

SECTION 1

PROGRAM OBJECTIVES AND SCOPE

1.1 Objectives

The objectives of the collaborative proposed six month air monitoring and analysis program are to chemically characterize and quantify concentrations of acidic and basic gaseous pollutants, aerosols and particulate matter (less than 2.5 micrometers in aerodynamic diameter) in the Pamlico River airshed. The designed program will also permit characterization of potential regional episodic air quality events during the study period. This is planned to be accomplished through the use of nephelometers, which will continuously provide visibility readings from the four sampling sites during the entire program period. Furthermore, data will be evaluated with the aim of documenting regional conditions that lead to the formation of the irritant fog and if possible, the sources contributing to it's formation.

1.2. Scope of the Proposed Program

The scope of the program activities shall include:

- Selection of four sampling sites based on regional meteorology, micrometeorology and topography
- Inclusion of four to eight local citizens of varying ages to document episodic events, odors, etc. during the program period.
- Collection of meteorological data from 10-meter meteorology towers for barometric pressure, wind speed, wind direction, temperature, humidity and solar radiation from four sampling sites and also from the 30-meter radio tower. Data is averaged at every 15-minute, 1-hour and 24-hours for six months.
- Installation and operation of ADS systems at each of the four sampling sites and monitor for acidic and basic gaseous pollutants, aerosols and fine particulate matter (less than 2.5 micrometers in aerodynamic diameter)
- Nephelometers at four sites to continuously measure levels of visibility degradation due to airborne fine particulate matter in the Pamlico River airshed. Nephelometer data will be averaged every 15-minutes, 1-hour and 24-hours during the program period
- Developing relationships between light scattering coefficient readings of the nephelometer and fine particulate matter concentrations provided by the TEOM continuous particulate monitor
- Using nephelometers to trigger episodic acidic and basic gaseous, aerosol and fine particulate matter sampling using seven-day ADS

- Each ADS shall be a unit that holds one field blank denuder assembly, a second dedicated denuder assembly used to sample episodic events and five 24-hour denuder assemblies to collect acidic and basic gaseous pollutants. A filter pack to collect particulate matter less than 2.5 micrometers in diameter and nitric acid shall be also part of each ADS. Deployment of a trip blank denuder assembly at each monitoring site for QA/QC will also occur
- Denuder sampling times shall be from midnight to midnight for all four sites. Each ADS system will sample for five consecutive days. On the sixth day, the field operator will deploy and collect eight denuder assemblies (five 24-hour samples and one each of field blank, episodic sample and trip blank)
- Use of the Passive Cloud Water Collector during episodic events to collect fog water samples
- Transport of field collected denuder samples, under chain-of-custody, to AQL
- Preparation of denuders with appropriate coatings for field sample collection at AQL
- Receive field collected samples at AQL and check for sample integrity
- Extraction of denuders for gaseous acidic and basic pollutants and preparation of extracts for analysis
- Obtain weight change for teflon filters to determine airborne particulate matter concentrations
- Extraction of teflon and nylon filters and preparation of extracts for analysis
- Analysis of all samples including those from the passive cloud water collector using IC for sulfur dioxide (SO_2), sulfate (SO_4^-), phosphoric acid (H_3PO_4), hydrofluoric acid (HF), hydrochloric acid (HCl), nitric acid (HNO_3), nitrous acid (HNO_2), ammonia (NH_3) and ammonium (NH_4^+). Determine pH of samples using a pH meter
- Development of project work-specific QAPP and implementation of QAPP during field operations and chemical analysis of samples
- Reduction of meteorological and analytical data and evaluation of all data together with QA/QC data to meet project work objectives
- Developing Standard Operating Procedures for all program objectives

SECTION 2

INTRODUCTION

2.1. Background Information

The Division of Air Quality, Washington Regional Office has compiled years of data on citizen complaints, documenting odors and eye burning, irritating and choking incidents that occur in the Pamlico River area within a few miles north, northeast and northwest of the PCS facility ⁽¹⁾. These incidents are mostly described as a pungent, biting odor that is sometimes strong enough to cause burning of eyes, nose or other sensitive parts of human face and importantly appear to coincide with early morning meteorological inversion conditions and southwesterly winds and periodically coincide with a visible fog. However, these may not all be manifested as fog, but instead may be a “dry irritant” incidents with similar characteristics of a “fog”. The precise chemical composition of the irritant fog has to-date not been determined, although certain preliminary data suggest a relationship between the formation of an irritant fog with emissions from the PCS facility. The complaint history spanning a period of twenty years documents approximately 200 complaints ⁽¹⁾, hereafter referred to as “episodic events”.

In spite of years of history of citizen complaints, little scientific work has been done to-date to characterize the air quality in general and during these episodic events in terms of chemical composition, pollutant types and their airborne concentrations. Further, it is suspected that regional industrial activities may be contributing to the fogs and episodic events. It is also believed that emissions from the PCS facility are reacting, particularly during episodic events (meteorological inversions), in the environment to produce secondary pollutants (primarily acidic and basic aerosols) that may be responsible for fog formation and in turn for citizen complaints.

2.1.1. PCS Facility Location and Processes

PCS Phosphate, Inc., (formerly known as Texas Gulf, Inc.,) has established the world’s largest ⁽²⁾ vertically integrated phosphate mining operation on the south shore of the Pamlico Sound, near Aurora, North Carolina in Beaufort County. PCS’s northern boundary is the Pamlico River and the land immediately surrounding this industrial facility is largely wetlands and pine forest. A few residential properties are around PCS on the north side of the Pamlico River, but in general, the area is sparsely populated. The closest populated areas are Bayview, Bath and Aurora. Bayview is approximately four kilometers north-northwest, across the Pamlico River and Bath is just north of Bayview and about seven kilometers north-northwest from PCS. The Town of Aurora is approximately seven kilometers south of PCS. The largest urban area nearest to PCS is Washington and is located about thirty three kilometers northwest of PCS headwaters of the Pamlico River-where the Tar River becomes Pamlico River. As reported by the Washington Regional Office, there is a minimal industrialization within 35 kilometers of the PCS site ⁽³⁾

The PCS Aurora Complex is designed to produce a number of end products: dry phosphate rock, technical/feed grade phosphoric acid, di-ammonium phosphate, ammonium polyphosphate solution, superphosphoric acid and merchant grade phosphoric acid. Phosphatic fertilizer production, Standard Industrial Classification (SIC) 2874, is ranked 10th in overall ranking in the “Draft” priority SIC ranking paradigm developed for the State of North Carolina Toxics Program. SIC 2784 ranks 4th statewide in both acute systemic toxicant emissions and acute irritant emissions, 5th in chronic toxicant emissions and 49th in carcinogenic emission (these rankings are based on PCS’ 1996 emission inventory. The facility-wide air emission summary of PCS Phosphate, Inc., for the year 1996 (the latest available air toxics emission inventory) is included in Table 2-1. The PCS facility reported total emissions of 8,258,319 pounds in 1996 and emits 11.76 percent of the statewide total emissions, excluding emissions from the electric power utilities. Air emissions from PCS facility accounts for nearly half of the total emission estimates in the Washington Region.

The information in Table 2-1 indicates that the PCS facility is emitting a variety of pollutants, in relatively large quantities. Some of these pollutants are of health concern and Table 2-2 includes relevant Acceptable Ambient Levels (AAL’s), as promulgated by the State of North Carolina Air Toxics Program. The emissions from PCS facility are generated during the processing of phosphate ores and also during the production of phosphate fertilizers and high purity phosphoric acid. The prevailing summer time winds distribute the emissions over the Pamlico Sound Region and in the general direction of many of the residences, from where complaints have historically been received and documented.

2.1.2. Prevailing Regional Meteorological Assessment

Meteorological data for the PCS facility from 1989 to 1998 have been documented⁽⁴⁾ and evaluated by the ATAST for the proposed study. Wind roses that plot the frequency of wind direction and wind speed were generated from these data. In general, wind followed a strong southeast (SE)/south-southeast (SSE) and north-northeast (NNE) directional patterns. However, the predominant wind direction appears to have shifted slightly in the past few years. As seen in Figure 2.1, the predominant winds from 1989 until 1994 were from the SE for approximately 11.5 percent of the time and from the NNE for about 9 percent of the time. Figure 2.2 reveals that from 1995 to 1998, the predominate wind direction shifted and was from the SSE approximately 11 percent of the time and from the NNE for about 9.5 percent of the time. Figures 2.3 and 2.4 indicate that this same wind pattern held true for the months of May to October, when the citizen complaints of burning and irritating fogs were most common.

In October 1993, Dr. Donald L. Fox, Department of Environmental Sciences and Engineering from the University of North Carolina, Chapel Hill, North Carolina, evaluated⁽⁵⁾ regional meteorology for the years 1988 to 1993 associated with 84 citizen complaints records, provided by PCS Phosphate. His preliminary conclusions were that of the 38 morning complaint events, 31 were in the May to October months and of the 20 afternoon/evening events, 14 were in the May to October months. He concluded that a high percentage of events were associated with southerly wind flows. Dr. Fox indicated

