

QUALITY ASSURANCE PROJECT PLAN

for the

Chemical Characterization of Aerosols and Fine Particulate Matter in the Airshed at the Pamlico River

ATAST Investigation Number: 99013

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Quality Assurance Project Plan

Preface

This document serves as the Quality Assurance Project Plan (QAPP) for the Chemical Characterization of Aerosols and Fine Particulate Matter in the Airshed at the Pamlico River. The QAPP describes the quality assurance practices for field sampling operations, meteorological data collection, chemical analyses of field collected samples, and project data collection and management. Those involved in the project must read, understand, and follow all the protocols and procedures explicitly.

Due to the nature of this study, the QAPP may need to be revised as the study progresses. The Quality Assurance Manager (QAM) will initial, date, and concurrently incorporate any changes into all official copies of the document. Personnel involved with the study should forward all suggestions and changes to the QAM for consideration and incorporation into the QAPP.

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Appendix A - Standard Operating Procedures (SOPs)

Acronyms

AQL - Air Quality Laboratory of the Toxics Protection Branch
ATAST - Air Toxics Analytical Support Team
COC - Chain of Custody
CLP - Contract Laboratory Program
DAQ - Division of Air Quality
DOT - Department of Transportation
DQO - Data Quality Objectives
EPA - Environmental Protection Agency
IC - Ion chromatograph
NCSU - North Carolina State University
NIST - National Institute of Standards and Technology
QA/QC - Quality Assurance/Quality Control
QAM - Quality Assurance Manager
QAPP - Quality Assurance Project Plan
PCS - Potash Corporation of Saskatchewan Inc.
SOP - Standard Operating Procedures
TEOM - Tapered Element Oscillating Membrane
WaRO - Washington Regional Office

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A. Project Overview

This document serves as the Quality Assurance Project Plan (QAPP) for the Chemical Characterization of Aerosols and Fine Particulate Matter in the Airshed at the Pamlico River Study (hereafter called the study). The intent of the QAPP is to provide guidelines to ensure that data of appropriate accuracy, precision, and representativeness are obtained in the study. This QAPP describes the quality assurance (QA) practices for field sampling operations, meteorological data collection, chemical analyses of field collected samples, and project data collection and management. This document complies with the requirements and the specified format outlined in *EPA Requirements for Quality Assurance Project Plans*¹.

A.1 Project and Task Organization

The Air Toxics Analytical Support Team (ATAST) of the North Carolina Division of Air Quality (DAQ) will have the primary responsibility for field operations and sample analysis in the study. As part of the study four ambient monitoring sites and associated meteorological equipment are to be located around the PCS Phosphate facility. The ATAST and the DAQ, Washington Regional Office (WaRO) will set up, operate, and maintain three ambient monitoring sites, and PCS Phosphate will be responsible for performing identical tasks at the remaining site. All field samples will be analyzed by the Toxics Protection Branch, Air Quality Laboratory (AQL).

Key personnel in this study are shown in Figure A-1, and descriptions of their roles are given in Table A-1. As seen in the figure, the Quality Assurance Manager (QAM) is organizationally independent of all study personnel except the Project Administrator because the QAM must be able to give completely unbiased advice on data quality and other project related activities to the Project Manager and Administrator².

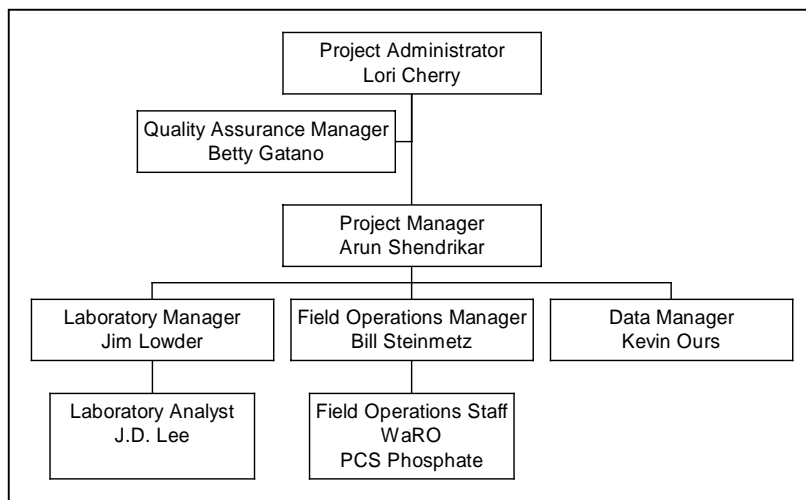


Figure A-1. Organizational Chart of Key Personnel Participating in the Study

Table A-1. Roles of Key Personnel in the Study

Position	Role
Project Administrator	The Project Administrator has overall supervision of all aspects of the project. The Project Manager and Quality Assurance Manager (QAM) report to the Administrator.
Project Manager	The Project Manager is responsible for ensuring successful outcomes and managing all aspects of the study. All staff except the QAM will report to the Project Manager.
Quality Assurance Manager	The QAM is responsible for developing the QAPP, objectives, and procedures. The QAM will perform system and performance audits, data validation and data quality assessment.
Field Operations Manager	The Field Operations Manager has the overall responsibility of field operations, field activities, and the operation of the sites.
Field Operations Staff	The Field Operations Staff (i.e., the field operator) will be responsible for collecting and deploying samples and retrieving meteorological data at the four monitoring sites. Staff at the WaRO will serve as the primary field operator for the three monitoring sites located north of the Pamlico River. Personnel from PCS Phosphate will serve as the field operator for the upwind site located south of the Pamlico River.
Laboratory Manager	The Laboratory Manager is responsible for the delivery of valid analytical data to the data management project staff. He is also responsible for developing and instituting appropriate laboratory quality assurance (QA) parameters and for ensuring that these QA parameters are maintained during the study sample analysis.
Laboratory Analysts	The analytical chemists are responsible for accomplishing all analytical work including sample analysis, performing QA checks, equipment certifications and cleaning, and providing appropriate sampling media to the Field Operations Staff.
Data Manager	The Data Manager develops standard operating procedures for data management and is responsible for the data management of the reported concentrations and meteorological data and for preparing periodic reports.

A.2 Program Definition and Background Information

The ATAST plans to conduct an air toxics monitoring study around the PCS Phosphate facility on the Pamlico River near Aurora, North Carolina. The primary objective of this study is to investigate the formation of acidic and basic aerosols by characterizing the temporal and spatial distributions of precursors and products. A secondary objective is to characterize episodic fog events that have historically occurred in the area around the facility.

PCS Phosphate is an open-pit phosphate mining and processing facility located along the Pamlico River near Aurora, North Carolina. The WaRO has compiled many years of data and citizen complaints documenting odors and burning and irritating "fogs" that occur in the Pamlico River area within a few miles north, north-east, and north-west of the PCS Phosphate facility. The fog events typically occur during early morning or late night hours and are usually associated with meteorological inversions and high humidity. In the proposed study, ambient monitoring and meteorological data will be collected to characterize these fog episodes, if they occur during the study period.

A.3 Project and Task Descriptions

This study will be conducted for six months, beginning in May 2000 and ending in October 2000. The May to October time frame was selected because fog events have historically occurred more frequently during this period. Table A-2 contains the schedule for this study.

To complete the study, seven-day annular denuder systems will be located at four air monitoring sites around the facility. Each denuder system is a unit that will hold one field blank denuder assembly, a second dedicated denuder assembly used to capture a fog event should it occur, and five 24-hour denuder assemblies to collect ammonia and acid gases. A filter pack to collect fine particles is included as part of each denuder assembly. A trip blank denuder assembly will also be deployed at each monitoring site. The following lists the proposed locations of the four monitoring sites around the PCS Phosphate facility:

- Two complaint locations located on the north shore of the Pamlico River where residents have historically complained of fog events
- One distant complaint site located north of the Pamlico River near the town of Bath where residents have historically complained of fog events
- A location upwind of the facility.

Meteorological data will be collected to support the study. The parameters to be measured at all four air monitoring locations are barometric pressure, wind speed, wind direction, temperature, humidity, visibility, and solar radiation. Additionally, a fifth meteorological monitoring site with a 30-meter tower is to be located at the North Carolina Department of Transportation (DOT) Bayview Ferry Landing, across the Pamlico River from the facility. The DOT meteorological station will provide data on higher-level atmospheric conditions that may differ from ground-level patterns and may provide additional insight into plume movement.

