

QUALITY ASSURANCE PROJECT PLAN

for the

**North Carolina
Department of Environment & Natural Resources
Division of Air Quality**

Salisbury Ambient Air Monitoring Study

ATAST Investigation Numbers:

01007: Volatile Organic Compounds (VOCs)

01008: Hydrogen Sulfide (H₂S)

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Quality Assurance Project Plan

PREFACE

This document serves as the Quality Assurance Project Plan (QAPP) for the Salisbury Ambient Air Quality Monitoring Study. The QAPP describes the quality assurance practices for field sampling operations, meteorological data collection, chemical analysis of field collected samples, and project data collection, management, and reporting. Those involved in the project work 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 Study Manager in conjunction with the Quality Assurance Manager(s) (QAMs) will initial, date, and concurrently incorporate any changes into all copies of the document.

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ACRONYMS

AQL	Air Quality Laboratory of the Toxics Protection Branch
ATAST	Air Toxics Analytical Support Team
COC	Chain of Custody
DAQ	Division of Air Quality
DQO	Data Quality Objectives
EPA	Environmental Protection Agency
H ₂ S	Hydrogen sulfide
NIST	National Institute of Standards and Technology
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedures
VOC	Volatile Organic Compounds

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A. PROJECT OVERVIEW

This document serves as the Quality Assurance Project Plan (QAPP) for the Salisbury Ambient Air Quality Monitoring 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, management, and reporting. 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), Toxics Protection Branch (TPB) will have the primary responsibility for the design and implementation of the study plan, the installation and operation of the sites, and the sample analysis for volatile organic compounds (VOCs) and hydrogen sulfide (H₂S). The ATAST will coordinate its field site operations with the Morrisville Regional Office (MRO), the City of Salisbury, and Agency for Toxic Substances and Disease Registry (ATSDR) as needed. The study sampling sites will consist of three ambient monitoring sites with associated VOC sampling equipment, H₂S monitor, and meteorological equipment.

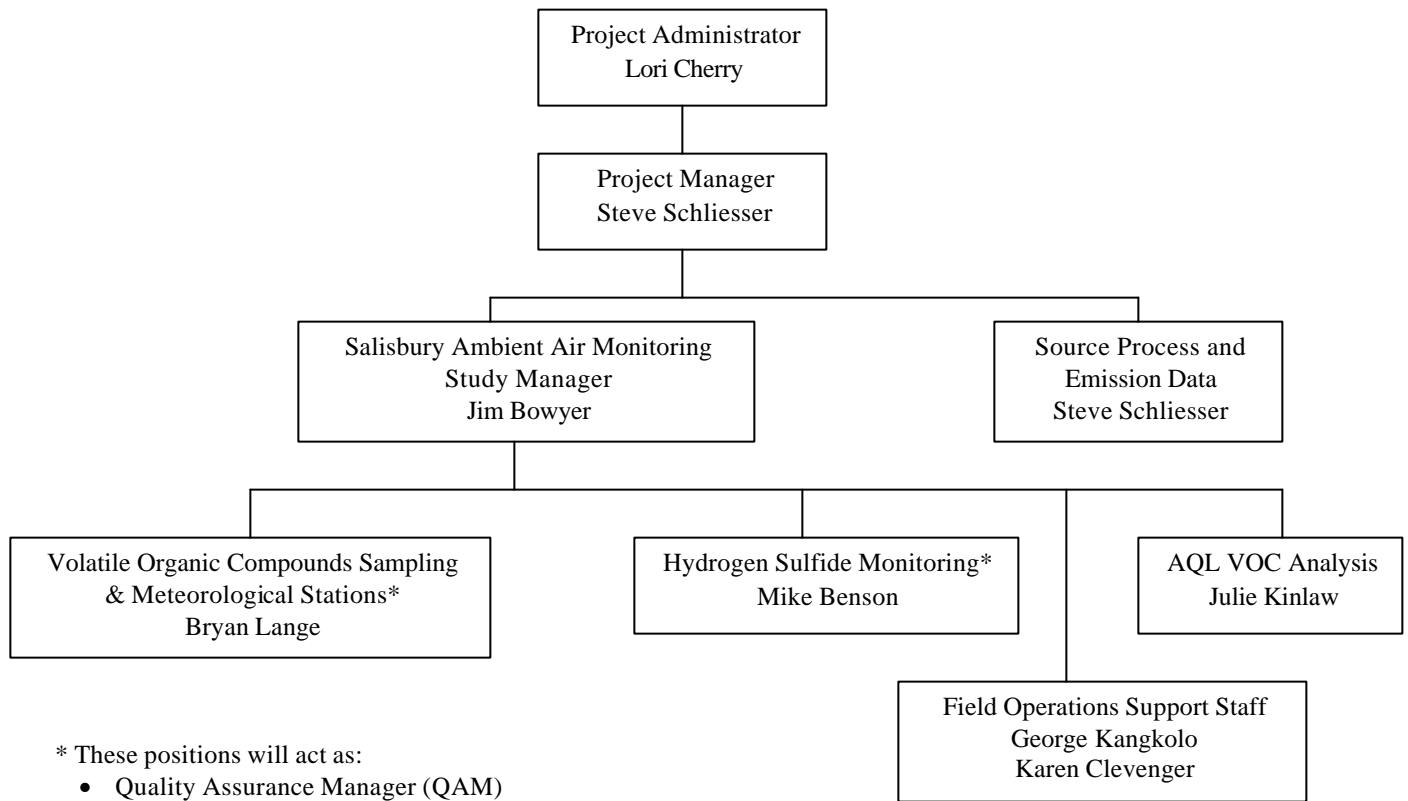
These three sites are described as follows:

- Site 1 (Residential): This site is located on a cul-de-sac in the Colonial Heights (Milford Hills) Residential area. This site will represent the best available site for assisting in assessing residential exposures to various VOCs and H₂S.
- Site 2 (Maximum Impact): This site is located near the maximum exposure impact point for H₂S emissions near the asphalt storage facility as determined from the modeling of area source emissions.
- Site 3 (Off-Axis Upwind Site): This site will represent an area that is upwind of site 1 and site 2 when the wind is from the prevailing wind direction but is not directly upwind of these sites.

The TPB personnel will collect all field samples and/or data either directly in the field via downloading of data from the meteorological stations, the VOC samplers, and the continuous H₂S monitors and/or at the Air Quality Lab (AQL) via the analysis of the SUMMA canisters-collected VOC samples.

Key personnel in this study are shown in **Figure A1**, and descriptions of their roles are given in **Table A1**.

Figure A1. Organizational Chart of Key Personnel Participating in the Study



* These positions will act as:

- Quality Assurance Manager (QAM)
- Field Operations Manager and Staff (FOM/FOS)
- Data Manager

And will be responsible for reporting the results of that particular part of the study.

Table A1. 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 reports to the Administrator.
Project Manager (PM)	The Project Manager is also responsible for ensuring successful outcomes and managing all aspects of the project. All staff will report to the Project Manager.
Study Manager (SM)	The Study Manager is responsible for assisting in the establishment of the sites as well as ensuring that staff members are trained in site operation and sample handling. The Study Manager is also responsible for ensuring successful outcomes and managing all aspects of the study. All staff will report to the Study Manager.
Quality Assurance Manager	The QAM will perform system and performance audits, data validation and data quality assessment.
Field Operations Manager (FOM)	The Field Operations Manager has the overall responsibility of field operations, field activities, and the operation of the sites and will also act as the primary field operations staff.
Field Operations Staff (FOS)	The Field Operations Staff (i.e., the field operator) will be responsible for collecting and deploying samples and retrieving meteorological data, when necessary, at the three monitoring sites. The FOM and FOS are one and the same for this size of study and will be responsible for the duties for each. They will report directly to the SM
AQL Analysts (AQLA)	The Laboratory Analyst will be responsible for accomplishing all analytical work including sample analysis, performing QA checks, equipment certifications and cleaning, and providing appropriate sampling canisters to the Field Operations Staff for VOC sampling.
Data Manager	The Data Manager assists in the development of standard operating procedures for data management and is responsible for the data management of the reported compound concentrations and meteorological data. The Data Manager also assists in the preparation of periodic reports.

A.2 Project Description

This study is being conducted in conjunction with air quality issues arising from odor complaints and potential health concerns from residents of the Milford Hills area in Salisbury, NC. In an effort to address these concerns, the NC Division of Air Quality (DAQ) has performed modeling of the relevant air pollutants of interest such as volatile organic compounds (VOCs, namely BTEX (benzene, toluene, ethyl benzene, xylenes), various semivolatile organic compounds (SVOC), and hydrogen sulfide (H₂S). Of these the monitoring effort described in this document will address monitoring for EPA Compendium Method TO-14A compounds² and hydrogen sulfide.

Additionally, the federal Agency for Toxic Substances and Disease Registry (ATSDR) will be conducting sampling of several other compounds such as benzene-soluble particulate matter (PM), total organic compounds, and polycyclic aromatic hydrocarbons (PAHs). This document does not address the ATSDR sampling and analysis protocol or the reporting of the results of those sampling protocols.

Three monitoring sites will be designed to characterize ambient air pollutant concentrations and meteorological data. Each monitoring site will be configured with one meteorology station, one volatile organic compounds sampling system, and

one hydrogen sulfide tape meter housed in a 4'x8' climate-controlled enclosure surrounded by controlled access security fencing. Polycyclic aromatic hydrocarbons, crystalline silica, and sulfur species will be sampled by ATSDR. ATSDR collection frequency and the number of samples have as yet not been determined.

Meteorological stations will be established at each site location to collect data to support the study. The equipment is manufactured by Climatronics and data from these instruments will be stored for later retrieval on Campbell Scientific CR-10X data loggers. The parameters to be measured at all of the sites are wind speed, wind direction, temperature, relative humidity, and barometric pressure (at site 2 only). Meteorological parameters will be measured at 6 meters (18 feet). The meteorological equipment is located adjacent to the ambient air monitoring site. Photos of a typical configuration is provided in **Appendix C.1**.

Each volatile organic compound sampling system consists of equipment designed to collect 24-hour ambient air sample in SUMMA™ canisters via the XonTech 911A/912 air sampling system. The required air sampling equipment will be housed within a 4'x8' building. A stainless steel sampling line will extend from the Xontech 911/912 multiport sampling manifold to the stainless steel sampling funnel, which is equipped with a 15-micron filter. A diagram of the XonTech 911A/912 Ambient Air Sampling system has been included in **Appendix C.2** of this document.

The VOC sampling acquisition will consist of 24-hour runs from midnight to midnight and will be consistent among the three monitoring sites. The sampling schedule will follow a 10-day sampling schedule with exchange of sampling canisters occurring at all sites on the 11th day and sampling resuming on the 12th day of the cycle. Following this schedule over an approximately 3½ month period will allow collection of approximately 90 sample days. If source testing at the facility occurs, the ATAST will collect samples on a 12-hour basis that will encompass as yet to be determined time periods.

The analysis of the ambient air samples for VOCs will take place at the Toxics Protection Branch, Air Quality Laboratory (AQL) in Raleigh. An inventory of certified clean SUMMA™ canisters is maintained at the AQL. Site operators will deliver canisters to the sites under chain of custody (COC) on an 11-day change out schedule. Once samples are collected they are returned under sealed sample COC to the AQL. Ambient air samples are analyzed following established EPA methodology, Method TO-14A (Determination of Volatile Organic Compounds In Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography)². Method TO-14A allows for the identification and quantification of up to 40 organic compounds. Data from the analysis of the field collected samples will be QA/QC validated, summarized, and presented to ATSDR and DHHS at the conclusion of the study for the purpose of a human health risk assessment.

All air sampling equipment is cleaned, leak checked, and certified by the Air Quality Laboratory in Raleigh, NC prior to being released for field sampling.

Each hydrogen sulfide (H₂S) tape meter system consists of equipment designed to collect an ambient air sample on colorimetric tape via the Zellweger Analytics Single Point Monitor (SPM) or Tapemeter. The SPM employs a specially treated cloth tape reel called a “Chemcassette” and an electronic key called a “Chemkey”. The Chemkey stores setup information and other functional information (i.e. flow rate, alarm levels and compound concentration times) needed for accurate detection of target gases. The Chemcassette is a medium onto which a known quantity of ambient air is concentrated. The Tapemeter can be equipped with either a high range (53-1500 parts per billion (ppb)) or a low range (2-90 ppb) tape. The Tapemeter will be initially equipped with the manufacturer’s “low level” hydrogen sulfide paper tape cartridge. If ambient air concentrations consistently exceed these values, then the “high level” paper tape will be installed.