**TABLE 2.1 FACILITY-WIDE EMISSIONS SUMMARY, 1996
 PCS PHOSPHATE COMPANY, INC – AURORA***

	Sulfuric	Mill/		Phosphoric	Purified		Misc.	
HAPs/TAPs	Acid	Calcliner Area	Fertilizer	Acid	Acid	Shipping	Sources	TOTAL
	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)
1,1,1-Trichloroethane	7.44E-02	1.26E+00	3.68E-01					1.70E+00
2,4-Dinitrotoluene		1.26E-02						1.26E-02
2-Chloroacetophenone		3.16E-01						3.16E-01
Acetaldehyde		2.57E+01						2.57E+01
Acetophenone		6.76E-01						6.76E-01
Acrolein		1.31E+01						1.31E+01
Ammonia			3.47E+06		1.55E+04	1.67E+05	5.49E+02	3.65E+06
Antimony	1.66E+00	4.92E+01	6.43E+01	1.01E+00		4.73E-01	1.39E-02	1.17E+02
Arsenic	7.93E-01	6.58E+00	3.37E+00	4.55E-01		2.13E-01	1.93E-02	1.14E+01
Benzene	6.75E-02	5.89E+01	3.33E-01					5.93E+01
Benzo(a)pyrene		1.71E-03						1.71E-03
Benzyl chloride		3.16E+01						3.16E+01
Beryllium	2.33E-01	1.90E+00	3.31E+00	7.08E-02		3.31E-02	8.77E-03	5.55E+00
Bis(2-ethylhexyl)phthalate		3.29E+00						3.29E+00
Bromoform		1.76E+00						1.76E+00
Cadmium	1.11E+00	1.89E+03	2.38E+01	9.69E-01		4.53E-01	4.76E-02	1.92E+03
Carbon disulfide		5.86E+00						5.86E+00
Chlorobenzene		9.92E-01						9.92E-01
Chloroform		2.66E+00						2.66E+00
Chromium	5.42E+00	1.31E+02	8.11E+00	4.05E+00		1.89E+00	2.35E-01	1.51E+02
Chromium VI	7.82E-02	3.94E+00	3.86E-01					4.40E+00
Cobalt	1.90E+00	1.17E+01	1.65E+01	2.86E-01		1.34E-01	3.93E-03	3.05E+01
Cumene		2.39E-01						2.39E-01
Cyanide		1.13E+02						1.13E+02
Dimethyl sulfate		2.16E+00						2.16E+00
Ethyl chloride		1.89E+00						1.89E+00
Ethylbenzene	2.01E-02	4.34E+00	9.91E-02					4.45E+00
Ethylene dibromide		5.41E-02						5.41E-02
Ethylene dichloride		1.80E+00						1.80E+00
Fluorides (except HF)		4.16E+03	2.16E+04	6.68E+03		1.39E+03	6.63E+03	4.05E+04
Formaldehyde	4.16E+01	6.10E+01	5.14E+01					1.54E+02
Hexachlorodibenzo-p-dioxin		1.35E-04						1.35E-04
Hexane		3.02E+00						3.02E+00
Hydrogen chloride		5.41E+04						5.41E+04
Hydrogen fluoride		7.49E+03	1.56E+04	5.11E+03	1.33E+03		5.36E+04	8.31E+04
Hydrogen sulfide		1.27E+04		3.66E+06	7.55E-02	7.07E+03	3.55E+02	3.68E+06
Isophorone		2.62E+01						2.62E+01
Lead	1.27E+00	5.15E+01	2.98E+01	2.23E-01		1.04E-01	3.08E-02	8.30E+01
Manganese	2.20E+00	4.95E+01	3.02E+01	4.68E-01		2.19E-01	5.01E-02	8.27E+01
Mercury	3.05E-01	2.39E+01	7.06E-01	1.77E-03		8.28E-04	9.38E-03	2.49E+01
Methyl bromide		7.22E+00						7.22E+00
Methyl chloride		2.39E+01						2.39E+01
Methyl ethyl ketone		1.76E+01						1.76E+01
Methyl hydrazine		7.67E+00						7.67E+00
Methyl Isobutyl Ketone					5.43E+04	8.60E+03		6.30E+04
Methyl methacrylate		9.02E-01						9.02E-01
Methyl tert butyl ether		1.58E+00						1.58E+00
Methylene chloride		1.31E+01						1.31E+01
Naphthalene	3.56E-01	2.31E+00	1.76E+00					4.42E+00
Nickel	2.83E+01	2.65E+02	5.50E+02	4.43E-01		2.07E-01	6.22E-02	8.44E+02

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 PCS PHOSPHATE COMPANY, INC – AURORA***

	Sulfuric	Mill/		Phosphoric	Purified		Misc.	
HAPs/TAPs	Acid	Calciner Area	Fertilizer	Acid	Acid	Shipping	Sources	TOTAL
	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)
o-Xylene	3.44E-02	1.66E-01	1.70E-01					3.70E-01
Phenol		7.22E-01						7.22E-01
Phosphorous	2.98E+00	2.63E+01	1.47E+01					4.40E+01
Polycyclic Organic Matter	8.26E-03	9.98E-01	4.08E-02					1.05E+00
Propionaldehyde		1.71E+01						1.71E+01
Radionuclides		3.47E-03	1.06E-06			7.74E-05	3.18E-02	3.18E+02
Selenium	2.15E-01	4.49E+00	2.71E+00	4.30E-02		2.01E-02	5.91E-04	7.48E+00
Styrene		1.13E+00						1.13E+00
Sulfuric Acid Mist	2.71E+05	2.36E+02	2.68E+02				1.64E+00	2.71E+05
Tetrachloroethylene		2.76E+00						2.76E+00
Toluene	1.96E+00	2.67E+01	9.66E+00					3.83E+01
Vinyl acetate		4.88E-01						4.88E-01
Xylene		2.38E+00						2.38E+00

*Source: 1996 Air Quality Emissions Inventory as submitted by PCS Phosphate Company, Inc.

FIGURE 2.1: PCS Phosphate Onsite Meteorological Conditions
January 1, 1989 through December 31, 1994

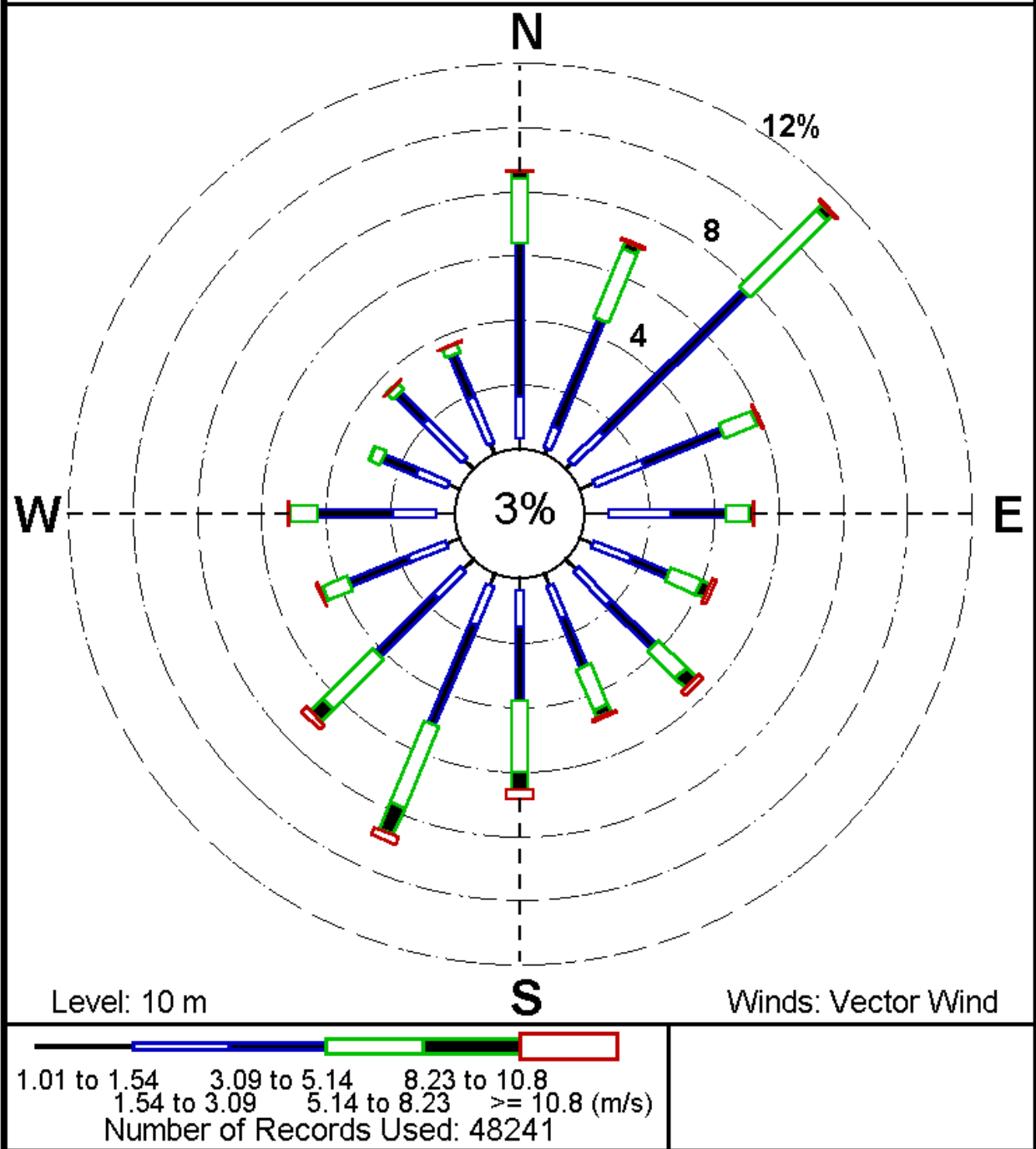


FIGURE 2.2: PCS Phosphate Onsite Meteorological Conditions
January 1, 1995 through December 31, 1998

