CTCLUSI PurpleAir Monitoring Project

Quality Assurance Project Plan

Prepared by
Confederated Tribes of the
Coos, Lower Umpqua & Siuslaw Indians
Department of Culture and Natural Resources
1245 Fulton Avenue
Coos Bay, Oregon

Version 1.2
November 2023

TITLE AND APPROVAL

X DocuSigned by: Matthew Schwoebel 1/18/2024
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Matthew Schwoebel, CTCLUSI
Director of Culture and Natural Resources

X DocuSigned by: Ali Grove 1/18/2024
0A526F67D3FC466...

Ali Grove, CTCLUSI
Air Protection Specialist

X ANDREA MANION Digitally signed by ANDREA MANION Date: 2024.01.18 11:18:14 -08'00'

Andrea Manion, EPA R10
Project Officer

X HENRY WALLACE Digitally signed by HENRY WALLACE Date: 2024.01.18 13:15:35 -08'00'

Will Wallace, EPA R10
Quality Assurance Coordinator

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DISTRIBUTION LIST

Paper copies of this QAPP shall be distributed to the people listed in the **Distribution List**. When this QAPP is revised, individual sections or the entire QAPP are sent to the following:

Upon approval of the QAPP a copy will be distributed to the following.

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians

Brad Kneaper, Tribal Council Chair
Lee Ann Wander, Chief Executive Officer
Matthew Schwoebel, Director, Department of Culture Natural Resources

U.S. Environmental Protection Agency, Region 10

Will Wallace, Air QA Reviewer
Andrea Manion, Project Officer

Oregon Department of Environmental Quality

Annalisa Bhatia, Tribal Liaison

DEFINITIONS

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.

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."

INTRODUCTION

As a sovereign nation, the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians has a responsibility to the members of the Tribe to manage and protect the air resources on the Tribe's land and within the Tribe's ancestral home. The CTCLUSI Air Quality Program (AQP), located within the Department of Culture and Natural Resources, exists to monitor, research, and assess indoor and ambient air quality, provide advice and expertise on air quality health impacts, and assess the impact of local and state laws, executive actions, and permits on the Tribe's air resources.

To further these responsibilities, CTCLUSI maintains a network of low-cost ambient air quality sensors. These sensors can be located at homes, community spaces, Tribal offices and properties, and anywhere else where a need has been identified. The purpose of this Quality Assurance Project Plan is to ensure that ambient monitoring using PurpleAir air quality monitors is conducted properly, reliably and predictably. Doing so improves our ability to provide Tribal members with knowledge of local air quality health hazard conditions emerging from industrial pollution sources and wood smoke.

CTCLUSI ROLES AND RESPONSIBILITIES

The following sections list the responsibilities of individuals in the CTCLUSI air program:

Director of the Department of Culture and Natural Resources, manages and oversees the development and successful operation of the AQP, prepares and reviews budgets, contracts, grants and proposals, and oversees the implementation of projects. This position is partially funded through Section 105 of the Clean Air Act.

Air Protection Specialist, is responsible for collecting, verifying, and reporting on air quality and meteorological data collected in accordance with an EPA approved QAPP and SOPs. Staff in this position installs, operates, and maintains monitoring equipment and the monitoring site, and participates in trainings that increase air quality monitoring skills. In addition, this position monitors and follows Title V air quality permits in the Tribe's areas of interest. This position is partially funded through Section 105 of the Clean Air Act.

TECHNICAL ASSISTANCE

The following EPA staff assists in technical support for CTCLUSI

EPA Region 10 Regional Project Officer

EPA Region 10 Quality Assurance Coordinator

EPA Region 10 Tribal Air Technical Advisor

PROBLEM BACKGROUND/DEFINITION

Since Time Immemorial, our people have lived along the coasts of the Pacific Ocean and the Coos, Umpqua, and Siuslaw estuaries and tributaries. Our expansive homeland stretched from the Pacific Ocean to the forested slopes of the Coastal Mountain range of Oregon encompassing 1.6 million acres and 80 miles.

In 1855, CTCLUSI signed a treaty with the United States government that ceded our Ancestral Territory in exchange for compensation of ceded lands and a large reservation. Unfortunately, the treaty was never ratified. As a result, we were never appropriated a reservation or compensated for our lands. Most of our people were rounded up, confined, and then moved to the Alsea sub-agency area at the southern end of the Siletz Reservation. It is believed that about half of our people lost their lives during these dismal years because of disease, starvation, and exposure. In 1875, the Alsea sub-agency was opened for Euro-American settlement despite protests by our Chiefs, Headmen, and Tribal delegates. Our people became refugees in their own homeland and were forced to linger in the shadows of our Euro-American neighbors.