The unit has an internal sample pump which draws air at a manufacturer’s predetermined constant flow rate through a chemically treated paper tape. The tape darkens on exposure to H₂S. At the end of each sample period (15-minute) the concentration is converted into a 4 to 20 milliamp (ma) analog output signal. This output is then digitally stored on an attached data logger. The SPM, data logger, and other sampling equipment will be housed within a climate controlled weather-resistant storage building. Approximately six feet of Teflon tubing will extend from the Tapemeter sample port to the exterior of the building at approximately the same level as the sampling port for the VOCs. The tubing is equipped with a moisture knockout impinger and a sampling funnel equipped with a screen. A diagram of the Zellweger SPM system has been included in **Appendix C.3** of this document, “U.S. EPA Environmental Response Team, Standard Operating Procedures, Single Point Monitor”.

Tapemeter data will be downloaded manually and reviewed once per 11 days. All measurements will be validated, and averaged to provide short (15-minute), medium (one-hour) and long-term (24-hour) concentration, summarized, and presented to ATSDR and DHHS at the conclusion of the study for the purpose of a human health risk assessment.

No calibration is necessary for this unit. The chemical tape that is used to detect H₂S is manufactured in a manner as to eliminate any need for instrument calibration in the laboratory or field. However, the instrument does allow for a response verification using an optical test card. This test will be completed each time the Chemcassette is changed. The air flow rate is not adjustable by the user. However, plugging the sample tube temporarily will generate the code “fault 15”, which is an indication that the sample flow is working properly.

The instrument is capable of operation for over one month on each chemical tape cassette. However, data should be downloaded every 1-2 weeks. Specific instructions on how to check the instrument’s response are located in **Appendix A.4**, “U.S. EPA Environmental Response Team, Standard Operating Procedures, Single Point Monitor”. The instrument’s response will also be verified each time the chemical tape cassette is changed.

A.3 Study Site Descriptions

Federal regulations as set forth by the EPA, specify the criteria to be used in the selection of monitoring sites for ambient air sampling for criteria pollutants (40 CFR, Pt. 58 Appendix D and E)⁴. These EPA guidelines do not specifically address placement of air sampling equipment for measurement of toxic air pollutants but many of the considerations in the guidelines are relevant and useful. The siting for the study monitoring sites incorporated the following criteria for ambient monitoring sites as closely as possible:

- Chose parameters that are appropriate to the scale of the monitoring effort, in this study that would be a neighborhood scale.
- Minimize obstructions between source and sampler by placing the monitors away from any possible obstruction a distance of at least twice the height of the obstruction.
- Minimize trees between the source and sampler by placing the monitor at least 10 meters from the tree dripline (trees may obstruct and adsorb compounds of interest).
- Maximize unrestricted airflow by placing the monitors in a location that has an arc of at least 270° of unrestricted airflow from the source direction.
- Place the air intake of the sampler in the breathing zone if possible.
- The minimum separation distance between roadways and the sampler probe inlet, as based on 40 CFR Part 58, Appendix E, Section 10.3, should be between 10 and 30 meters.

Site 1 will be located on city property at the end of the Spring Drive cul-de-sac in the prevailing downwind direction from the area sources of interest and will represent a maximum neighborhood exposure area. Site 2 will be on a strip of Rowan County-owned land that is part of the Army Reserve Training Center. It will represent a source-dominated exposure location and will be in proximity to the Air Quality Analysis Branch's (AQAB) multiple-source modeling study maximum point of impact. Site 3 will be in an open area behind Mike's Transmission just off of Jake Alexander Boulevard on property owned by Food Lion. It will represent a site that is upwind and off-axis of the prevailing wind direction from the area sources of interest. A map of the sites and their relationship to one another is included in **Appendix D.1**.

Table A.2 Site Locations

Site Name	Site Address
Site 1 (residential)	Spring Drive cul-de-sac
Site 2 (Max Impact)	Army Reserve Property
Site 3 (Off-axis Upwind)	Food Lion Property (Mike's Transmission)

A.4 Data Quality Objectives and Criteria for Measurement

The primary data quality objective of this study is to produce valid data that is representative of urban air for the area in which samples are being collected. Specific quality control requirements and limits are discussed under **Section B.5**.

The EPA recommends using the Data Quality Objectives (DQO) Process outlined in *Guidance for the Data Quality Objectives Process* to develop data quality objectives for monitoring studies⁵. 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 this guidance [for the DQO Process] may not apply." Thus, although the entire DQO Process could not be followed for this study, the relevant steps were used.

A.5 Training Requirements

A.5.1 Field Operations

All personnel involved in the meteorological data collection, VOC sampling, and hydrogen sulfide sampling will follow Standard Operating Procedures (SOPs) when carrying out their duties. **Appendix A** contains all SOPs used in this study. A minimum of two people from DAQ Toxics Protection Branch will be trained to operate the sites. Other DAQ personnel will be trained as needed. SOPs will be provided for all field equipment operation and sample handling.

A.5.2 Laboratory Operations

Analysts involved in the study will be certified in all of the laboratory methods and procedures used in the study for VOCs. Certification for the analytical method will consist of the analysis of Quality Control (QC) samples, the determination of the method detection limit, and the determination of the practical quantification limit. The number of samples used in certification will be sufficient to verify the precision and accuracy of the analysis and to measure the bias between analysts.

A.6 Documentation and Records

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

- Activity log book maintained at each monitoring site
- Chain of custody forms
- Analytical instrument and analysis logbooks
- Inventory control (certified canisters/field samples) spreadsheets
- Meteorological equipment checklist for operations and audits

Examples of miscellaneous forms are contained in **Appendix B**. Copies of all log sheets, forms, and checklists will be maintained in the project files throughout the study period, as long as deemed necessary by the Program Administrator.

The Data Managers will maintain the validated, quality-coded meteorological and analytical data on a dedicated computer for their particular portion of the study. Additionally, they will place this data on the N-drive of the DAQ computer network so that the data will be available in a timely manner to the DAQ personnel for ready distribution to inquiries for information. Copies of these validated, raw data will be maintained on the Data Managers' computers and the N-drive throughout the study period, as long as deemed necessary by the Program Administrator.

The final report generated for the study will include the QA/QC'd data, summary statistics, charts of the validated data if appropriate, and a discussion of the quality assurance audits. This study has an intended limited time frame of approximately 45 sampling days with the potential to be extended to 90 sampling days. An approximate start date is scheduled for May 12, 2001.

B. METEOROLOGICAL STATION, MEASUREMENT AND DATA ACQUISITION

This group of QAPP elements covers aspects of measurement system design and implementation ensuring that appropriate methods for sampling, data handling, and quality control are employed and documented for the meteorological stations.

B.1 Sampling System Design

The sampling design process outlines the experimental strategy of the study to integrate sampling related information on the type, frequency, period, and how the locations are selected.

Meteorological data will be collected to support the study. The parameters to be measured at all of the network sites are wind speed, wind direction, temperature, relative humidity, and barometric pressure (at site 2 only). Meteorological parameters will be measured at six meters above ground level. This height allows for the best measurement of met conditions on a neighborhood scale as opposed to microscale or regional scale measurements.

The siting criteria for wind speed, direction, temperature, relative humidity, and barometric pressure are in accordance with the *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume 4*.³ Only an overview of the siting criteria is given in this section. According to the guidance, wind speed and direction measurement instrumentation 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. Ideally, the ground should not be concrete or asphalt. Meeting all of the siting criteria may not be attainable in practice, and deviations from the criteria will be documented for each site.

A detailed SOP for the meteorological siting, audits, and quality assurance is contained in **Appendix A.1.1** of this document. **Table B1** contains an overview of this information.

Table B1. 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 site operator will download all collected data on the 11-day change out schedule.
Wind direction (WD)	Wind vane		
Temperature (T)	Temperature and humidity probe		
Relative Humidity (RH)			
Barometric Pressure	Barometric pressure probe		

B.2 Quality Control Requirements

In order to insure the validity of the data generated from the study and meet the data quality objectives set forth by the study it is imperative to establish quality assurance and quality control measures in each aspect of the study.

The parameter accuracy is the amount by which a measured variable deviates from a value accepted as true. System accuracy for the meteorological parameters to be measured in this study is shown in **Table B2**. Also shown in the table are measurement resolutions, which are defined as the smallest parameter measurement that can be distinguished. All recommendations in the table are from the *On-Site Meteorological Program Guidance for Regulatory Application*.⁶ Assurance of parameter accuracy will be determined through system audits of the meteorological equipment.

Table B2. Recommended System Accuracy and Resolutions for Meteorological Parameters

Meteorological Variable	System Accuracy	Measurement Resolution
Wind Speed	$\pm (0.2 \text{ m/s} + 5\% \text{ of observed})$ $\pm (0.45 \text{ mph} + 5\% \text{ of observed})$	0.1 m/s or 0.2 mph
Wind Direction	± 5 degrees	1 degree
Ambient Temperature	$\pm 0.5 \text{ }^\circ\text{C}$ or $\pm 0.9 \text{ }^\circ\text{F}$	$0.1 \text{ }^\circ\text{C}$ or $0.2 \text{ }^\circ\text{F}$
Vertical Temperature Difference	$\pm 0.1 \text{ }^\circ\text{C}$ or $\pm 0.2 \text{ }^\circ\text{F}$	$0.02 \text{ }^\circ\text{C}$ or $0.4 \text{ }^\circ\text{F}$
Humidity	<i>To be determined</i>	<i>To be determined</i>

B.3 Instrument and Equipment Inspection and Maintenance Requirements

Each week the field operator will conduct visual inspections of the meteorological equipment. Additionally, the field operator and staff who visits a site will document all activities in a logbook maintained at each site. Because of the relatively short duration of this study, preventative maintenance operations will not be necessary but audits will be performed at the beginning and the end of the study with appropriate documentation and reporting completed.

B.4 Instrument Calibration and Frequency

Calibration of meteorological equipment is made by the manufacturer and completed prior to installation. Field audits will be performed prior to installation of the equipment and only units that “pass” the audits will be installed. The “fail” unit will then be returned to the manufacturer for recalibration. **Section E.1.1** contains a discussion of audits for meteorological equipment used in this study. The equipment

at the sites utilizing established meteorological monitoring equipment is audited and maintained by the personnel from NC DAQ, ATAST. These meteorological equipment audit reports will be generated and archived by NC DAQ, ATAST.

B.5 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, etc.), all analytical and meteorological data, and summaries and reports.

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

The Data Manager will distribute only validated, quality-coded data as directed by the Project Administrator. In this way, the data will be available in a timely manner to the NC DAQ personnel, communities, and other appropriate persons.

To centralize all of the data generated, one computer will be dedicated to data management of meteorological data for this study controlled by the Data Manager for the meteorological portion of the study. The meteorological data will be downloaded in a consistent format, such as a comma delimited ASCII format.

The meteorological stations at each site will operate based on established criteria and SOPs. The meteorological data will be collected and stored on the on-site data loggers for every fifteen minute, one-hour, and 24-hour averages at each monitoring site. To prevent inconsistency in the data collection, SOPs for downloading meteorological data 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.

C. VOC SAMPLING SYSTEM, ANALYTICAL MEASUREMENT, AND DATA ACQUISITION

C.1 Ambient Air Monitoring Sampling System Design

The sampling design process outlines the experimental design of the study and includes information on the type of samples collected, sampling frequency, sampling period, and how the sample locations are selected.

Three air monitoring sites will be established for this study with a sampling system for volatile organic compounds (VOC) located at each site. Each VOC sampling system utilizes a XonTech 911A/912 Air Sampler system. Pictures and schematics of this equipment are included in the Equipment Pictures Appendix (**Appendix C.2**). All air sampling equipment is cleaned, leak checked, and certified by the Air Quality Laboratory in Raleigh, NC prior to being released for field sampling. The procedures for accomplishing these tasks are discussed in laboratory analysis section.

The VOC sampling acquisition will consist of 24-hour runs from midnight to midnight and will be consistent among the three monitoring sites. The sampling schedule will follow a 10-day sampling schedule with exchange of sampling canisters occurring at all sites on the 11th day and sampling resuming on the 12th day of the cycle. Following this schedule over an approximately 3½ month period will allow collection of approximately 90 sample days. An additional sampling period will occur during potential stack testing and will be conducted on a 12-hour sampling period basis.

C.2 Canister Shipment, Sample Handling and Custody Requirements

Sample quality and the ensuing data can be compromised if sample collection is inconsistent throughout the study period. To prevent inconsistency, SOPs have been developed and followed for canister shipping, installation, and sample handling. All personnel involved in field operations are trained in using these SOPs prior to participating in the field operations.