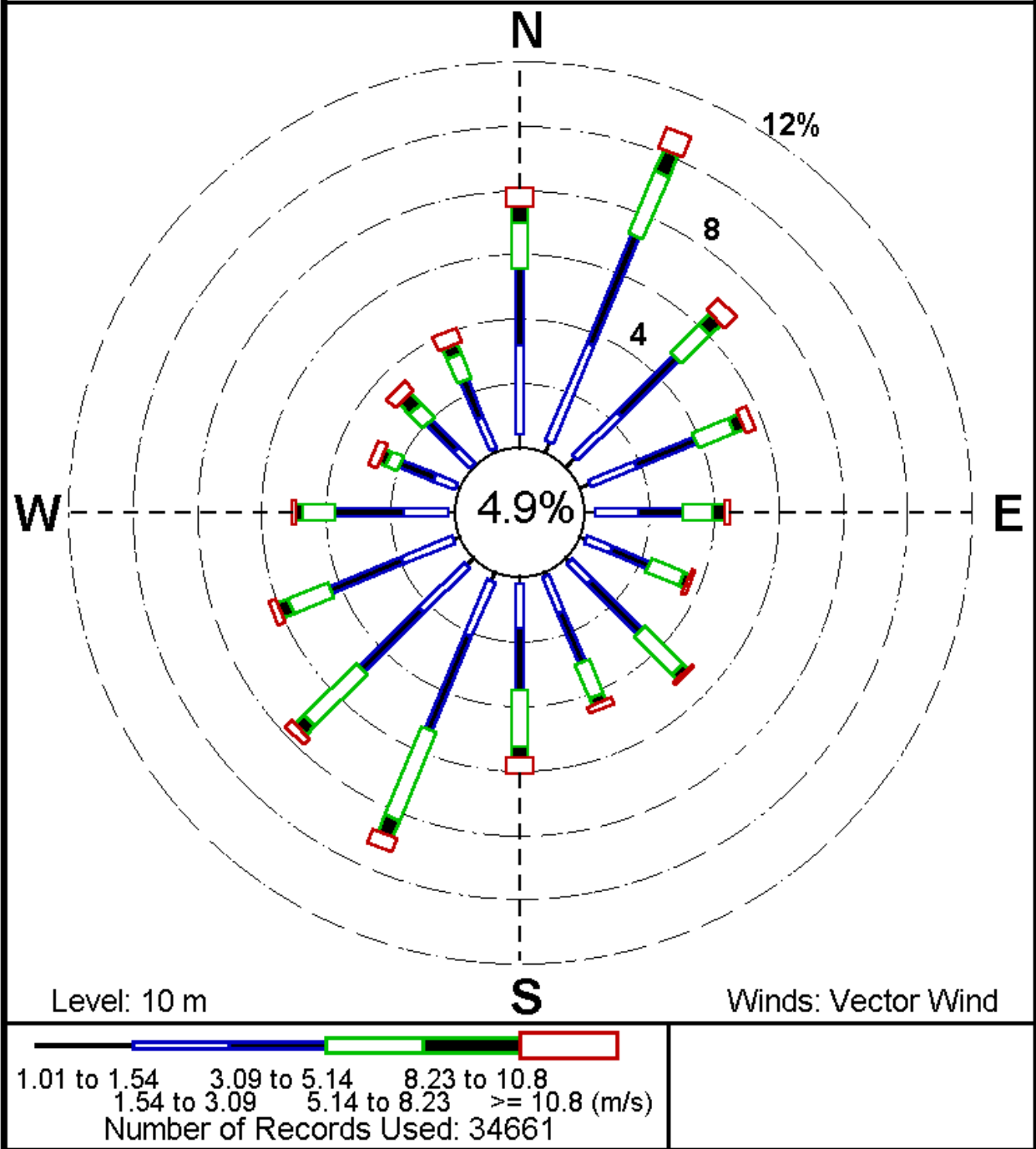


FIGURE 2.3: PCS Phosphate Onsite Meteorological Conditions
May 1, 1989 through October 31, 1994

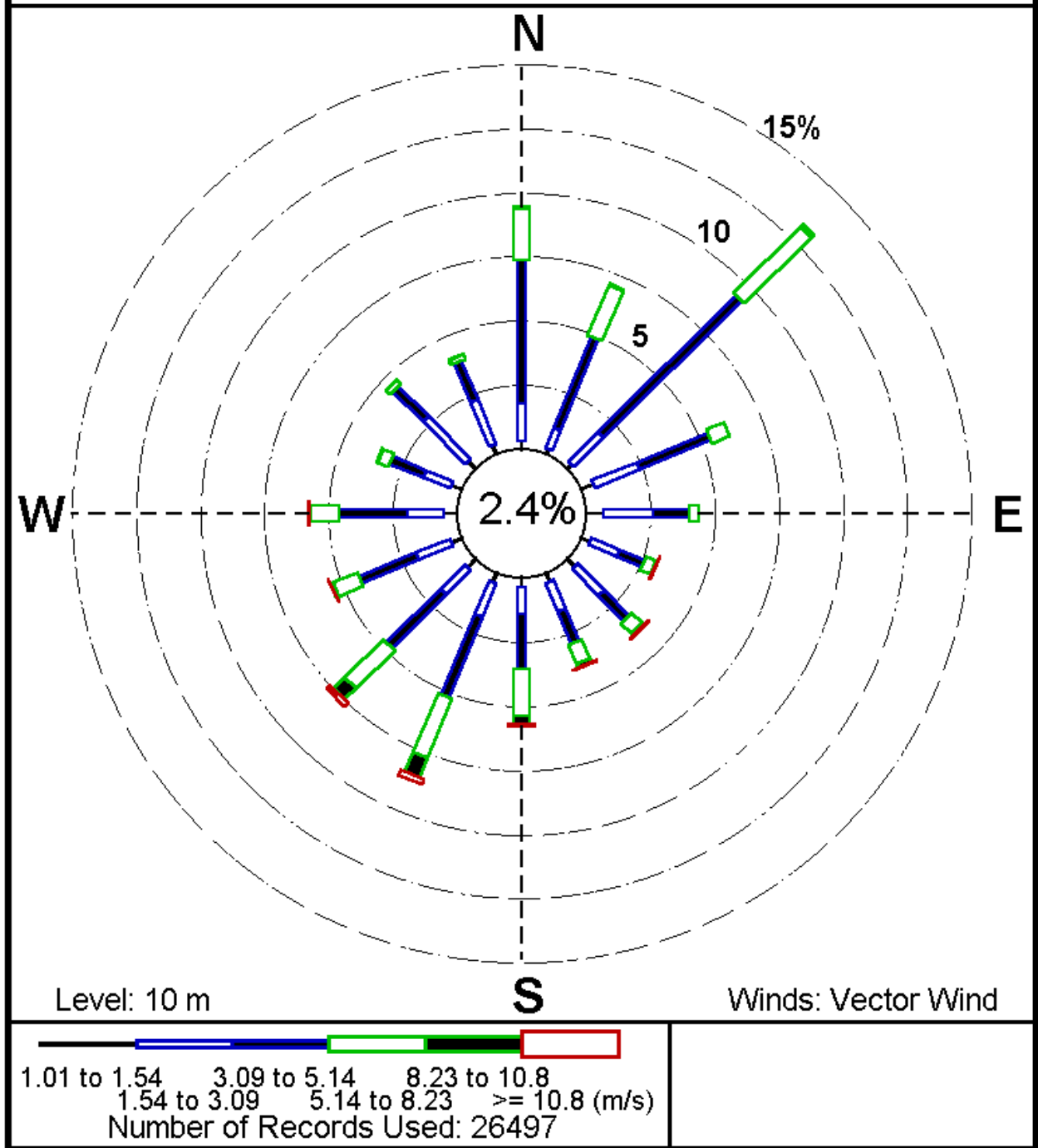


FIGURE 2.4: PCS Phosphate Onsite Meteorological Conditions
May 1, 1995 through October 31, 1998

