**Background on this QAPP template:**

The EPA requires Quality Assurance Project Plans (QAPPs) for all projects it supports via grant funding that involve the collection, production, evaluation, or use of environmental information. Measuring levels of particulate matter with a PurpleAir Sensor is a form of collecting, evaluating, and using environmental information.

The intent of writing a QAPP is to improve the outcome of a project by:

* involving everyone who is part of the project in the planning process
* making sure that everyone in the project agrees on the objectives and how the project will be conducted
* making sure that the planned activities will work toward addressing the project objectives

“What are the project objectives?” or simply: “Why are we doing this project?” are the first questions that should be asked during the planning process. The answers to these questions will drive the project design, including the level of rigor needed for the quality assurance and quality control of the environmental information.

From EPA’s [Air Monitoring QAPP Guide](https://www.epa.gov/sites/default/files/2020-10/documents/air_monitoring_qapp_guide_-_final.pdf):

A Quality Assurance Project Plan (QAPP) is your agency’s specific planning document for conducting a specific monitoring project. It is an overview of your agency’s specific business rules, policies, and quality assurance/quality control (QA/QC) procedures for conducting the monitoring project – in other words, it is how your agency plans to assure the quality of your project’s data. The QAPP is designed to help your agency produce high quality data in a consistent manner. It is designed to help improve communications with all staff involved with the monitoring project, as well as detail their responsibilities such that all parties are aware of their roles within the project. The QAPP also helps participants understand the importance of the specific monitoring project and can serve as both a training guide and legacy documentation.

The first step in deciding whether this template is appropriate for your project is to determine what “Category” it is. The EPA uses a “graded approach” with QAPP requirements depending on the type of project. The graded approach is an attempt to scale the level of effort involved in QA with the importance of decisions that will be made using the data. The table below summarizes the four QAPP categories.

|  |  |  |  |
| --- | --- | --- | --- |
| **Categories** | **Project Objectives** | **Required QAPP Sections** | **Example Programs** |
| Category 1 | Directly support rulemaking, enforcement, regulatory, or policy decisions | 24 | SLAMS, NCore, IMPROVE, CastNet |
| Category 2 | Complement projects that support rulemaking, regulatory or policy decisions | 21 | Speciation Trends, NATTS |
| Category 3 | Evaluate and select options; determine feasibility; preliminary assessment  | 16 | One-time studies, local air quality |
| Category 4 | Proof of concept; education and outreach | 6 | Education/outreach |

This template is designed for Category 4 projects. Category 4 projects are those that investigate issues for the purpose of education and outreach. The EPA has the most stringent QAPP requirements for Category 1 projects that collect and use environmental information to support regulatory decisions and need legal defensibility, both in terms of the number of sections and the amount of information required in each section.

Category 4 QAPPs only require 6 sections. This template includes additional recommended sections for a total of 13 sections. The table below indicates which are required versus optional but recommended.

QAPPs should be composed of standardized, recognizable elements covering the entire project from planning through implementation to assessment. While there can be variability and flexibility in both the section names and what information is included under different sections, the guidance in this template strives to be consistent with the latest EPA guidance in the [Air Monitoring QAPP Guide](https://www.epa.gov/sites/default/files/2020-10/documents/air_monitoring_qapp_guide_-_final.pdf) and the [Quality Assurance Handbook](https://www.epa.gov/sites/default/files/2020-10/documents/final_handbook_document_1_17.pdf).

The table below summarizes the QAPP sections covered in this template and whether they are optional or required for Category 4 QAPPs.

|  |  |  |
| --- | --- | --- |
| Section Grouping | QAPP Section | Required or Optional for Category 4 QAPPS? |
| A: Planning and Project Management *What is the plan for the project?* | Title and Approval Sheet | Required |
| Table of Contents | Optional |
| Definitions | Optional |
| Project/Task Organization Roles and Responsibilities | Optional; required if project is combined QAPP + QMP |
| Problem Definition/Background | Optional |
| Project/Task Description | Required |
| Quality Objectives and Criteria for Measurement Data/Program Goals and Objectives | Required |
| Documentation and Records | Optional |
| B: Data Generation and Acquisition *How will the plan be implemented?* | Sample Process/ Network/ Experimental Design | Required |
| Sampling methods requirements | Optional |
| \*Sample Handling and Custody Requirements | Not recommended |
| \*Analytical Methods Requirements | \*Usually required, but not applicable for sensor projects.  |
| QC requirements | Required |
| C: Data Validity and Usability *How will the data be evaluated?* | Data review, validation, and verification | Optional |

Your project may involve more than education and outreach, and in that case, this Category 4 QAPP template is not appropriate. Assistance for more extensive level 3 -1 QAPPs is available from the Institute for Tribal Environmental Professionals (ITEP) or EPA’s Quality Assurance Coordinator.