A.4 Data Quality Objectives and Criteria for Measurement

The primary data quality objective (DQO) of this study is to produce data that are of sufficient quality to characterize the atmosphere around the PCS Phosphate facility. This document describes the procedures needed to meet the study objective. Project quality objectives and measurement performance criteria are discussed in Section B.5.

The EPA recommends using the Data Quality Objectives Process outlined in its *Guidance for the Data Quality Objectives Process* to develop data quality objectives for monitoring studies³. As stated in EPA's DQO guidance, "*every step of the DQO guidance may not be applicable to data collection activities where specific decisions cannot be identified, such as studies that are exploratory in nature...[P]art of the DQO Process includes formulating statistical hypotheses. If a statistical hypothesis is not linked to a clear decision in which the decision maker can identify potential consequences of making a decision error, then some of the activities recommended in*

Table A-2. Study Schedule

TASKS	TIME SCHEDULE													2001					
	1999						2000												
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL		AUG	SEP	OCT	NOV	DEC
1. Program Planning	[Shaded bar from Jul 1999 to Apr 2000]																		
2. Purchase Of Ion Chromatograph		▲																	
3. Laboratory Expansion	[Shaded bar from Jul 1999 to Feb 2000]																		
4. Laboratory Supply Purchases				[Shaded bar from Oct 1999 to Dec 1999]			[Shaded bar from Jan 2000 to Mar 2000]												
5. Laboratory Instruments (Set-up)		[Shaded bar from Aug 1999 to Jan 2000]																	
6. Field Equipment Purchases				[Shaded bar from Oct 1999 to Dec 1999]															
7. Sampling Site Selection					[Shaded bar from Nov 1999 to Dec 1999]														
8. Sampling Site Preparation					[Shaded bar from Nov 1999 to Apr 2000]														
9. Project QA/QC Protocol Development	[Shaded bar from Jul 1999 to Jun 2000]																		
10. Staff Training (Field)						[Shaded bar from Dec 1999 to May 2000]													
11. Field Trial Runs							[Shaded bar from Jan 2000 to Apr 2000]												
12. Analytical Method Validation			[Shaded bar from Sep 1999 to Dec 1999]				[Shaded bar from Jan 2000 to Mar 2000]												
13. Open House									▲										
14. Field Sampling Period											[Shaded bar from May 2000 to Sep 2000]								
15. Sample Analysis											[Shaded bar from May 2000 to Nov 2000]								
16. Met/Analytical Data Reduction											[Shaded bar from May 2000 to Dec 2000]								
17. Draft Report																			[JANUARY 2001] → ▲
18. External Data Review																			[FEBRUARY 2001] → ▲
19. Final Report																			[SPRING 2001] → ▲

this guidance [for the DQO Process] may not apply."⁴ Nonetheless, the DQO Process was used for planning with the DQO activities modified slightly to address the needs of this particular study, as recommended in the DQO guidance.⁴ Table A-3 presents an overview of the DQO Process as modified for use in this study.

Table A-3. DQO Process Utilized in This Study

DQO Step	DQO Action
1. State the problem/ purpose of study	1) To characterize the atmosphere around the PCS Phosphate facility 2) To characterize the fog events in which residents have complained of burning and irritating "fogs" that occur in the Pamlico River area around the PCS Phosphate facility
2. Identify the decision	Conduct a six month extensive, continuous monitoring of atmospheric levels of acidic and basic gases and aerosols in impacted area.
3. Identify the inputs of the decision	Ambient air concentrations of ammonia, acid gases (hydrogen fluoride, hydrogen chloride, hydrogen sulfide, and sulfuric acid mist), and particulates. The pH of the fog will also be measured
4. Define the study boundaries	Results from this study will be considered representative for atmospheric conditions in and around the PCS Phosphate facility and will be conducted initially for six months from May until October, 2000.
5. Define a Decision Rule	The initial six-month study should provide a good indication of atmospheric conditions around the PCS Phosphate facility. If significant questions remain after completion of the study, further sampling may be warranted.
6. Specify Limits on Decision Error	Ninety percent (90%) of the data should be valid over the duration of the study period.
7. Optimize the Design	The study design is an extension of a previous study conducted around the PCS Phosphate facility. Additionally, this QAPP has been peer reviewed by DAQ and PCS Phosphate staff in disciplines ranging from analytical chemistry to air toxics monitoring.

A.5 Special Training Requirements and Certification

A.5.1 Field Operations

All personnel involved in the denuder sampling and meteorological data collection will follow Standard Operating Procedures (SOPs) when carrying out their duties. Appendix A contains all SOPs used in this study. A minimum of three people from DAQ will be trained - two from the WaRO and one from the Toxics Protection Branch. Other DAQ personnel will be trained as needed. Also, the DAQ staff or other appropriate individuals will train PCS Phosphate personnel who participate in the study and will provide them with the SOPs for sample removal and placement of denuders and for downloading meteorological data.

A.5.2 Laboratory Operations

Analysts involved in the study will be certified in all of the methods and procedures used in the study. Certification for the analytical method will consist of the analysis of Quality Control/Laboratory Control Spike samples conducted on separate days, the determination of the method detection limit, and the determination of the practical quantitation limit. The number of samples used in certification will be sufficient to verify the precision and accuracy of the analysis (at least 6) and to measure the bias between analysts. Certification of personnel will be documented in the training records for the AQL.

A.6 Documentation and Records

Various types and levels of documentation are required for this study. Listed below is a summary of the field documentation required:

- Activity log book maintained at each monitoring site
- Chain of custody forms
- Denuder assembly tracking forms
- Denuder assembly log sheet
- Meteorological equipment checklist.

Examples and descriptions of the documentation are contained in Section B. Copies of all log sheets, forms, and checklists will be maintained in the project files throughout the study period, until as long as deemed necessary by the Program Administrator^a.

Each month, the Quality Assurance Manager will review and validate the raw meteorological and analytical data. Any problematic data will be flagged (i.e., quality-coded). Once the data are reviewed by the Quality Assurance Manager, the Data Manager will then post the monthly, validated, quality-coded meteorological and analytical data on the DAQ web site. In this way, the data will be available in a timely manner to the study managers, the WaRO, PCS Phosphate personnel, and other appropriate persons. The raw data will be provided when requested, and all requests should be made through the Quality Assurance Manager. Copies of the validated data and the raw data will be maintained on a dedicated computer or in the study files throughout the study period, until as long as deemed necessary by the Program Administrator.

The reports to be generated for this study include quality assurance audit reports and a final study report. The audit reports will detail the results of the field operations audits, analytical audits, and data management audits. The Quality Assurance

^a The State of North Carolina has a records retention schedule for archiving files that are no longer active. For the Air Toxics Program, no time period is given for retaining records. Instead, records are to be transferred to the State Records Center "when administrative value ends." Thus, the Project Administrator has the discretion for determining when files generated for this project are to be archived.

Manager will prepare an initial and final audit report at the beginning and end of the study and quarterly throughout the study period. The final report generated for the study will include the validated, quality-coded data; summary statistics; charts of the validated data if appropriate; and a discussion of the quality assurance audits. All personnel involved in the study, including the WaRO and PCS Phosphate, will have the opportunity to review the study report and provide comments before the report is finalized. As seen in Table A-2, the final report is scheduled for completion in Spring of 2001.

B. Measurement and Data Acquisition

This group of QAPP elements covers all aspects of measurement system design and implementation ensuring that appropriate methods for sampling, chemical analysis, data handling, and quality control are employed and documented.¹

B.1 Sampling Process Design

The sampling design process outlines the experimental design of the study and includes information on the type of samples required, sampling frequency, sampling period, and how the sample locations are selected.⁵ The two components of the field operations are the annular denuder sampling and the meteorological data collection. The sampling design process for both components is discussed in this section.

B.1.1 Annular Denuder Sampling System

Four air monitoring sites will be included in this study, with a seven-day annular denuder system located at each site. Each denuder system is a unit that will hold one field blank denuder assembly, a second dedicated denuder assembly used to capture a fog event should it occur, and five 24-hour denuder assemblies to collect ammonia and acid gases. A filter pack to collect fine particles is included as part of each denuder assembly. A trip blank denuder assembly will also be deployed at each monitoring site.