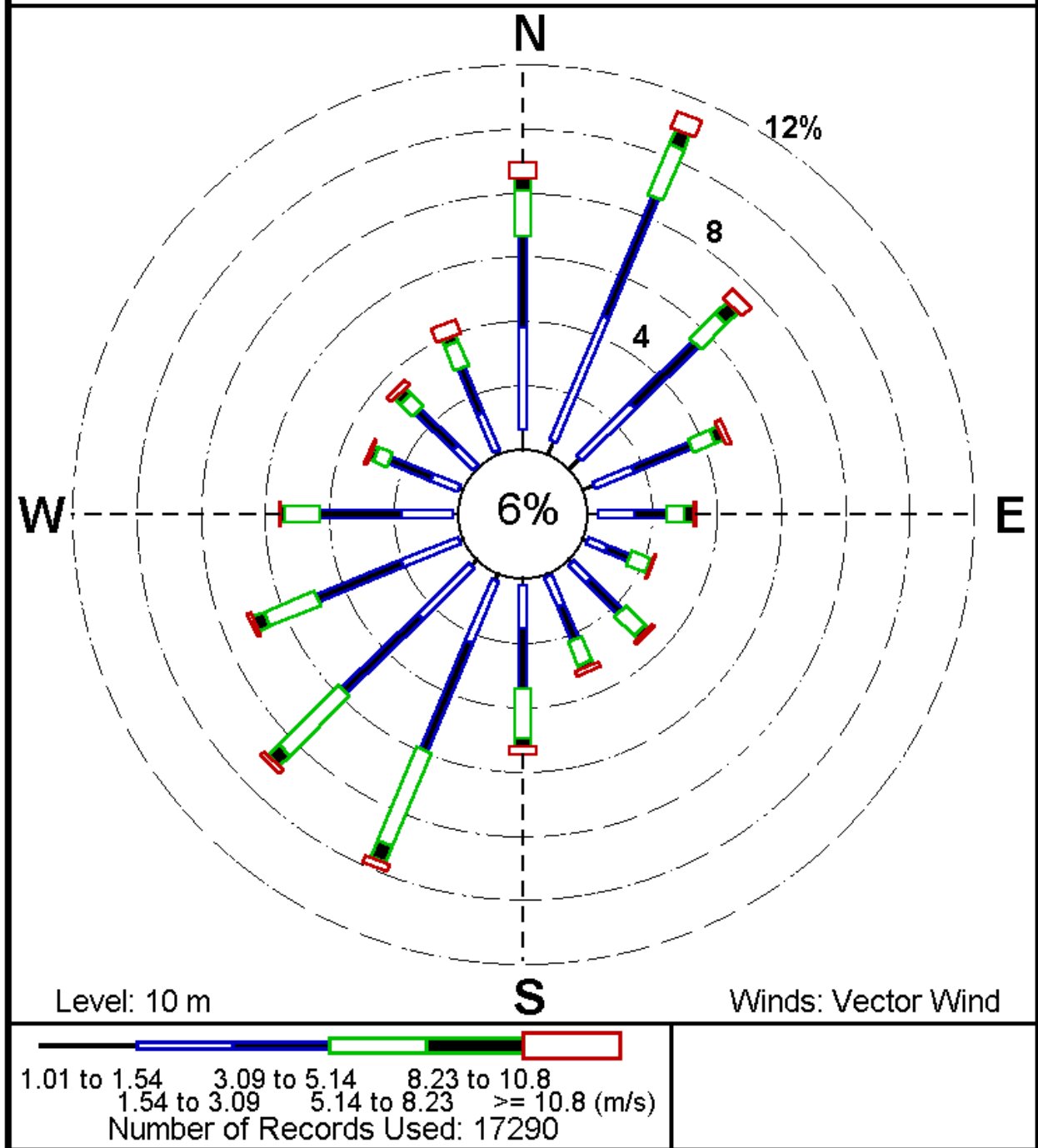


TABLE 2.2
**NORTH CAROLINA ACCEPTABLE AMBIENT LEVELS/
 NATIONAL STANDARDS FOR SOME STUDY POLLUTANTS**

POLLUTANT	STANDARD	TIME PERIOD	CONCENTRATION
Ammonia (NH ₃)	North Carolina AAL	One Hour	2.7 mg/m ³
Ammonium nitrate (NH ₄ NO ₃)	NONE		
Ammonium sulfate [(NH ₄) ₂ SO ₄]	NONE		
Fluorides (F ⁻)	North Carolina AAL	24-Hour	0.016 mg/m ³
		One Hour	0.25 mg/m ³
Hydrogen chloride (HCl)	North Carolina AAL	One Hour	0.7 mg/m ³
Hydrogen fluoride (HF)	North Carolina AAL	24-Hour	0.03 mg/m ³
		One Hour	0.25 mg/m ³
Nitric acid (HNO ₃)	North Carolina AAL	One Hour	1.0 mg/m ³
Nitrous acid (HNO ₂)	NIOSH	TWA	46 mg/m ³
Sulfuric acid* (SO ₄ ⁼)	North Carolina AAL	24-Hour	0.012 mg/m ³
		One Hour	0.1 mg/m ³
Nitrogen dioxide (NO ₂)	NAAQS	Annual	100 ug/m ³
PM2.5 (Remanded Standard)*	NAAQS	Annual	15 ug/m ³
		24-Hour	65 ug/m ³
Sulfur dioxide (SO ₂)	NAAQS	Annual	80 ug/m ³
		24-Hour	365 ug/m ³
		Three Hour	1300 ug/m ³
Notes: The NAAQS for PM2.5 has been temporarily remanded.			
Sulfuric acid analysis is under consideration.			

that a preliminary evaluation of the regional meteorological conditions indicated the presence of a high-pressure cell over eastern North Carolina or the presence of a Bermuda High over the southeast coast. This weather pattern is typical of summer in North Carolina. Dr. Fox also points out that his evaluations were preliminary in nature and should not be considered to be conclusive for defining the meteorological conditions associated with the events/citizen complaints- although a strong correlation appears to exist between the frequency and location of complaints, the time of the year and the wind direction in that it places PCS upwind of the complaint sites.

On a related subject matter, Dr. Carl M. Shy, School of Public Health, Department of Epidemiology, University of North Carolina, Chapel Hill, North Carolina submitted a report ⁽⁶⁾ on April 27, 1990 to Mr. William Schimming, (Past) Director of Environmental Program, Texasgulf, Inc., (now PCS Phosphate, Inc.,) on acute health effects, associated with potential community exposure to acid aerosols. This was a preliminary report and included results of acid aerosol exposure of only 4 out of 32 days, when regional atmospheric pH levels could be classified as somewhat low, i.e. less than a pH of 5.0.

This study found no differences in symptom frequency between the low pH days (pH < 5.0) and other days. Likewise, study subjects in the non-exposed area reported the same

frequency of symptoms on days of low pH and normal pH. Thus, the study concluded “that for the non-exposed area, low pH days simply are identical days on which low pH readings were obtained in the exposed area”.

2.2. Proposed Program Basis

In response to numerous citizen complaints of episodic events and irritating fogs, the only scientifically systematic study to-date to characterize air quality over the Pamlico Sound Region was performed ⁽⁷⁾ at the request of the Division of Air Quality (DAQ) by the Atmospheric Research and Exposure Assessment Laboratory (AREAL) of the U.S. Environmental Protection Agency (US-EPA). This study was conducted in the months of August and September 1989 to characterize the chemical composition of regional fog. The US-EPA’s sampling approach included:

- Filter packs to collect samples to quantify sulfates, nitrates and acidity of fine particles (< 2.5 um)
- A dichotomous sampler to collect particulate samples in the coarse and fine fractions for X-ray fluorescence (XRF) elemental composition analysis and Scanning Electron Microscopy (SEM) for particle morphology
- Annular denuder sampler to collect sulfur dioxide, nitric acid and ammonia
- A fog sampler to collect regional fog droplets

Two sampling sites were used in this study, one was downwind and the other upwind of the PCS facility. Samples were typically collected for 12 hours, 9:00 PM to 9:00 AM. The conclusions of the two months study indicated ⁽⁷⁾ that fine particle aerosols downwind of the PCS facility were predominately acid sulfates. The fine and coarse particulate fractions contained calcium, phosphorus, and chromium and these elements are present in the phosphate ore processed by PCS Phosphate, Inc., These study results also implicated that an association between ammonia and sulfuric acid and the formation of ammonium sulfate aerosols, may exist.

Further, the study recommended ⁽⁷⁾ that additional sampling be performed concurrently at several locations and the project period should be extended to one year. Accordingly, a collaborative six months study between ATAST and PCS Phosphate, Inc., to characterize air quality in the Pamlico Sound region is proposed. This monitoring program from May 1, to Oct. 31, 2000 will quantify on a continuous basis and during episodic events, the concentrations of reactive acidic and basic gases, aerosols and fine particulate matter at four selected sites.

Data collected are expected to address the primary issue of irritant fog characterization in the Pamlico River airshed. The proposed study also involves detailed chemical characterization of irritant fog and possible clarification of the regional meteorological conditions that lead to the occurrence of irritant fog as well the source(s) contributing to the problem.

SECTION 3

TECHNICAL APPROACH

3.1. Basis

The technical approach for the proposed collaborative monitoring program to characterize air quality in the Pamlico Sound Region requires consideration of two important factors:

1. The field sample collection for a variety of acidic and basic pollutants and fine particulate matter, and meteorology
2. The analytical quantification of the samples.

Such considerations are vitally important so that the end result approaches the ideal in terms of ultimate utility of the generated data. In compliance with the Scope of Work Statement (see Section 1 for details), ATAST, WaRO and PCS Phosphate will perform an integrated sample collection program, at four selected sampling sites in the Pamlico River Region. A well-run and complete field testing program requires careful, detailed planning and analysis of not only the field testing activities but also of non-field testing activities such as regional meteorology and micrometeorology, topography, sample site selection etc. The other aspects that also require careful consideration are the activities of sample retrieval in the field, sample identification, sample transportation to the AQL, chemical analysis and timely data analysis. Each of these is considered to be important for the successful outcome of the project study.

3.2. Technical Approach

The proposed program is complex in nature and thus a multifaceted technical approach would be necessary. Technical approaches for each of the following four aspects of this program study are discussed below:

- Sampling site selection
- Operation and data collection from meteorological instruments
- Field operation of Annular Denuder Systems at sampling sites
- Chemical analysis of field collected samples for acidic and basic gases, aerosols and fine particulate matter
- Data analysis

3.2.1. Sample Site Selection

One of the limitations of US-EPA's 1989 study ⁽⁷⁾ was that the two selected sampling sites did not perform as expected. Monitored pollutant concentrations at both sites were essentially the same. Thus, the background site had almost same pollutant concentrations

as the high impact site. Consequently, extrapolations of analytical data obtained from these monitoring sites for source attribution(s) could not be made with any degree of scientific certainty.

During this program's design, it was concluded that a minimum of four sample collection sites around the PCS facility would be required to fully characterize the air quality at the Pamlico Sound region. One of the four sites should be an upwind site so that source attribution objectives of the project are met. The second should be a high impact site based on PCS facility's location, regional topography and meteorology. The third site should be in the direction of the majority of citizen complaints of irritating fog events and the fourth should be further north (3 to 5 kilometers) of the third site to collect quantitative information related to chemical transformation of pollutants (both acidic and basic) in air as the distance from the emission source point increases.

For the proposed monitoring program, a number of meteorological and other related parameters were considered for and during sampling selections of sites and these are summarized below.

On-site meteorological data from 1989 to 1998 provided by the PCS Phosphate, Inc., were evaluated by the ATAST group ⁽⁴⁾. From these data, wind roses that plot the frequency of wind direction and wind speed were generated. Overall, wind followed a strong southeast/south-southeast and north-northeast directional patterns. However, the predominant wind direction appeared to have shifted slightly in the past few years. From 1989 until 1994, the predominant winds were from southeast for approximately 11.5 percent of the time and from north-northeast for about 9 percent of the time. From 1995 to 1998, the predominant wind direction has shifted and was from south-southeast approximately 11 percent of the time and from the north-northeast for about 9.5 percent of the time. The same wind pattern held true for the months of May to October, when the citizen complaints of burning and irritating fogs were most common.

Further, based on the wind rose data, sites were visited to evaluate topography, land use, micrometeorology, physical obstructions for meteorological data collection, etc. Before site selection, discussions were also held with WaRO staff and others knowledgeable of site selection. Five selected sampling sites, meeting above mentioned siting criteria are included in Figure 3.1 and these are:

1. St. Hooker Site: This site is located upwind or south-southeast of the PCS Phosphate facility and is expected to provide background monitoring data of the meteorological and chemical parameters of the program.
2. Hardison Site: This site is located northeast of the PCS Phosphate facility along the Pamlico River's north shore, and was included in US-EPA's 1989 study. It is considered a high impact site by reason of prevailing wind patterns and citizen complaints.
3. Kilby Island Site: This site is located on the Pamlico River's north shore and is in the general direction of the regional wind patterns, and historically the majority of citizen complaints have been reported in this area.