Copies of the EPA’s graded approach and which sections are needed for which types of projects can be found on the EPA’s website at:

<https://www3.epa.gov/ttn/amtic/files/ambient/monitorstrat/gradeapp.pdf>

<https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance>

<https://www.epa.gov/quality/quality-assurance-project-plan-development-tool>

[http://www.epa.gov/QUALITY/exmural.html](http://www.epa.gov/QUALITY/exmural.html#pagecontents)

It is important that you consult with your EPA Project Officer to ensure that your QAPP meets the requirement for the project type.

**Instructions for using this template:**

* The first step to using this template is to establish that your project qualifies as Category 4. If you answer “yes” to any of the following questions, your project is likely Category 3 and additional QAPP requirements apply:
	1. Will the monitoring data from this project be used to support rulemaking, enforcement, regulatory, or policy decisions?
	2. Will the monitoring data be used to inform decisions related to regulatory monitoring, such as siting of future regulatory monitoring sites?
* If your project Qualifies as Category 4, the next step is to determine whether you have an existing Quality Management Plan (QMP) for your organization. A QMP describes the quality assurance policies and structure for the whole organization across air, water, and any other programs that collect environmental information. If you do not have a QMP, or you aren’t sure, be sure to include the additional required elements in the Project Organization Roles and Responsibilities section.
* Notes on template formatting:
	+ This template is locked for editing to preserve its content. To start using this template, copy and paste it into a new word document:
		- Press “ctrl+a” to select all text
		- Press “ctrl+ c” to copy all selected test
		- Press “ctrl+ n” to open a new word doc
		- Press “ctrl+p” to paste the text into a new word doc
		- Save the new word doc and start editing!
	+ Items in red italics add context or provide guidance on the QAPP. The red, italicized text needs to be incorporated into the QAPP narrative or deleted before the QAPP is complete.
	+ Items in plain text are suggested language based on R10’s experience with PurpleAir Sensor projects. You can use these directly in your QAPP if they are applicable to your project.
	+ The XXXX characters are where you may want to add or delete information.
	+ TEXT IN RED CAPITALS must be replaced by your own text, for example, the name of your organization and staff titles

Quality Assurance

Project Plan TITLE

INSERT YOUR LOGO HERE

Prepared by: *NAME*

Date: XXXX

## 1: Project Plan Identification and Approval

Project Name: (Develop a descriptive project title, state who wrote the QAPP, and provide a signature and a date space for all parties who need to acknowledge they have read, understand, and agree with the plan.)

The Air Quality Project Officials

1) Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_

 XXXXXXX, Tribal Chairman (as appropriate, this may not be necessary)

2) Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_

 XXXXXXX, Project Manager, add or delete these lines and insert names and titles

3) Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_

 XXXXXXX, Natural Resources Dept. Director

4) Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_

 XXXXXXX, Environmental Specialist

U.S. Environmental Protection Agency, Region 10

7) Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_

 XXXXXXX, Project Officer

 EPA, Air and Radiation Division

8) Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_

 Will Wallace, Quality Assurance Coordinator

 EPA, Laboratory and Applied Sciences Division

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## 2. Definitions: (optional but recommended):

It can be helpful to have a central location for many of the technical and/or regulatory terms in the QAPP to avoid confusion. Please keep/delete/add to this list as appropriate for your project.

**AQI:** Air Quality Index. An EPA-developed index for reporting daily (24-hour average) air quality and relating it to health effects For more information on the AQI and how it works, please see [https://airnow.gov/aqi/aqi-basics](https://www.airnow.gov/aqi/aqi-basics).

