limited assistance to the consultant in the various tasks of the project scope as described in section II.

Role of the Consultant
The consultant is to conduct a technical and institutional assessment as outlined in the described tasks along with cost estimates. The consultant will also refer to their work as an extension of MORPC (i.e., “MORPC Air Quality Consultant” or “MORPC consultant”).

REPORTING

Interim Reports
The consultant shall prepare technical memos at milestone points (at a minimum at the end of each task) of the study which are to be suggested by the consultant. Each of these technical memos shall describe the major issues addressed and results obtained in that portion of the study. All these technical memos will serve as a basis for the formal final report. In addition to these technical memos, the consultant shall provide and/or present the interim findings before the Committee as appropriate at milestone points. The consultant shall prepare presentation materials (display graphics, Power Point presentations, and written summaries) at specified milestones throughout the study as suggested by MORPC.

Interim reports shall be provided in electronic format. All components of a single technical memo would be combined into a single file in Microsoft Word or Adobe Acrobat (PDF) format. Page sizes shall be limited to 8.5" x 11" or 11" x 17”.

Final Reports
The Final Draft Report shall be provided in electronic format. All components of the Final Draft Report would be combined into a single file in Microsoft Word or Adobe Acrobat (PDF) format. Page sizes shall be limited to 8.5" x 11" or 11" x 17”. An easily reproducible less technical summary document in electronic format should be included for presentation to council persons and other educated and informed non-technical persons. The document will be supported by the technical memorandums.

The Final Report, along with an executive summary, shall be provided in electronic format. All components of the Final Report would be combined into a single file in Microsoft Word or Adobe Acrobat (PDF) format.

PROPOSAL TERMS & CONDITIONS

Evaluation of Proposal Compliance with Specifications
Understanding that no consultant may completely meet all requirements of the specifications, MORPC reserves the sole right to determine whether a proposal substantially complies with the specifications; accept, negotiate modifications to, or reject the terms of any proposal; and waive the right to accept a part, or parts, of a proposal, unless otherwise restricted in the proposal.

Modification and/or Withdrawal of Proposals
Modifications of the submitted proposal must be received by the designated due date specified. Withdrawal of proposals will be allowed only in those cases in which a written request to withdraw

a Proposal is received by MORPC prior to the date and hour for receiving and opening Proposals. In such case, same will be returned to consultant unopened.

Proposer Qualifications
MORPC may require all proposers to submit evidence of qualifications, and may consider any evidence of the financial, technical, and other qualifications and abilities. MORPC will not award a contract to a proposer who, in its opinion, is not fully qualified on the basis of financial resources and responsibility, possession of adequate equipment, personnel, experience, and past record of performance to perform the obligation to be undertaken competently and without delay.

Award of Contract
Each consultant acknowledges that MORPC will use its discretion and judgment in making the final decision and further acknowledges that no claim by the consultant will arise in any way relating to the exercise of that judgment by MORPC. MORPC reserves the right to accept the Proposal deemed to be in the best interest of MORPC or to reject any and all Proposals.

MORPC's Executive Director is the only individual who may legally commit MORPC to the expenditure of public funds. No cost chargeable to the proposed contract may be incurred before receipt of either a fully executed contract or a specific, written authorization to proceed.

GENERAL INFORMATION & REQUIREMENTS

Ownership of Products
MORPC will retain the copyright for all data, materials, information, processes, studies, reports, surveys, proposals, plans, codes, scientific information, technological information, regulations, maps, equipment, charts, schedules, photographs, exhibits, software, software source code, documentation, and other materials and property that are prepared, developed or created under or in connection with this project. Therefore the submitter should anticipate that all products of this work effort will become the property of MORPC who will make them available to other government agencies and their contractors.

Deviation Clause
The consultant's attention is called to the condition that, if awarded a contract, the consultants will be required to furnish the particular item referred to in strict accordance with the specifications or descriptions as proposed, unless a departure or substitution is clearly noted and described in the proposal, along with the reasons therefore.

Tax Exemption
MORPC is exempt from the payment of federal excise and transportation taxes levied under the provisions of the Internal Revenue Code. MORPC is also exempt from Ohio State Gross Retail (sales tax). The successful consultants will be furnished with any certificates of exemption required.

MORPC STATEMENTS ON DIVERSITY & INCLUSION

Equal Opportunity
The consultant agrees that it will not discriminate against any employee, applicant for employment, or sub-contractor and that it will take affirmative action to insure that employees, applicants and sub-contractors are treated equally during employment without regard to race, color, creed, religion, ancestry, national origin, gender or sex (including pregnancy, gender identification or expression, and sexual orientation), gender identity or expression, age (including federally protected 40 years or older), disability or other handicap, genetic information, marital/familial

status, military status (past, present or future), limited English proficiency, medical conditions, or income or status with regard to public assistance.

Disadvantaged Vendors

Disadvantaged Vendors shall have the maximum opportunity to participate in the performance of contracts financed under this solicitation. In this regard, all proposers shall take all necessary and reasonable steps to ensure that minority vendors have the maximum opportunity to compete for and perform any subcontracts. Also, proposing firms are encouraged to notify MORPC if they meet one of the disadvantaged vendor designations, such as Minority Business Enterprise (MBE), Small Business Enterprise (SBE), or Women-owned Business Enterprise (WBE).

CONTRACTING REQUIREMENTS

The following are not part of the proposal requirements but will be requirements in the contract in addition to other contractual requirements. *Please also note that prior to negotiation, the firm selected for negotiation must provide average hourly rates for personnel assigned and a copy of the last audited financial statement.*

Compensation

A not-to-exceed contract amount based on satisfactory work performed and products and services produced will be entered into after negotiations between MORPC and the selected firm.

Alternative compensation models may be considered.

During contract negotiations, the selected firm must provide individually-priced and prioritized tasks to be completed "if authorized." The sequencing of work tasks must be done in such a way that successful completion of earlier tasks is not dependent upon the completion of later tasks.

Cancellation

MORPC reserves the right to cancel any contract for failure or refusal of performance, fraud, deceit, misrepresentation, collusion, or any other misconduct on the part of the consultant.

Unresolved Finding for Recovery

The selected consultant affirmatively represents and warrants to MORPC that it is not subject to a finding for recovery under ORC 9.24 or that it has taken appropriate remedial steps required under ORC 9.24 or otherwise qualifies under that section. The consultant agrees that if this representation or warranty is deemed to be false, the agreement shall be void *ab initio* as between the parties to this agreement, and any funds paid by MORPC to the consultant hereunder shall be repaid to MORPC immediately, or an action for recovery may be commenced immediately by MORPC for recovery of said funds.

Covenants of Consultant

The consultant will be required to covenant and warrant the following:

a) Consultant is not debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in any contract, supported in whole or in part by the funding sources for this project;
b) Consultant has not within a three (3) year period had one or more public transactions terminated for cause or default;
c) Consultant will comply with the provisions of Section 1352, Title 31 of the U.S. Code, which prohibits the use of federal funds to lobby any official or employee of any federal agency, or member or employee of Congress; and to disclose any lobbying activities in connection with federal funds.

Appendix A: Quality Assurance Project Plan

Quality Assurance Project Plan

for

Air Monitoring and Source Apportionment in Underserved Communities, Franklin County, Ohio

Assistance Program 66.034
Surveys-Studies-Investigations- Clean Air Act: Sec. 103
Demonstrations and Special Purpose Activities relating to the Clean Air Act

Revision date: 2023-12-01

Prepared by

Mid-Ohio Regional Planning Commission
111 Liberty St., Columbus, Ohio 43215

Prepared for

U.S. E.P.A. Region 5, Air and Radiation Division

77 W. Jackson Blvd., Chicago, IL 60604

Approvals:

This QAPP is approved by the undersigned and effective on the date of last EPA signature.