4. Bath Site: This site is located at a greater northern distance (3 to 5 kilometers) of the Bayview site where citizens have complaints of the fog events. Monitoring at this site is expected to provide quantitative information related to pollutant concentrations at distance from the source (s) and their, if any, chemical transformation in air from the emission source(s).
5. Ferry Landing Meteorology Site: This site is located on the DOT radio tower at the Bath ferry landing. Wind direction, wind speed, temperature and solar radiation sensors will provide meteorological data at the 30 meter elevation, which may provide insight into plume movement.

The proposed study activities also include selection of four to eight local citizens, residing in the vicinity of each of the sampling sites, of varying ages from 15 to 75 years old. Each is expected to document and report to a WaRO contact, of any episodic meteorological conditions, especially those which reduce visibility such as fog and haze

FIGURE 3.1
PAMLICO RIVER AIRSHED
WITH SELECTED MONITORING SITE LOCATIONS



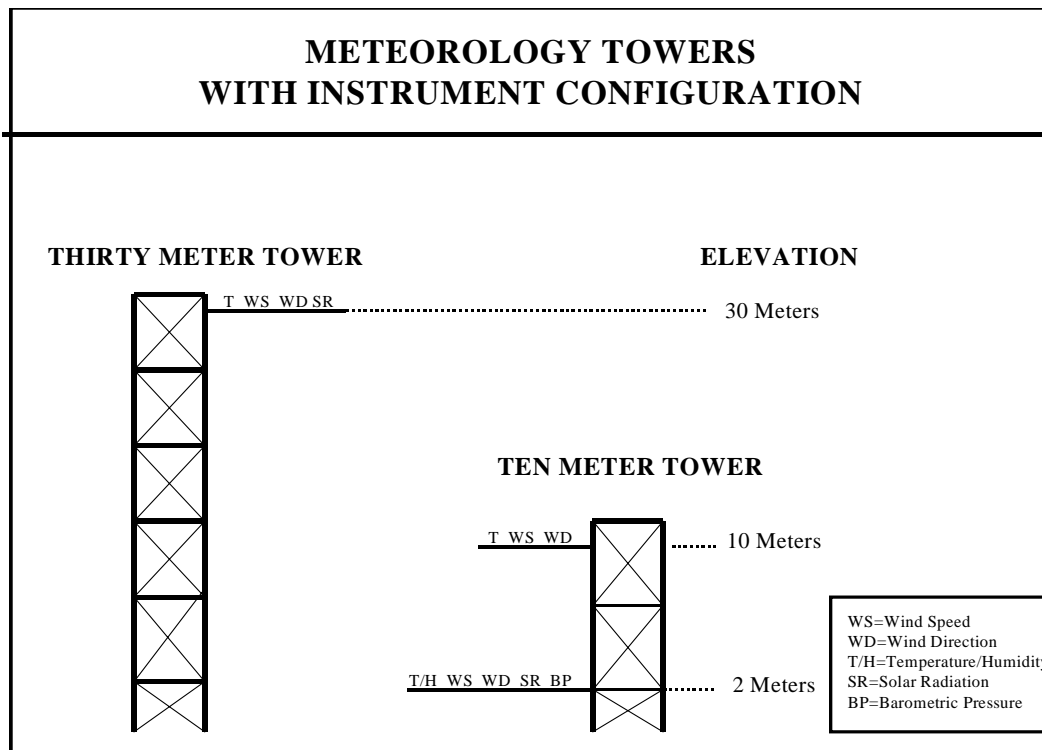
and any air quality complaints due to odors, smoke and/or particulate fallout. The objective here is to correlate airborne concentrations of measured pollutants (quantified via sampling and analysis) to the observation of possible unusual occurrences of any regional meteorological conditions.

3.2.2. Field Operation and Data Collection from Meteorological Instruments

In this sub-section the technical approach and rationale for the meteorological monitoring, nephelometer, real time particulate matter monitoring , and passive fog event sampling are discussed.

Meteorological monitoring equipment at all four sites will consist of wind direction, wind speed, temperature, relative humidity, solar radiation, and barometric pressure sensors. These sensors will be installed on 10-meter meteorology towers at 2 and 10-meter elevations. The 2-meter elevation will be representative of the human breathing zone and will include sensors for measuring wind direction, wind speed, temperature, relative humidity, solar radiation, and barometric pressure. Sensors positioned at the 10-meter elevation represent standard meteorological conditions and will include wind direction, wind speed, and temperature. Additionally, an existing radio tower located at the North Carolina Department of Transportation (NCDOT) Bayview Ferry Landing is proposed for inclusion into this study for measurement of upper level atmospheric conditions including wind speed, wind direction, temperature, and solar radiation at the 30-meter elevation. Figure 3.2 depicts the meteorology tower configurations for this study.

FIGURE 3.2



All meteorology parameters will be recorded and stored through the use of Campbell Scientific CR10(X) data loggers. The dataloggers will be configured to store the meteorological data in a format suitable for stability classes determinations. Two separate data loggers will be deployed at each site for the duration of this study due to the high volume of recorded parameters. Data generated by meteorological sensors at the 2-meter elevation will be recorded and stored onsite. Hence, the 2-meter meteorology data will require weekly downloading via a laptop computer. A SOP for the data downloading will be developed and followed for this study. Data generated by meteorological sensors at the 10-meter elevation will be considered part of the episode monitoring configuration and will be remotely downloaded from the Raleigh DAQ office via phone-modem connections. However, data from the 10-meter elevation will still require local examination during weekly site visits to assure proper function of meteorological sensors. The method for onsite data review will be explained via the SOP. The St. Hooker monitoring site will feature remote data acquisition capability from both data loggers but will still require weekly site visits to assure proper meteorological sensor function. Site visits should include visual and electrical (via the keypad) examination of sensor integrity, along with documentation of all activities performed while at the site.

Power to the data loggers will be supplied via an AC/DC power supply converter connected to residential 120 VAC service. Battery backup will be provided at each site in order to continue meteorological data storage during short-term power outages. Data loggers will be protected from the elements within weatherproof enclosures. However, temporary removal of meteorological sensors and data loggers will be evaluated if hurricane force wind conditions and/or significant flooding is expected.

Meteorology towers and the associated sensors will be sited and installed in accordance with the *“Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV-Meteorological Measurements, Revised August, 1999”* ⁽⁸⁾. Additional information concerning the siting and installation of meteorological equipment can be found in the QAPP for this study. Existing wind direction and wind speed sensors are scheduled to be refurbished and calibrated by the manufacturer (Climatronics) prior to deployment. Field auditing and calibration of all meteorological sensors is scheduled to occur before this study commences, at the halfway point, and following the completion of this six month study. Standard Operating Procedures (SOPs) for meteorological equipment are scheduled to be developed prior to study commencement.

3.2.2.1. Nephelometer/Continuous PM_{2.5} Operations

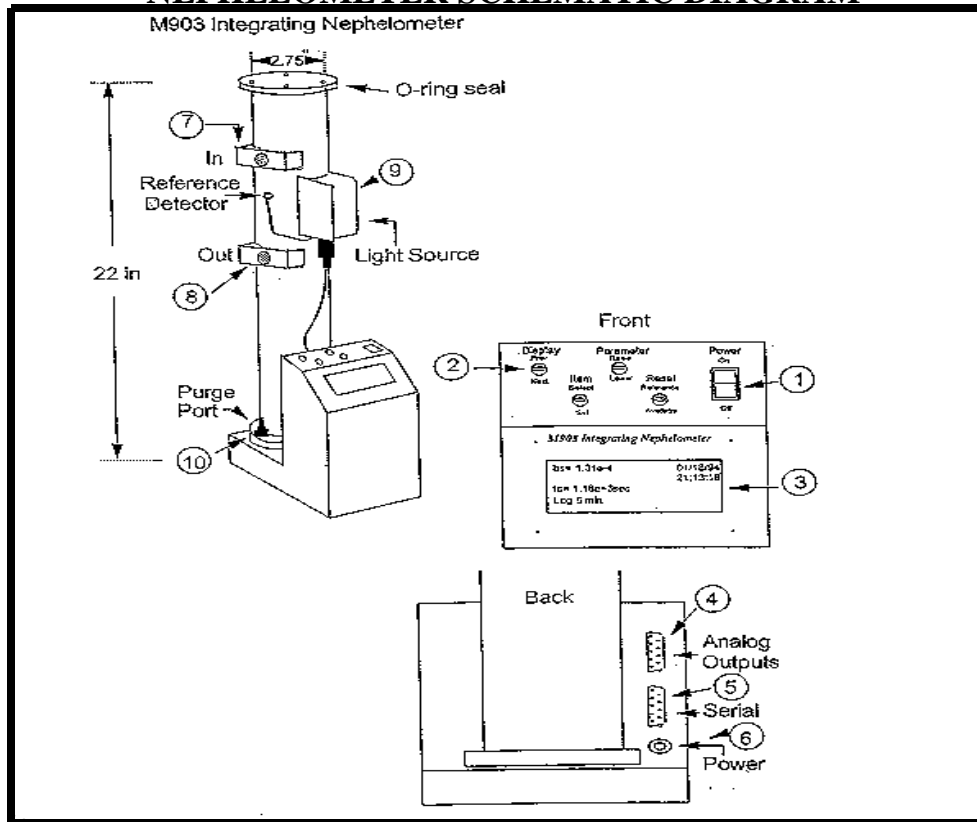
Visibility monitoring through the use of nephelometers, (see Figure 3.3 for operational details) will be conducted at all four monitoring sites for the duration of the monitoring program. The objectives of visibility monitoring are to determine the level of visibility degradation due to fine particulate matter in the Pamlico River Airshed, verify the relationship ^(9, 10) between light scattering extinction coefficient and PM_{2.5} concentration, and trigger episodic or short-term acid aerosol sampling using light scattering as a

surrogate for PM 2.5 concentration. The continuous PM2.5 will enable the ATAST to develop the correlation between measured PM2.5 mass concentration and light scattering coefficient and thereby establish a set point or trigger point for the short-term episodic sampling. This application satisfies the Washington Regional Office request for episodic or short-term air monitoring capability and enables ATAST to characterize air quality during these episodic events. The regional office request for episodic monitoring was generated by a history of citizen complaints involving odors from PCS Phosphate and health concerns about exposure to the short-term chemical fog events.