**AirNow:** A web-based (airnow.gov) source for air quality information including interactive maps of local air quality. AirNow presents air quality information in the form of a NowCast of the AQI.

**AirNow Fire and Smoke Map:** The AirNow Fire and Smoke Map provides information for people to use to help protect their health from wildfire smoke. The Map displays current particle pollution air quality information for your location; fire locations and smoke plumes; smoke Forecast Outlooks, where available; and recommendations for actions to take to protect yourself from smoke. These recommendations were developed by EPA scientists who are experts in air quality and health. The Map is a collaborative effort between the U.S. Forest Service (USFS)-led Interagency Wildland Fire Air Quality Response Program and the U.S. Environmental Protection Agency (EPA).

**Air Sensor:** Air sensor (or simply “sensor”) is a simplified way of referring to a class of technology that has expanded on the market in recent years and has common traits of directly reading a pollutant in the air, being smaller in size, and often sold at a price that supports a wider number of monitoring locations than possible in the past. Many groups refer to this class of technology as “low-cost air sensors,” “air sensor devices,” and “air quality sensors.”

**Environmental Justice:** the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

**EPA Correction Factor:** a multi-linear correction equation (including temperature and relative humidity) for PurpleAir PM2.5 data. an extended U.S.-wide correction equation, developed by EPA scientists, that reduces the bias in the sensor data correcting for the overestimation. The corrected data are more comparable to the permanent and temporary monitor data. More information here: <https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=349513&Lab=CEMM>.

**Fine Particulate Matter (PM2.5):** fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller. For context, the average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle. See: <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>.

**NAAQS:** National Ambient Air Quality Standards. The EPA sets limits for ambient levels of several air pollutants knows to be harmful to human health: lead (Pb), carbon monoxide (CO), sulphur dioxide (SO2), nitrogen dioxide (NO2), ozone (O3), coarse particulate matter (PM10), and fine particulate matter (PM2.5).

**NowCast:**  The real-time weighted average that AirNow applies to the air quality data displayed on its maps. AirNow uses this weighted average to balance the need to be responsive to rapidly changing air quality conditions with the longer exposure time (24 hours) used in studies on air pollution and health. The NowCast is not available on the PurpleAir Map.

**PurpleAir[[1]](#footnote-2)**

**PurpleAir Map:** a web application that displays a network of community owned, PurpleAir sensors. Each sensor uploads data to the PurpleAir map in real time. See: <https://community.purpleair.com/t/map-start-up-guide/90>.

**PurpleAir Sensor:** PurpleAir Sensors use laser counters to measure particulate matter in real time. A laser counter uses a fan to draw a sample of air past a laser beam. Any particles in the air will reflect some light from the laser beam onto a detection plate, like dust shimmering in a sunbeam. The reflection is measured as a pulse by the detection plate, and the length of the pulse determines the size of the particle while the number of pulses determines the particle count. These particle counts are used to calculate the mass concentrations of PM1.0, PM2.5, and PM10 for standard indoor and outdoor particles.

**Regulatory monitor:** in the context of air quality monitoring, a regulatory monitor is an air monitoring instrument that has gone through a formal review process and been approved by the EPA as a Federal Reference Method (FRM) or a Federal Equivalent Method (FEM). These data collected by these monitors can be compared to the NAAQS, if the monitor siting, operation, and data handling meet regulatory requirements

**Regulatory monitoring:** monitoring using a regulatory monitor that also meets all the requirements for siting, quality assurance, data handling and storage, and other regulations. When all the requirements for regulatory monitoring are met, we have high confidence that the measurements accurately represent a locations air quality, and thus we can use the data to determine if the area is meeting or exceeding the NAAQS.

## 3. Project Organization and Roles & Responsibilities (required for combined QAPP-QMP; optional but recommended for QAPP-only):

Clarifying project roles and responsibilities in writing sets expectations and can help prevent future miscommunications.

For a combined QAPP-QMP,

Examples of what to include:

* Personnel in category XXXX are responsible for …
* Personnel in category XXXX are responsible for…
* Named individual XXXX has the role of \_\_\_\_ and will be responsible for \_\_\_\_.
* Include roles & responsibilities of contractors/subcontractors and/or partnering agencies.
* In some cases, it is helpful to include an agency organizational chart.