A sealed sample chain of custody procedure (**Appendix A.5**) is used to insure that sample integrity is maintained before, during, and after sample collection. Chain of custody (COC) refers to tracking the possession of SUMMA™ canisters from the time they are issued for field deployment and from the sample collection through final analysis. Strict chain of custody documentation will be maintained at all times, SOPs will be followed throughout the study period to maintain consistency in COC procedure.

Samples with broken COC seals or other obvious signs of tampering will be analyzed but flagged by the lab analyst and/or Data Manager as suspect for record keeping purposes. These samples will not be numerically included in a statistical analysis of the study results. Samples with improper COC paperwork will be analyzed 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.

C.3 Analytical Method Requirements

The objective of the sample analysis program is to assure the validity of the data resulting from the analytical analysis of collected samples. In order to analyze samples for volatile organic compounds via the EPA Compendium Method TO-14A² certain instrument requirements were necessary. **Table C1** lists the requirements of Method TO-14A as well as the AQL response to those requirements.

Table C1. Analytical Requirements for Method TO-14A Analysis

T0-14A Requirement	NC Air Quality Laboratory Response
Preconcentrator	Entech system preconcentrator
Water Management	Entech system preconcentrator
Gas Chromatograph	Varian Saturn 2000 Column: DB-1 60m x 0.32m Capillary column
Mass Spectrometer	Varian Saturn 2000

Daily instrument tune checks are performed prior to each batch of samples analyzed. Injecting a sample of zero air through the analytical system performs the instrument tune check. A sample of the internal standard is added to the sample by the Entech concentrator. 1-Bromo-4-fluoro-benzene (BFB) is a constituent of the internal standard and therefore provides for the instrument tune check. The acceptance criteria for the BFB tune check have been established in the EPA Compendium Method TO-14A and are listed in **Table C2**.

Table C2. Tune Acceptable Limits

m/z	Abundance
50	15 – 40% of 95 intensity
75	30 – 60% of 95 intensity
95	Base peak, assigned 100%
96	<2% of 95 intensity
173	<2% of 174 intensity
174	>50% of 95 intensity
175	5 – 9% of 174 intensity
176	>95 and < 101% of 174 intensity
177	5 – 9% of 176 intensity

Table C3 details the daily system checks that are completed prior to analysis.

Table C3. Daily Analytical System Checks

Item	Criteria
Check Disk Space	<80% full
Zero Air	Record supply pressure
Helium	Record tank level and supply pressure
Carrier Head Pressure	Record pressure
Canister Leak Check	No leak
Canister Valves Open	Open
Internal Standard valves open	Record ISTD used
Liquid nitrogen valve open	Open
System vacuum	Record if vacuum gauge is present
Air/Water Spectrum	Print out
Integrator zero	Print out
Electron Multiplier Voltage	Print out
Filament Emission Current	Check
Cal Gas (FC-43) pressure	Check biweekly
Mass Calibration	Perform and print
Internal Standard Flow	Adjust to 10 ml/min & recorded daily

C.4 Quality Control Requirements

In order to insure the validity of the data generated from the study and meet the data quality objectives set forth by the study it is imperative to establish quality assurance and quality control measures in each aspect of the study.

C.4.1 Ambient Air Monitoring Sampling System

Providing field specific quality control measures assures that the air samples collected are the basis for valid data. The main objective of the field sampling program is to assure the integrity of the sample before, during, and after sample collection. This objective is accomplished by using certified field equipment and sealed sample chain of custody.

C.4.2 Analytical Data

The implementation of a stringent quality control program allows for optimum instrument performance and analytical precision in sample analysis. Imperative to the quality control of the analytical program is the verification of optimum instrument performance. Also vital to this aspect of the study is the analysis of QA/QC samples such as replicate sample analysis. Sample split analysis may serve as a QA/QC measure depending on the incorporation of the second GC/MS at the AQL. Ideally all VOC samples will be analyzed within 30 days of sampling date. Those analyzed after 30 days will be not be considered in the data set.

C.5 Instrument and Equipment Inspection and Maintenance Requirements

C.5.1 Ambient Air Monitoring Sampling System

The ambient air monitoring equipment will be inspected weekly by the site operator during the canister change out procedure. Visual inspection as to the operation and condition of the equipment and site is made and noted in the site logbook.

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 the study SOP. When possible, the field operator will correct the problem (i.e., by repairing leak, and etc.) while in the field independently or by communication with relevant personnel at the AQL. If the operator cannot fix the problem, he will notify the Field Operations Manager and the Study Manager *immediately* to determine a course of action via phone. He will also document the problem in the logbook and note any corrective action taken. As soon as the field operator returns to the office, the operator will update the Field Operations Manager, the Quality Assurance Manager, and the Study Manager on the situation.

C.5.2 Analytical Instruments

The performance of the laboratory equipment used in the analysis will be monitored and documented in the appropriate equipment logbooks. Preventive maintenance procedures will be followed throughout the study. Valid instrument tune checks, which are implemented daily serve as an indicator of usability for the GC/MS. Problems detected will be corrected by the instrument operator and/or by personnel contracted to provide technical support and maintenance.

C.6 Instrument Calibration and Frequency

C.6.1 Field Equipment

As discussed in the SOP for site operation, the flow of the air sampler will be verified during canister change out procedures. Bubble flow meters employed by the field operator are certified by the manufacturer and calibrated based on established specifications. Leak checks will be performed at every canister change out.

C.6.2 Analytical Instruments

Quality analytical performance begins with the determination of the method detection limit (MDL), values below the reporting limit (BRL), and the lower quantitation limit (LQL). The MDL is set at the reporting limit (RL) and below the LQL in order to insure that minor losses of system sensitivity would not cause data loss at the RL. The MDL values may change during the course of the study based on the changing sensitivity of the instrument and the addition of a new GC/MS. All values, detection limits as well as calibration curve information will be reported with the data sets.

The Gas Chromatograph/Mass Spectrometer (GC/MS) is calibrated as needed using a five-point calibration curve. The normal curve range is from 0.25 to 10 ppb.

Correlation coefficients for each accepted curve is >0.98 . Average Response Factor (RF) values for each compound should agree within 30% relative standard deviation (RSD). Calibration standards are prepared as needed with the Entech Dynamic Dilution System using a 1.0 ppm certified cylinder mixture as a starting point for the serial dilutions. Correlation Coefficients, RF values, compound spectra, peak areas, and RF %RSDs are printed and included with data for confirmation.

C.7 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, 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 data gathered in the field and laboratory are not altered (other than appropriate unit conversions) as they are transferred from field and laboratory to the periodic and final reports.

The Data Manager will distribute only validated, quality-coded data as directed by the Project Administrator. In this way, the data will be available in a timely manner to the NC DAQ personnel, communities, and other appropriate persons.

To centralize all of the data generated, one computer will be dedicated to data management of meteorological data for this study controlled by the Data Manager for the meteorological portion of the study.

C.7.1 Analytical Data

The analytical data will be handled on a per site basis, and results will be reported to the Project Manager within 10 days of sample analysis. All information collected in the course of the study including, but not limited to, 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 and appropriately referenced.

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.

D. H₂S SAMPLING SYSTEM, ANALYTICAL MEASUREMENT, AND DATA ACQUISITION

D.1 H₂S Sampling System Design

The sampling design process outlines the experimental design of the study and includes information on the type of samples collected, sampling frequency, sampling period, and how the sample locations are selected. The sampling design process for the ambient air sampling is discussed in this section.

Three air monitoring sites will be established for this study with a sampling system for hydrogen sulfide (H₂S) located at each site. Each hydrogen sulfide (H₂S) tape meter system consists of equipment designed to collect an ambient air sample on colorimetric tape via the Zellweger Analytics Single Point Monitor (SPM) or Tapemeter. The SPM employs a specially treated cloth tape reel called a “Chemcassette” and an electronic key called a “Chemkey”. The Chemkey stores setup information and other functional information (i.e. flow rate, alarm levels and compound concentration times) needed for accurate detection of target gases. The Chemcassette is a medium onto which a known quantity of ambient air is concentrated. The Tapemeter can sample at either a 53-1500 parts per billion (ppb) range or a 2-90 ppb range. The Tapemeter will be initially equipped with the manufacturer’s “low level” hydrogen sulfide paper tape cartridge. If ambient air concentrations consistently exceed these values then the “high level” paper tape will be installed.

The unit has an internal sample pump which draws air at a constant flow rate through a chemically treated paper tape. The tape darkens on exposure to H₂S. At the end of each sample period (15-minute) the concentration is converted into a 4 to 20 milliamp (ma) analog output signal. This output is then digitally stored on an attached data logger. A diagram of the Zellweger SPM system has been included in **Appendix C.3** of this document, “U.S. EPA Environmental Response Team, Standard Operating Procedures, Single Point Monitor”.

The Tapemeter will data log at 15-minute intervals continuously over the study period of approximately 3 ½ months. The data will be downloaded from the data logger manually and reviewed once every 11 days. All measurements will be validated, and averaged to provide short (15-minute), medium (one-hour) and long-term (24-hour) concentration, summarized, and presented to ATSDR and DHHS at the conclusion of the study for the purpose of a human health risk assessment.

D.2 Quality Control Requirements

In order to insure the validity of the data generated from the study and meet the data quality objectives set forth by the study it is imperative to establish quality assurance and quality control measures in each aspect of the study.

A log book will be maintained on-site. It is acceptable to use the general logbook associated with each site. The following information will be recorded each time the

data is downloaded. Procedures on downloaded the data are contained in the SOP for the datalogger.

- Date and time the data is downloaded.
- Period of time for the corresponding data set.
- Visually inspect the screen filter.

The following will be recorded each time the Chemcassette is changed.

- Date, time, and serial number of the chemical tape cassette when it is changed.
- The results of the system optics check.
- The results of the leak check.
- The name of the person changing the tape.

Any anomalies will be noted in the log book and reported immediately to the Study Manager.

D.2.1 Ambient Air Monitoring Sampling System

Providing field specific quality control measures assures that the air samples collected are the basis for valid data. The main objective of the field sampling program is to assure the integrity of the sample before, during, and after sample collection.

To ensure quality, Chemtapes will be stored in a cool atmosphere and kept out of direct sunlight. SOPs have been developed and followed for SPM operation and data download. All personnel involved in field operations are trained in using these SOPs prior to participating in the field operations.

D.2.2 Analytical Data

The implementation of a quality control program allows for optimum instrument performance and analytical precision in sample analysis. Imperative to the quality control of the analytical program is the verification of optimum instrument performance. The main quality control mechanism for these tape meters are what is referred to in the SOP as the “verification routine” that checks the operating condition of the Tapemeter’s optical system through use of the optical test card supplied with the instrument. In addition to this routine, a “Simulating Gas Conditions” check can be performed to determine the operational readiness of the system as described in the appendix of the SOP (See **Appendix A.4** of this document).

D.3 Instrument and Equipment Inspection and Maintenance Requirements

D.3.1 H₂S Sampling System

The H₂S monitoring equipment will be inspected on the 11-day change out schedule by the site operator during the VOC canister change out procedure. Visual inspection as to the operation and condition of the equipment and site is made and noted in the site logbook.

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 the study SOP. 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 and the Study Manager *immediately* to determine a course of action via phone. He will also document the problem in the logbook and note any corrective action taken. As soon as the field operator returns to the office, the operator will update the Field Operations Manager, the Quality Assurance Manager, and the Study Manager on the situation.

D.4 Instrument Calibration and Frequency

No calibration is necessary for this unit. The chemical tape that is used to detect H₂S is manufactured in a manner as to eliminate any need for instrument calibration in the laboratory or field. However, the instrument does allow for a response verification using an optical test card. This test will be completed each time the Chemcassete is changed. The air flow rate is not adjustable by the user. However, plugging the sample tube temporarily will generate the code “fault 15”, which is an indication that the sample flow is working properly.

The instrument is capable of operation for over one month on each chemical tape cassette. However, data should be downloaded every 1-2 weeks. Specific instructions on how to check the instrument’s response are located in Section 7.0 of the attached Appendix “U.S. EPA Environmental Response Team, Standard Operating Procedures, Single Point Monitor”. The instrument’s response will also be verified each time the chemical tape cassette is changed.

D.5 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, etc.), and summaries and reports about the study.

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

The Data Manager will distribute only validated, quality-coded data as directed by the Project Administrator. In this way, the data will be available in a timely manner to the NC DAQ personnel, communities, and other appropriate persons.