Each denuder system will sample for five days. On the sixth day, the field operator will deploy and collect the eight denuder assemblies at each site. Denuder system run times will be from midnight to midnight and will be consistent among the four monitoring sites. Multiple samples are associated with each denuder assembly as specified in Table B-1. Over the six month study almost 4,000 samples will be collected and analyzed.

Table B-1. Estimation of Number of Samples

Number of Denuder Assemblies at Each Site	Number of Samples for Each Denuder Assembly	Number of Sampling Sites	Sampling Frequency	Total Number of Samples
5 24-hour denuder assembly 1 field blank 1 trip blank 1 episodic denuder assembly	1 acidic denuder 1 basic denuder 1 Teflon filter 1 Nylon filter	4 sites	Samples collected every 6 days for a total of 30 times over the six month study period	
8	4	4	30	3,840

The following lists the proposed locations of the four monitoring sites around the PCS Phosphate facility:

- Two complaint locations located on the north shore of the Pamlico River where residents have historically complained of fog events
- One distant complaint site located north of the Pamlico River near the town of Bath where residents have historically complained of fog events
- A location upwind of the facility.

A map showing the four monitoring locations is given in Figure B-1. The three complaint sites are selected to enable characterization of the downwind spatial and temporal distribution of secondary pollutant aerosols. Two monitoring sites are to be located along the north shore of the Pamlico River and are intended to measure the primary pollutants that are emitted from the PCS Phosphate facility. The distant monitoring location near Bath, North Carolina is intended to measure any secondary acidic and basic aerosols that may form in the ambient atmosphere due to from interactions of the primary pollutants.

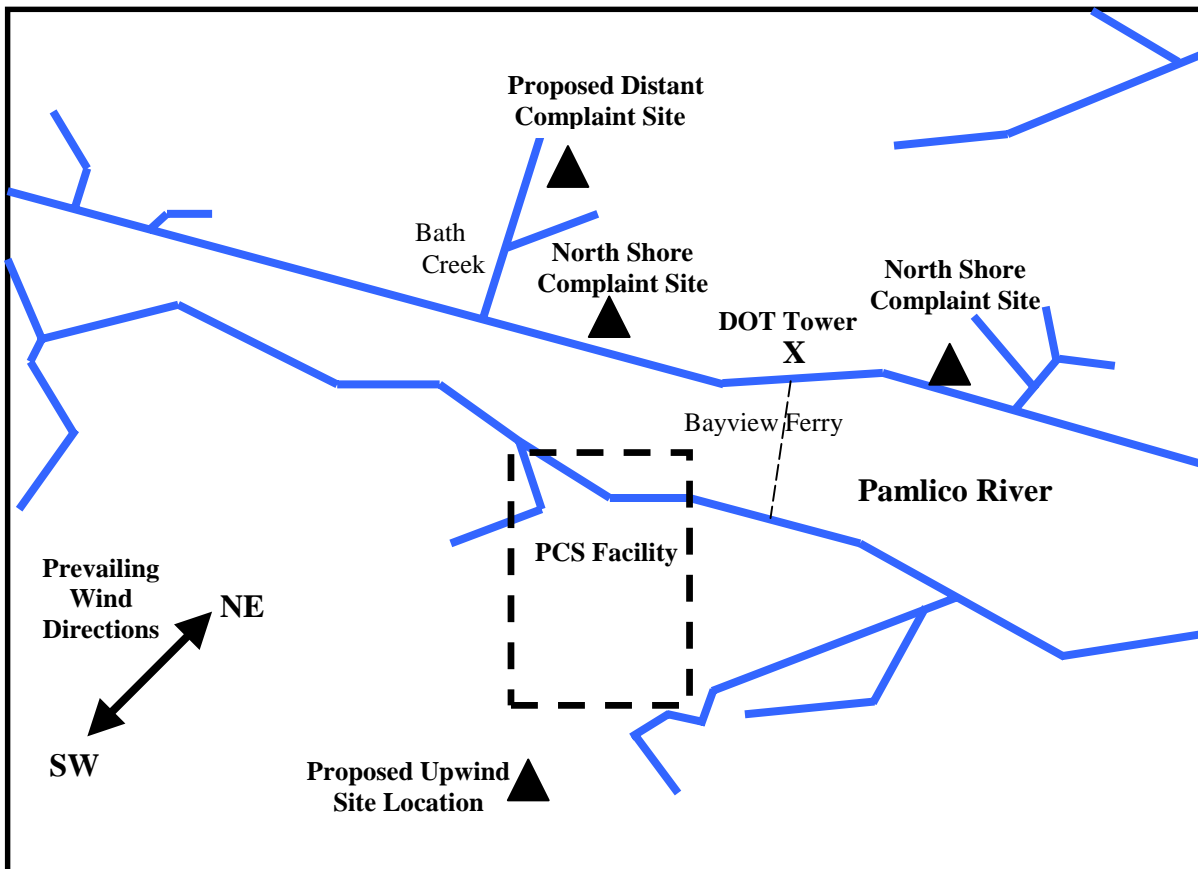


Figure B-1. Proposed Monitoring Locations around the PCS Phosphate Facility

B.1.2 Meteorological Data Collection

Meteorological data will be collected to support the study. A 10-meter meteorological tower will be installed at all four air monitoring locations, and meteorological equipment will be placed at 2 and 10 meters on each tower. Placement at 2 meters will be used to represent ambient conditions in the breathing zone, while placement at 10 meters is the height at which standard meteorological conditions are measured. Wind speed, wind direction, and temperature will be measured at both the 2 and 10 meter levels. Barometric pressure, solar radiation, and humidity will be measured only at the 2 meter level because these meteorological parameters are expected to vary only minimally over a vertical distance of eight meters.

Visibility monitors are also planned for each monitoring site. The visibility monitor, called a nephelometer, will be a stand alone sensor not located on the 10-meter meteorological towers. The nephelometer measures light scattering resulting from fine particulate matter. For this study, light scattering will serve as a surrogate parameter for particle concentration. A site-specific correlation will be developed to relate the light scattering to the concentration of particulate matter under 2.5 μm using a Tapered Element Oscillating Membrane (TEOM) particle sampler. In this way, the nephelometer will be used to trigger the event denuder assembly during periods of elevated particulate matter concentrations

A DOT radio tower located near the Bayview Ferry Landing on the Pamlico River will be used as an additional location for meteorological monitoring. Meteorological equipment will be placed at the 30 meter level on the radio tower to provide data on higher-level winds and temperatures that may differ from ground-level patterns. The higher-level atmospheric conditions may also provide additional insight into plume movement. Wind speed, wind direction, temperature, and solar radiation will be measured at the 30-meter level. No visibility measurement is planned for the radio tower.

The siting criteria for wind speed, direction, temperature, humidity, and solar radiation will be in accordance with the *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume 4*.⁶ Only an overview of the siting criteria is given in this section. *Volume 4* of the *Quality Assurance Handbook* has more detail. According to the guidance, wind speed and wind direction instruments should be placed at 10 meters over level, open terrain. Open terrain is defined as an area where the horizontal distance between the instrument and any obstruction is at least ten times the height of the obstruction. Temperature and humidity sensors should be mounted over a plot of open ground at least 9 meters in diameter. The ground should not be concrete or asphalt. Solar radiation should be taken in a location free from any obstruction that could cast shadow on the instrument. The solar radiation instrument should also be far from light colored walls or artificial sources of radiation. Meeting all of the siting criteria may not

be attainable in practice, and deviations from the criteria will be documented for each site.⁶

Siting requirements for optical monitoring instruments and particle samplers are given in EPA's *Visibility Monitoring Guidance*⁷. In general, the visibility monitoring instruments, such as the nephelometer, should meet the same siting criteria as particle samplers, such as the TEOM. Siting criteria for the particle samplers should meet the following criteria:

- The location should have a distance from the instrument to the nearest obstruction greater than 2.5 times the difference in heights of the instrument and the obstruction
- The location should be representative of the air mass to be measured
- The location should be removed from local pollution influences (e.g., vehicle exhaust, wood smoke, road dust, and etc.)