Date: 12/3/23

Brandi Whetstone, Project Manager

Mid-Ohio Regional Planning Commission

Date: 12/4/23

Adam Porr, QA Officer

Mid-Ohio Regional Planning Commission

Cranberg, Carter

Digitally signed by Cranberg, Carter
Date: 2023.12.06 08:43:47 -06'00'

Date: 12/6/23

Carter Cranberg, Project Officer

U.S. E.P.A. Region 5, Air and Radiation Division

RACHEL KIRPES

Digitally signed by RACHEL KIRPES
Date: 2023.12.05 15:50:56 -06'00'

Date: 12/5/23

Rachel Kirpes, Quality Assurance Official

U.S. E.P.A. Region 5, Air and Radiation Division

Acronyms:

ARD - Air and Radiation Division (U.S. EPA Region 5)

CAA - Clean Air Act

DQI - Data Quality Indicators

DQO - Data Quality Objectives

EPA - Environmental Protection Agency

FCPH - Franklin County Public Health

MORPC - Mid-Ohio Regional Planning Commission

PAC - Project Advisory Committee

QA - Quality Assurance

QAM - Quality Assurance Manager

QAPP - Quality Assurance Project Plan

QC - Quality Control

SOP - Standard Operating Procedure

Contents

List of Figures

List of Tables

A Project Management

A.1 Title and Approval Page

See pages 1 and 2.

A.2 Table of Contents

See page 6.

A.3 Distribution List

Name	Role	Affiliation
Brandi Whetstone	Project Manager	MORPC
Adam Porr	Quality Assurance Manager	MORPC
Mauro Diaz-Hernandez	Program Lead	MORPC
Ethan Hug	Data Lead	MORPC
Jennie McAdams	Public Health and Outreach Lead	FCPH
Layla Abraham	Sensor/Field Lead	FCPH
TBD	Contractor Project Manager	TBD

A.4 Project Organization

The Project Manager will be the official responsible for this project overseeing the overall project and budget, as well as tasking sub-recipients and contractors with work required to complete this project. They will communicate project needs to the Public Health and Outreach Lead and the contractor's project manager.

The QA Manager will be responsible for reviewing and approving the QA Project Plan. They may provide technical input on proposed sampling design, analytical methodologies, and data review, but will not be involved in data generation.

The Program Lead will be responsible for overseeing the implementation of the project work plan, in conjunction with the Project Manager and the rest of the team. They will take the lead to coordinate meeting agendas and convene meetings of the Project Advisory Committee (PAC) working closely with the rest of the team. They will provide guidance on the development of sampling design and analytical methodologies and oversee processes and procedures for the deployment and management of sensors.

The Data Lead will be responsible for data collection, storage, analysis, and quality control.

The Public Health and Outreach Lead will be responsible for overseeing Franklin County Public Health's role on elements including the Project Advisory Committee, community engagement, communication and outreach efforts, and sensor management.

The Sensor/Field Lead will assist with community engagement and communication efforts and deployment and management of sensors.

The Contractor Project Manager will be responsible for overseeing all responsibilities defined in the subcontract scope of work, included but not limited to monitoring and analysis of sensor data, development of the photochemical air quality model, implementation of a community engagement platform, and all required reporting. They will be responsible for ensuring all subcontract deliverables are delivered in accordance with the agreed schedule and budget.

The organizational structure for the project is depicted in Figure 1.

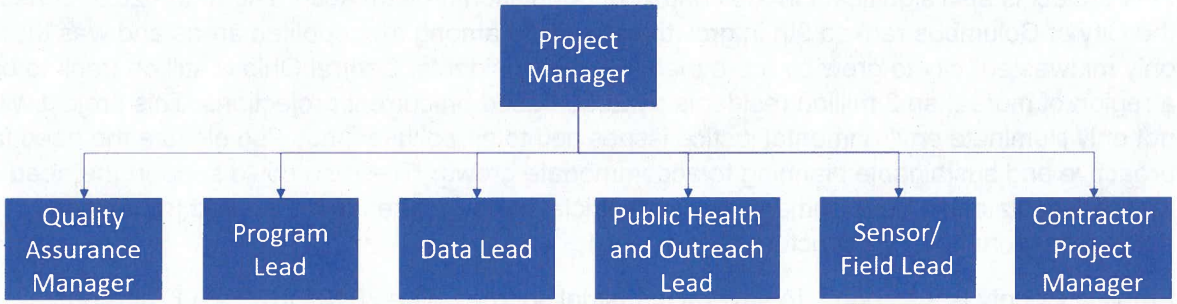

Figure 1. Project organizational structure

A.5 Problem Definition/Background

Franklin County is in Central Ohio with a population of 1.321 million. For the purposes of this project, our team will focus on areas with populations that are most vulnerable to health impacts from air pollution and COVID-19. Collecting particle pollution data and using modeling will allow the project team to better understand air quality hot spots and evaluate air quality patterns and sources in Franklin County. The project will help illuminate potential disparities in air pollution levels within underserved communities, identify unknown sources that are both temporary and ongoing, and evaluate the impact of mobile sources, including freight traffic, on air quality.

This project is aligned with MORPC's Regional Sustainability Agenda, with goals and measurable objectives that make Central Ohio a better place for all residents, and actions that promote a sustainable and equitable region. This project will also bolster several complementary initiatives in the region, including the City of Columbus Climate Action Plan and FCPH's Strategic Goal of achieving Equity. The data can also be leveraged to quantify air quality impacts of the transformation of key corridors to more walkable, bike friendly, and transit friendly places through the LinkUS initiative.

MORPC's annual report for ground-level ozone and particle pollution from November 2020 - October 2021 shows continuous air quality improvement in the Columbus Region over the past 29 years measured by federal standards. However, the two regulatory monitors used to

measure PM2.5 are meant to capture regional level data, whereas low-cost air quality sensors can be deployed for neighborhood level data, providing a more detailed look at air pollution.

In 2020, MORPC and FCPH partnered to establish an air quality monitoring network using PurpleAir sensors to measure air pollution across neighborhoods to help guide strategies that improve local conditions. The program used sociodemographic data (percent population below poverty line, non-white populations, age 65+, and under 5), and health data (adult asthma rates and COVID-19 rates) to identify priority zip codes for sensor placement. The data collection phase concluded in the spring, and the team is creating a final report to identify the take aways and lessons learned. The proposed EPA project will build on this experience and greatly expand the team's ability to conduct community and partner engagement along with the advanced technical work necessary to analyze air pollution patterns and sources at the hyperlocal level.

This project is also significant in the context of population growth. According to the 2020 census, the City of Columbus ranked 9th in growth nationwide among metropolitan areas and was the only midwestern city to grow by more than 100,000 residents. Central Ohio is still on track to be a region of more than 3 million residents by 2050 based on current projections. This project will not only illuminate environmental justice issues tied to air pollution, but also elevate the need for proactive and sustainable planning to accommodate growth. The data could support the need for more sustainable development, electric vehicle infrastructure, and improved transit and active transportation infrastructure.

Franklin County is also home to several industrial sources. The 2019 Ohio EPA Emissions Inventory found that the greatest stationary air quality contributors to PM2.5 concentrations include unpaved road traffic from a solid waste disposal facility, and metal processing facilities (Ohio EPA, 2019 EIS Data). This data is valuable, but may not capture local scale air quality impacts, identify unknown sources, nor better understand how smaller sources may impact underserved communities. The proposed model will provide local scale air quality data to help better understand sources contributing to PM2.5 concentrations.