Each monitoring site will include a nephelometer sheltered within a two by three foot weather-proof enclosure which will also contain the power supply, nephelometer pump, and modem. Electrical power for the nephelometer will be provided by an AC/DC power supply converter connected to residential 120 VAC service. The nephelometers will be sited and installed in accordance with the QAPP. Hence, the inlet for the nephelometer sample line will be protected by a funnel positioned at the 2-meter elevation above ground level, and the horizontal distance between any collocated sampler inlets will be at least two meters. Retrieval of all nephelometers and their supporting equipment from the field is expected to occur if hurricane force wind conditions and/or significant flooding is expected. A nephelometer specific SOP will be developed and followed for its operation at sampling sites.

FIGURE 3.3

NEPHELOMETER SCHEMATIC DIAGRAM



The nephelometer will operate continuously, 24 hours per day for the duration of the six months study. Exceptions to continuous nephelometer operation are calibrations, audits, and potential disruptions such as power outages or instrument component failure. Averaging periods for light scattering data are scheduled to be 15 minute, one hour, and 24 hour. Nephelometer zero and span calibrations are scheduled to occur on a monthly basis as well as prior to and following the six month sampling period. Consult the QAPP for additional information concerning instrument audits and calibrations.

The sampling plan proposes that light scattering data collected by the nephelometers will be wired into the data loggers and downloaded daily for storage on a dedicated computer in the Raleigh DAQ office. Nephelometer data are expected to be reviewed each workday morning by ATAST staff in order to evaluate current operating status and examine the previous 24 hours of light scattering data. Concurrent field storage of light scattering data as well as operating parameters will be provided via the nephelometer's internal 21 day data storage capability. In the case of telemetry failure, the downloading of nephelometer data will occur in the field through the use of a laptop computer. A SOP for downloading nephelometer data in the field will be developed as part of this study.

The continuous PM_{2.5} will be rotated among the four sampling sites prior to commencing the air study to establish the relationship between light scattering coefficient and fine particulate concentration at each site. After establishing this relationship, the monitor will be based at one of the two sites located on the north shore of the Pamlico River. The data averaging periods for the continuous PM_{2.5} will be 15 minute, one hour, and 24-hour. This monitor will be sited and installed based upon quality assurance procedures stated in the QAPP. The SOP for continuous PM_{2.5} operations will be developed as part of this study. At this time, it is proposed that data from this monitor will be downloaded in the field via a laptop computer. Additionally, the continuous PM_{2.5} will be retrieved from the field if hurricane force wind conditions and/or significant flooding is expected.

3.2.2.2. Fog Sampling

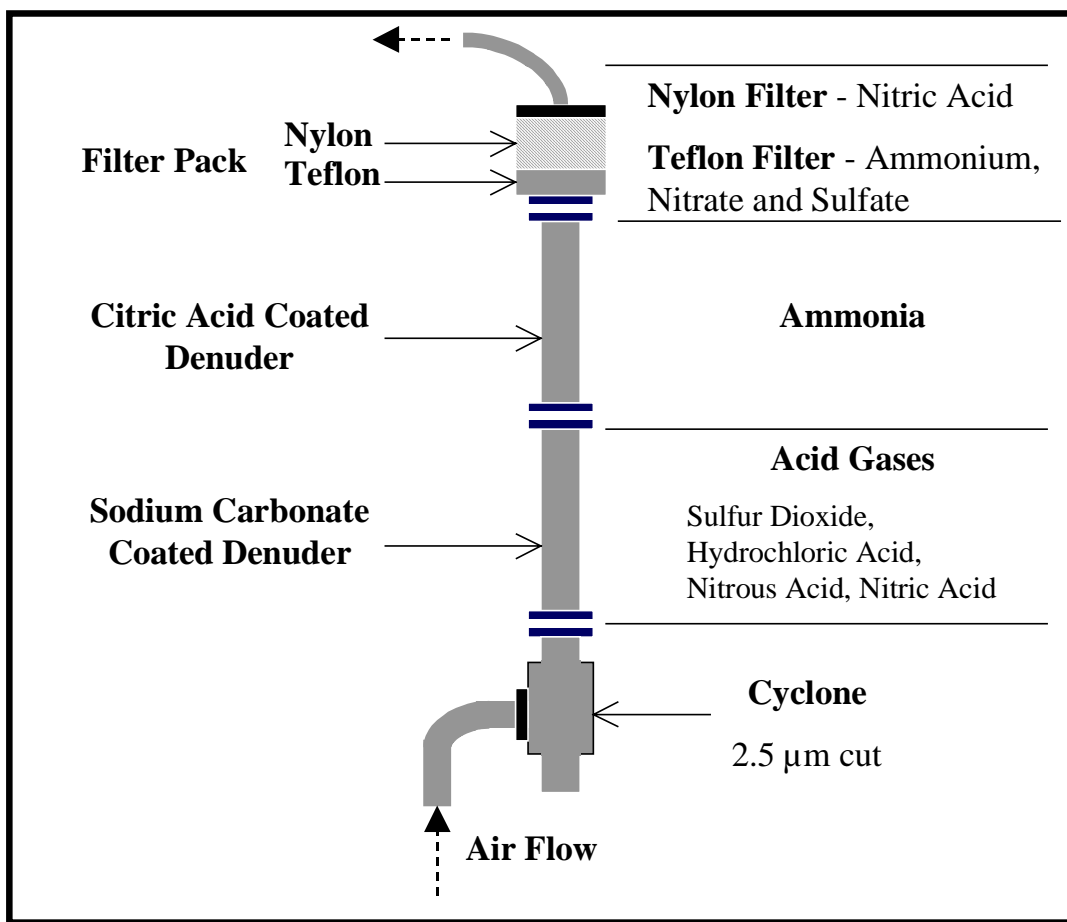
A passive water droplet or fog sampler provided by North Carolina State University (NCSU) is included in this study to determine the pH and chemical composition of condensed fog water samples collected in the Pamlico River airshed. The fog sampler is portable⁽¹¹⁾ and will be deployed in the field based upon National Weather Service forecasts, regional office and local citizen reports, and when episodic conditions are occurring as indicated by site data loggers. The fog sampler will be operated by WaRO staff.

The objectives of fog sampling are to evaluate the pH of both meteorological fog as well as fog that occurs in conjunction with episodic events. This allows for the comparison of fog pH during episodic conditions with baseline or general meteorological fog conditions in the Pamlico River airshed. It is proposed that condensed fog water samples be analyzed by the Ion-Chromatograph. A SOP for fog sampler operations will be developed, as part of this study.

3.2.3. Field Operation Of Annular Denuder Sampler System

The schematic of a typical ADS assembly is included in Figure 3.4. A seven-day ADS will be installed at all four sampling sites associated with this study. The sampler will operate ⁽¹²⁾ continuously, collecting 24-hour samples of ammonia, acid gases, and fine particulate matter, from midnight to midnight, for five consecutive days. On the sixth day, the sampler will not operate to allow for field sample retrieval and site maintenance. Sample collection will resume at midnight on the seventh day to initiate the next five consecutive day period of continuous 24-hour sampling. This schedule is expected to continue for the duration of the study.

FIGURE 3.4
SCHEMATIC OF ANNULAR DENUDER



The standard configuration of this ADS system is such that seven consecutive 24-hour samples can be collected. Each sample assembly consists of a filter pack for fine particulate matter and acidity, and two denuders, one for ammonia and one for acid gases. The configuration for this study is unique in that all seven assemblies will not be used for 24-hour sampling. Instead, the first five assemblies will collect samples for consecutive 24-hour periods, the sixth assembly will collect episodic, or short-term samples, and the seventh assembly will be used as either the field blank or if required, for episodic sampling. Analysis of the field blank will indicate any passive adsorption of analytes of interest and may be used to correct data accordingly. A trip blank sealed at the AQL will accompany the denuder assemblies from the lab to the field and back to determine if any measured concentration is attributable to denuder preparation and/or transportation. One trip blank will be used per site, per each five-day sampling period. The trip blank will act as a secondary check on laboratory procedures. A SOP for ADS system operation in the field will be developed and used.

The ADS system is housed within a weatherproof enclosure. Electrical service for the ADS system and associated pump will be provided by the 120 VAC residential service at the monitoring sites. Each of the seven output channels, which represent the seven assemblies or 24-hour samples, will be wired into a data logger with telemetry, to remotely examine ADS system channel voltage. This will allow for the remote determination of sampler status and whether an episodic sampling event has occurred or is in progress. Remote initiation of episodic sampling could also be conducted via telemetry.

All sampled denuders and filter packs, including blanks and unused episodic denuders, will be collected every six days during the entire program period. The procedure will include placing the sampled denuders and filter packs under COC for shipment to Raleigh. The collected samples will be transported to the WaRO for delivery via state courier to the AQL in Raleigh, North Carolina. The WaRO will be responsible for collecting/installing denuders and filter packs at three of the four monitoring sites. Personnel from the PCS Phosphate facility will be responsible for collecting/installing denuders and filter packs at the St. Hooker site. Samples collected at the St. Hooker site will be placed under COC and transferred to WaRO staff and then shipped to the AQL via the state courier. The WaRO will also be in charge of distributing clean denuders and filter packs to PCS Phosphate for use at the St. Hooker site. ATAST will be responsible for delivering denuders and filter packs to site operators in the field.

For quality assurance purposes, a collocated 24-hour annular denuder sampling system will be rotated among the four monitoring sites to demonstrate precision of the seven-day ADS systems. Corrective actions such as leak checking, flow-rate evaluation, and equipment inspection will be conducted if imprecision occurs. Consult the QAPP for additional information concerning collocated sampling. A SOP for collocated annular denuder sampling is expected to be developed for this study. The ADS will be retrieved from the field if hurricane wind conditions and/or significant flooding is expected.

3.2.4. Chemical Analysis of Field Collected Samples

3.2.4.1. Sample Handling and Custody Requirements

The program design includes delivery of all field collected samples together with necessary documents to the AQL via the state courier. Upon receipts of a batch, each sample will be visually inspected for damages and then logged (with sample number) in to the AQL system, while ensuring that all associated paper work is in order. The sample identifying system at the AQL will be such that all samples for analysis will be traceable to the field assigned sample number.