In addition to meeting these criteria, the nephelometer should also be placed so that the sample inlet can be oriented towards true north. Additionally, the probe on the nephelometer is normally placed 2 to 5 meters above the ground.

B.1.3 Collection of Water Vapor in Fog

A fog collector provided by North Carolina State University (NCSU) is proposed for use in this study. The fog collector is a passive string-type water collector. The fog collector will not be stationed permanently at all sites. Instead, it is portable and will be manually deployed in the field at a specific monitoring site when National Weather Service forecasts fog, when WaRO or local citizens report fog, or when the on-site data loggers indicate episodic conditions are occurring. The fog collector will be used to evaluate the pH and the concentrations of water soluble pollutants in the fog for both meteorological fog and fog that occurs in conjunction of episodic conditions. In this way, the composition of the fog during episodic conditions can be compared with meteorological fog conditions in the Pamlico River airshed.

B.2 Sampling Methods Requirements

Detailed SOPs for the denuder sampling system are contained in Attachment 1 of this document. Table B-2 contains a portion of this information, and Figure B-2 presents a schematic of the annular denuder assembly.

Table B-2. Overview of Field Sampling using Annular Denuder System

Matrix	Compound Measured	Sampling Equipment	Method of Sample Preservation	Maximum Holding Time in Field
Air	Ammonia	Annular denuder coated with citric acid	Samples packaged using COC and sent directly to AQL. No extraction occurs in the field	The denuder system will pull 24-hour samples from midnight to midnight. The samples will be collected every 6 days
Air	Acid gases: Sulfur dioxide, nitric acid, nitrous acid, and hydrochloric acid	Annular denuder coated with sodium carbonate		
Air	Aerosols: Sulfate, nitrate, and ammonium	Teflon filter		
Air	Nitric acid that dissociates from aerosols collected on the Teflon filter	Nylon filter		

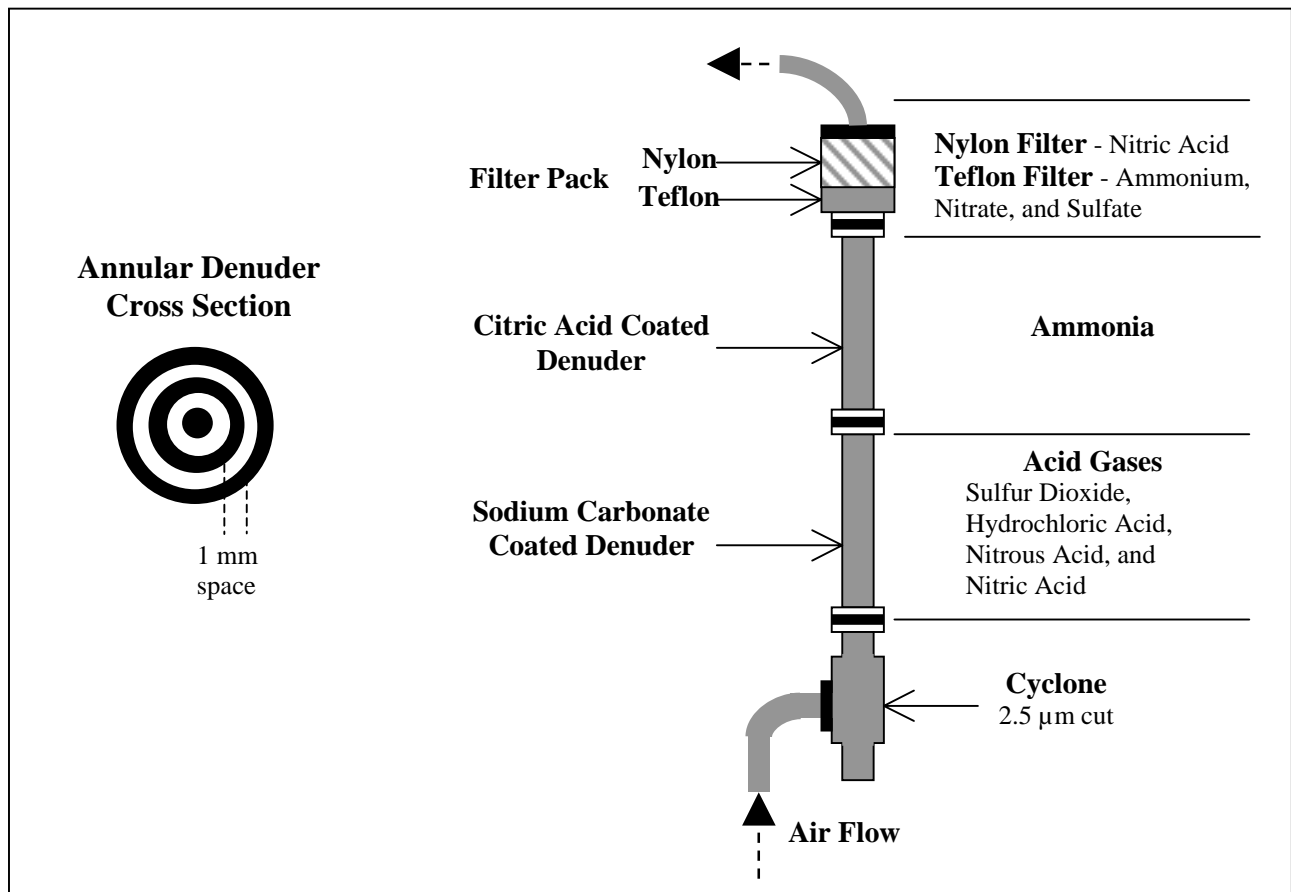


Figure B-2. Schematic of Annular Denuder

Detailed SOPs for the meteorological data collection are contained in Attachment 1 of this document. Table B-3 below contains a portion of this information.

Table B-3. Overview of Meteorological Data Collection

Meteorological Parameter	Equipment	Sampling Frequency	Maximum Holding Time in Field
Wind speed (WS)	Anemometer	Meteorological data will be averaged and recorded at 15 minutes, 1 hour, and 24-hour intervals. The 24-hour average will be from midnight to midnight to correspond with the denuder sampling scheme.	Certain meteorological data will be downloaded nightly via modem. Other meteorological data will be downloaded weekly by the field operator. Section B.10.2 contains more details
Wind direction (WD)	Wind vane		
Temperature (T)	Temperature and humidity probe		
Humidity			
Solar Radiation	Solar radiation sensor		
Barometric pressure	Barometric pressure sensor		
Visibility as measured via particulate light scattering	Nephelometer	Light scattering coefficients will be averaged and recorded every 15 minutes and will be used to trigger the event denuder assembly	Data will be downloaded nightly via telemetry

Detailed SOPs for the fog collector are contained in Attachment 1 of this document. Table B-4 below contains a portion of this information.

Table B-4. Overview of Fog Collection

Matrix	Compound Measured	Sampling Equipment	Method of Sample Preservation	Maximum Holding Time in Field
Water	pH	Fog collector	pH will be measured in the field. Fog samples packaged using COC and sent directly to AQL	Samples will be collected after each fog event
Water	Water soluble compounds, including sulfate, nitrate, and chloride compounds	Fog collector		

B.3 Sample Handling and Custody Requirements

Sample quality can be compromised if sample collection is inconsistent throughout the study period. To prevent inconsistency, SOPs will be developed and followed for placement and removal of denuders from the sampling sites. All personnel involved in field operations will be trained in using these SOPs prior to participating in the field operations.

Sample custody is used to ensure that sample integrity is maintained before, during, and after sample collection. Sample custody refers to tracking the possession of denuders and associated filter packs from the time they are prepared in the lab to field deployment and from the sample collection through final analysis and disposal. Strict chain of custody (COC) documentation will be maintained at all times. Table B-5 shows an example of the COC form that may be used for the study. Each time the denuders and filters change hands, both the sender and receiver will sign and date the COC form. The denuder assembly number, the section number, the sample number, and the start date and time should be noted for each denuder and filter pack collected. Additionally, the denuders and filter packs will be sealed for transport to and from the field. The custody seals indicate whether the denuders or filters have been opened before they reach their intended receiver. SOPs will be developed and followed throughout the study period to prevent inconsistency in COC procedures.