In 2018, MORPC conducted a community-driven study in the Rickenbacker Area located in the southern portion of the Columbus metro area. Rickenbacker is home to one of the world's only cargo-dedicated international airports, rail yard intermodal facility, and a logistics study. The study provided recommendations to position the area as a complete community including mobility, transportation, and economic growth. The study does not directly address air quality, but air quality may be exacerbated from forecasted increases in truck traffic volume, which may impact residents.

A.6 Project/Task Description and Schedule

A.6.1 Project Location

Measurements of PM2.5 concentrations will be collected from at least 20 locations throughout Franklin County. The specific locations will be chosen with input from a project advisory committee which will be formed during the project, however the locations generally will be selected within zip codes whose residents are more likely to be underserved populations and impacted by poor air quality, as identified through data aggregation. The locations will also be chosen in such a manner that provides distributed coverage throughout the county. The priority

zip codes are depicted in the map in Figure 2 with the higher-priority zip codes indicated by warmer colors. The figure will be augmented with specific sensor locations when these have been selected.

Each sensor will perform continuous sampling at a rate of one sample every two minutes. Continuous sampling over a period of 18 months will allow for comparisons between different times of day, days of the week, seasons of the year, and a variety of ambient conditions.

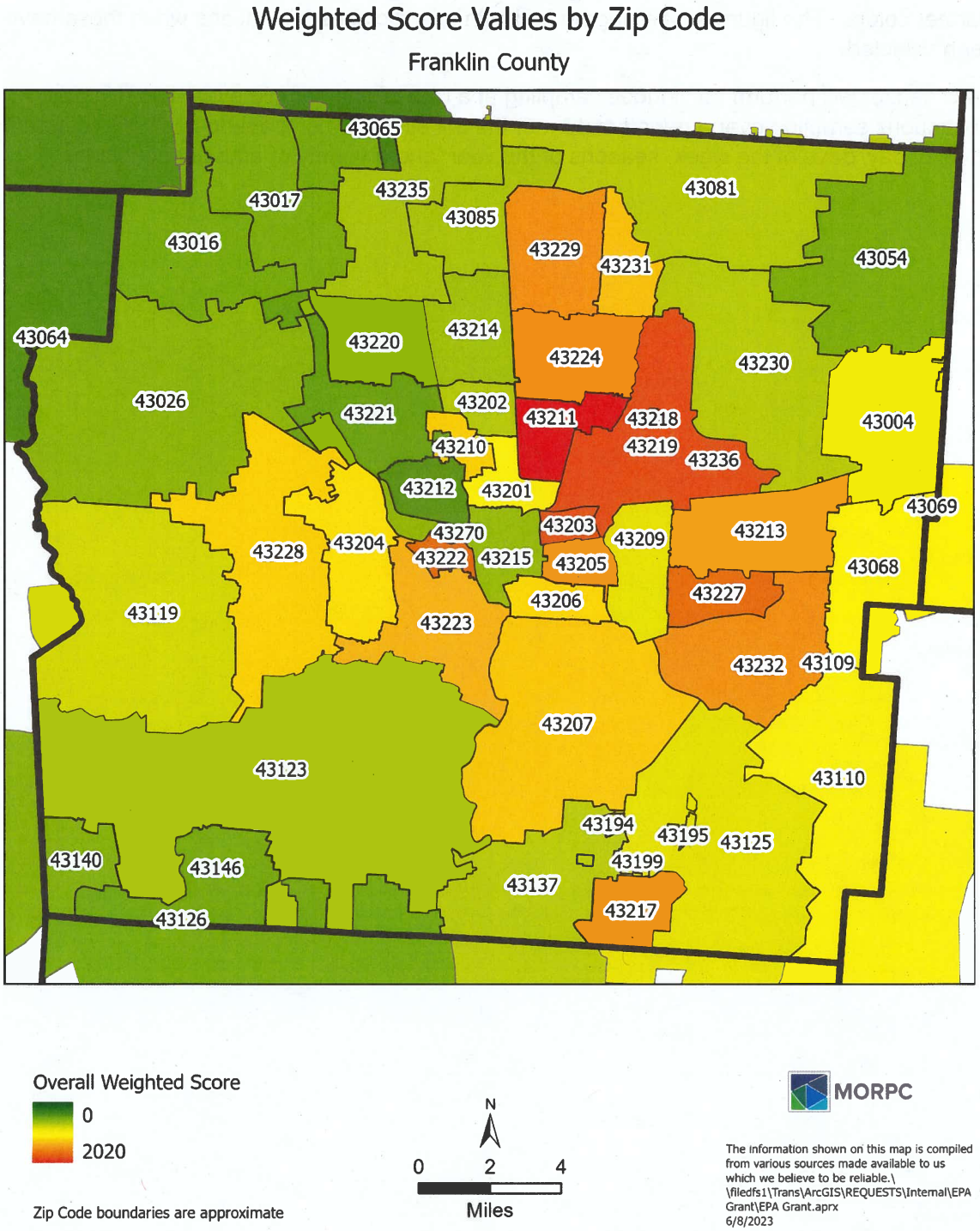

Figure 2. Zip codes prioritized for siting of air quality sensors

A.6.2 Post-Measurement Analyses

Each sensor will be deployed in a location with available Wi-Fi, or a cellular "hot spot" will be installed, which will facilitate real-time transmission of the data to the PurpleAir website, where it will be archived in their proprietary database. Data will be retrieved weekly using an automated script which requests the data from the PurpleAir public API and stores the raw data and a standardized and corrected version of the data in a dedicated location in the project file. The data will be reviewed regularly to ensure that all sensors are operating as expected and trigger corrective action if one is not. The data will be screened for completeness, outliers, drift, and calibration shift.

The complete suite of analytics will be defined with input from the consultant; however, it will likely include at least the following: aggregation by time period, aggregation by temporal cycles (e.g., day of week), aggregation by zip code, summary statistics, and frequency analysis. Spatial analysis may also be appropriate, depending on the specific locations of the sensors. The measurements will also be used to inform a photochemical source apportionment model to be developed/implemented by the consultant. Records will be maintained for all operations involved with the processing and analysis of the data, including who performed the operation, when it was performed, what process was used, what inputs were used, and what outputs were produced. More details about measurement acquisition, processing, and analysis are provided in Section B.

A.6.3 Project Timeline

The project began in June 2023 following the formal award of grant funding from the EPA. Planning and QAPP development have taken place in summer 2023. During fall 2023 and winter 2023/2024, the project team will select a consultant for modeling, analysis, and communications work, obtain at least 20 air quality sensors, and perform preliminary characterization and calibration of the sensors.

In spring 2024, the project team will select sensor locations with input from a community advisory board. Sensors will be deployed to the selected locations in May 2024 and will provide continuous monitoring for 18 months, between June 2024 and December 2025. Early in the monitoring period, the project team will work with the consultant to develop a photochemical source apportionment model and to develop a real-time communications platform and other educational resources to share findings with the public continuously during the monitoring period. The outreach effort will conclude in May 2026, when the team will prepare the final report for the project for delivery at the end of the project in September 2026. A detailed timeline for the project is provided in Table 1.