Samples will be labeled in the field, immediately after collection using the following format:

99013-Y-ZZZ- #	
99013	The ATAST project number, assigned to this study
Y	The sampling site identifier- the site number will be 1, 2, 3, 4
ZZZZ	The denuder assembly identifier- In this study, denuder assemblies will be sequentially starting with 0001 and continuing until the end of the study
#	The denuder section identifier- The section identifier corresponds to the three denuder sections that will be analyzed. The section identifier will be A, B, C

An example of the label numbering together with a typical ADS assembly is shown in Figure 3.5. Figure 3.6 shows a COC form that will be used for the proposed 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 will 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. SOP's will be developed and followed throughout the study period, to prevent inconsistency in COC procedures.

NOTE: The sample identification system at the AQL will be such that all samples for analysis can be traceable to the field assigned sample number.

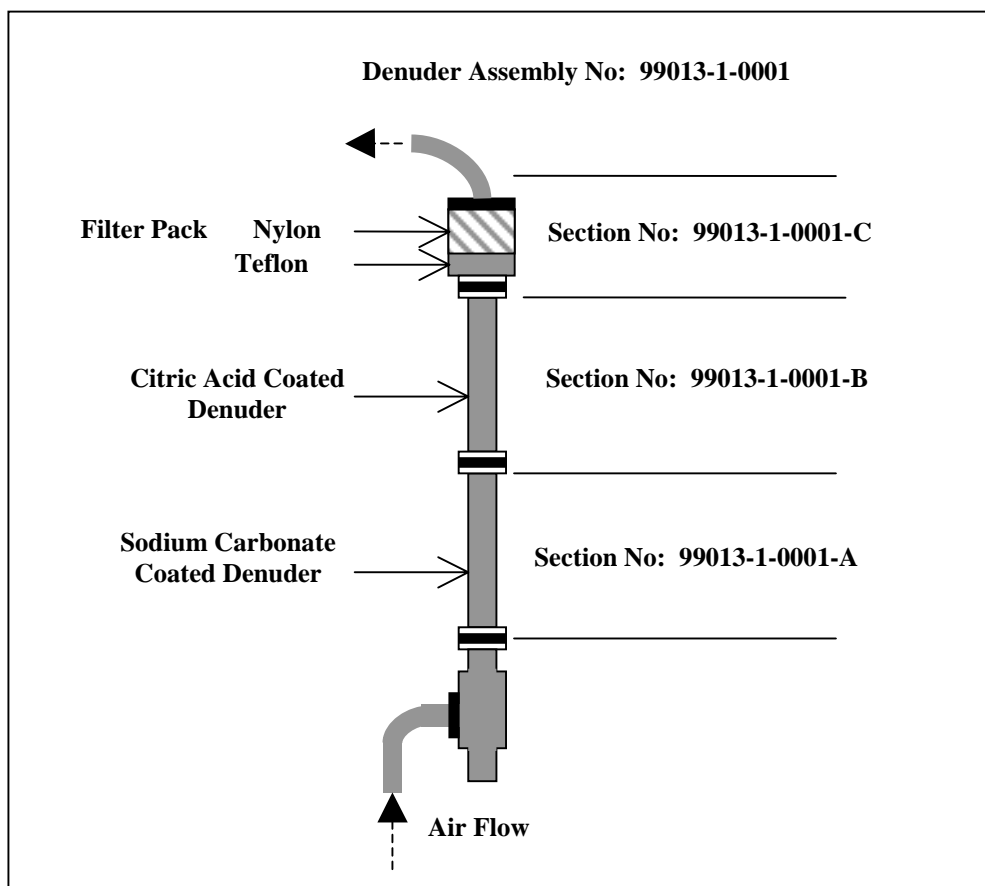
Based on the study design, approximately 4000 (see Table 3.1) filter and denuder samples will be analyzed during the six month study. The samples will be analyzed on a per batch basis with a batch consisting of no more 35 samples. All analytical data will under go QA/QC review and reported to QAM within 30 days of the sample batch receipt at the AQL.

Activities at AQL, after sample receipts from the field are summarized in Figure 3.7. Denuder coating for field deployment will be as per SOP guidance.

3.2.4.2 Chemical Analysis of Samples

Table 3.2 gives the details of sampling device used, pollutants collected and the analysis method used for the pollutant quantification. The proposed analytical method for

**FIGURE 3.5:
LABEL NUMBERING FOR DENUDER ASSEMBLY**



quantification of acidic and basic constituents of the denuder, filter and fog samples is the *“Determination of Reactive Acidic and Basic Gases and Strong Acidity of Atmospheric Fine Particles (<2.5 um), Method IO-4.2”* ⁽¹²⁾.

The annular denuder sampling system (see Figure 3.5 for details) collects gaseous nitric acid (HNO₃), nitrous acid (HNO₂), phosphoric acid (H₃PO₄), hydrochloric acid (HCl), hydrofluoric acid (HF), sulfur dioxide (SO₂), ammonia (NH₃), particulate sulfate (SO₄⁻), particulate nitrate (NO₃⁻), particulate ammonium (NH₄⁺) and acidic particles. The acidic

TABLE 3.1
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

FIGURE 3.7
CHEMICAL ANALYSIS: LABORATORY ACTIVITIES

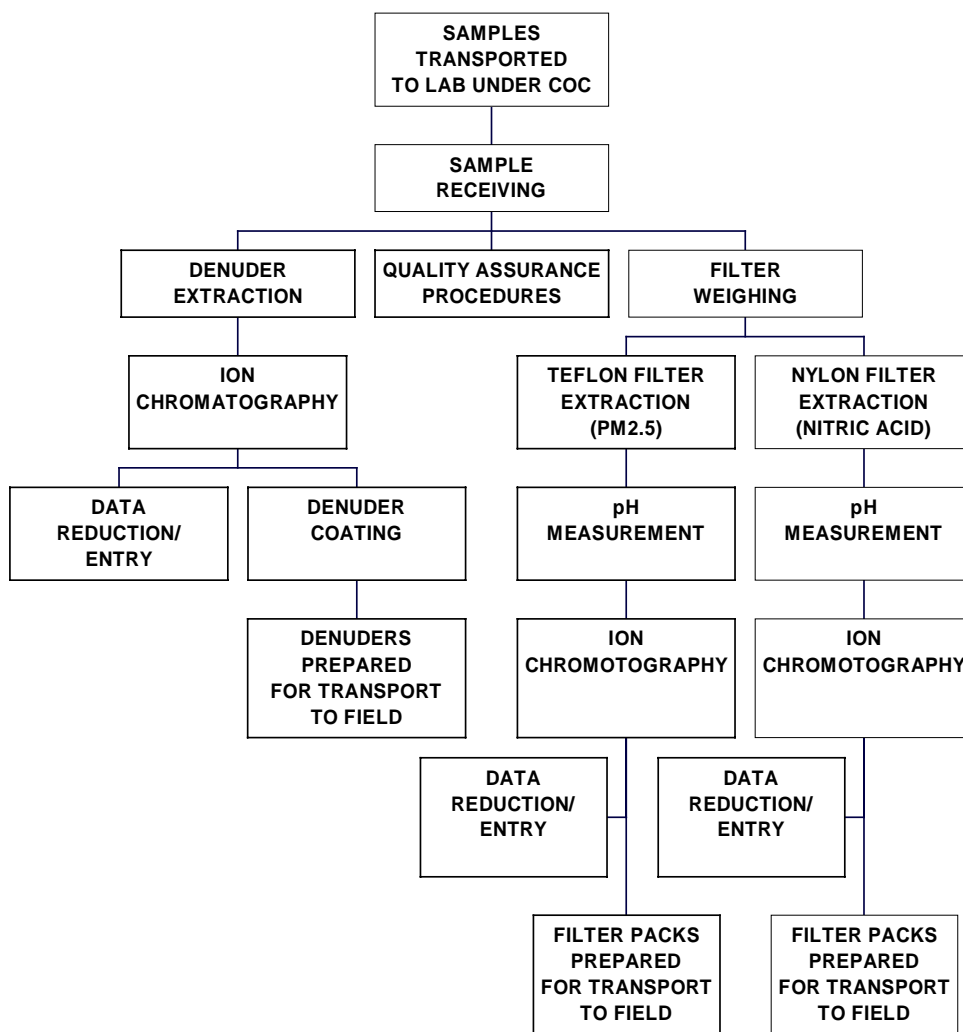


TABLE 3.2
ANALYSIS METHOD FOR MEASURED PARAMETERS

COLLECTION SYSTEM	PARAMETER/ POLLUTANT	MEASUREMENT/ ANALYSIS METHOD
Meteorological	Wind Direction	Wind Vane
	Wind Speed	Anemometer
	Temperature	Temperature Sensor
	Relative Humidity	Humidity Sensor
	Solar Radiation	Photosynthetic Photon Flux Density Sensor
	Barometric Pressure	Barometric Pressure Sensor
	Visibility (Light-Scattering)	Nephelometer
Annular Denuder System		
Gaseous Species:	Sulfur dioxide	Ion Chromatography
	Nitrogen dioxide	Ion Chromatography
	Nitric Acid	Ion Chromatography
	Ammonia	Ion Chromatography
	Sulfates	Ion Chromatography
	Hydrogen Chloride	Ion Chromatography
Annular Denuder System		
Particulate Species:	Nitrate	Ion Chromatography
	Ammonium	Ion Chromatography
	Sulfate	Ion Chromatography
	Fine Particulate Matter PM2.5 (<2.5 micrometers in diameter)	Gravimetric Analysis pH Analysis Particle Morphology
Fog Collection System		
Gaseous Species:	Sulfur dioxide	Ion Chromatography
	Nitrogen dioxide	Ion Chromatography
	Nitric acid	Ion Chromatography
	Ammonia	Ion Chromatography
	Sulfates	Ion Chromatography
	Hydrogen chloride	Ion Chromatography
Liquid Analysis:	Condensed Water Vapor	pH Analysis

gases and sulfur dioxide are collected on the sodium carbonate (Na_2CO_3) coated denuder and gaseous ammonia is trapped on the citric acid denuder. Particulate sulfate, nitrate, and ammonium are collected on the Teflon filter^(7,8). Some of the particulate nitrate collected on the Teflon filter decomposes/evaporates and is collected on the 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 level of acid aerosols present in the ambient atmospheres.