Denuder samples must be labeled properly and consistently to ensure that the COC is maintained. Samples will be labeled in the field with a ten digit code using the following format:

99013 - Y - ZZZ - #

99013 The ATAST project number assigned to the study

Y The site identifier - In this study, the site number will be 1, 2, 3 or 4

ZZZ The denuder assembly identifier - In this study, denuder assemblies will be numbered sequentially starting with 001 and continuing until the end of the study

The section identifier - The section identifier corresponds to the three denuder sections that will be analyzed (i.e., the sodium carbonate coated denuder, the citric acid coated denuder, and the filter pack). The section identifier will be 1, 2, or 3.

An example of the label numbering is shown in Figure B-3.

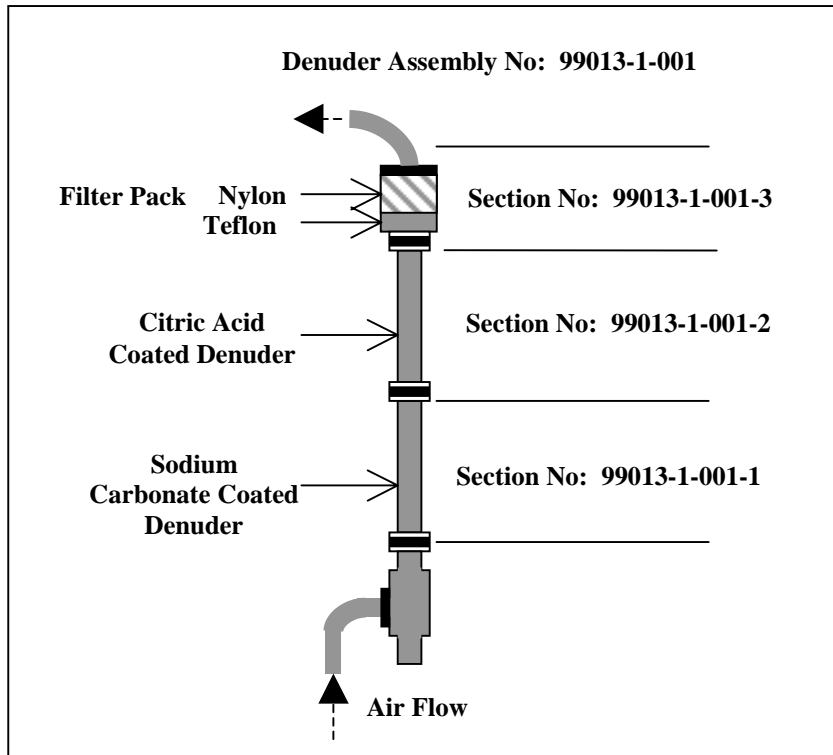


Figure B-3. Example of COC Labeling

Water samples obtained from the fog collector will also be handled using strict COC procedures. The standard COC forms currently used by the AQL will be used for tracking these samples.

Samples with obvious signs of tampering will be analyzed and flagged by the Data Manager for record keeping purposes. These samples will not be numerically included in the study results. Samples with COC seals broken during shipment or with improper COC paperwork will be analyzed, flagged, and will be included in the final results. If improper COC procedures are a recurrent problem during the study, then the SOP for COC will be re-examined and field staff will be retrained.

B.4 Analytical Method Requirements

The analytical method for determining the inorganic basic and acidic constituents on the denuder and filter samples is the “*Determination of Reactive Acidic and Basic Gases and Strong Acidity of Atmospheric Fine Particles (<2.5 μ m)*”, Method IO-4.2.⁸

The annular denuder sampling system described in the previous sections collects gaseous nitric acid (HNO₃), nitrous acid (HNO₂), hydrochloric acid (HCl), hydrofluoric acid (HF), sulfur dioxide (SO₂), ammonia (NH₃), particulate sulfate (SO₄⁻), particulate nitrate (NO₃⁻), particulate ammonium (NH₄⁺), and acidic particles. The acid gases and sulfur dioxide are collected on the sodium carbonate coated

denuder. Ammonia gas is trapped on the citric acid coated denuder. Particulate sulfate, nitrate, and ammonium are collected on the first (Teflon[®]) filter. Some of the particulate nitrate collected on the first filter evaporates and is collected on the second (Nylon) filter as nitric acid. Also collected on the Teflon[®] filter are fine particles that contain hydrogen ions (H⁺). The concentration of these H⁺ ions indicates the acid aerosol content of the atmosphere.

An ion chromatograph (IC) equipped with the appropriate anion or cation exchange column, a membrane suppressor, and conductivity detector for measuring acidic and basic ions in solution will be used for the analysis of the denuder and filter extracts, as well as the water samples obtained using the fog collector.

A pH meter with “integral” automatic temperature compensation that has been calibrated with standard buffers will be used to determine the pH of the Teflon[®] filter extracts prior to IC analysis for the particulate sulfate contents. The pH meter will also be used to determine the pH of the Nylon filter and the water samples obtained using the fog collector.

Before extraction of the Teflon[®] filters for pH and IC analysis, an analyst will use an electronic microbalance to determine the total mass of the particulate matter collected on the filters.

B.5 Quality Control Requirements

B.5.1 Annular Denuder Sampling System

Flowrate and Leak Checking

Since an incorrect flowrate can compromise the data quality, the field operator will leak-check the denuder system and calibrate the flowrate weekly as specified in Section B.7.1. The quality control limits for the denuder system are given in Table B-6. If the system is not within the limits specified in the table, then the field operator will follow the course of action described in Section B.7.1.

Table B-6. Quality Control Limits for the Denuder System

System Check	Performance Goals
Flow rate	Display value $\pm 2\%$ of measured value
Leak check	Vacuum gauge should not drop below 12" Hg after one minute

Co-locating Denuders

A co-located, 24-hour annular denuder system will be used to demonstrate precision of the denuder samplers used in the study. Prior to the official start of the study (May 1, 2000), precision will be established between each of the four stationary denuder systems and the co-located denuder. The analysis of the initial

samples will be used to determine the degree of precision. Once the study begins, the co-located denuder system will be rotated among the monitoring sites every six days. A total of seven co-located denuder samples will be made at each site, unless one or more sites show a tendency for imprecision. In the latter case, the co-located denuder system will be deployed at these sites more often. Corrective action to be taken when imprecision among denuder systems is detected includes leak-checking, equipment inspection, and measuring flowrates.

Blanks

One quality control measure is to include a field blank with the denuder samples. Seven denuder assemblies will be uncapped and placed in the sampling unit. One of these assemblies will be identified as the field blank and will not have air flow drawn through it. In this way, the analysis of the field blank will indicate any passive adsorption of analytes of interest and may be used to correct data accordingly. The field blank will remain in the sampler for five days and will be removed on the sixth day when the active denuder samples are collected. All denuders and associated filter packs are then sent to the AQL for analysis.

The trip blank is another quality control measure. One trip blank denuder assembly will be prepared, capped, and placed in the field every six days when the sample denuders are deployed. The trip blank will remain capped during the time that it is in the field. The analysis of the trip blank will indicate if any measured concentration is attributable to denuder preparation and will be used to correct data accordingly.

B.5.2 Meteorological Data

The parameter accuracy is the amount by which a measured variable deviates from a value accepted as true. Recommended system accuracies for the meteorological parameters to be measured in this study are shown in Table B-7. Also shown in the table are measurement resolutions, which are defined as the smallest parameter measurement that can be distinguished. Assurance of parameter accuracy will be determined through system audits of the meteorological equipment as discussed in Section C.1.2.

B.5.3 Fog Collector

The fog collector will be thoroughly cleaned before and after each fog event to prevent any cross contamination that might occur. The collector is cleaned by spraying distilled, deionized water and methanol on the collection strands to remove traces of chemicals that may have been present from previous sampling. The collector will be enclosed in a clean bag after each use to avoid contamination by dry aerosol impaction on the collection surfaces.⁹ Analysis of water samples obtained from the fog collector will meet the same quality control limits specified in Section B.5.4.