Table 1. Project timeline

#	Task/Subtask	Deliverable	Start Month	End Month	Organization Responsible
		1. QAPP			
1	Submit QAPP	1. Draft and gain approval of quality assurance project plan	06/2023	9/2023	MORPC
		2. Project Management			
2a	Solicit consultant via RFP	Draft, approve, and post RFP; select consultant and prepare/finalize contract for 1/24 start	07/2023	12/2023	MORPC, FCPH
2b	Project coordination	Set up work plan for staff and contractors	06/2023	09/2023	MORPC, FCPH
2c	Purchase Sensors	Identify sensors and complete purchase	07/2023	09/2023	MORPC
		3. Air Monitoring and Modeling			
3a	Collocate sensors with reference monitor	Post QAPP approval - monitor performance metrics, will be quantified for 2-3 weeks	09/2023	02/2024	MORPC, FCPH
3b	Site and Deploy Sensors	Identify site hosts, deploy sensors at targeted locations after including PAC input and collocation is complete.	12/2023	05/2024	MORPC, FCPH
3c	Sensor network upkeep	Continued sensor network upkeep (quality assurance, troubleshooting) starting from their collocation.	9/2023	01/2026	MORPC, FCPH
3d	Real-time localized model implementation	Real-time localized model platform displaying real-time 50 m x 50 m pollution map	1/2024	05/2026	Consultant
3e	Real-time source contributions	Real-time source contributions displayed on model platform	1/2024	05/2026	Consultant
		4. Community Engagement			
4a	Digital air quality displays/rotating screens	Identifying locations to display digital air quality displays/rotating screens and implement them	1/2024	05/2026	MORPC, FCPH, Consultant
4b	Project advisory committee (PAC)	Identify members, and schedule PAC meetings	06/2023	05/2026	MORPC, FCPH
4c	PAC Meetings	Conduct initial meeting to introduce project and monitor siting, propose quarterly meetings host through end of project.	08/2023	05/2026	MORPC, FCPH
4d	Identify sites for sensors	List of sites will be prepared based on known sources and methodology, get PAC feedback	08/2023	11/2023	MORPC
4e	Analysis Dashboard	Summary of findings from multi-year monitor deployment and Real-time localized model modeling	06/2025	05/2026	Consultant
4f	Deliver insight on source contributions	Figures, tables, and visualizations to support community engagement	06/2025	05/2026	MORPC, Consultant
4g	Educational Materials/Presentations to Engage the Public/ Youth	Create educational materials/presentations focused on air quality, health and pollutants for PAC, youth, the public	08/2023	05/2026	MORPC, PAC, FCPH, Consultant
		5. Reporting			
5a	Quarterly Report	12 reports, one every 3 months	09/2023	09/2026	MORPC

5b	Final Report	One report, end of project, with summary of all findings and future implications (depending on final due date)	06/26	09/2026	MORPC

A.7 Quality Objectives and Criteria for Measurement Data

A.7.1 Objectives and Project Decisions

MORPC will serve as the project manager, working with local partner FCPH to implement a hyperlocal air quality monitoring network with a focus on increasing particle pollution (PM2.5) data collection, identifying source drivers from modeling, strengthening community engagement, and elevating environmental justice concerns. The data collected from this network will be shared with a consultant to analyze the PM2.5 concentrations and source contributions. The project will take place within the limits of Franklin County, Ohio in zip codes identified through data aggregation that focus on populations most impacted by poor air quality and COVID-19, as identified by a project advisory committee, and informed by data-driven vulnerability analysis.

The project team will deploy PurpleAir sensors in vulnerable neighborhoods, as identified by a data-informed community advisory process. The sensors will measure PM2.5 concentrations, and the results will be evaluated to identify locations with locally high concentrations. A photochemical model will be used to apportion the pollutants to local sources. Pollutant measurements and source apportionment information will be shared with the public to increase awareness of air quality and potential actions the public can take to reduce or avoid air pollution exposure. Pollutant measurements will be compared to nearby state-operated monitors.

The EPA's proposed rulemaking for the reconsideration of the National Ambient Air Quality Standards for particulate matter identifies PM2.5 as "a pollutant of great concern to already overburdened and vulnerable communities of color and indigenous and low-income communities throughout the United States." (U.S. Environmental Protection Agency, 2023). Further, a study published in April 2021 by researchers at the EPA-funded Center for Air, Climate, and Energy Solutions, found that people of color are disproportionately exposed to PM2.5 air pollution regardless of income (Tessum, et al., 2021). Neighborhood level sensor data can begin to fill the gaps where geographic coverage is not provided by regulatory monitors and help us identify areas where residents are disproportionately burdened by higher PM2.5 levels. By gaining a better understanding of pollution patterns and the affected communities, the team can more effectively engage residents and work toward potential solutions together.

A.7.2 Action Limits/Levels

Because the data produced by this project is intended solely for educational purposes, there are no limits or levels that will trigger specific actions. Nonetheless, measured PM2.5 concentrations that deviate substantially from regulatory measurements may influence the content, form, or delivery method for our communications and engagement for the county or for specific neighborhoods in the vicinity of those sensors.

There are two regulatory monitors in Columbus region that report PM2.5 on an hourly basis[1]. Between April 21, 2022 and April 23, 2023, the concentrations reported by the regulatory

[1] The regulatory monitors are located at 7560 Smoky Row Rd and 7600 Fodor Rd.

monitor at Smoky Row ranged from lowest quartile of 5.6 to highest quartile of 11.2 with a mean concentration of 7.8, while the New Albany EPA monitor ranged from the lowest quartile of 3.7 to highest quartile of 8.0 with a mean concentration of 5.6[2].

During the same period, the project team collected data from up to 20 PurpleAir sensors as described in section A.5. Each sensor was collocated with the regulatory monitor prior to deployment elsewhere. Based on collocating findings, a sensor is deemed acceptable or not for deployment based on its overall agreement with the regulatory monitor after the sensor's data has gone through initial quality control steps and recommended calibration techniques. Measurements taken after deployment at collection sites are calibrated based on U.S. EPA recommendations, described below in section B.7. The calibrated concentrations measured by the set of sensors ranged from the lowest mean of 6.4 at Shepard Library (lowest quartile 4.0 / highest quartile 9.6), to the highest mean of 9.6 at Franklinton Cycle Works (lowest quartile 6.8 / highest quartile 14.1).

A.7.3 Measurement Performance Criteria/Acceptance Criteria

The quality control requirements for field measurements are specified in Table 2.

Table 2. Quality Control Requirements for Field Measurements

Data Quality Indicator	Evaluation Method	Limits
Precision	The absolute difference between the corrected measurements of any two co-located sensors (independent devices or multiple channels within a device) is less than the larger of: 1. The specified absolute limit 2. The specified percentage of the average of the measurements of the two sensors	Absolute difference < max(5 µg/m3, 30% of the average of both sensors)
Bias	A correction equation will be developed through collocation with a regulatory monitor such that the mean absolute error is below the specified limit. The correction equation will be applied to data collected while the sensor is deployed elsewhere.	Mean Absolute Error < 20%
Comparability	For any two co-located sensors, R^2 is greater than the specified limit	R^2 > 80%
Completeness	An hour of data is considered complete if at least one valid measurement is recorded. A day of data is considered complete if the specified percentage of the hourly data are complete and valid. Validity requires that precision and bias goals are met.	Hourly: Number of valid data points >= 1 Daily: Percent of valid hourly data points >= 60%
Measurement range	The manufacturer reported detection limit is sufficient to meet the project objectives and measure expected concentrations for action levels. The sensor has a linear response across the expected concentration	0 to 500 µg/m^3 (values in the non-linear range above 250 µg/m^3 are

[2] These are averages of valid 1-hour measurements for the analysis period.

	range or can be corrected (e.g. with the EPA Purple Air extended correction for wildfire smoke).	suppressed post-calibration. See Plantower, 2016)