To centralize all of the data generated, one computer will be dedicated to data management of meteorological data for this study controlled by the Data Manager for the hydrogen sulfide portion of the study.

D.5.1 Sampling Data

The sampling data will be handled on a per site basis. All information collected in the course of the study including, but not limited to, data logger outputs, spreadsheets, 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.

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 and appropriately referenced.

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.

E. ASSESSMENT AND OVERSIGHT

E.1 Assessments and Response Action

E.1.1 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. All meteorological parameters will be checked during audits, and the required parameter accuracies are given in **Table B2**. SOPs will be developed and followed to ensure consistency during audits. **Table E1** contains an overview of the required audits. Audits will be conducted at the initial installation of the equipment and at the conclusion of the study. Any findings or concerns from the audits will be addressed to the Study Manager.

Table E1. 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.</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

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

E.1.2 Field Equipment (VOC and H₂S Samplers)

Audits of the field equipment are imperative to insure proper sampler operation, flow, and adequate sample collection. Periodically ATAST personnel will visit the sampling sites in order to verify that all sampling equipment is operating properly. All flow and pressure checks will be noted within the site logbook. If necessary, the field equipment may be replaced by ATAST personnel.

E.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 in the established SOPs 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 Study Manager will be conducted at this time.

The completed data package will undergo an audit conducted by Quality Assurance Managers. 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 and field portions of the study. Any findings or concerns from the audits will be addressed to the Study Manager.

E.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.

E.2 Reports to Management

The Quality Assurance Manager will summarize the results of any audits into audit reports that will be documented and archived by the DAQ, TPB-ATAST in either hardcopy or electronic formats. These audit reports will include those that were conducted (if any) for the field sampling operations, the meteorological data collection, the analytical procedures, and data management procedures.

F. DATA VALIDATION AND USABILITY

F.1 Data Review, Validation, and Verification Requirements

All analytical and meteorological data are reviewed by the Study Manager, the Quality Assurance Manager, and the Project Administrator to determine if these data meet the QAPP objectives. Decisions to reject or qualify data are made by the Study Manager and the Quality Assurance Managers. The Data Manager will distribute only validated, quality-coded data as directed by the Project Administrator. In this way, the data will be available in a timely manner to the NC DAQ personnel, communities, and other appropriate persons. All personnel involved in the study will have the opportunity to review these data before they are incorporated into the final report.

F.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. Both the meteorological data and the analytical data will be validated to ensure that the quality goals of the study are met.

Computers can be used to assist in validation of meteorological data by determining if the values fall outside a specified range. An Excel macro will be developed to assist in validating meteorological data. Validation guidelines for meteorological parameters are provided in *On-Site Meteorological Program Guidance for Regulatory Applications*⁶ and are summarized below. 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

G. REFERENCES

1. US EPA. 1998. *EPA Requirements for Quality Assurance Project Plans: Final Draft*. Office of Research and Development.
2. Winberry, Jr., W.T. "Compendium Method TO-14A: Determination of Volatile Organic Compounds (VOC) In Ambient Air Using Specially Prepared Canisters With Subsequent Analysis By Gas Chromatography" (EPA document #625/R96/010b)
3. US EPA. 1989. *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume 4*. Office of Research and Development. RTP, NC.
4. US EPA 40 Code of Federal Regulations Appendix D & E to Part 58, Section 58.61, pp.218 - 291, Revised July 1, 2001.
5. US EPA. 1994. *Guidance for the Data Quality Objectives Process*. Office of Research and Development. Washington, D.C. EPA/600/R-96/055.
6. US EPA. 1987. *On-Site Meteorological Program Guidance for Regulatory Applications*. Office of Research and Development. RTP, NC. EPA-450/4-87-013.

APPENDICES

Appendix A – Standard Operating Procedures (SOPs)

A.1 Meteorology Station

A.1.1 Meteorology Station Siting/Audits/Quality Assurance

DIVISION OF AIR QUALITY TOXICS PROTECTION BRANCH STANDARD OPERATING PROCEDURE

1.0 PURPOSE:

The purpose of this Standard Operating Procedure (SOP) is to describe the required procedures for siting and performing quality assurance audits of meteorology stations.

2.0 REFERENCES:

Quality Assurance Handbook For Air Pollution Measurement Systems, Volume IV-Meteorological Measurements, U.S. EPA, August 1989.

General Guidelines For On-Site Meteorological Data Collection For N.C. Air Quality Analysis, NCDAQ, October 1994.

IMPROVE, Particulate Monitoring Network: Standard Operating Procedures, University of California, Davis.

3.0 EQUIPMENT DESCRIPTION:

This Standard Operating Procedure will discuss meteorology station siting and quality assurance procedures for meteorology towers and associated instrumentation including wind direction, wind speed, temperature and humidity, solar radiation, barometric pressure sensors and rain gages.

4.0 PROCEDURES FOR SITING METEOROLOGY STATIONS

The primary objective of instrument siting is to place the instrument in a location where it can make precise measurements that are representative of the general state of the atmosphere in that area, consistent with the objectives of the data collection program. Meteorology station siting should include interviewing property owners to determine past, present, and future land use of candidate sites. Additionally, site photographs, including panoramic, should be taken of the proposed site location. Latitude and longitude coordinates along with site elevation should also be documented.

Meteorology Towers

Meteorology towers should be located in an open level area such that instruments will be unaffected by local obstructions or objects such as buildings, paved parking lots, and trees, or by topographic features such as hills, valleys, and water bodies. The tower should be located at a distance away from the obstruction of at least ten times the obstruction's height. Meteorology towers deployed during emergency response activities may not always meet siting criteria due to the immediate need for local meteorological conditions. Additionally, when siting air quality monitors for long term trend analysis or large geographic area coverage, it is acceptable to have meteorological equipment located at a different location that better meets the large scale requirements of the study. This is acceptable as long as both sites are in the same area of interest and meet their respective siting criteria. However, when the air quality data are to be used for short-term diffusion model validation or studies of short-term levels from specific sources, a meteorological station should be located in the vicinity of the air quality sensor. The tilt direction of meteorology towers should be carefully evaluated prior to sensor installation to allow for lowering of the tower during quality assurance auditing.

Wind Speed and Wind Direction Sensors

According to the World Meteorological Organization (WMO), the standard height for wind instruments over level, open terrain is ten meters above the ground. 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 that obstruction. An obstruction may be of human construction, such as a building, or natural, such as trees and other vegetation. The wind instrument should be securely mounted on top of a mast or a tower that will not twist, rotate, or sway. Wind instruments should be mounted either on top of the tower or on booms projecting horizontally out from the tower. The sensors should be located at least twice the diameter or diagonal of the tower away from the tower and at least one tower diameter/diagonal above the tower structure if located on top of the tower. The sensors should also be mounted on the side of the tower which provides the least distortion for the most important wind direction or the prevailing wind direction. Windset crossarms should be oriented in a north-south fashion with wind direction sensor at 360 degrees and the wind speed sensor at 180 degrees. Erecting wind sensor crossarms in this manner establishes consistency among sampling sites, enhances quality assurance auditing efficiency, and supplements field operator orientation during odor events.

If it is necessary to mount the wind instrument on a roof of a building, it should be mounted high enough to be out of the area in which the airflow is disturbed by the building. This is usually 1.5 times the height of the building above the roof so that it is out of the wake of the obstruction. Rooftop mounting of wind instruments should only be resorted to when absolutely necessary. If the emissions point is substantially higher than ten meters or in cases of complex terrain, additional wind measurements at the plume height elevation may be needed.

Temperature and Humidity Sensors

Temperature sensors must be housed in a ventilated radiation shield to protect the sensor from thermal radiation and should be mounted over a plot of open level ground at least nine meters in diameter. The ground surface should be covered with non-irrigated or unwatered short grass or, in areas where grass does not grow, natural earth. The surface must not be concrete or asphalt or oil soaked. The standard height for recording surface temperature and humidity is two meters above ground level. Elevations of two and ten meters are used during PSD monitoring and to establish temperature difference.

The sensors should not be closer to obstructions such as trees and/or buildings than a distance equal to four times their height. They should be at least 30 meters from large paved areas and not close to steep slopes, ridges, or hollows. Areas of standing water should also be avoided. Louvered instrument shelters should be oriented with the door opening toward true north, when establishing northern hemisphere sites. Humidity sensors should be sited in the same manner as temperature sensors. However, avoidance of sources which may influence measurements such as cooling towers, automatic sprinklers, and air vents must be considered.

Solar Radiation Sensors

Solar radiation measurements should be taken in a location free, throughout the year, from any obstruction that could cast a shadow over the sensor. The sensor should not be located near light colored walls or artificial sources of radiation.

Barometric Pressure Sensors

Measurements of barometric pressure are desirable from a QA/QC standpoint, but not necessary for modeling purposes. Sensor height is not critical, however, two meters is generally considered acceptable. The sensor should be protected from wind by placement within an enclosure.

Rain Gauges

A rain gauge should be mounted on level ground that is covered with short grass or gravel in order to eliminate splashing. The gauge should be mounted a minimum of 30 centimeters above the ground and should be high enough so that it will not be covered by snow. Rain gauges should also be heated if necessary to properly measure liquid equivalent of frozen precipitation. Wind obstructions should not be closer than at least two times the obstruction height from the instrument. Obstructions include buildings, natural vegetation, and collocated equipment. In open areas, a wind shield such as that used by the National Weather Service is recommended.

Specific siting criteria for precipitation collectors is beyond the scope of this document. However, it is recommended that the heights of the rain gauge and the precipitation collector openings be equivalent.

5.0 Meteorological Sampling Frequency

Meteorological data is typically averaged over a one hour time period for reporting purposes. A 15-minute averaging period is acceptable and usually provides better resolution for QA/QC purposes. The Toxics Protection Branch dataloggers are typically programmed to record 15-minute, one hour and 24-hour averaging periods for meteorological parameters. The recommended recording interval for most meteorological parameters during 15-minute averaging periods is 15 seconds. A sampling frequency of one second may be required for some wind direction sensors to ensure that consecutive values do not vary by more than 180 degrees. Additionally, if atmospheric stability is to be determined, through the standard deviation of the horizontal wind, then meteorological parameters must be collected every 2.5 seconds.

6.0 Quality Assurance Procedures

A. Performance Audits

Performance audits of meteorology stations and meteorological sensing equipment are required to ensure the collection of quality meteorological data. Meteorology stations should be evaluated on a quarterly basis to determine status with respect to the siting criteria previously mentioned in this document. Meteorological sensors require quarterly auditing when in use during a field study. Also, meteorological sensors should be audited within thirty days of beginning a study and again following study completion. During the audits, sensors will be temporarily removed from the towers for connection with audit devices. Standard Operating Procedures for auditing meteorological sensing equipment will be developed and attached to this document. The following audits are to be performed on at least a quarterly basis. More frequent auditing may be conducted when suggested by unusual data.

METEOROLOGICAL SENSOR	audit performed	method
Wind direction	Threshold	Vane Torque Gauge Vane Angle Bench Stand
Wind direction	Signal	Vane Angle Bench Stand
Wind speed	Threshold	Propeller Torque Disc
Wind speed	Signal	Anemometer
Temperature	Response/Comparison	NIST mercury thermometer
Humidity	Comparison	NIST sling psychrometer
Solar Radiation	Response	Lamp with known spectral response
Barometric pressure	Comparison	Anenoid barometer calibrated with mercury barometer
Rain gauge	Response	Squeeze bottle method: known water volume with controlled drip rate
Visibility	Response	Zero/Span check

New meteorological sensing equipment should arrive from the manufacturer in a field ready state. Existing meteorological sensing equipment which has been stored following a field study, especially those with mechanical parts such as wind direction and speed

sensors, require refurbishment and calibration by the manufacturer. All field auditing activities should be documented in the monitoring site logbooks. Field audits results should be distributed among appropriate personnel and included with the final report.

B. Recommended System Accuracies and Resolutions

The following table displays EPA recommended system accuracies and response characteristics for meteorological sensors.