Table B-7. Recommended System Accuracies and Resolutions for Meteorological Parameters^{7, 10, 11}

Meteorological Variable	System Accuracy	Measurement Resolution
Wind Speed	± (0.2 m/s + 5% of observed) ± (0.45 mph + 5% of observed)	0.1 m/s or 0.2 mph
Wind Direction	± 5 degrees	1 degree
Ambient Temperature	±0.5 °C or ± 0.9 °F	0.1 °C or 0.2 °F
Vertical Temperature Difference	±0.1 °C or ± 0.2 °F	0.02 °C or 0.4 °F
Radiation	± 5% of observed or 25 W/m ² , whichever is greater	10 W/m ²
Humidity	1.5%	0.3%
Visibility as measured via particulate light scattering	± 10% of true value for air near Rayleigh and using two minutes of integration	~5%
Time	± 5 minutes	Not applicable

B.5.4 Analytical Data

Table B-8 lists the quality control limits for the ion chromatograph that is to be used in analyzing the samples. Following the table is a list of related definitions. The criteria in the table are derived from Compendium Method IO-4.2⁸ and from EPA Method 300.1, *Determination of Inorganic Anions in Drinking Water by Ion Chromatography*¹².

Quality control limits for the accuracy of the balance used to weigh filters will be less than 1% relative percent difference, as compared to known standard weights traceable to National Institute of Standards and Technology (NIST) standards. The NIST standard weights used will bracket the range of expected filter weights.

Quality control limits for the accuracy of pH measurements will be less than ±0.03 for a pH 4 certified buffer using the procedure set out in Method IO-4.2, Section 19.2 and 19.3.⁸

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

B.6.1 Annular Denuder Sampling Systems

The field operator will perform preventative maintenance on the denuder system to help prevent equipment failure. SOPs for preventative maintenance will be developed and followed throughout the study. The following preventative maintenance procedures will be conducted regularly on the denuder system¹³:

Table B-8. Quality Control Limits for Ion Chromatography

QA Parameter	Control Limits	Frequency	Comments
Laboratory Reagent Blank (LRB)	<MDL	Daily	<i>(or <5% of minimum observed value in samples)</i>
Laboratory Control Sample (LCS)	75 – 125% Recovery	Daily	<i>Fortified LRB Sample</i>
Fortified Matrix Sample (FMS)	75 – 125% Recovery	1 per batch of 20 samples	<i>Fortified Field Sample (Spiked 1 –5 times the measured value)</i>
Field or Lab Duplicates	Less than ±20% Relative Percent Difference	1 per batch of 20 samples	<i>Fortified Field Sample or Split Field Sample</i>
Calibration Check Standard	85 – 115% Recovery (mid range)	Every 10 Samples	<i>75 – 125% Recovery if less than the mid range of the Standard Curve</i>
Initial Calibration Least Squares Regression OR Average Response Factor	> .99 Correlation Coefficient (r ²) < 15% Relative Standard Deviation	Each Curve Each Curve	<i>At least 5 std levels (not forced through 0)</i> <i>At least 5 std levels</i>
METHOD DETECTION LIMIT (MDL) -- Detection limit are taken as three standard deviations above field blanks. LIMIT OF QUANTIFICATION (LOQ) or PRACTICAL QUANTIFICATION LIMIT (PQL) are taken as ten standard deviations above field blanks. The standard deviation may need to be determined using FMS samples at or near the MDL or LOQ.			
CALIBRATION STANDARD (CAL) -- A solution prepared from the primary dilution standard solution or stock standard solutions. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.			
CALIBRATION CHECK STANDARD -- An individual Calibration solution that verifies previously established calibration curves.			
DUPLICATE -- Two sample aliquots, taken in the laboratory from a single sample bottle, and analyzed separately with identical procedures. The analyses indicate precision associated specifically with the laboratory procedures, removing any associated variables attributed by sample collection, preservation, or storage procedures.			
LABORATORY CONTROL SAMPLE (LCS) OR LABORATORY FORTIFIED BLANK (LFB) -- An aliquot of reagent water or other blank matrices to which known quantities of the method analytes are added in the laboratory. The LFB is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements.			
LABORATORY FORTIFIED MATRIX SAMPLE (FMS) -- An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The FMS is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the FMS corrected for background concentrations.			
LABORATORY REAGENT BLANK (LRB) -- An aliquot of reagent water or other blank matrices that are treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and surrogates that are used with other samples. The LRB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.			

- Leak checking - weekly
- Flow checking - weekly
- Cleaning the sample train - inspected weekly and cleaned as needed
- Inspecting and cleaning the water traps - inspected weekly and cleaned as needed
- Inspecting and cleaning/changing the coalescing filter - every six months
- Conducting upkeep and housekeeping activities at monitoring sites.

B.6.2 Meteorological Equipment

Each week the field operator will conduct visual inspections of the meteorological equipment and complete an inspection checklist. An example of the checklist for the meteorological equipment is given in Table B-9. Information to be noted includes the time and date, the general condition of the meteorological equipment, all QA/QC and maintenance activities taken, and other pertinent information. Additionally, the field operator and anyone else who visits a site, will document all activities in a log book maintained at each site.

Table B-9. Example Meteorological Site Checklist

Site Name:		Field Operator:	
Date:			
Visual Inspection			
Power Supply			
Support			
Guy Tension			
Cups Turning Freely			
Vane Turning Freely			
Signs of Vandalism			
Data Logger 1		Data Logger 2	
Time of Day by Watch		Time of Day by Watch	
Time of Day by Logger		Time of Day by Logger	
Channel	Parameter	Channel	Parameter
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
Nephelometer			
Time of Day by Watch			
Time of Day by Logger			
Recording Data			
Flow rate Calibrated	PASS	FAIL	Flow rate:
Leak Check	PASS	FAIL	
Corrective Actions:			
Additional Comments/Notes:			

Preventative maintenance on the meteorological equipment will be performed regularly to help prevent equipment failure. SOPs for preventative maintenance will be developed and followed throughout the study. Preventative maintenance procedures will be developed for the equipment listed below:

- Anemometer
- Wind vane
- Temperature probe
- Relative humidity sensor
- Barometric pressure sensor
- Solar radiation sensor
- Nephelometer

B.6.3 Laboratory Instruments

The performance of the laboratory equipment used in the analysis will be monitored and documented in the appropriate equipment logbooks. SOPs describing preventive maintenance procedures will be developed and followed throughout the study.

The IC instrument performance will be demonstrated daily (when in use) by the retention and resolution of standards and the ability to model the response of the detector during calibration. Failure of the instrument to meet calibration specifications given in Table B-8 may indicate the need for maintenance. The appropriate spare parts needed to maintain performance (e.g. check valves, piston seals, compression fittings, extra columns, etc.) will be on hand to reduce down time.

The pH meter will be calibrated and checked daily (when in use) using certified pH buffers. Temperature and any other variable affecting the accuracy of the results will be noted in a log book.

The balance calibration will be checked daily (when in use) by the determination of standard weights. The relative percent difference of the measured weight to the true weight should be <1%. If feasible, the check standards should be in the general range and bracket the observed sample weights. Failure of a check standard weighing will require that the instrument be electronically recalibrated after checking that the instrument is leveled. Temperature and any other variables affecting the accuracy of the results will be noted in a log book.

The ambient laboratory temperature and humidity will be monitored during the study. These data will be included in the study records. The actual temperature for the refrigerators and freezers used to store samples, solutions, or standards used in the study will also be monitored daily and the results maintained with the appropriate logbooks.

B.7 Instrument Calibration and Frequency

B.7.1 Annular Denuder Sampling System

Since an incorrect flowrate can compromise the data quality, the field operator will leak-check the denuder system and calibrate the flowrate regularly. An initial leak-check and flowrate calibration will be performed immediately after the denuder system is placed in the field. The flowrate will be calibrated against a primary calibration device. Additionally, each time the field operator removes samples from the denuder system, (i.e., every six days), he will leak-check the system and record the flowrate displayed on the front panel of the denuder system on the denuder log sheet (Table B-11). The field operator will also re-calibrate the flowrate each week with a primary calibration device.

The field operator will notify the Field Operations Manager and the Quality Assurance Manager immediately if the system is not within the goals specified in Table B-6. If possible, the field operator will correct the problem (i.e., by repairing leak, and etc.) while in the field. If the operator cannot fix the problem, he will notify the Field Operations Manager *immediately* to determine a course of action. He will also document the problem in the log book and note any corrective action taken. As soon as the field operator returns to the office, the operator will update the Field Operations Manager and the Quality Assurance Manager of the situation.