## **4. Problem Definition and Background *(optional but recommended)*:**

This section can usually be adapted from the grant workplan problem background and/or project significance sections.

Clearly state the environmental problem(s), question(s), or threat(s) to be addressed by the project. Explain why the work will be beneficial, identifying the reasons for conducting the work or collecting information relating to the project. Provide relevant historical information, previous studies, and data that have been collected. Identify the data gaps that this project will fill.

## **5. Project Description *(required)***:

Similar to the Problem Definition and Background section, you can make use of the grant workplan as a starting point for this section.

Describe how the project addresses the problem or answers the environmental questions and links data results with possible actions. Can start with “This grant project is designed to…”. Summarize the work to be performed, and the data you want or need to collect, the technologies or methods used to collect data and the decisions you plan to make with the data. The project description should include information on project objectives, study area, and data users.

The project objectives should link data results with possible actions. Clearly describe the decision to be made, or outcome to be achieved. This statement can be as simple as: “Sensor readings accessed via the AirNow Fire and Smoke Map will help community members plan their outdoor activities”.

In EPA R10’s work with PurpleAir Sensors, we have found that project objectives usually fall into one of two types:

1. Real-time informational/educational use only. Users will access sensor readings via the publicly available AirNow Fire and Smoke Map. (Most user-friendly)

And/or:

1. Informational investigations (e.g., air quality spatial or temporal trends). Users/air quality agencies will download sensor time series data to analyze. (Less user-friendly. Downloading PurpleAir Sensor raw data requires using the PurpleAir Application Programming Interface (API) and applying the QA steps. This process can be completed using a web browser and a spreadsheet software like Excel but can be a time-intensive process.)

How the sensor data will be accessed has important implications for the data quality needs. The AirNow Fire and Smoke Map has several quality assurance steps built into the sensor readings it displays. The Fire and Smoke Map imports readings from outdoor (not indoor) PurpleAir Sensors, screens the readings using a precision check, applies the EPA correction factor, and displays the sensor data’s NowCast on the Fire and Smoke Map.

In addition to the project objective, include the following information in narrative, tabular, or graphic formats:

* Project Sites or Study Area (for example, a map of sampling locations and other important geographic features of the area).
* Time Period: how long will the sensors be deployed for? What times of year is PM2.5 a concern?
* Data Users: who will be using the sensor measurements?

We also recommend including the following disclaimer language:

Expectations and use are limited to informal evaluations and should not be represented as definitive measurements to be used for anything other than informational investigations, education, and awareness. **Important Note: The air sensors are non-regulatory and the data they collect are not eligible for comparison to the NAAQS. This equipment is not to be used for confined space evaluations for safety considerations. The EPA does not endorse using this equipment to meet any requirements related to health and safety.**

## 6. Data Quality Objectives and Indicators (required):

This section is the core of the QAPP as it defines what environmental information (that is, data) is useful for the project and what data are not qualified enough to be used.

The goals of this program/project are to…

### **6.1: Data Quality Objective(s) (DQO):**

DQOs are qualitative and quantitative statements that:

* Clarify the intended use of the data (Why are the data needed?)
	+ Restate the problem definition and project objective with a focus on why PM2.5 readings from sensors is needed.
* Define the type of data needed (What measurements are required and what do they need to represent?).
	+ Indoor or outdoor measurements?
	+ PM2.5 sensors make hyper-local measurements of ambient fine particulate matter levels, which represent PM2.5 exposure levels for people in that community.
	+ PM2.5 sensor data may be used to compare local ambient conditions to the Air Quality Index (AQI) or to determine local air quality trends and patterns.
* Specify the tolerable limits on the probability of making a decision error due to uncertainty in the data (How much measurement uncertainty can be tolerated in the data set?). Some suggested points to make:
	+ Moderate uncertainty is acceptable in translating the measured PM2.5 levels to the AQI and exploring trends and patterns.
	+ Sensors, including the PurpleAir Sensor, typically measure particles using light scatter, operate at lower flowrates, and do not dry the sampled particles like permanent and temporary monitors operated by clean air agencies. These methodological differences can lead to inaccuracies compared to permanent and temporary monitors. EPA scientists have found that air sensors often report data that overestimates, or underestimates pollutant concentrations compared to the permanent or temporary instruments that are operated in the same location.
	+ PurpleAir Sensors, without the use of the EPA correction equation, measure the same trends in PM2.5 concentrations as collocated monitors, but they tend to overestimate the PM2.5 mass concentrations and respond nonlinearity at high smoke concentration (>200 µg/m3).
	+ For the sensor data used in the Fire and Smoke Map, EPA has applied an extended U.S.-wide correction equation, developed by EPA scientists, that reduces the bias in the sensor data correcting for the overestimation. The corrected data are more closely comparable to the permanent and temporary monitor data.