A.8 Special Training Requirements/Certification

Table 3. Training Requirements

Operating Procedure	Training Requirements	Responsible Roles	Frequency
Sensor Pre-Deployment Verification	Read work instruction	Sensor/Field Lead	As required
Sensor Collocation	Read work instruction, Perform operation one time under supervision	Sensor/Field Lead	As required
Sensor Deployment	Read work instruction, Perform operation one time under supervision	Sensor/Field Lead	As required
Site Host Onboarding	Training session with Sensor/Field Lead (distribute reference document)	Sensor/Field Lead, Site Host	At time of deployment
Weekly sensor status monitoring	Read work instruction, Perform operation one time under supervision	Sensor/Field Lead	As required
Raw data retrieval and verification	Read work instruction, Perform operation one time under supervision	Data Lead	As required
In-Process Analysis and Validation	Read work instruction, Perform operation one time under supervision	Data Lead	As required
Sensor Decommissioning	Read work instruction (assuming prior deployment/collocation experience)	Sensor/Field Lead	As required

A.9 Documents and Records

A.9.1 Record management

Unless otherwise specified, all project documents and data will be stored in the digital project file[3] hosted on MORPC's SharePoint site. The specific location, active revision, retention period, and other administrative details about each document will be recorded in the Master Resource List[4]. Before revising a document, the existing version will be archived in the Master Resource

[3] Project file root: https://morpc1.sharepoint.com/:x:/r/sites/Central-OhioPurpleAirMonitoring/Shared%20Documents/General/US%20EPA%20Air%20Monitoring%20Project/

[4] <Project file root>\QAPP\Master Resource List.xlsx

List. A detailed list of revisions will be maintained within each document or in a separate revision history document referenced therein. The entire project file will be backed up in accordance with standard backup processes as defined by MORPC's IT department, including but not limited to the automatic version history capabilities built into SharePoint. All documents, records, and data produced by the project will be stored for a minimum of five years following project completion.

A.9.2 QA Project Plan Distribution

The QAPP is the source for all quality requirements associated with the project. The QAPP will be made available to project staff via the digital project file hosted on MORPC's SharePoint site. The Quality Manager is the custodian for the QAPP and is responsible for making any necessary revisions, documenting the revisions in the integrated revision history and Master Resource List, and notifying the project team of those revisions.

A.9.3 Field Documentation and Records

Field records will be produced during sensor deployment and collocation operations. All data from the field will be recorded directly in the Air Quality Monitor Tracking Spreadsheet (resource number AQ-22-5000), which will be accessible from all sites via wireless network.

A.9.4 Sensor Data

Data from air sensors will be downloaded from the PurpleAir API and standardized using a custom script created exclusively for that purpose (see resource no. AQ-15-6000). The original raw data will be kept on file in case of discrepancies or errors. The raw and standardized data will be electronically stored in a SharePoint folder in the project file (resource no. AQ-15-8003). Standardized data will be periodically compiled in a format or formats suitable for dissemination to local stakeholders (including the Project Advisory Committee) and made available via Mid-Ohio Open Data (MOOD)[5]. MOOD is a web-based open data repository implemented using ArcGIS Online and maintained by MORPC. Updates to the online data repository will occur monthly or more frequently. Near real-time snapshots of sensor data will be shared with stakeholders and the public continuously, as described in Section A.6.3.

A.9.5 Project Status Reports

Project status reports will be produced quarterly for the project's duration and at its conclusion, as stipulated by funder requirements. The release schedule for the reports is shown in Table 4. Project status reports will be stored in a designated location in the digital project file (resource no. AQ-24-8000).

Table 4. Release schedule for project status reports

Title	Release date
Quarterly Report #1	9/30/2023
Quarterly Report #2	12/31/2023
Quarterly Report #3	3/31/2024
Quarterly Report #4	6/30/2024
Quarterly Report #5	9/30/2024
Quarterly Report #6	12/31/2024

[5] Mid-Ohio Open Data (MOOD): https://public-morpc.hub.arcgis.com/

Quarterly Report #7	3/31/2025
Quarterly Report #8	6/30/2025
Quarterly Report #9	9/30/2025
Quarterly Report #10	12/31/2025
Quarterly Report #11	3/31/2026
Quarterly Report #12	6/30/2026
Quarterly Report #13	9/30/2026
Quarterly Report #14	12/31/2026
Quarterly Report #15	3/31/2027
Final Report	6/30/2027

A.9.6 Personally Identifiable Information

The only personally identifiable information (PII) anticipated for this project are the addresses of private residences where sensors are deployed and the names and contact information of the owners of those properties. Specifically, we will not collect sensitive information about individuals including but not limited to demographic, socioeconomic, or health data. To the maximum extent possible, the team intends to deploy sensors at institutional sites. This will limit the quantity of PII collected. Each sensor will be referenced by a unique anonymous identifier that is not intrinsically linked to the property address or owner. When the specific location of the sensor must be disclosed, it will be referenced by coordinates only without reference to the property owner. The names and contact information associated with each deployment location will be recorded in one location only, namely a spreadsheet in the digital project file. Access to the spreadsheet will be restricted to project team members using the access control features built into SharePoint.

B Data Generation and Acquisition

B.1 Sampling Design (Experimental Design)

Measurements of outdoor PM2.5 concentrations will be collected from at least 20 locations throughout Franklin County. The specific locations will be chosen with input from a project advisory committee which will be formed during the course of the project, however the locations generally will be selected within zip codes whose residents are more likely to be underserved populations and impacted by poor air quality, as identified through data aggregation. The locations will also be chosen in such a manner that provides distributed coverage throughout the county. The priority zip codes are depicted in the map in Figure 2 and listed in Table 5. The map will be augmented with specific sensor locations when these have been selected.

Concentrations of PM2.5 will be measured using new PurpleAir sensors purchased specifically for this project. The data produced by these sensors will be used in conjunction with data produced by existing MORPC/FCPH-managed air quality sensors for applications beyond the scope of this project.

Each sensor will perform continuous sampling at a rate of one sample every two minutes. Continuous sampling over a period of 18 months will allow for comparisons between different times of day, days of the week, seasons of the year, and a variety of ambient conditions. The rapid sampling frequency will allow for aggregation at various temporal scales and will allow for mitigation of missing or invalid data.

Table 5. Sampling locations

Sensor ID	Location ZIP code
MORPC_40	43235
Additional sensors to be added	

B.2 Sampling Methods Requirements

B.2.1 Sensor Description

PurpleAir manufactures indoor/outdoor air quality sensors that measure PM2.5 concentrations in real-time using a pair of laser particle counters. The device also includes integrated temperature and humidity sensors. The device transmits data continuously via a Wi-Fi connection to a central public API operated by PurpleAir. Where Wi-Fi is not available, the project team intends to install standalone cellular Wi-Fi hot spots to provide the necessary connection. The monitor also offers optional on-board data storage on a SD card for locations where wireless connectivity cannot be achieved.

The sensor produces a PM2.5 measurement every two minutes by averaging measurements made by the two particle counters. A measurement is taken from a particle counter every five seconds, alternating between the two. The particle counter operates by drawing ambient air past a laser beam using a fan. When a particle crosses the beam, the beam is reflected onto a detection plate where it is measured as a pulse. The size of the particle is determined by the duration of the pulse. The concentrations of particles of various sizes are determined by the count of the pulses that occur in a specific amount of time. The features of the monitors and the

mode of operation of the particle counters are described in more detail on the PurpleAir website (PurpleAir, 2023) and in the technical documentation from the laser particle counter manufacturer (Plantower, 2016).

B.2.2 Sensor Deployment and Status Monitoring

Each sensor is subjected to a collocation process as described in Section B.7 to ensure the sensor is capable of producing measurements in conformance with the data quality indicators specified in Section A.7.3. After the collocation process has been completed for a sensor, it is eligible for deployment at its intended location, as described in Section B.1 and Table 5. These locations are described as addresses and refer to properties owned by local institutions or private entities. The specific location of the sensor is determined by a site assessment, as described in the Sensor Deployment Procedure (resource no. AQ-13-6000), and includes considerations such as power and Wi-Fi availability, shelter from sun and wind, and avoidance of local pollution sources. In short, the site assessment ensures that the sensor can collect and transmit data reliably and that the measurements obtained will be representative of the nearby area. The specific location is selected in collaboration with the property owner or a representative of the institution that operates the property. This person is known as the site host.