An ion-chromatograph (IC) equipped with anion and cation exchange columns, a membrane suppressor, and conductivity detector for determining acidic and basic ions in solution will be used for the analysis of denuder and filter extracts. The IC analysis of sodium carbonate denuder will quantify sulfur dioxide concentrations as sulfate (SO_4^-), however, data collected will be reduced and reported as sulfur dioxide. Similarly, fog water samples will be analyzed for H^+ ion concentrations and other soluble pollutant species.

A pH meter with an “integral” automatic temperature compensation that has been calibrated with standard buffers will be used to determine the pH of the Teflon and Nylon filters and of fog water samples. All pH measurements of the filters will be performed, prior to IC analysis.

Denuders and filters will be extracted as per above cited reference method using a specific SOP which will be developed for the study. Before extraction of Teflon filters, an electronic micro-balance will be used to determine the weight gain due to collected particulate mass.

A batch of field sample (no more than 35) extracts for IC will include quality assurance samples to assure the reliability of the analytical data. Table 3.3 lists the quality control limits for the IC analysis of the denuder, filter and fog water samples. Included in this Table are definition of acronyms commonly associated with chemical analysis of samples. The acceptance criteria/control limits are derived from Compendium Method IO-4.2⁽¹³⁾ and also from EPA Method 300.1 “*Determination of Inorganic Anions in Drinking Water by Ion-Chromatography*”⁽¹⁴⁾.

All analytical data collected during course of the program including 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 data entry was performed. All handwritten entries will be made in black ink only. For any analytical work that needs to be repeated or sample(s) re-analyzed, the original data/results will be included in the study records along with an explanation as to why data were not used or why the needed to be repeated. For other related further details, such as data reduction, review, QC checks, etc., refer to QAPP.

TABLE 3.3: 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 of 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.			

SECTION 4

PROJECT ORGANIZATION

4.1. Resources

The proposed project “*Chemical Characterization of Aerosols and Fine Particulate Matter in Airshed at the Pamlico River*” will be conducted as a collaborative effort. The collaborators in the study are personnel from the Division of Air Quality, ATAST and the Washington Regional Office (WaRO) and staff from the PCS Phosphate, Inc.,

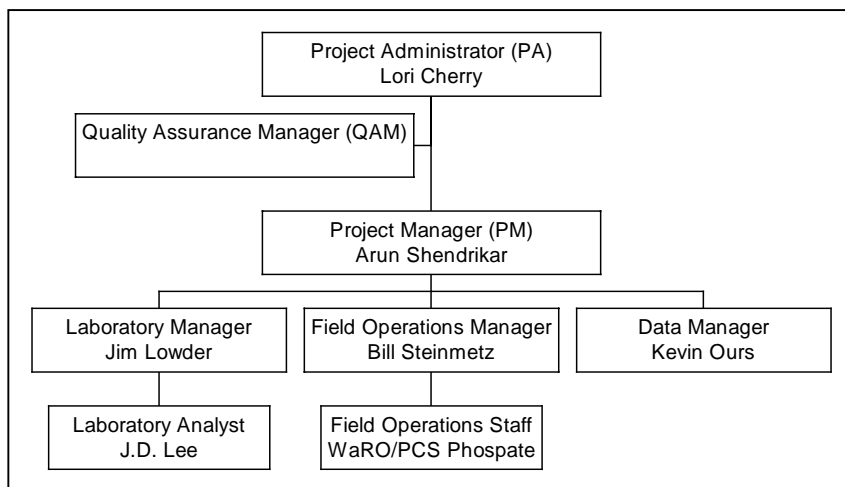
The personnel from ATAST and the WaRO will install, operate and maintain three monitoring sites, and PCS Phosphate will be responsible for performing identical tasks at the remaining one site. However, personnel from PCS Phosphate will only collect and deploy samples from the one site (St. Hooker) and transfer the collected samples to field operations staff at the WaRO. These samples together with samples from the other three sites, collected by WaRO, will be transported under the COC, to the AQL. In order to ensure collection of data that meets the project data quality objectives SOP’s for various field activities will be developed and followed by field operation staff.

All field collected samples will be analyzed by the analysts at AQL. Analytical data management and quality assurance personnel will perform their responsibilities to validate and report the data. Analysts at AQL will also prepare (coating) and transfer denuders to WaRO for field deployment.

4.2. Project Key Personnel

The ATAST key personnel involved in this study are shown in Figure 4.1. Each has been selected on the basis of their experiences in aerosol science and chemistry, field testing, air monitoring and project management. As seen in Figure 4.1, the QAM is organizationally

FIGURE 4.1: PROJECT ORGANIZATION



independent of all study personnel, except the PA because the QAM must be able to give completely unbiased advice on data quality and other project related activities to the PA and PM. Table 4.1 includes description of roles of ATAST personnel.

TABLE 4.1: ROLES OF KEY PERSONNEL IN THE STUDY

Position	Role
Project Administrator (PA)	The Project Administrator has overall supervision of all aspects of the project. The Project Manager (PM) and Quality Assurance Manager (QAM) report to the Administrator.
Project Manager (PM)	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 (QAM)	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 Laboratory Manager will oversee the analytical chemists who 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. Analysts in DAQ Ambient Monitoring Branch will also participate.
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.

Figure 4.2 provides a schematic of project communication paths and operating relationships among ATAST, WaRO and PCS. Individual staff members from WaRO and PCS Phosphate, Inc., as of to-date are not identified, however, they are expected to get involved only in field related activities of the program.

4.3. Project Schedule

The project activity schedule is included in Figure 4.3. This was developed on the principles of Program Evaluation and Review Technique (PERT) and will be applied to the establishment of program goals and schedules. This technique will permit ATAST to identify the most critical path or paths experienced at various times in the program cycle and to take the necessary corrective action. This becomes a useful tool for problem(s) identification and leads to improved schedule control.

FIGURE 4.2

**SCHEMATIC OF PROJECT COMMUNICATION PATHS
AND OPERATIONS RELATIONSHIPS**

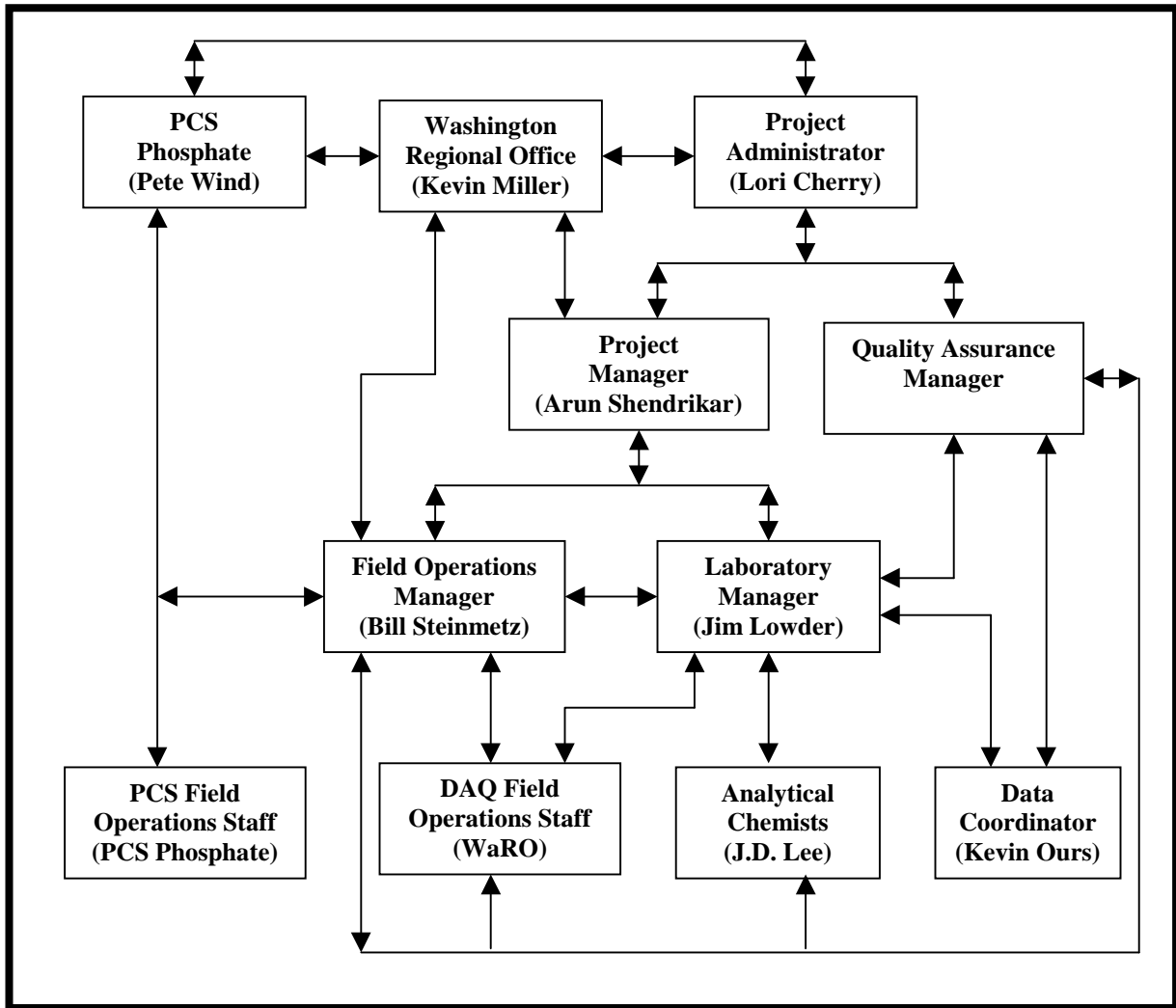


FIGURE 4.3

STUDY SCHEDULE

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

SECTION 5

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