### 6.2: Data Quality Indicators

Data quality indicators (DQIs) are quantitative and qualitative characteristics associated with the collected data (i.e., calculated statistics). The QAPP should list the DQIs for the monitoring project, provide brief definitions for each, and then explain how the DQIs are measured / determined by the agency.

Suggested DQIs for Category 1 or 2 projects (select based on what you selected in Section 5, or provide DQIs appropriate for your project):

Sensor data used solely for education/awareness (Type 1 as defined in Section 5) do not have any quantitative DQIs.

and/or:

Sensor data used for informational investigations (Type 2 as defined in Section 5) should use the following DQIs:

1. **Precision** refers to the random error of a given measurement. One way of quantifying precision is by comparing multiple measurements of the same thing, in this case of the level of PM2.5 in the ambient air. PurpleAir sensors make duplicate measurements of ambient PM2.5 which are recorded as two “channels”: A and B. The precision can be determined by calculating the difference in these two channels.
2. **Bias** is a systematic error in a set of measurements, or the difference between the measurements and the true value. EPA scientists have quantified the typical bias of PurpleAir sensors and developed a correction equation (see above).
3. **Data completeness** is a measure of the data coverage over time. Since PM2.5 levels often have patterns over time (e.g., more elevated at night or during inversion events), it is important that the measurements are representative of reality.

### 6.3: Measurement Quality Objectives:

Measurement quality objectives (MQOs) are the acceptance or performance criteria for individual DQIs. They are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs.

Projects using the sensors for informational/educational use only (Type 1 as defined in Section 5) will be accessing data that has already had these indicators applied via the AirNow Fire and Smoke Map. Sensor data used for informational investigations (Type 2 as defined in Section 5) must have the same quality tests applied as data imported into the AirNow Fire and Smoke Map listed in the table below. Any data not meeting the MQOs must be invalidated and excluded from the dataset used for the informational investigation.

|  |  |
| --- | --- |
| DQI | Acceptance/Performance Criteria |
| Precision | The two sensor channel measurements (A and B) are within 70% or 5 ug/m3 of each other.  |
| Bias | The EPA correction equation must be applied to PurpleAir sensor data. |
| Data Completeness | An hour is considered complete if at least four of the six (67%) 10-minute windows in an hour are reported by the sensor.A day is considered complete if 80% of the hourly data are complete.  |

## 7. Documents and Records *(optional but recommended)*:

This section identifies the information and records needed for the project. At a minimum, we recommend all QAPPs include the following statement:

The most current QAPP will be provided to all sampling personnel prior to sensor mobilization. Additional optional but helpful details can include answers to the following questions:

* How will you make sure everyone has the same approved version of the QAPP?
* Who will be responsible for making sure this happens?

In addition to info on the QAPP distribution, it may be helpful to include details as applicable on:

* Project plan and/or experimental design description (see example in Appendix B)
* Field data sheets: Record relevant information for sensor siting and checks. (Appendix C).
* Downloaded sensor data files
* Auxiliary data from other sources such as data bases or scientific literature
* Final data report: what data will be included? What analyses will be performed?

## 8. Experimental Design *(required):*

Describe your plan to use PurpleAir sensors to achieve the objective you set out in Section 5. How many sensors are you deploying and how long will they be deployed? What are your criteria for deciding where to deploy sensors?

Some example criteria for deciding where to deploy sensors:

1. Are there PM2.5 monitors or sensors reporting to the Fire and Smoke Map in the vicinity?
2. Is there access to an appropriate location with power and Wi-Fi access for meaningful sampling?
3. How will the data collected from this monitoring be used?
	* Will the sensor be located indoors, outdoors, or will the user be deploying paired indoor/outdoor sensors?
	* Will the data be public or private? If private, how will the user use the data?
	* Will the data be used to inform any decisions on outdoor activities?
	* What additional information/measurements/data/outreach are needed to achieve the project objectives?