After a specific location has been selected that is mutually agreeable to the project team and the site host, the sensor is installed in accordance with instructions provided in the same document. In addition to physical installation, the document also covers configuration of the device and verification that the device is operating correctly and is able to transmit data to the PurpleAir API. The document also covers documentation of the deployment details in the "Install Monitors" tab of the Air Quality Monitor Tracking Spreadsheet (resource no. AQ-22-5000).

All deployed sensors are monitored for proper operation on a weekly basis by the Sensor/Field Lead or delegate in accordance with the Sensor Status Monitoring Procedure (resource no. AQ-17-6000). The weekly check includes verification that each sensor is reliably transmitting data to the PurpleAir API and that the PurpleAir website does not report any problems related to inter-channel agreement, operation of the temperature/humidity/pressure sensor, Wi-Fi signal strength, and qualitative review of the PM2.5 measurement time series for each sensor. Based on the result of this inspection, each sensor is assigned a designation of "Good", "Maybe", or "Bad" on the "Weekly Monitor Checks" tab of the Air Quality Monitor Tracking Spreadsheet. Sensors designated "Maybe" or "Bad" are reviewed in more detail by the project team and the review process and findings are documented using the Corrective and Preventive Action Procedure (resource no. AQ-21-2000). Troubleshooting activities may include but are not limited to those described in part in the Field Operation and Maintenance Procedure (resource no. AQ-20-6000).

In the event that the sensor location becomes inaccessible, for example due to inclement weather or introduction of physical barriers, monitoring will continue as usual unless a problem is encountered during the weekly check. If the weekly check identifies a problem that cannot be resolved remotely, the Corrective and Preventive Action (CAPA) Procedure will be invoked to document the exception. If the issue has the potential to produce non-conforming data, the sensor may be disabled, if possible, until access is restored and the issue can be resolved. If

the sensor cannot be disabled, the potentially non-conforming data will be sequestered until it can be evaluated, and a disposition determined.

B.2.3 Data Retrieval and Standardization

Raw PM2.5 measurements produced by the sensors are retrieved from the PurpleAir API on a periodic basis (typically weekly) in accordance with the Raw Data Retrieval and Verification Procedure (resource no. AQ-15-6000). This procedure consists mainly of execution of a custom R script which retrieves a time-bounded set of data from the PurpleAir API, updates a metadata tracking table, creates a local copy of the raw data, and creates another copy of the data that has been standardized. All data are stored in the designated project data repository(resource no. AQ-15-8003). The standardization process consists of the following operations:

1. Extract only the sensors of interest for the period
2. Remove measurements with physically impossible PM2.5, temperature, and humidity values
3. Replace outliers with smoothed values
4. Remove measurements with inter-channel agreement that does not satisfy the precision DQI
5. Apply a calibration equation (see section B.7)
6. Compute hourly averages for each channel separately in accordance with the completeness DQI
7. Average the data for the two channels (when both are valid)

B.3 Sample Handling and Custody Requirements

All sensors will collect real-time direct measurements of ambient air pollutants and thus, no physical samples will be collected or tracked.

B.4 Analytical Methods

B.4.1 Data Analysis Tools

Data analysis typically will be performed using a custom R script written for this purpose, as described in the following section. The Data Lead will be sufficiently proficient in R to configure, execute, and troubleshoot the script.

From time to time the following other tools may be used to inspect the data and carry out one-off analyses:

- Excel
- ArcGIS Pro
- ArcGIS Online
- Other custom scripts written in R or Python

The Data Lead will select the most appropriate tool on a case-by-case basis given the application and their proficiency with the tools.

B.4.2 Data Analysis Methods

The typical analysis process is documented in the In-Process Analysis and Validation Procedure (resource no. AQ-19-6000). This procedure consists mainly of execution of a custom R script which performs the following operations:

1. Updates the **Dataset_PM025_by_Site_DSA** .csv file with the calibrated hourly $PM_{2.5}$ values by site of sensors
2. Updates the **Dataset_PM025_by_ZIP_DSA** .csv file with the calibrated hourly $PM_{2.5}$ values by ZIP Codes of sensors, averaging ZIP Codes with multiple sensors
3. Creates multiple figures, maps, and accompanying data sets pertaining to:
    a. **Average Concentration by ZIP Code** map shows the average $PM_{2.5}$ values for each ZIP Code for the analysis period, averaging multiple sensors into one value if within the same ZIP Code.
    b. **Average Concentration** map shows the location of each sensor by a colored marker that represents each sensor's average $PM_{2.5}$ value on a continuous scale
    c. **Average Difference from Nearest Reference Monitor** map shows the location of each sensor by a colored marker that represent the direction and magnitude of the difference the sensor's $PM_{2.5}$ value is to the reference monitor
    d. **Cluster Assignment** map shows by color, the cluster assignment of sensors based on similarities of $PM_{2.5}$ values during the analysis period.
    e. **Clusters Diurnal Plot** shows the average 24-hour period's 1-hour average $PM_{2.5}$ values by sensor clusters denoted by color.
    f. **Comparison Plot (Thresholds) by Sites** plot shows the percent of daily average $PM_{2.5}$ readings that fall within each "thresholds".
    g. **Comparison Plot (Thresholds) by ZIP Code** plot shows the percent of daily average $PM_{2.5}$ readings that fall within each "thresholds".
    h. **Daily Averages** plot for period of analysis shows the daily average $PM_{2.5}$ values by sensor site for days with enough valid data on a continuous scale.
    i. **Demographic to $PM_{2.5}$ Significance Association** plots show the correlation between a set of variables used to determine a ZIP Code's vulnerability index and the daily average $PM_{2.5}$ to assess if there is some level of association by using P-values where: 0.001 or less is considered a high association; 0.01 or less is considered moderate association; 0.05 or less is considered a slight association; and 0.1or less is considered a weak association.
    j. **Distribution of Hourly Differences for Period of Interest for Sites** plot shows the 1-hour average $PM_{2.5}$ values for the week of interest **difference** to the 1-hour average $PM_{2.5}$ for the values outside of the week of interest.
    k. **Distribution of Hourly Differences for Period of Interest for ZIP Codes** plot shows the 1-hour average $PM_{2.5}$ values for the week of interest **difference** to the 1-hour average $PM_{2.5}$ for the values outside of the week of interest.
    l. **Distribution of Hourly Differences from Nearest Reference Monitor** plot shows the individual sites' 1-hour average $PM_{2.5}$ difference to the reference monitor by quartiles, where 50% shows the mean difference the sites' sensors are from the reference monitor.
    m. **Sites Daily Averages (thresholds)** plot for period of analysis shows each day's average $PM_{2.5}$ for each site that fall within each threshold.