B.7.2 Meteorological Equipment

Calibration of meteorological equipment is made by the manufacturer and completed prior to installation. If system and precision audits of the meteorological equipment reveal that the equipment is out of calibration, then the equipment will be removed from the field and returned to the manufacturer for recalibration. In the event that the meteorological equipment needs to be removed from the field, replacement equipment that has already been calibrated will be available for immediate installation. In this way, the interruption in meteorological data collection will be minimized.

Section C.1.2 contains a discussion of audits for meteorological equipment used in this study.

B.7.3 Laboratory Instruments

Calibration procedures for the pH meter and analytical balance will be developed and followed throughout the study. The buffers or standard weights used in the calibration procedures will be identified and will be traceable to NIST standards. The pH meter will be calibrated daily (when in use). The balance calibration will be checked daily (when in use) and calibrated electronically when the quality

control limits described in Section B.5.4 are exceeded. Additionally, calibration of both the pH meter and the balance will be checked at regular intervals when in use (e.g., at the beginning and end of batch analysis) to ensure that measured data is accurate.

Ion chromatography is a standardized procedure in that the detector responses of unknown solutions are compared to those of known standards. The instrument does not perform a direct measurement and, in this sense, does not require calibrating. However, standardization procedures included in Method IO-42⁸ will be followed in this study to ensure that the QC performance criteria for the IC system as specified in Table B-8 are met.

B.8 Inspection and Acceptance Requirements for Consumables

A laboratory reagent blank (LRB) will be analyzed daily to insure that all glassware, equipment, solvents and reagents used in the analysis do not interfere with the analysis. The control limits for the reagent blank and fortified control sample (or fortified blank) are included in Table B-8. Acceptable results indicate that consumables used are suitable for the analysis.

If new analytical standard solutions or pH buffer solutions are required for the study, then the new standards will be analyzed using a “fresh” calibration curve determined by the older standards. The recovery of the new standards should be 85-115%. These data will be maintained in the study records.

B.9 Data Acquisition Requirements for Non-direct Measurements

Not applicable in this study.

B.10 Data Management

The data management program involves collecting, entering, transferring, verifying, validating, summarizing, and reporting the data gathered in this study. These data include descriptive and historical information about each site (e.g. log books and sheets, and etc), all analytical and meteorological data, and summaries and reports about the study.

The objective of the data management program is to ensure that the raw data gathered in the field and laboratory are not changed or altered (other than appropriate unit conversions) as they are transferred from field and laboratory to the periodic and final reports.

Each month, the Data Manager will post the validated, quality-coded meteorological and analytical data on the DAQ web site. In this way, the data will be available in a timely manner to the study managers, the WaRO, PCS Phosphate personnel, and

other appropriate persons. The raw data will be provided when requested, and all requests should be made through the QAM.

B.10.1 Annular Denuder Sampling System

Documentation of activities at the monitoring sites during field sampling is essential for ensuring quality data. A log book will be maintained at each monitoring site. Anyone who enters the sampling site will document his activities in this log book. A denuder assembly tracking form will also be maintained at each site. The field operator will complete the tracking form for each denuder assembly collected. The assembly number, the start and stop date and time, and any comments about the sample will be tracked. Table B-10 shows an example of the denuder tracking form. Additionally, each denuder assembly will have its own sample log sheet. An example of the sample log sheet is shown in Table B-11. Information to be noted on the log sheet includes the time and date the samples were removed, the general condition of the sample site, all QA/QC and maintenance activities taken, and other pertinent information. The field operator will send copies of the tracking form and sample log sheet to the Quality Assurance Manager and Field Operations Manager for review each month. Finally, the field operator will send the denuder assemblies removed from the field to the AQL using the COC procedures discussed in Section B.3.

Table B-10. Example Denuder Assembly Tracking Form

Denuder Assembly Number	Sample Start Time		Sample End Time		Comments
	Date	Time	Date	Time	

B.10.2 Meteorological Data

Fifteen minute, 1-hour, and 24-hour averages of meteorological data are stored on the onsite data loggers at each monitoring site. At the monitoring site operated by PCS Phosphate, all meteorological data from the field will be downloaded nightly via modem to a dedicated computer at the DAQ. At the three sites operated by DAQ, temperature, wind speed, and wind direction at the 10 meter level will be downloaded nightly to a dedicated computer at the DAQ via a modem. Additionally, visibility data from all four monitoring sites will also be downloaded nightly in this manner. Meteorological equipment located on the DOT radio tower at the Bayview Ferry Landing and at the 2 meter level at the three DAQ operated sites will not be controlled via telemetry. Instead, the field operator will download meteorological data from these locations onto a laptop computer every sixth day during the site visit and forward the meteorological data to the Field Operations Manager. To prevent inconsistency in the data collection, SOPs for downloading meteorological data and visibility data via telemetry and in

Table B-11. Example Denuder Assembly Sample Log Sheet

Denuder Assembly Number:				Sample Preparation Date:			Prepared by:	
Site Location/Description:								
Air Quality Lab (AQL)				Field Operations Use				AQL
Section #	Media	Lot	Hardware Serial #	Sample Date	Start Time	End Time	Flowrate (l/min)	Extract Volume (ml)

Field Operation Use

Installation Date: _____ Installed by: _____

Collection Day (Circle One): Sun Mon Tue Wed Thu Fri Sat

Leak Check Completed: **YES** **NO** Leak Check Passed: **PASS** **FAIL**

Removal Date: _____ Removed by: _____

COC Seal no: _____

Notes: _____

Air Quality Lab Use

Date/Time COC Seal Broken: _____ Broken by: _____

Date Extracted: _____ Extracted by: _____

Date Analyzed: _____ Analyzed by: _____

Notes: _____

the field will be developed and followed. All personnel involved in collecting the meteorological data will be trained in using these SOPs prior to participating in the field operations.

To centralize all of the data generated, one computer will be dedicated to data management for this study. The meteorological data will be downloaded in a consistent format, such as a comma delimited ASCII format. SOPs will be developed and followed to ensure that these formats remain consistent throughout the study.

B.10.3 Analytical Data

The analytical data will be handled on a per batch basis, and results will be reported within 30 days of receipt of samples to the Project Manager. All data collected in the course of the study - including all chromatograms, worksheets, original observations, and relevant notes and memos - will be maintained in the data files. All data collected will include the name or initials of the person collecting the data and the date on which the data or entry was made. All handwritten entries will be made in ink. For any analytical work that is repeated or re-analyzed, the original data or results will be included in the study records along with an explanation as to why the data was not used or why the work was repeated.

Any corrections made to the data will be made in a manner so that the original entry is still legible. The name or initials of the person making the correction, the date of the correction, and an explanation for the change will be included with the original entry. The use of footnotes is acceptable provided that they are on the same page as the original entry.

All samples and subsequent extracts or subsamples will be properly labeled and identified using a unique identifier traceable to the sample label specified in section B.3. All data, chromatograms, worksheets, and etc. will be identified to the appropriate sample.

For data captured electronically, a printout of the data will be produced prior to any further handling of the data. This "first printout" will be initialed and dated by the analyst and will be archived as "raw data" in the study file. With any electronic correction or reworking of the data, a printout of the final corrected data will be collected, initialed, and dated. An explanation for the correction may need to be included. Any worksheets used in calculating results will be formatted in a manner (e.g., unit conversion factors and any necessary formulas will be included) so that all calculations can be audited and verified using only the printed results.

All analytical data will be maintained in a secure location throughout the course of the study. Electronic data will be maintained on the dedicated computer, and

the data will be backed-up periodically. A disk copy of the data will be included with the study file. At the conclusion of the study, the study files will be transferred to the Project Manager and will be retained as long as deemed necessary by the Project Administrator.

C. Assessment and Oversight

C.1 Assessments and Response Action

C.1.1 Annular Denuder Sampling System

A performance audit will be conducted to check the flowrate of the denuder system against a primary calibration device. A SOP will be developed and followed for conducting the flowrate measurement. The Quality Assurance Manager will conduct the performance audit within 30 days of the beginning and the end of the study. Quarterly auditing of the denuder system will also be conducted. Any findings or concerns from the audits will be addressed to the project managers and included in the audit reports.