Meteorological parameter	system accuracy	resolution
Wind Speed (horizontal & vertical)	(0.45 mph + 5 % of observed)	0.2 mph
Wind Direction (azimuth & elevation)	5 degrees	1 degree
Ambient Temperature	0.9 °F	0.2 °F
Vertical Temperature Difference	0.2 °F	0.4 °F
Dew Point Temperature	2.7 °F (or 0.9 °F if icing or fog from facility is possible)	0.2 °F
Humidity	1.5% (according to IMPROVE)	0.3%
Precipitation	10% (or 0.02 inches of precip, whichever is greater)	Not applicable
Barometric Pressure	3 mb or 0.09 inches of Hg	0.5 mb or 0.015 inches of Hg
Radiation	5% of observed (or 25 W/m ² , whichever is greater)	10 W/m ²
Visibility (light scattering due to particulates)	10% (calculated from regular [usually weekly] zero/span calibrations)	About 5% with collocated samplers
Time	5 minutes	Not applicable

A.1.2 Acquisition of Stored Meteorology Data

DIVISION OF AIR QUALITY TOXICS PROTECTION BRANCH STANDARD OPERATING PROCEDURE

The Collection of Meteorological Data from the CR-10 And CR-10X Datalogger

1.0 Purpose

The purpose of this document is to provide standard operating procedures for the proper collection of meteorological data from the CR-10 and CR-10X datalogger using computer program PC-208W.

2.0 References

- Campbell Scientific Inc., 815 West 1800 North, Logan, Utah, 84321 (435) 750-9540
- CR10X/PC208W Training Manual

3.0 Equipment Description

- The CR10X is a data logger is a data storage, processing and the control unit for the weather stations. The non-flash memory and lithium backed SRAM stores up to 62,000 data points. The data logger is stored in a weatherproof fiberglass enclosure.

4.0 Procedures

4.1 Calibration and Certification

The data logger must be returned to Campbell Scientific to be calibrated.

4.2 General operation

- Turn your lap top computer on and connect it to the data logger using the blue ribbon cable and the SC32A module.
- On your laptop find the computer program **PC208W** Click on it, this will bring up the Datalogger Support Software. Find the connect Icon and click it this will bring up the CR10X data logger connection screen at the bottom of that screen is a **Connect** button Press this the computer and the datalogger are now able to communicate with each other.
- On the Datalogger Connection screen is a window for Manual Data Collection make sure that the Prompt for data file name is checked. Press the collect button a screen will pop up asking for a File name, type in the first letter of your site name and the date you are collecting the data (ex: P040102). The % collected will start getting darker as the data is collected. When all the data is collected go to the

bottom of the window and press the disconnect button. You can now disconnect all the cables from your laptop connect the CR10KD key pad to the blue ribbon cable and press *0 this starts the data logger collecting data again

- Close all the windows on your laptop and turn it off.
- Your data will be saved in the PC208W file and will be in an Excel format.

A.2 Varian GC/MS with Entech Pre-concentrator

DIVISION OF AIR QUALITY TOXICS PROTECTION BRANCH STANDARD OPERATING PROCEDURE

US EPA Compendium Method TO-14A/TO-15 VOC Analysis via Varian Saturn GC/MS (Ion Trap) Entech 7100/Entech 7016 CR Preconcentrator & Autosampler

7.0 PURPOSE:

The purpose of this Standard Operating Procedure (SOP) is to describe the required procedures for the analysis of Volatile Organic Compounds (VOC's) via US EPA Compendium Method TO14A.

8.0 REFERENCES:

1. Winberry, Jr., W.T. "Compendium Method TO-14A: Determination of Volatile Organic Compounds (VOC) In Ambient Air Using Specially Prepared Canisters with Subsequent Analysis By Gas Chromatography"
2. NC Division of Air Quality Toxics Protection Branch "Chemical Hygiene Plan"
3. Varian Saturn 2000 GC/MS Operator Manual
4. Entech 7100 Operator Manual

9.0 EQUIPMENT DESCRIPTION:

This Standard Operating Procedure will discuss the operation of the Varian Saturn 2000 GC/MS and Entech 7100 Preconcentrator in the analytical analysis of VOC ambient air samples in specially prepared canisters.

10.0 THEORY OF OPERATION

The analysis of VOC's in ambient air at specified detection limits requires an initial sample preconcentration. Enhancement of VOC concentrations relative to the fixed gases found in air is accomplished by passing a known volume of air through a trap that selectively retains the organics while allowing bulk gases (N₂, O₂, & Ar) to pass through unimpeded. A reduction in the trapping temperature is then needed to allow for a quantitative retention of VOC's on the trap. TO14 recommends a trapping temperature of -150 degrees C.

Entech 7100 does not utilize a Nafion Dryer for water management as specified in TO-14 but instead uses a microscale purge and trap 3-stage concentration technique to analyze nonpolar VOC's in humid air. The air sample is concentrated to approximately 0.5 cc volume in a cryogenic trap. VOC's are initially trapped cryogenically on glass beads and are then recovered by desorbing at room temp to leave the water behind on the first trap. The trap is heated to room temp and held while helium passes through to transfer the compounds to a second trap.

The 2nd cryotrap using Tenax is cooled to –10 degrees C to trap the complete range of VOC's while allowing CO₂, to pass through. From module 2, the VOC's are backflushed at 180 degrees C and then focused at –150 degrees C in the module 3 focusing trap. Heating the focusing trap is then performed rapidly while sending a START signal to the GC. Cool down of Module 1 trap initiates trapping procedures. Once temperature is achieved the internal standard mix is metered through module 1 trap until specified volume is reached. If a calibration standard is to be injected the sample is metered through to the module 1 trap until specified volume is reached. If samples from autosampler are specified they are metered through the module 1 trap. Final trap sweep with helium eliminates the remaining air in the trap. Module 1 trap is flushed and Module 2 is cooled to –10 degrees C. With no flow, Module 1 is preheated to 20 deg C. Transfer of VOC's from Mod 1 to Mod 2 is accomplished via helium at 10cc/min for approx. 4 minutes. System waits for GC Ready. Mod 3 cryogenic valve will cool down the focusing trap until setpoint is reached (-150 degrees C). Sample is transferred from Mod 2 to Mod 3 via GC Carrier gas. Focuser is heated from –150 degrees C to 0 degrees C within 1-2 seconds and GC START is initiated.

Upon sample injection onto the chromatographic column, the MS computer is signaled by the GC computer to begin detection of compounds which elute from the column. Detection by Ion Trap MS allows for the mass spectra for individual peaks in the total ion chromatogram to be examined with respect to the fragmentation pattern of ions corresponding to various VOCs including the intensity of primary and secondary ions. The fragmentation pattern is compared with those in the NIST library for qualitative identification. For any given compound, the intensity of the primary fragment is compared with the system response to the primary fragment for known amounts of the compound. Quantitation is accomplished via a 3 point calibration curve. A standard of known concentration for TO-14 target compounds is prepared and introduced to the analytical system in varying amounts for the required points of the calibration curve. Unknown samples are analyzed in relation to this calibration curve. Each sample is also analyzed with a known volume of an internal standard mix.

5. QUALITY ASSURANCE/QUALITY CONTROL MEASURES

- Analytical system integrity is tested via daily BFB tuning. A sample of zero air containing 4-Bromofluorobenzene is introduced to the analytical system. System tune criteria are as follows:

Mass	Ion Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base Peak, 100% Relative Abundance
96	5 to 9% of mass 95
173	<2% of mass 174
174	>50% of mass 95
175	5 to 9% of mass 174
176	>95% but < 101% of mass 174
177	5 to 9% of mass 176

- Daily analysis of zero air sample prior to sample analysis to certify that system is clean. All target compounds should be less than 0.2 ppb.
- Initial three point calibration of the system. Proper operation of the system is verified by expected retention times and ion abundance. A calibration response factor is also calculated for each compound. The %RSD for the Relative Response Factors should be $\leq 30\%$.
- A daily calibration check should be performed prior to sample analysis. The results of this analysis should be within 20% of the expected value.
- Laboratory replicates, once per batch of samples, should be within 20%.

6. PROCEDURE

1. Check Air/Water of the Varian Saturn 2000 GC/MS
 2. Install sample canisters on the Entech 7016 CR Autosampler. Keep canisters closed.
 3. Flush all sample lines within the autosampler and perform a leak check on each line.
 4. Analyze zero air sample with the internal standard mix. This sample to serve as certification of clean system as well as BFB tuning sample. Pass BFB tuning criteria accomplished continue with sample analysis.
 5. Prepare sample list in the Entech 7100 software as well as within the Saturn software.
 6. Sat1 system select Begin and the GC/MS will wait for START signal from the Entech 7100.
 7. The first sample in the prepared sequence list (Entech 7100 software) should be highlighted and GO selected on the toolbar. This will start the sampling process.
- A step by step 'daily' procedure is available to operators of the system.

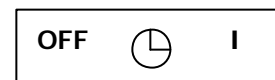
A.3 XonTech 911/912 VOC Sampling System

VOC Site Operation:



Verify & Inspect:

- All power is ON (Building/UPS/911A/converter box/912)
 - changeout day: equipment will be running but sample not collecting: port 11 should be open
- 911A Power Switch is in ON position & 911A Valve Control Switch is CLOSED
- 912 is in NORMAL position
- Candy Cane Funnel (Inlet) is clear


Manual Override Switch (MOS)



Canister Change-Out Procedure:

1. Turn 911A & 912 Power OFF
2. Close valve on all sample cans and remove canisters from sampling lines.
3. Check final pressure on all sample canisters with pressure gauge.
 - Connect pressure gauge to can and open canister valve.
 - Note final pressure on can tag/new COC form generated.
 - Close canister valve and remove pressure gauge.
4. Verify flow of 911A
 - Connect Bubble Flow Meter to Outlet Line of the 911A via stainless connection.
 - 911A Power ON & MOS to I position and check flows using bubble flow meter
 - Average of 3 flows...approximately 9 mls/min is desired rate
 - Adjust flow if necessary & note in onsite logbook results and adjustments
 - MOS to 
 - Detach Flow Meter & reconnect 911A line to 912
 - Check flows on at least 2 of the lines from the 912 to the cans following the same procedures above. Random Selection (note the line selected and the results or adjustments made in the on site logbook)
5. Check start pressure of new sample cans to be installed using pressure gauge.
 - Note start pressure on can tag/ check the field verification box on the COC form initiated at the lab
 - See notes above for pressure check instructions.
6. Install new sample canisters on sampling lines. Please note the line number on the canister tag
7. Perform Pressure/Leak Check using the following directions:
 - With Canister Valves CLOSED...MOS to I position
 - Allow pump to run with cans closed until pressure of appr. 15 psi
 - MOS to  Pump will stop
 - Pressure should not drop more than 1 psi over a period of 5 minutes.
 - Check each line by stepping through the ports on the 912. Pressure will drop slightly as you step through the ports. Run 911A pump whenever needed to take pressure back to appr. 15 psi...watch for pressure drop on 911A gauge
 - If pressure drops...tighten fittings and pressurize again.
 - Remember DO NOT OPEN CAN
 - Note any adjustments in the onsite logbook.
8. Set 24 hour multi sample runs using 911A timer to start and end runs:
 - 912 position to NORMAL and at Port 1: Turn OFF



- 911A MOS to — 911A Power ON and Valve Control CLOSED
 - Press R (reset) with pen to clear current program
 - Verify correct current time and day.
 - To set current time and day
 - Press  Program Button
 - Press h: sets hour (24 hour clock) Press m: sets minute
 - Press 1-7: sets day (Sunday = 1)
 - Press Pr: sets current time/day on timer. Blinking [:] indicates time is set.
 - Press Ch: (twice) to show previous program w/pen press recessed C to clear.
 - Press I/O: I sets start time
 - Press h: sets hour (0) Press m: sets minutes (:00) will start pump at midnight
 - Press 1-7: sets day (Sunday = 1)
 - Press q
 - Press I/O: O sets end time
 - Press h: sets hour (23) Press m: sets minutes (:59) will end pump at 11:59pm
 - Press 1-7: sets day (Sunday = 1)
 - Press q
 - Press Pr to set program
 - Press Ch: (twice) allows you to verify correct program
 - Press Pr (display should show current time)
9. 912 turned ON...check Port 1 NORMAL position
10. Open all Sample Canisters (pressure on 911A gauge will read -29" Hg)

Timing Notes:

On sample changeout day you will be setting up to start sampling at Midnight that night which is technically the next day. You will be setting the timer to end at 11:59pm on the last day of the 7 day sampling cycle. For example if you change out on Monday: you would set the timer for 0 hour :00 minutes on day 3...that would mean that at midnight on Tuesday the 911A would start pumping. The 912 will be set to operate starting at port 1 for 24 hours and will switch ports every 24 hours.