Nevertheless, we maintained our identity as Native People. In 1917, we officially banded together as CTCLUSI and established a formal elected government that we have maintained ever since. In 1941, the Bureau of Indian Affairs ("BIA") took a small parcel into trust for CTCLUSI in the City of Coos Bay, Oregon. On this small Reservation, the BIA also erected a Tribal Hall that included an assembly hall, kitchen, offices, and medical clinic. In 1954, the U.S. government terminated our federal recognition. We refused to accept the termination of our existence as a tribe. In 1984, after three decades of hard work, our federal recognition was restored.

At the time of restoration, CTCLUSI held only our Tribal Hall on six acres and three other slivers of land totaling less than eight acres, a far cry from our original 1.6 million acres. Since restoration, we have continued the work of reconstructing our fragmented land base and revitalizing our culture. As of today, the Tribe's Reservation and trust land base is greater than 14,800 acres, and more than 400 acres are held in fee.

Protecting the health of our Tribal members, especially vulnerable populations such as children and our elders, is critical for the Tribe's wellbeing and quality of life. Our elders connect us to our culture and heritage, and our children are our future. Exposure to air pollution, and $PM_{2.5}$, specifically, is associated with increased risk of respiratory infections, asthma incidence, cardiovascular disease, chronic obstructive pulmonary disease, COVID-19, and others.

Although air pollution comes from many sources, there are two main air pollution sources of concern for our community: wildfires and wood-fueled heating. First, air quality is being increasingly impacted by wildfires. Research from these events has linked wildfire smoke to increased susceptibility to respiratory infections including COVID-19, as well as overall increases in mortality and morbidity. Climate scientists predict that wildfires and the associated air pollution events in our area will continue to get longer and more intense.

Air quality is also impacted in our region by wood-fueled heating stoves. Nationally, wood stoves and fireplaces emit 345,000 tons of $PM_{2.5}$ into the air each year, and account for 44 percent of total stationary and mobile polycyclic organic matter emissions, nearly 25% of all area source air toxic cancer risks and 15 percent of noncancer respiratory effects. These regional pollutants persist despite improved stove certification programs because 65% of the 12 million wood heaters in use today are still older, inefficient devices.

During heating seasons, studies have shown woodsmoke is the dominant source of ambient $PM_{2.5}$ in many rural communities similar to ours. A recent EPA source apportionment study, for example, found that over 85% of ambient $PM_{2.5}$ in Oakridge, OR and Klamath Falls, OR was from woodsmoke during the heating season. Woodstove heating is prevalent in our communities, and in addition to the ambient contributions, also poses substantial risks due to indoor air pollution. Personal exposure to $PM_{2.5}$ from residential wood heaters was found to be inversely correlated with income, disproportionately affecting low-income households, and several studies have documented high indoor $PM_{2.5}$ concentrations among Native American communities reliant of wood heating.

Our approach is informed by three main components research indicates is key for successful application of air monitoring networks for improving community response. First, the data needs to be of sufficient quality and granularity (in time and geography) to inform decisions. Second, people are more likely to take action if the data is coming from a trusted source. Third, the information needs to be accompanied by actionable steps. Our project explicitly addresses these three components by providing high quality and granular data to the community, which will be generated a trusted community source (CTCLUSI's monitoring network), and will be accompanied by outreach and educational materials to help our members and the community make informed decisions to reduce their exposures and protect public health.

PROJECT DESCRIPTION

This grant project is designed with three goals in mind:

1. Provide more granular air quality data for Tribal members and the broader community.
2. Explicate the impact of wood heating on outdoor and indoor air quality. This means community members can make informed decisions on heating practices and technologies.
3. Provide members with guidance on actionable measures to reduce exposures (e.g. staying indoors and closing doors and windows during wildfire events, use of HEPA purifiers, using dry wood, switching to cleaner heating technologies, etc.).

The following Tribal facilities have been identified as locations for ambient air monitoring:

- Tribal Housing (Qaxas) in Coos Bay
- Three Rivers Casino in Coos Bay
- Three Rivers Casino in Florence
- Outreach Office in Florence
- Outreach Office in Eugene
- Schools in Tribal counties (Coos, Curry, Douglas, Lane and Lincoln)

Deploying PurpleAir sensors in accordance with this QAPP means the data can be made available on EPA's AirNow Fire and Smoke Map. This real-time and easily accessible data helps assist our community with all three goals. Users will access sensor readings via the publicly available AirNow Fire and Smoke Map for informational and educational purposes.