C.1.2 Meteorological Equipment

Performance and system audits are required to ensure the quality of the meteorological data. Prior to initial installation, any previously used meteorological equipment will be returned to the manufacturer for recalibration and any necessary repair. New meteorological equipment purchased for this project will come from the manufacturer already calibrated. All meteorological parameters will be checked during audits, and the required parameter accuracies are given in Table B-7. SOPs will be developed and followed to ensure consistency during audits. Table C-1 contains an overview of the required audits. The Quality Assurance Manager will conduct the performance audit within 30 days of the beginning and the end of the study. Quarterly auditing of the meteorological equipment will be also conducted. Any findings or concerns from the audits will be addressed to the project managers and included in the audit reports.

Table C-1. Overview of Meteorological Audits*

Overview of Audit
<p>Sensors are removed from tower and connected to conditioning modules with sensor cable patch cords. Also vertical alignment of sites checked during audit to ensure that met tower is properly aligned at 90°.</p> <ul style="list-style-type: none"> ▪ Check wind speed threshold with Propeller Torque Disc ▪ Check wind speed signal with Anemometer Drive ▪ Check wind direction threshold with Vane Torque Gauge and Vane Angle Bench Stand ▪ Check wind direction signal with Vane Angle Bench Stand ▪ Check temperature with NIST traceable mercury thermometer ▪ Check humidity with NIST traceable sling psychrometer ▪ Check solar radiation with lamp with known spectral response ▪ Check visibility using span and zero options on the Nephelometer

* Descriptions of wind calibrations were obtained from literature from the RM Young Company.

C.1.3 Laboratory Operations

All data will be reviewed by the analyst or analytical team at the time the data are collected. Any data not meeting the QC criteria set forth on Table B-8 will require that the analysis be repeated. All data entries will be reviewed for completeness and accuracy, including any electronic data collected. A preliminary reporting of results to the Project Manager will be conducted at this time.

The completed data package will undergo a further review by an independent analyst from AQL who will provide a technical assessment of the data. Any findings or concerns will be addressed to the Laboratory Manager and to the analytical team collecting the data.

The completed data package will undergo an audit conducted by the Quality Assurance Manager. The data will be reviewed along with any pertinent methods and SOPs. This audit will include an assessment as to the overall conduct of the laboratory portion of the study. The Quality Assurance Manager will conduct the performance audit within 30 days of the beginning and the end of the study. Quarterly auditing of the laboratory operations will be also conducted. Any findings or concerns from the audits will be addressed to the project managers and included in the audit reports.

C.1.4 Data Management

The Quality Assurance Manager will audit the data management system at least monthly. Auditing will involve comparing the processed meteorological and analytical data in the spreadsheets with the raw data obtained from the field and laboratory to ensure that the data are being processed correctly. SOPs will be developed and followed for the data audits.

C.2 Reports to Management

The Quality Assurance Manager will summarize the results of all audits into audit reports. Separate audit reports will be conducted for the field sampling operations, the meteorological data collection, the analytical procedures, and data management procedures. The reports will be distributed to study managers, the WaRO, PCS Phosphate personnel, and other appropriate persons. The Quality Assurance Manager will prepare an initial and final audit report at the beginning and end of the study and quarterly throughout the study period.

D. Data Validation and Usability

D.1 Data Review, Validation, and Verification Requirements

All analytical and meteorological data are reviewed by the Project Managers and the Project Administrator to determine if these data meet the QAPP objectives. Decisions to reject or qualify data are made by the Project Manager and the Quality Assurance Manager. Each month, the Data Manager will post the validated, quality-coded meteorological and analytical data on the DAQ web site. In this way, the data will be available in a timely manner to the study managers, the WaRO, PCS Phosphate personnel, and other appropriate persons. All personnel involved in the study, including the WaRO and PCS Phosphate, will have the opportunity to review these data before they are incorporated into the final report. A final report of these data is scheduled for completion in the Spring of 2001.

D.2 Validation and Verification Methods

Verification

The Data Manager will electronically back up all data that are obtained from the field and the laboratory. These backup copies will be maintained until the data are transferred to the dedicated computer and verified. Verification entails a review to ensure that all the data for the collection period are accounted for. The verified, raw data will be maintained on the dedicated computer throughout the study period, until as long as deemed necessary by the Program Administrator.

Validation

The purpose of data validation is to detect any data value that may not represent actual air quality conditions at the sampling locations.³ Both the meteorological data and the analytical data will be validated to ensure that the quality goals of the study are met.

Before the field monitoring phase of the study begins, a validation study on the IC methods will be conducted and documented. Additionally, this monitoring study is designed with rigorous QA/QC measures that conform to EPA's Contract Laboratory Program (CLP) guidelines, which are intended to produce legally defensible data. An overview of the QA/QC procedures for the analytical methods is described in Table B-8.

Computers can be used to assist in validation of meteorological data by determining if the values fall outside a specified range. An Excel macro may be developed to assist in validating meteorological data, if necessary. Validation guidelines for meteorological parameters are provided in *On-Site Meteorological Program Guidance for Regulatory Applications* and are summarized below.¹⁰ If data fall outside these guidelines, the data are further reviewed to determine validity.

Wind speed - 1) is less than 0 or greater than 25 m/s (56 mph), 2) does not vary by 0.1 m/s (2 mph) for 3 consecutive hours, 3) does not vary by 0.5 m/s (1.1 mph) for 12 consecutive hours

Wind direction - 1) is less than 0° or greater than 360°, 2) does not vary by more than 1° for more than 3 consecutive hours, 3) does not vary by more than 10° for 18 consecutive hours

Temperature - 1) is greater than the local record high or is less than the local low on a monthly average, 2) is greater than a 5°C (9°F) change from the previous hour, 3) does not vary by more than 0.5°C (0.9°F) for 12 consecutive hours

Solar Radiation - 1) exceeded 0 at night, 2) is greater than the maximum possible for the date and location.

Visibility - The procedures listed in EPA's *Visibility Monitoring Guidance*⁷ for validating data from the nephelometer will be followed in this study.

D.3 Reconciliation with User Requirements

As soon as possible after each sampling event, calculations and determination for precision, completeness, and accuracy will be made and corrective action implemented if needed. If data quality indicators do not meet the projects specifications, data may be discarded and, if possible, resampling may occur. The cause of failure will be evaluated. If the cause is found to be equipment failure, then calibration and preventative maintenance techniques will be reassessed and improved. If the problem is found to be sampling team error, then team members will be retrained. Any limitations of the data will be detailed in both interim and final reports and other documentation as needed.

E. References

1. US EPA. 1998. *EPA Requirements for Quality Assurance Project Plans: Final Draft*. Office of Research and Development.
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Appendix A - Standard Operating Procedures

Appendix A is under development. Listed below are the SOPs that will be included in this study. The list is not all inclusive, and additional SOPs will be added if needed.

Field Sampling Operations

- 1) Sample Collection and Sample Deployment (including tracking info)
- 2) Leak Checking and Flow Calibration of Denuder system
- 3) Preventative Maintenance
- 4) Chain of Custody

Meteorological Data Collection

- 1) Siting Met Equipment
- 2) Setting up Met Equipment
- 3) Downloading Met Data and Uploading to System Computer
- 4) Preventative Maintenance SOPs
- 5) Operation and Cleaning of Fog Collector
- 6) Operation of Nephelometer
- 7) Calibration of Nephelometer
- 8) Conducting Weekly (visual) Inspections of Met Equipment

Chemical Analysis of Field Collected Samples

- 1) Logging and Tracking Samples
- 2) Coating Denuders
- 3) Extracting Denuders
- 4) Running IC/HCLP
- 5) Weighing Filters
- 6) Measuring pH
- 7) Calibrating Instruments
- 8) Preventative Maintenance SOPs

Project Data Collection and Management

- 1) Processing Met Data
- 2) Processing Raw Data from Denuder System
- 3) Incorporating Met Data and Concentration Data

Quality Assurance Audits

- 1) Auditing Denuder system
- 2) Auditing Met Equipment
- 3) Auditing Data Management
- 4) Auditing Laboratory