Addenda for SOP above for Use in Salisbury

Salisbury Initial Site Start Up Notes:

- Make sure that all equipment information installed at each site is listed in the on site logbooks: FAS #'s/ Equipment Serial #'s etc.
- Label each sampling line at the canister end with lab tape...this will make sample change out easier later
- 911A will be Power ON with Valve Control Switch CLOSED in order to operate a timed start operation...pump will be operated from the timer itself.
- Manual Override Switch (MOS) to Clock position turns pump off until time set arrives. MOS to I position allows pump to run for flow and pressure checks

- Initial flow check should first be done at the end of the stainless line coming from the 911A into the 912. Hook this line to the flowmeter and take 3 consistent readings. Switching the MOS to I position will start the pump. Should be approximately 9 mls/min for 24 hour composite sample. Note these readings and adjustments in the onsite logbook.
- Reconnect the stainless line to the 912 and check at least 2 of the stainless sample lines that will be connected to the canisters. I suggest line 1 and line 10. Take 3 consistent readings on each line and note in logbook. MOS back to clock position to turn pump OFF
- Install 10 cans
- Cans are at site/ not individually COC'd but tamper taped box
- Each box has a COC form with cans listed (generated by Bryan Lange at lab)
- Prior to installing on sampling system, check pressure of can and if ok check off Lab Ver. Box (I'll change this to Field/Lab Ver. Box on new COC)
- Write the start pressure on the individual can tags
- Depending on which line you install the can on, write the appropriate sample date on the can tag and on the COC form that was in the box. Also write the sample line on the can tag just in case there is confusion later.
- Sign and date the COC broken by form and bring these forms back to the lab. A new COC will be generated for these cans when they return to the lab after sampling.
- Make sure that all cans are CLOSED and perform pressure/leak checks on each line.
- Turn 912 on / NORMAL position / port 1
- MOS to I position turns pump ON / pressure on 911A gauge up to approx. 15 psi / MOS to clock position to turn pump OFF
- Pressure should not drop more than approx. 1 psi over a period of 5 minutes
- Check the pressure on each sampling line/ CANS CLOSED / by switching through the ports on the 912
- The pressure will drop slightly each time the port is switched/ just make sure it holds once switched and pump the pressure back up for verification if needed.
- Tighten any fittings if needed and note results and adjustments in the onsite logbook.
- Return the 912 to port 1 by HOME and make sure it is still in NORMAL mode
- Turn the 912 OFF
- MOS to clock
- Set the current time and day on the 911A timer. Procedure 8 on Site operation page.
- Set the START time on the 911A timer. Procedure 8 on Site Operation Page.
- 912 turned ON
- Open all canisters/ pressure on 911A gauge should read -29" Hg

A.4 Zellweger Tapemeter

U. S. EPA ENVIRONMENTAL RESPONSE TEAM

STANDARD OPERATING PROCEDURES

SOP: 2115
REV: 0.2
DATE: 01/24/01

SINGLE POINT MONITOR

1.0 SCOPE AND APPLICATION

The Zellweger Analytics Single Point Monitor (SPM) or Tapemeter employs a specially treated cloth tape reel called a "Chemcassette" and an electronic key called a "Chemkey". The Chemkey stores setup information and other functional information (i.e. flow rate, alarm levels and compound concentration times) needed for accurate detection of target gases. The Chemcassette is a medium onto which a known quantity of ambient air is concentrated.

When the Tapemeter is monitoring, the tape from the Chemcassette is drawn into the Tapemeter's "Read Head" where it is exposed to a predetermined amount of ambient air. If the target gas is present the tape responds with a color change in proportion to the concentration of the target gas present. The Tapemeter's optics then reads this color change and through an algorithm stored in the Chemkey converts the observed color change into the concentration which is sent to the Tapemeter's LED display. The concentration is also converted into a 4 to 20 Milliamp (ma) analog output signal which is available via the 14 pin connector located on the left side of the unit.

The range and detection limits of the Tapemeter are determined by the Chemkey's programming. Zellweger manufactures a standard set of Chemkeys with the most popular detection ranges available.

The Tapemeter's use of the Chemcassette as a concentration media allows the instrument to "SEE" a very large variety of compounds in some cases down to the low Parts Per Billion (PPB) range. Chemkeys and Chemcassette are available for: Amines, Diisocyanates, Hydrazines, Hydrides, Mineral Acids and Oxidizers.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedure employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHODOLOGY

Before the Tapemeter can be deployed it must be configured, which depends upon the operating environment. Refer to manufacturer's *Operating Instructions Section 2: Installation* for detailed information.

3.0 SAMPLE PRESERVATION

This section does not apply.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The Tapemeter, although very accurate and reliable, is still a monitoring instrument and does suffer from all the shortcomings that implies. It is limited by cross-sensitivities and other environmental conditions. Always consult with the manufacturer's *Technical Notes* and *Operating Instructions* regarding these factors before deploying the instrument.

5.0 EQUIPMENT/APPARATUS

The Tapemeter comes with several different configuration options. Refer to manufacturer's "*Operating Instructions Section 4 and 5*" for detailed information.

5.1 Instrument Features:

Self-contained power supply, for 8 hours of use. (Nominal)
 Self-diagnostic system
 Printer port
 Analog output, for data logging
 2 week or 30 day sampling run options
 2 alarm levels (set by manufacturer)

5.2 Instrument Topography

The following is a description of the operating controls and ports. (See Figure 1)

- | | |
|------------------------------|-------------------------|
| 1. Line Power Cord | 18. Tape load lever |
| 2. Power Port | 19. Digital display |
| 3. 14 pin circular connector | 20. Cover screw |
| 4. Chemcassette | 21. Retaining ring |
| 5. Guide Post | 22. Collar fixing screw |
| 6. Vent | 23. Door thumb screw |
| 7. Tape Path | 24. Exhaust port |
| 8. Main power switch | 25. Capstan assembly |
| 9. Green system status light | 26. Guide post |
| 10. Alarm test key | 27. Take-up reel |
| 11. Alarm reset key | 28. Vent |
| 12. Red system status LED | 29. Cover |
| 13. Relay disable LED | 30. Collar |
| 14. Relay disable key | 31. Body |
| 15. Sample inlet port | 32. Chemkey slot |
| 16. Alarm lamp | 33. Fuse/fuse holder |
| 17. Detector head | |

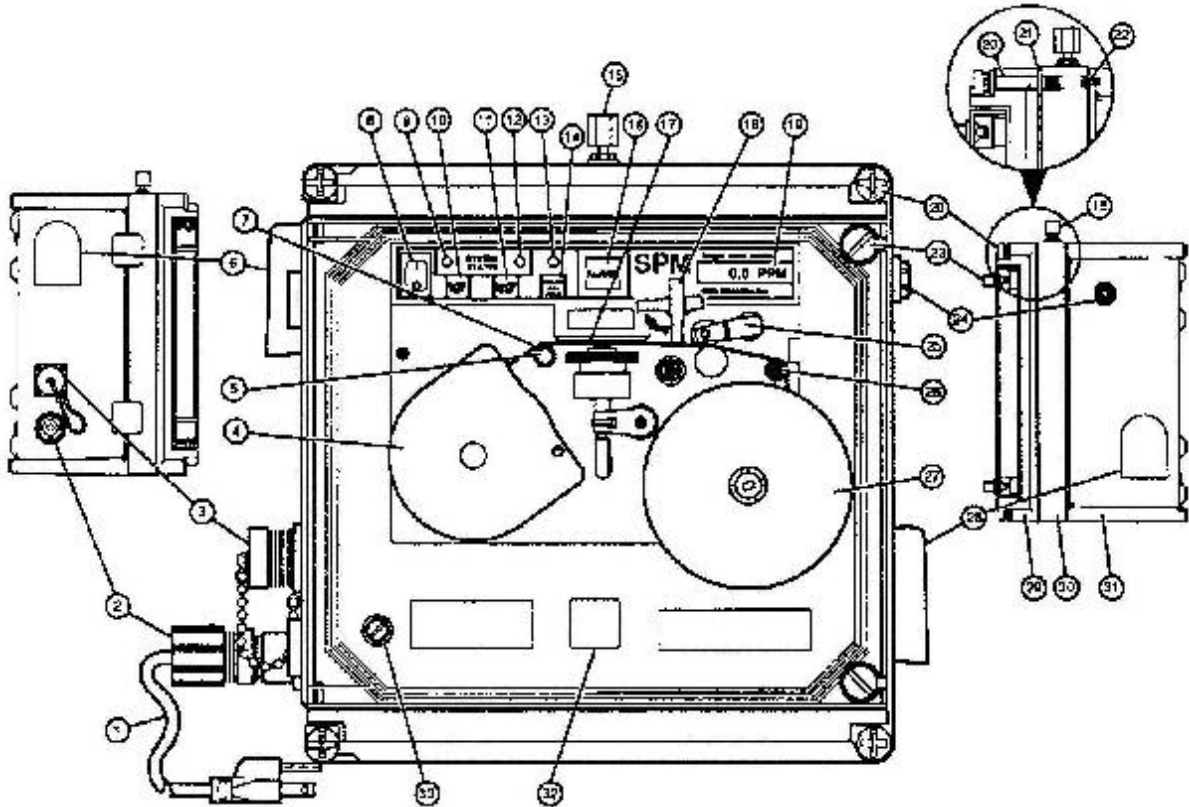


Figure 1

6.0 REAGENTS

This section does not apply.

7.0 PROCEDURES

Before beginning refer to manufacturer's *"Operating Instructions Section 1: Operation"* for complete information.

- 7.1 Response Verification: The verification routine checks the operating condition of the Tapemeter's optical system through use of the optical test card supplied with the instrument. The instrument must be in Monitor Mode to start this test, and if the unit has the Chimney option, the Chimney must be installed and turned on.

Perform the verification routine as follows:

- (1) Open the tape load lever (18). Remove the Chemcassette (4) from the head (17).
- (2) Press alarm test (10). The green system status LED (9) will flash rapidly and the display will show "VERIFY."
- (3) Insert the test card with position #1 centered in the detector head (17). Be sure that the floored chip on the test card faces up and that the card is inserted fully into the detector head (17).
- (4) Close the tape load lever (18) and press alarm test key (10). The audible alarm will emit one short signal.
- (5) Open the tape load lever (18) and reverse the test card, centering position #2 in the detector head (17).
- (6) Close the tape load lever (18) and press alarm test key (10).

- (7) If all electronics and optical systems are operating properly, the instrument will simulate an alarm condition and activate both the audible and visual alarms. The 4-20 mA circuit will output a signal of 10.1 mA to 13.2 mA.
- (8) Open the tape load lever (18) and press alarm reset (11). Replace the Chemcassette (4) and re-thread the tape (7). After pressing the alarm reset button, the alarm lamp (16) does not extinguish. Wait until monitoring is resumed, then press the alarm reset button again.
- (9) Close the tape load level (18). The Tapemeter will automatically begin monitoring.
- (10) Press the alarm reset button to turn off the alarm lamp (16).
- (11) Plug the end of sample line. A fault #17 will be generated, indicating that there are no leaks between the sampling point and Tapemeter.

Note: Alarm relays will not activate during the verification routine.

- 7.2 Improper System Response: If the system is not operating properly, the audible alarm will signal two times and the read system status LED (12) will light.

If this occurs, open the tape load lever (18), press alarm reset (11) and repeat the verification procedure. If the system still indicates a malfunction, contact Zellweger Service for assistance.

- 7.3 Open Tape Load Lever Fault. An internal timing circuit is activated when you open the tape load lever (18) for the verification routine. If the lever is not closed within two minutes, the:
1. Red system status LED (12) will flash
 2. Audible alarm will sound
 3. Green system status LED (9) also flashes
 4. Tapemeter display will show "FAULT 25"
 5. Instrument fault relay is activated (de-energized)

Do not confuse this two minute alarm with the proper response to the verification routine. To prevent the two minute alarm, do not leave the tape load lever (18) open for more than two minutes.

Note: The two minute alarm will also activate during Chemcassette replacement if the tape load lever (18) is left open for more than two minutes.

- 7.4 Loading the ChemKey/Chemcassette Detection Tape. Load a fresh Chemcassette as follows:
- (1) Open the tape load lever (18).
 - The green system status LED (9) will flash slowly.
 - AC Line (1) instruments will display "AC LINE" on the digital display (19).
 - Battery powered instruments will display current battery condition.
 - Insert Chemkey into slot(32)
 - (2) Remove the center retaining screw securing the Chemcassette. Remove and discard the old Chemcassette.
 - (3) Install the fresh Chemcassette (4) with raised lettering facing up. Pull 30 cm (12 inches) of tape (7) out of the fresh Chemcassette (4). Place the end of the tape in the slot on the Chemcassette take-up reel cover (27).
 - (4) Thread the Chemcassette tape (7) through the detector head (17), capstan assembly (25), and over the guide posts (5 & 26).
 - (5) Install the take-up reel cover (27). Rotate the assembled take-up reel (27) clockwise to take up any slack.
 - (6) Install the Chemcassette center retaining screw.
 - (7) Close the tape load lever (18). The Tapemeter will automatically begin monitoring.