Expectations and use are meant for 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.**

QUALITY OBJECTIVES AND CRITERIA FOR MEASURING DATA

Data Quality Objectives (DQO)

The Tribal Air Quality Monitoring Project is focused on assessing potential risks to human health from air pollution and smoke. Particulate matter pollution is highly dependent on local weather conditions. Therefore, deploying sensors as widely as possible, and as close to sensitive locations and community members, is essential for meeting the educational and informational goals of the project. In order to be consistent with our departmental activities of outreach and education about the environment, we have identifies Data Quality Objectives (DQO) to define what information is useful and effective for our purposes.

1. To be consistent with our goals and the AirNow mapping tools, we intend to deploy monitoring equipment outdoors.
2. Data should be collected from locations where it can be useful to the community as a whole, community members with particular sensitivity to pollution, further address environmental justice issues, and/or address the needs of the Tribe.
3. All of our activities are conducted with a long-term vision of scaling and sustainability. Specifically, materials developed for installing/maintaining equipment, education and outreach will all be user-friendly and well-documented.

Due to the importance of providing as much information as possible, data shall only be rejected or qualified if there is positive evidence that it is biased, in error, or otherwise incorrect. This data will not be used for regulatory decisions, and thus does not need to meet more stringent data quality review. Some uncertainty is thus acceptable in translating the measured air quality levels.

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. PurpleAir Sensors without the use of the EPA correction equation tend to overestimate the PM2.5 mass concentrations and respond nonlinearity at high smoke concentrations.

Data Quality Indicators (DQI)

DQIs provide additional information for evaluating the quality of data. CTLCUSI uses DQIs including **precision, bias, accuracy, and completeness** in other parts of our monitoring programs:

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 PM 2.5 in the ambient air. PurpleAir Sensors make duplicate measurements of ambient PM 2.5 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 PM 2.5 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.

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.

Measurement Quality Objectives

Measurement quality objectives are the acceptance or performance criteria for each DQI listed above. The MQOs are designed to ensure the measurement uncertainty does not exceed what is acceptable for 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. Any data not meeting the MQOs must be invalidated and excluded from the dataset used for the informational investigation.

TRAINING/CERTIFICATION

The Director of Culture and Natural Resources is ultimately responsible for ensuring that program staff receives adequate instruction, training, and certification to carry out their responsibilities under this Quality Assurance Project Plan. It is the responsibility of each staff member to present the Director with a plan outlining a schedule for taking the necessary coursework to satisfy the training and certification requirements.

At minimum, the Air Protection Specialist must complete the Air Pollution Technology (Level 2) course, which requires as a pre-requisite the courses of Introduction to Tribal Air Quality (Level 1) and Air Quality Computations (Level 1). If these courses are unavailable, the Director and Air Protection Specialist will work together to find a suitable alternative arrangement. Ideally, the air program staff will complete all of the following ITEP courses: Introduction to Tribal Air Quality (Level 1), Air Quality Computations (Level 1), Air Pollution Technology (Level 2), Air Pollution Modeling (Level 3), and Meteorological Monitoring (Level 3).

EXPERIMENTAL DESIGN

1. Sensor locations are selected based on the expertise of the Tribe's air quality staff and leadership.
    a. Location should be a location that will provide useful information.
    b. Location should be somewhere with easily accessible electricity and WiFi, security, and ease-of-access for maintenance.
2. Sensors are installed, connected, and maintained according to the instructions provided with each PurpleAir model.
3. Sensors are connected to EPA's AirNow system for data correction and timely online availability.

SAMPLING METHODS

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 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.

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. Quality control for this project is provided by:

1. Weekly review of the online connectivity of the sensors by the Air Quality Specialist.
2. Weekly review and comparisons of the data (as made available online) to look for potential data quality problems based on nearby sensors or known weather/smoke conditions.
3. Continuous research and familiarity with known uses and potential errors reported by other users, including the EPA.

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.

DATA MANAGEMENT AND REVIEW

Sensor data shall always be accessible via the AirNow Fire and Smoke Map. This data should be verified by comparison to observed conditions (e.g., can you see or smell smoke?). Sensor data shall also be compared to other nearby sensors/monitors on the Map as applicable.

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