Suggested descriptions of the experimental design for Type 1 or 2 projects (select based on what you selected in Section 5, or provide an experimental design appropriate for your project):

For informational/educational real-time only uses of sensors (Type 1), the experimental design is simply to install the sensor(s) and ensure it is/they are running.

AND/OR:

For informational investigations (Type 2), write a narrative that includes the information in the Experimental Design form, Appendix B.

## 9. Sampling Methods Requirements *(optional but recommended)*

This section of the QAPP describes field work. PurpleAir Sensors make measurements in situ, in contrast to environmental measurements where physical samples are collected and then analyzed in a lab. The air quality measurements made by the PurpleAir Sensors are “samples”.

It is recommended to include a description of how the PurpleAir Sensors work. The paragraph below is from the PurpleAir website (<https://www2.purpleair.com/>). You can use this paragraph if your project uses the PA-II, or update the information for the model of sensor you are using.

PurpleAir Sensors use laser counters to measure particulate matter in real time. A laser counter uses a fan to draw a sample of air past a laser beam. Any particles in the air will reflect some light from the laser beam onto a detection plate, like dust shimmering in a sunbeam. The reflection is measured as a pulse by the detection plate, and the length of the pulse determines the size of the particle while the number of pulses determines the particle count. These particle counts are used to calculate the mass concentrations of PM1.0, PM2.5, and PM10 for standard indoor and outdoor particles.

Most PurpleAir models (PurpleAir Classic, Flex, and Zen) are equipped with two sensors which measure and report particle concentrations in six sizes between 0.3μm and 10μm diameter. Temperature, relative humidity, and pressure values are also recorded. The sensors are calibrated by the manufacturer to associate a particle size with particle mass and estimate total mass for PM1.0, PM2.5 and PM10. Readings are then uploaded to the cloud approximately every 80 seconds where they are stored for download and display on the PurpleAir Map.

Any sampling methods and equipment in addition to the PurpleAir Sensors used in the project should also be identified in this section. If additional measurements are part of this project, the description here should answer the questions:

* What are your data collection activities?
* Why did you choose this method?
* State the specific methods or SOPs that will be used. Attach any SOPs as necessary in the appendices.
* What is the rationale for these samples, e.g., why are the data being collected at the particular location, frequency, and time?

The table below is one way to present this information:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter including sensor type | # of Sampling Locations | Frequency of measurements | Types of Field QC Samples or Activities | Averaging Period | Sampling SOP Reference |
|   |   |   |   |   |   |
|   |   |   |   |   |   |
|   |   |   |   |   |   |
|   |   |   |   |   |   |

## 10. Quality Control Requirements *(required)*

Suggested introductory language about quality control:

Quality Control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements. QC activities are used to ensure that measurement uncertainty can be estimated and is less than the measurement quality objectives so that the DQOs can be met.

Depending on the project objective, QC activities could include:

* Confirming sensors are reporting to the AirNow Fire and Smoke Map on a regular basis. Specify the frequency: daily, weekly, monthly?
* Comparing sensor results to other nearby sensors or nearby PM2.5 regulatory monitors.
* Applying the MQOs from section 6.3 to any downloaded raw data.
* Regular site visits to check on the sensor(s) and address any issues. Common issues include dust/debris/insects in the sensor housing, the sensor becoming unplugged, or problems with how the sensor is mounted (broken zip ties, etc).

The summary should include how any issues will be recorded, and how they will be addressed. The term for addressing data quality issues is “corrective action”. Here is example language for corrective action that can be adapted to your program/project:

If the sensor is not reporting or not meeting precision data requirements (see Section 6) the user should take the following corrective steps:

1. Check the WiFi connectivity at the site.
2. Physically inspect the sensor. Confirm the power cord is connected and does not look damaged. Inspect the internal sensor inlets inside the sensor housing for debris.
3. If there appears to be physical debris present, clean the sensor with compressed air. A vacuum hose may also be effective.
4. If none of these steps resolve the issue, contact PurpleAir for a repair or replacement if within the warranty period or replace the sensor.