n. **Sites Data Completeness** plot for period of analysis shows the percent of the hourly $PM_{2.5}$ readings that are considered valid and complete for each day.
o. **Sites Distribution of Hourly Measurements** plot shows the percentile distribution of 1-hour average $PM_{2.5}$ values for the analysis period by site, where the 50% is the mean
p. **Sites Diurnal Plot – Day and Hour** for period of analysis showing the daily average $PM_{2.5}$ values by the hour of the day and day of week
q. **Sites Diurnal Plot** for period of analysis showing the daily average $PM_{2.5}$ values by the hour of the day.
r. **Sites Range Plot – Daily Diurnal** shows by day of week the average of all sensors the 1-hour averages and the range of sensors with a line representing the reference monitor
s. **Sites Range Plot – Daily Timeseries** plot for period of analysis shows the average 24-hour $PM_{2.5}$ values by thresholds for all sites as one range
t. **Sites Range Plot – Hourly Diurnal** plot for period of analysis shows the averaged $PM_{2.5}$ values averaged by hour of days for all sites for one mean value and range to show an average day with a line representing the reference monitor
u. **Sites Range Plot – Hourly Timeseries** plot for period of analysis shows the 1-hour average $PM_{2.5}$ values by thresholds for all sites as one range
v. **Sites Timeseries** plot of 1-hour and 24-hour $PM_{2.5}$ values averages for period of analysis
w. **ZIP Codes Diurnal Plot – Day and Hour** for period of analysis showing the daily average $PM_{2.5}$ values by the hour of the day and day of week
x. **ZIP Codes Diurnal Plot** for period of analysis showing the daily average $PM_{2.5}$ values by the hour of the day
y. **ZIP Codes Timeseries** plot of 1-hour Averages and 24-hour Averages for period of analysis using calibrated and processed hourly $PM_{2.5}$ values
z. **ZIP Codes Timeseries** plot shows the 1-hour and 24-hour average $PM_{2.5}$ values for the period of analysis

All data are stored in the designated project data repository (resource no. AQ-15-8003).

B.5 Quality Control Requirements

Table 6. Quality Control Requirements

QC Activity	DQI	Frequency of QC checks	Acceptance Criteria	Corrective Action
Sensor Pre-Deployment Verification Procedure	Sensor functions go/no-go	Once per sensor prior to deployment	All functions go	Repair or replace sensor
Sensor Status Monitoring Procedure	Qualitative inspections: 1. Sensor transmitting data to API 2. Channel agreement is reasonable	Weekly during collocation and deployment	Sensor appears on PurpleAir map Channel agreement is greater than 90%	Troubleshoot sensor using one or more of the following: In-Process Analysis and

	3. Temperature / humidity / pressure are reasonable 4. Wi-Fi connection quality is reasonable		Temp/humidity/pressure readings are present	Validation Procedure Field Operation and Maintenance Procedure
Sensor Collocation Procedure	Bias Comparability Completeness The following additional metrics are also evaluated: - Standard deviation - Coefficient of variation - Scatterplot best-fit slope	Once per sensor prior to deployment	Comparison with regulatory monitor satisfies bias DQI and comparability DQI. Daily average satisfies daily completeness DQI. Standard deviation compared to regulatory monitor is reasonable. Coefficient of variation compared to regulatory monitor is reasonable. Slope of scatterplot best-fit line is close to 1.	Troubleshoot sensor using Field Operation and Maintenance Procedure
Raw Data Retrieval and Verification Procedure	Precision Completeness Also: - Physically impossible measurements are removed - Outliers are removed	Weekly	Inter-channel agreement satisfies precision DQI Hourly average satisfies hourly completeness DQI	Troubleshoot sensor using one or more of the following: In-Process Analysis and Validation Procedure Field Operation and Maintenance Procedure
In-Process Analysis and Validation Procedure	Bias Comparability Completeness The following additional metrics are also evaluated: - Standard deviation - Coefficient of variation - Scatterplot best-fit slope	Monthly	Inter-channel is agreement satisfies bias DQI and comparability DQI. Daily average satisfies daily completeness DQI. Inter-channel standard deviation is reasonable. Inter-channel coefficient of variation is reasonable.	Troubleshoot sensor using Field Operation and Maintenance Procedure

			Slope of scatterplot best-fit line is close to 1.	

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

Equipment will be verified (tested and/or inspected) before each deployment in accordance with the Sensor Pre-Deployment Verification Procedure (resource no.AQ-12-6000).

Equipment will be verified (tested and/or inspected) after each deployment in accordance with the Sensor Post-Deployment and Decommissioning Procedure (resource no. AQ-18-6000).

No other routine testing, inspection, or maintenance are planned, however additional activities will be performed as needed. Other relevant procedures include but are not limited to:

- Field Operation and Maintenance Procedure (resource no. AQ-20-6000)
- EPA Enhanced Air Sensor Guidebook, Appendix C.3 (Clements, et al., 2022)

B.7 Instrument/Equipment Calibration and Frequency

It is not possible to physically calibrate the sensor hardware. Instead, the measurements produced by sensor are calibrated after the fact by adjusting them based on the sensor's typical deviation from a standard sensor. Based on preliminary investigations of different calibration techniques, we have chosen to adopt a U.S. nationwide PurpleAir calibration equation developed by EPA scientists (Barkjohn, et al., 2021). The calibration equation is:

$$PM_{2.5,\ calibrated} = 0.524 * PM_{2.5,\ raw} - 0.0862 * RH + 5.75$$

where RH is the relative humidity in percentage points (e.g. "75%" = 75). Since the estimated valid range of this calibration equation is 0-250 $\mu g/m^3$, calibrated values below 0 $\mu g/m^3$ are set to 0 $\mu g/m^3$ and calibrated values above 250 $\mu g/m^3$ are removed.

To ensure that the measurements produced by a particular sensor can be corrected to a degree that satisfies the data quality indicators, the sensor is collocated with a regulatory-grade monitor for a pre-determined amount of time and the measurements produced by the two sensors are compared. For the purposes of this project, the collocation period is two weeks. The intended collocation site is the EPA-administered Smoky Row near-road site (AQS ID 39-049-0038). Assessments will be made individually for each sensor, as well as collectively considering the ensemble of sensors operating together. Assessments will be conducted according to the framework suggested by the U.S. EPA in their guidance document on Performance Testing Protocols, Metrics, and Target Values for Fine Particulate Matter Air Sensors (Duvall et al., 2021). This document recommends several performance metrics and assessments to be used, as well as providing appropriate ranges for these metrics. The collocation process is described in more detail in the Sensor Collocation Procedure (document no. AQ-14-6000). The calibration parameters for each sensor are captured on the "Collocation" tab of the Air Quality Monitor Tracking Spreadsheet (document no. AQ-22-5000).

After the collocation process has been completed for a sensor and the sensor has been deployed at its intended location, all subsequent measurements produced by the sensor are corrected prior to use as described in Section B.2.3.

The MORPC/FCPH team participated in a previous air quality monitoring project with other collaborators in which the project team evaluated the appropriateness of the EPA equation for our purposes and found it is appropriate. That evaluation is discussed in more detail in Appendix F. That section also includes some example results from a previous collocation assessment.

B.8 Inspection/Acceptance Requirements for Supplies and Consumables

This section is not applicable.

B.9 Data Acquisition Requirements for Non-Direct Measurements

Auxiliary data required for the project are listed in Table 7. Additional data will be identified during implementation of the source apportionment model, at which time it will be added to the table.

Table 7. Auxiliary data

Existing Data or Study	Data Source	How Data Will Be Used	Acceptance Criteria
Total population by ZIP code[6]	American Community Survey 5-year Estimates, U.S. Census Bureau	Prioritization of ZIP codes for sensor placement	No specific criteria. Source represents best available estimate.
Percent population under 5 by ZIP code	American Community Survey 5-year Estimates, U.S. Census Bureau	Prioritization of ZIP codes for sensor placement	No specific criteria. Source represents best available estimate.
Percent population 65 and over by ZIP code	American Community Survey 5-year Estimates, U.S. Census Bureau	Prioritization of ZIP codes for sensor placement	No specific criteria. Source represents best available estimate.
Percent population under 200% federal poverty limit by ZIP code	American Community Survey 5-year Estimates, U.S. Census Bureau	Prioritization of ZIP codes for sensor placement	No specific criteria. Source represents best available estimate.
Percent non-white population by ZIP code	American Community Survey 5-year Estimates, U.S. Census Bureau	Prioritization of ZIP codes for sensor placement	No specific criteria. Source represents best available estimate.
Rate of COVID infection by ZIP code	Franklin County Public Health	Prioritization of ZIP codes for sensor placement	No specific criteria. Source represents best available estimate.