Note: The EP (Extended Play) Chemcassette will lock in position when tape outlet is at approximately the one o'clock position.

7.5 Monitoring. The Tapemeter is monitoring whenever a Chemcassette (4) is in place, the tape load lever (18) is closed, and the power switch (8) on. The green system status LED (9) will also be lighted.

7.6 Simulating Gas Conditions. See Appendix A

8.0 CALCULATIONS:

This monitoring instrument reports its readings directly to its built in LED screen and a serial line printer (if attached). The instrument also has a 4-20 ma analog output port to be used for data logging.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

The Tapemeter is a monitoring/screening instrument with a quality assurance level of 1.

10.0 DATA VALIDATION

The Tapemeter is a monitoring/screening instrument with a quality assurance level of 1. This section does not apply.

11.0 HEALTH AND SAFETY

The Tapemeter is a monitoring/screening instrument and can be used to gauge changes in levels of protection.

12.0 REFERENCES

Manufacturer's Operating Instructions
Manufacturer's Technical Notes

13.0 APPENDICES

APPENDIX A **Simulating Gas Conditions** SOP #2115 January 2001

Simulating Gas Conditions

The Tapemeter allows two different electronic simulations of gas conditions: a gross alarm simulation (Section 1.7.2) and a full alarm simulation (Section 1.7.3).

1.0 Alarm Relays. Gross alarm simulation and full alarm simulation will activate the alarm relays. All external devices connected to the alarm relays will be triggered. To disable relays, press the relay disable key (14). The relay disable LED (13) will be lighted whenever the alarm relay contacts have been disabled.

2.0 Gross Alarm Simulation. To make a gross alarm simulation, press the alarm test key (10). This test activated the audible alarm and lights the alarm lamp (16). Unless the relay disable key (14) has been pressed, the gross alarm simulation energized the alarm relay contacts. The 4-20 mA output does not change.

To reset the alarm, press the alarm reset key (11).

3.0 Full Alarm Simulation

A full alarm simulation duplicates the Tapemeter response to four gas conditions:

- Sub-alarm Concentration
- Alarm Level 1 (1/2 of TLV)
- Alarm Level 2 (TLV)
- Above Scale

To begin a full alarm simulation, the Tapemeter needs to be in Monitor Mode. Press the hold the alarm reset key (11) for two seconds until the red system status LED (12) is flashing. The red system status LED will flash until the alarm test key is pressed or the instrument ends its current sample period.

For a simulation of each of the four gas conditions, continue with key entries as listed in Section 4.0.

4.0 Alarm Simulation Key Entries

Level	Entry	Exit
Sub-alarm	AT	After displaying concentration, the unit automatically returns to monitoring.
Alarm Level 1	AR, AT	AR
Alarm Level 2	AR, AR, AT	AR
Above Scale	AR, AR, AR, AT	AR
AT = Alarm Test Key (10) AR = Alarm Reset Key (11)		

Only one simulation can be made at a time. Conclude a simulation by pressing the alarm reset key (11). This will reset the relays, but the 4-20 mA output doesn't reset until the sample period ends. The display also acts the same way. Reenter the alarm simulation routine by pressing and holding the alarm reset key (11) until the red system status LED (12) begins flashing.

When a simulation is concluded the relay contacts will reset. The 4-20 mA signal and displayed value will stay at the simulated level. When the current sample period is completed the 4-20 mA signal and displayed value will be updated to indicate the sampled gas concentration.

Section 5.0 shows the Tapemeter alarms and signals for each level of alarm simulation.

5 Alarm Simulation Reporting

	Green System Status LED (9)	Red System Status LED (12)	Alarm LED (16)	Audio Signal	Display (19)
Sub-alarm	Steady On	Off	Off	Off	Concentration below alarm level 1
Alarm 1	Steady On	Off	Steady On	On	Concentration just above level 1
Alarm 2	Steady On	Off	Flashing Fast	On	Concentration between alarm level 2 and full scale
Above Scale	Steady On	Off	Flashing Fast	On	Xxx + ppb/ppm (above full scale)

Notes:

1. Press the alarm reset key (11) to reset all alarm indicators.
2. In actual gas condition, the display (19) will show last sampled concentration. In simulated gas condition, the display (19) will normally reset to 0 unless a concentration is detected.
3. When the unit is above scale, the display (19) will show xxx + ppb/ppm, e.g.: AsH₃ above full scale is 150 + ppb; Cl₂ above full scale is 1.50 + ppm.

A.5 Chain of Custody Procedure

DIVISION OF AIR QUALITY TOXICS PROTECTION BRANCH

STANDARD OPERATING PROCEDURES

ATAST CHAIN OF CUSTODY

OBJECTIVE:

The objective of the ATAST Standard Operating Procedure for sample Chain of Custody is to standardize the handling and shipment of air samples. This standardization will enable the branch to maintain quality control and sample integrity.

FILING OUT COC FORMS

On the Chain of Custody Form fill it out as follows.

1. fill out the number of pages at the top right hand corner
2. Fill the project(i.e. purpose collection)
3. To the right of the project (C.O.C. Sealed by:) Name, date and time sealed.
4. Name of the site follows
5. If canisters were sealed in the lab before shipment then the person who breaks the seal fills the space next to the site.
6. The number on the canister goes in the space under Canister No.
7. COC No refers to the numbers on the yellow seals or the numbers on the metal seal.
8. Sample No is Sample number assigned in the field. For Waste oil sample it is the Regional office initials followed the month, day, year 01 for the first sample.(i.e. the day the sample is collected).
9. Lab No is lab number we assign when the samples are logged in once the samples are received in the lab.
10. Sample media can be air or oil.
11. Dates refer to sampling dates.
12. Start time and end time refer to period the sample was collected.
13. Analysis can be type of analysis required.
14. Relinquished by and to is signed by the sample collector and the recipient.
15. Split sample refers to duplicate samples that are collected.

PROCEDURE:

1. Sealed sample Chain of Custody form (Attachment A) should be completed in the following instances:
 - Sample canister sealed for shipment from the laboratory to the field prior to sampling occurrence.

- Sample canister sealed for shipment from the field to the laboratory subsequent to sampling occurrence.
 - Sample canisters sealed for shipment to or from contract laboratories, regional offices, etc.
2. Individual canisters are sealed with a chain of custody seal and valve lock prior to initial shipment and again after sampling on return to the laboratory.
 3. Chain of Custody form is completed by documenting project name, name of person initiating the sealed custody, and the date/time of canister sealing. All canisters being shipped must be listed on the form.
 4. Signatures of all individuals involved in sample canister transfer must be included on the COC form. Sampling date, time, and duration are also listed on this form.
 5. A new Chain of Custody begins as field samples are removed from the sampling system and transferred to the laboratory.

SAFETY

Special care should be taken when handling the metal COC seal to prevent any accidental cuts.

NOTES:

Due to unique circumstances in recent ATAST investigations miscellaneous modifications and enhancements were made to this procedure. Any modifications and enhancements will be detailed in an attached addendum.

Appendix B. Chain of Custody Form (COC)

North Carolina Department of Environment & Natural Resources

Division of Air Quality

ATAST Investigation #:
Investigation/Study Site:
COC Sealed By/Date & Time:
COC Sealed By/Date & Time:

Toxics Protection Branch Laboratory

1403 Reedy Creek Road

Raleigh, NC 27607

919-733-9777

Fax: 919-715-0890

Canister #	Batch #	Canister Pressure			Sample Information			Sample Type	ATAST COC #	COC Broken By/Date & Time
		Lab Check	Sample End	Field/Lab Verify	Date	Start Time	End Time			

Relinquish By:				Relinquish To:			
Print Name	Signature	Date	Time	Print	Signature	Date	Time

Misc. Notes:

COC Sealed By/Date & Time: 1st signature and date & time of sealed sample chain of custody to the field. 2nd signature and date & time of COC to the lab.

Relinquish By & To: Printed name & signature of personnel relinquishing/receiving the sample canister(s), not breaking the COC.

Lab Check: Canister pressure checked at Toxics Laboratory prior to transport to field.

Sample End: Canister pressure checked in field after sampling period.

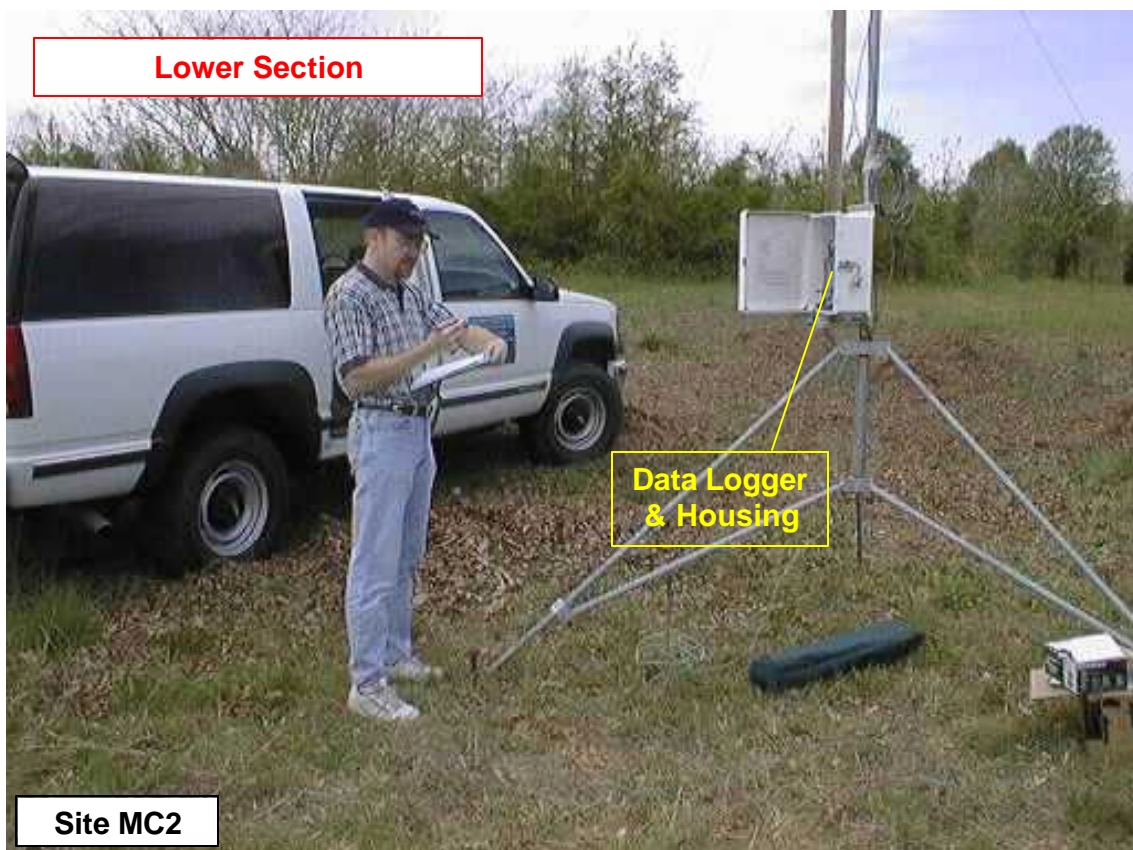
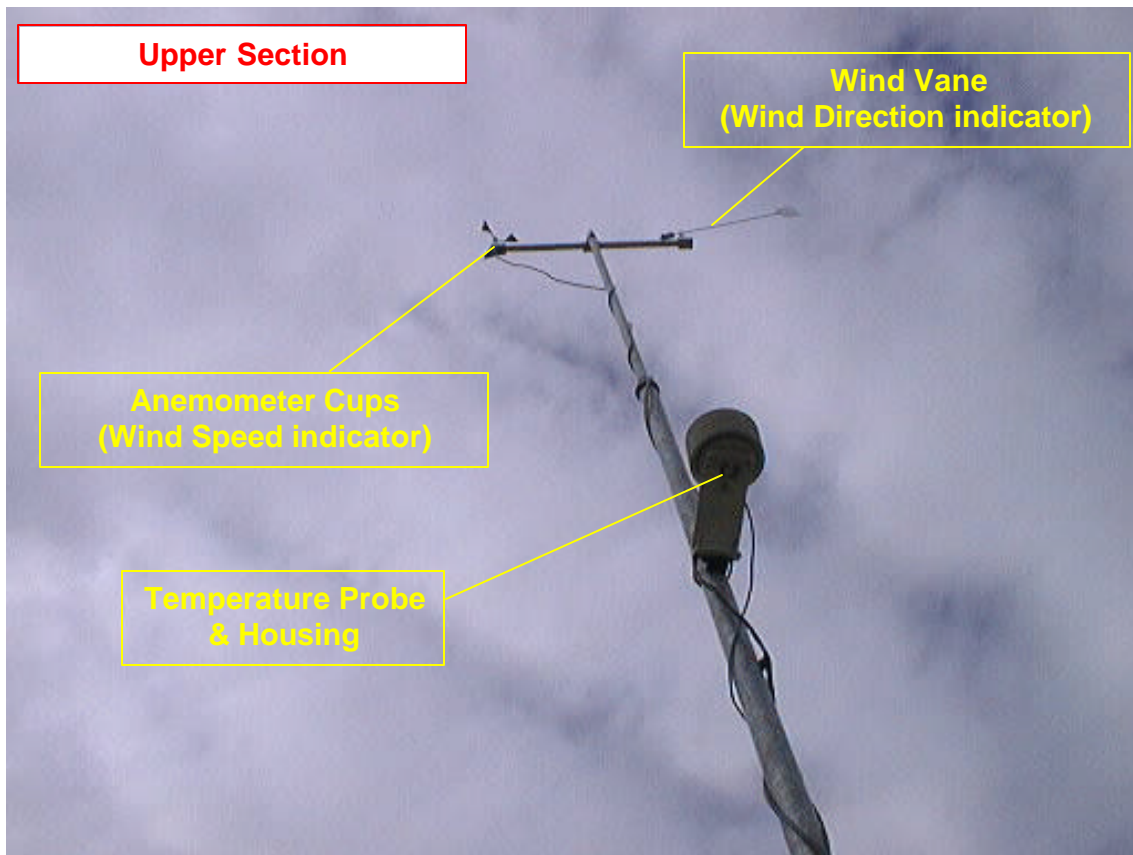
Field/Lab Verification: Canister pressure checked in the field prior to sampling or checked at Toxics Laboratory after field sampling.