## 11: Data Review and Verification

This section should describe the types of checks that will be performed to determine if the data collected meet the DQOs and are usable for the objectives of the project. Describe the data review and verification steps that will be performed to determine if project data were collected, generated, and analyzed according to the project's planned requirements. For the PurpleAir Sensor measurements, the following language may be appropriate:

Sensor data used solely for education/awareness (Type 1 as defined in Section 5) and accessed via the AirNow Fire and Smoke Map should be verified by comparing to observed conditions (e.g., can you see or smell smoke?). Sensor data should also be compared to other nearby sensors/monitors on the Map as applicable.

AND/OR

Sensor data used for informational investigations (Type 2 as defined in Section 5) should be verified by comparing the data to nearby sensor/monitor data as applicable. Data should also be excluded for any periods where the sensor was known to be malfunctioning (measurements failed to meet the MQOs, site visit inspection indicates improper siting or debris in the sensor housing).

For projects using PurpleAir Sensor measurements for informal investigations, this section should also include descriptions of:

* How the data will be summarized or analyzed (e.g., qualitative analysis, and descriptive statistics, or inferential statistics) to meet project objectives.
* If descriptive statistics are proposed, list how the data will be summarized (e.g., mean, median, standard error, or minimum and maximum values).

## Appendix A: Additional Resources

|  |  |
| --- | --- |
| Resource Description | URL: |
| EPA’s Sensor Toolbox guide to siting and installing air sensors | <https://www.epa.gov/air-sensor-toolbox/guide-siting-and-installing-air-sensors> |
| The Enhanced Sensor Guidebook, Clements, A., R. Duvall, D. Greene, AND T. Dye. The Enhanced Air Sensor Guidebook. U.S. Environmental Protection Agency, Washington, DC, 2022 | <https://www.epa.gov/air-sensor-toolbox/how-use-air-sensors-air-sensor-guidebook> |
| AirNow Fire and Smoke Map Technical Q&A: | <https://document.airnow.gov/airnow-fire-and-smoke-map-questions-and-answers.pdf> |
| PurpleAir’s Guide | <https://www.purpleair.com/sensors> |
|  |  |
|  |  |

## Appendix B: Experimental Design Description Sheet:

|  |
| --- |
| Use this experimental design description sheet to plan your experiment and data collection. *Sections can be adapted as needed.*  |
| Consideration | Response |  |
| What are the main sources of PM2.5 in your area? |  |  |
|  |  |
|  |  |
|  |  |
|  |  |
| Are you interested in comparing indoor and outdoor air measurements?  | Location | Reason |
|  |  |
|  |  |
| What time resolution are you interested in following?  |  \_\_\_\_\_\_\_ Daily Average \_\_\_\_\_\_\_\_Sub-daily/hourly |
| How often will you verify the sensor is reporting to the AirNow Fire and Smoke Map? | \_\_\_ Daily\_\_\_ Weekly\_\_\_ Monthly |
| What method(s) are being used to document sensor siting and any troubleshooting? |  e.g., Field datasheet, internal data log or other.  |

## Appendix C: PurpleAir Field Sheet

|  |
| --- |
| Sensor Log |
| PurpleAir Serial no. |
| Receiving and Setup: |
| Date sensor(s) received |  |
| All expected parts received? |  |
| Any noticeable damage? |  |
| Does the LED light turn on when the sensor is connected to power? |  |
| Sensor deployment: |
| Deployment date |  |
| Address or latitude and longitude of sensor |  |
| Deployment height |  |
| Any obstructions near the sensor? |  |
| Picture taken that shows sensor and surroundings? |  |
| Sensor registered and set to public? |  |
| Sensor maintenance |
| Sensor showing up on the fire and smoke map?  |  |
| Indicate dates when you confirmed the sensor is reporting to the Fire and Smoke map: |  |
| Site visit date, issue, and whether the issue was resolved: |  |
| Site visit date, issue, and whether the issue was resolved: |  |

1. Disclaimer: Any mention of trade names, products, or services does not imply an endorsement by the U.S.

 Government or the U.S. Environmental Protection Agency.​ [↑](#footnote-ref-2)