[6] In this table, "ZIP code" refers to ZIP code tabulation area (ZCTA) geographies as defined by the U.S. Census Bureau.

Rate of adult asthma occurrence by ZIP code	Franklin County Public Health	Prioritization of ZIP codes for sensor placement	No specific criteria. Source represents best available estimate.
ZIP code vulnerability assessment	Expert panel assembled by MORPC/FCPH for prior project	Prioritization of ZIP codes for sensor placement	Panelists are appropriately credentialed and competent to provide assessment of vulnerability
Community input for location of sensors	Project Advisory Council	To determine specific sub-ZIP code location for sensor placement	Project team will ensure that council members are sufficiently knowledgeable about the ZIP codes they represent.
Wind direction	National Weather Service	Source apportionment, evaluating impacts of known PM2.5-generating events	No specific criteria. Source represents best available estimate.

B.10 Data Management

This section is not applicable.

C Assessment and Oversight

This section is not applicable.

D Data Review and Usability

D.1 Data Review, Validation, and Verification Requirements

All data produced by the project will be reviewed for completeness, accuracy, and conformance with any relevant data quality indicators. The Corrective and Preventive Action (CAPA) Procedure (resource no. AQ-21-2000) will be initiated for any data found to be non-conforming. Each issue will be tracked to resolution using a unique identifier. Data and documentation produced during the process will be collected in a designated location in the project file (resource no. AQ-21-8000). The non-conforming data will be sequestered until the process concludes and the disposition for the data has been determined. The non-conforming version of the data or record will be positively identified as described in the CAPA procedure. If the non-conformance can be resolved through rework, a separate reworked version of the data or record will be produced. If the data can be reworked or otherwise made usable, it will be restored to the intended location. Regardless of the disposition, the non-conforming version of the data or record will be preserved.

D.2 Validation and Verification Methods

This section is not applicable.

D.3 Reconciliation and User Requirements

This section is not applicable.

E References

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U.S. Environmental Protection Agency, 2022. *The Enhanced Air Sensors Guidebook*, EPA 600/R-22/213, Office of Research and Development. https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=545843&Lab=CEMM

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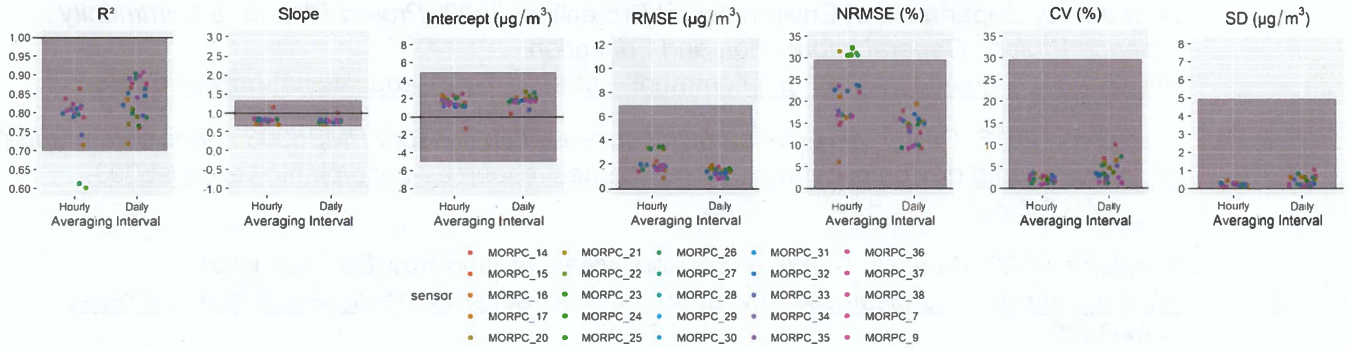
F Appendix: Collocation Precedent Details

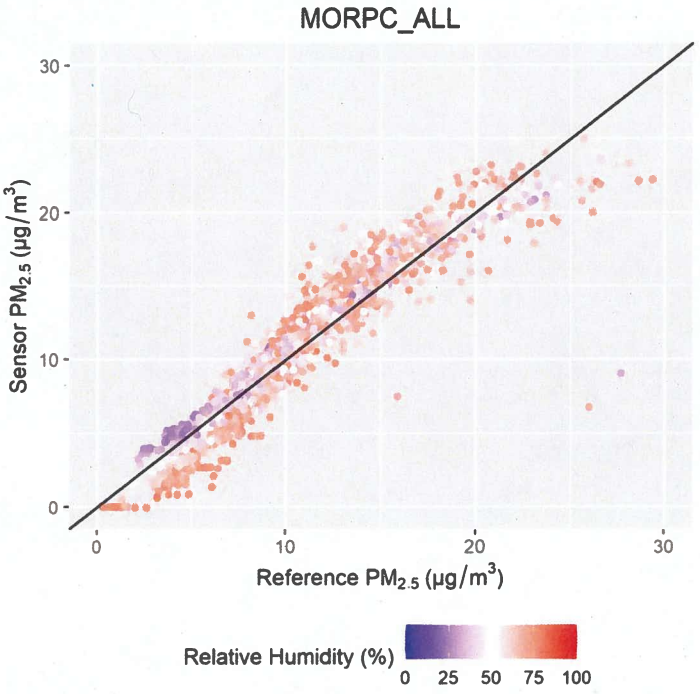
In 2020, MORPC and FCPH partnered with other collaborators to establish an air quality monitoring network using PurpleAir sensors to measure air pollution across neighborhoods to help guide strategies that improve local conditions. Below, an example is given from this earlier project where performance metrics evaluated for the PurpleAir units (colored markings) for both hourly-averaged and daily-averaged post-calibration PM2.5 measurements are plotted. The shaded regions denote expected performance ranges for low-cost sensor units as compared to regulatory-grade monitors. For most sensors, these metrics fell within the expected performance ranges, and therefore were considered suitable for deployment. Several sensors fell beyond these ranges by certain metrics, and so were not considered for field deployment.



The results of the above comparison were also used to establish the suitability of the US nationwide PurpleAir calibration equation for use with this dataset. According to the analysis of the collocation data (e.g., as shown above), PurpleAir data calibrated according to this method showed performance characteristics within the expected ranges for low-cost sensor systems. Considering this good level of performance and the fact that the nationwide calibration is well established with support in the scientific literature and is based on a broad dataset, the decision

was made to use this calibration in lieu of a new calibration specifically developed from this dataset.

Additional data analyses were also performed which indicated the capabilities and limitations of these low-cost sensor systems. For example, in the figure below, a scatterplot is presented of the calibrated hourly PurpleAir PM2.5 measurements (vertical axis) against the collocated reference monitor measurements (horizontal axis), with points being color-coded by relative humidity. Overall, despite some noise, there is a good linearity between these two measurements, which tend to follow the 1:1 line (black line in the figure). There is, however, a noticeable impact of relative humidity on the agreement, especially at low concentrations (less than 10 µg/m3). This is a known shortcoming of all low-cost particulate matter mass sensors, which the selected calibration equation has failed to fully correct for. Such a source of error is considered acceptable given the low costs of the sensors being used but should be kept in mind for later analysis of field data.



G Revision History

Revision Date	Author	Description
2023-09-29	Adam Porr	Initial draft for pre-release submission to EPA
2023-12-01	Adam Porr	Revised draft for pre-release submission to EPA. Revised in response to EPA feedback. Incorporated permanent resource identifiers.
2023-12-05	Brandi Whetstone	Final edits/accepted tracked changes.