Sample Type: Denote type of sample (Grab/24 hour/12 hour/8 hour etc.)

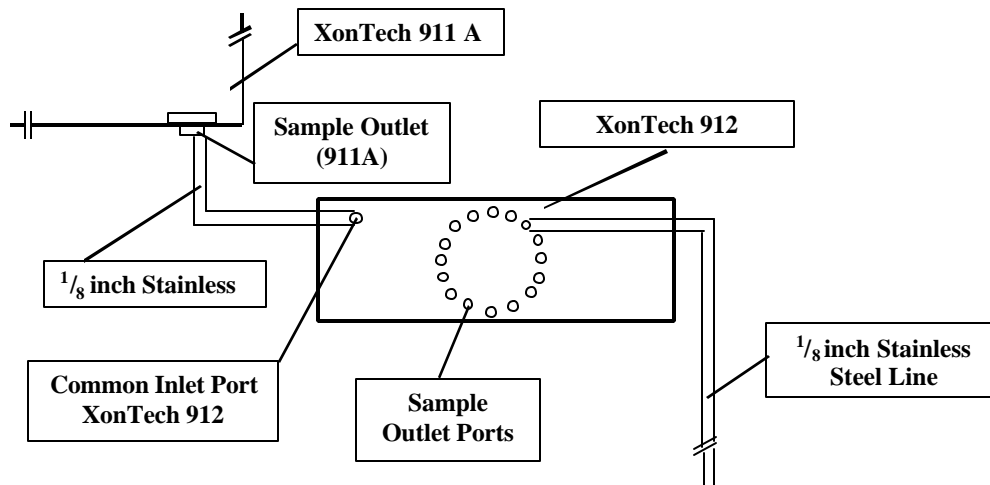
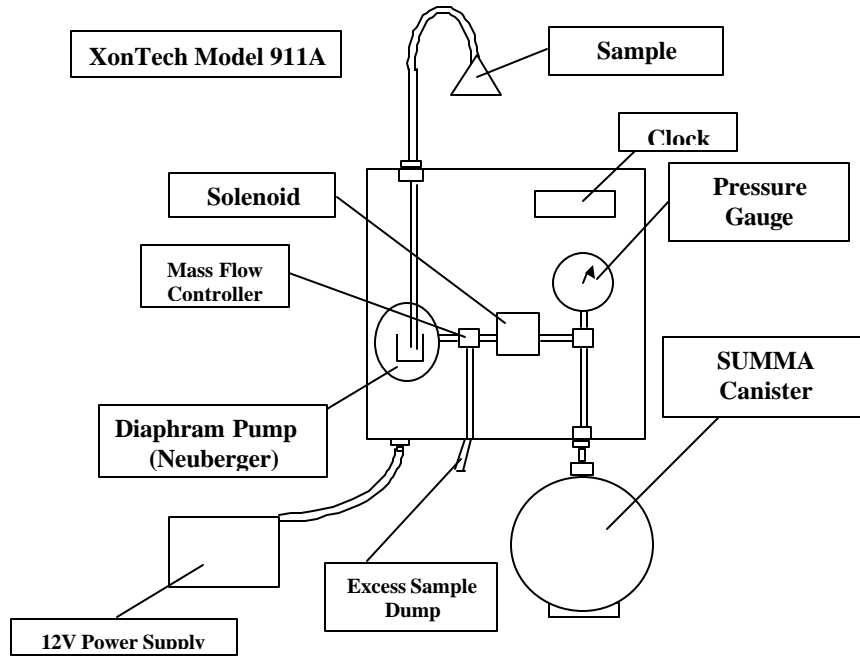
COC Broken By/Date & Time: Signature of personnel that 'breaks' the COC for that particular canister with date & time.

Appendix C. Equipment Diagrams and/or Photos

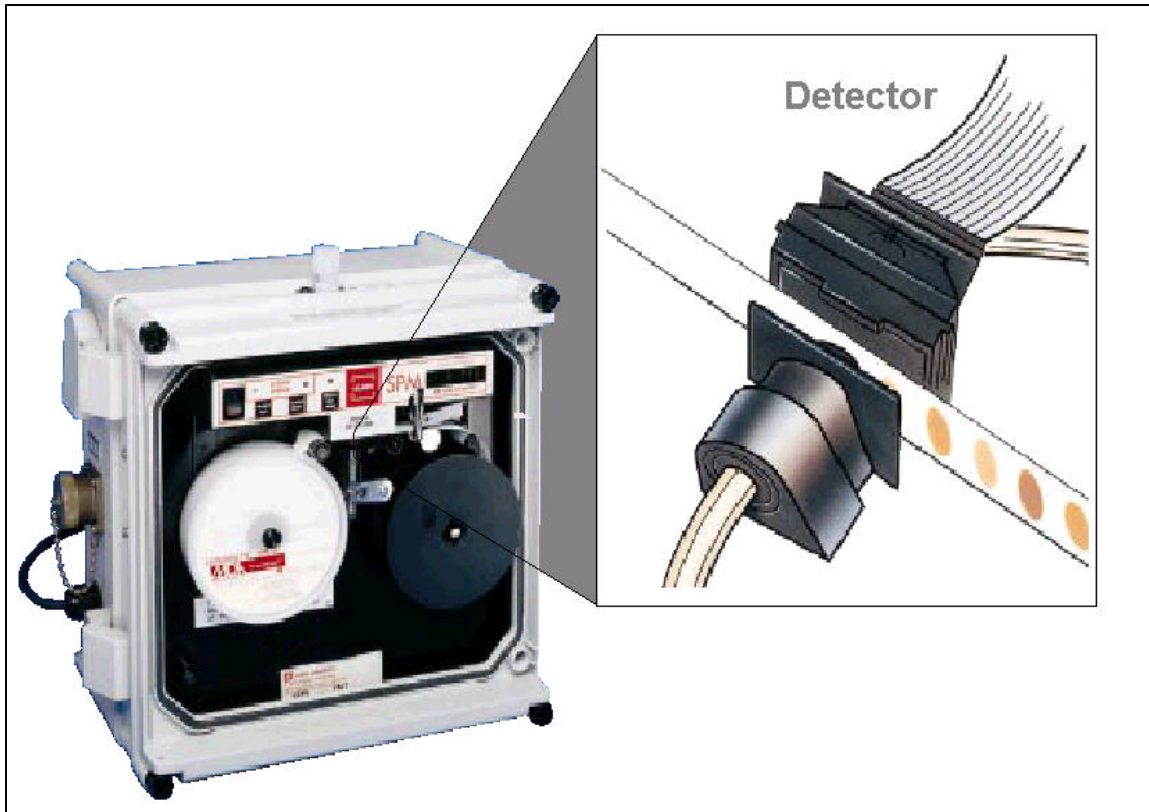
C.1 Meteorology Station (typical configuration)



C.2 XonTech 911/912 Sampling System

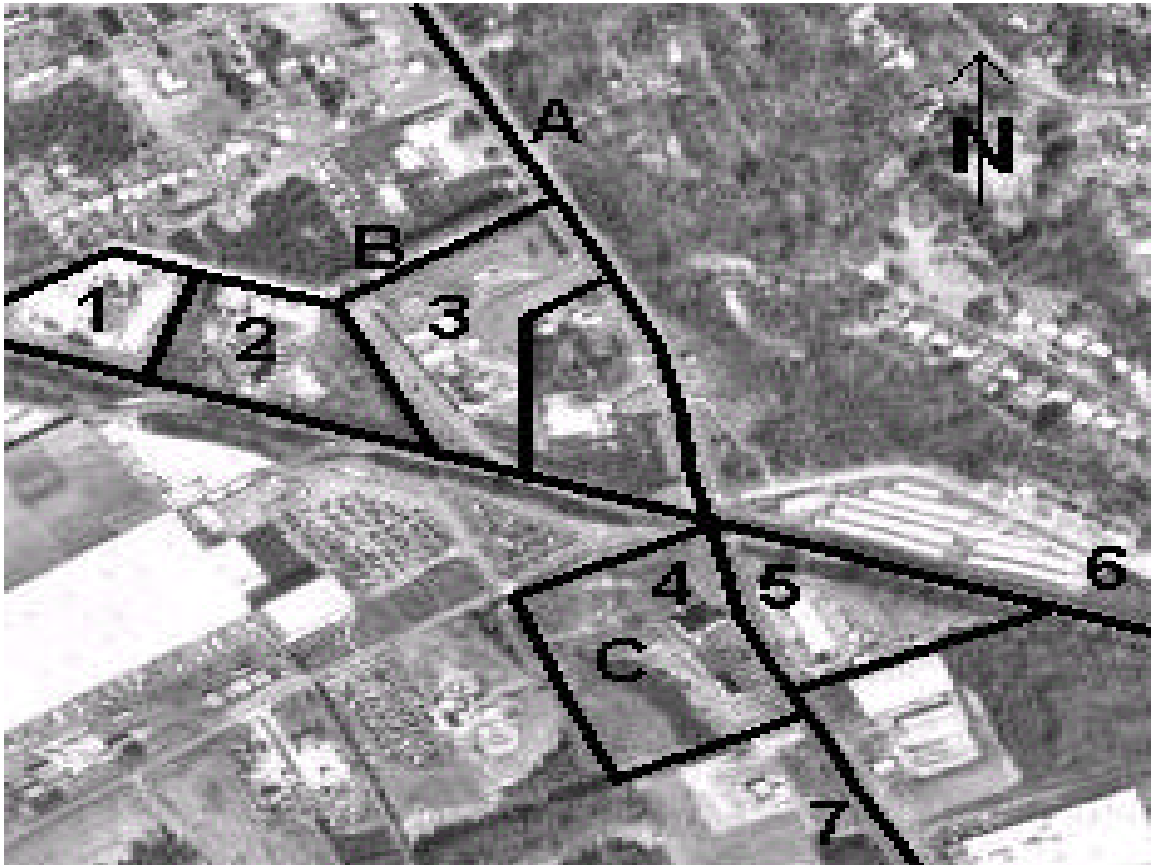


C.3 Zellweger Tapemeter



Appendix D. Map of Area and Site Photos

D.1 Map of the Area



Salisbury Study Area. Aerial View of the Salisbury Monitoring study area showing the monitoring stations (A [Cul-de-sac], B [Access Road], C[Remediation site]), asphalt plants (2, 3), concrete plant (1), remediation sites (4, 5), Southern Railway (6), and Jake Alexander Boulevard (7).

D.2 Site 1 – Cul-de-Sac



D.3 Site 2 – Access Road



D.4 Site 3 – Remediation Site

