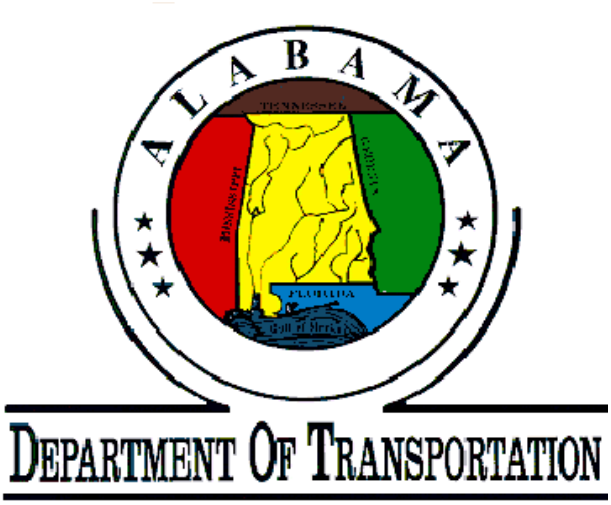
Addendum 09 – Revision 1
Ambient Air and Soil Vapor Monitoring

Coliseum Boulevard
Plume Investigation



February 20, 2002
Revised – April 26, 2002

Submitted to:
The Alabama Department of Environmental Management
Montgomery, Alabama

1.0 Introduction

Protection of public health has been a fundamental aspect of the Coliseum Boulevard Plume investigation since its inception. Soil vapor testing was conducted in 2000 as part of investigations at the Coliseum Boulevard Plume site. A deep and a shallow implant were constructed in the surficial sandy clay and in the unsaturated sands, respectively, along the traverse defined by the intersections of Fairground Road with Broadway Street, Chisholm Street, and Gardendale Drive and the intersection of East Park Avenue with Chelsea Drive. These implants were installed so that the concentrations, if any, of trichloroethylene (TCE) within the unsaturated parts of the sand could be compared to the concentrations of TCE, if any, in the overlying sandy clay. TCE concentrations were detected in the unsaturated sands at Fairground Road and Broadway Street, at Chisholm Street, and at Gardendale Drive. TCE was also detected at much lower concentrations in the unsaturated sands at the intersection of East Park Avenue with Chelsea Drive.

Only the two shallow samples at the intersection of East Park Avenue with Chelsea Drive yielded detectable concentrations of TCE in the surficial sandy clay. The investigators were unable to explain the results at these locations and suggested further studies.

Both these results and the evaluations conducted using the USEPA endorsed Johnson and Ettinger model (JEM) indicate limited, if any, penetration of the surficial sandy clay layer by TCE vapors. As a result, the estimated health risks were markedly smaller than the USEPA acceptable risk level. Results of the Johnson and Ettinger model runs are included in Appendix A.

Recent test data from certain areas of the groundwater plume have indicated higher levels of TCE than previously discovered. In addition, the Alabama Department of Environmental Management (ADEM) has indicated that additional soil vapor work is required. Therefore, the Alabama Department of Transportation (ALDOT) proposes a combination of ambient air, crawl space air and soil vapor monitoring to confirm the earlier testing and modeling results, while assuring that a broader array of conditions is more thoroughly studied.

2.0 Project Concept

This project plan has been designed to determine whether TCE or its degradation products have impacted, or have the potential to impact, air quality within the Coliseum Boulevard Plume. Based on input from ADEM, ALDOT has selected up to forty-five (45) locations for testing. The testing will be conducted in groups or sets of fifteen (15) locations at a time. The locations were selected based on multiple factors including:

1) TCE concentration in ground-water
2) Depth to ground-water from the land surface
3) Thickness of the surficial clay and
4) House construction type (i.e., conventional foundation, concrete slab, etc.)

Figures 1-4 visually depict these factors at the CBP site.

As part of the sample collection activities, ALDOT will collect meteorological data at a standard meteorological station erected on ALDOT property. The data will include barometric pressure, temperature, wind direction and velocities, relative humidity and precipitation. In so far as is practical, we will collect air and soil gas samples during a period of relatively low barometric pressure. Any volatile organic compounds present in the groundwater would be more likely to migrate to the land surface at that time. Thus, although not guaranteed, this approach will seek to measure potential air quality impacts in a worst-case scenario.

2.1 Definitions

To provide for a consistent use of terms as this discussion continues, the following definitions apply:

Open Crawlspace – is defined as an area underneath a house that is freely accessible and where the atmosphere is readily affected by external factors (e.g., wind).

Enclosed Crawlspace - is defined as an area underneath a house that is not freely accessible and where the atmosphere may not be readily affected by external factors (e.g., wind). This type of crawlspace may be enclosed by plywood, removable panels, etc.

Closed Crawlspace – is defined as a void or sand-filled space between the floor joists and the original land surface enclosed by a solid foundation wall constructed of block, brick, stone, or concrete irrespective of venting.

Slab-on-grade – is defined as a house built directly on a concrete slab poured on the surface of the land.

There will be some structures of mixed construction. Sampling procedures for these structures will be evaluated on a case-by-case basis.

2.2 Information Gathering

2.2.1 Property Surveys

The forty-five (45) candidate locations for testing are shown in Table 1. Prior to testing, ALDOT will develop information on the ownership and physical characteristics of each property. Each resident and the owner or owner's legal representative will be contacted by representatives of ALDOT who will explain the program, gather information using the Questionnaire attached as Appendix B, and get signed access agreements permitting sampling on their property.

2.2.2 Property Screening

This property survey and occupant survey data will be reviewed and non-candidate houses will be removed from the sampling list. Removal will be based upon the following:

- Inability to contact residents and/or owners
- Inability to procure a signed access agreement
- Property conditions that might result in confounding data (e.g., chemicals stored in or under the house, evidence of motor oil or other chemical discharge into the ground)

2.3 Sampling Plan

This project will be initiated within two weeks of approval of this sampling plan proposal. The implementation schedule is outlined in Section 4. The project includes the following components:

- Owner notification and property surveys of each selected lot
- Public meeting for all area residents
- Occupant and owner survey and procurement of an access agreement
- Installation of soil vapor implants or probes
- 1 Summa canister sample taken from the crawlspaces plus 10% duplicate samples
- 1 ambient air sample in each yard
- 1 or 2 shallow soil gas test in each yard
- 4 wind rose ambient air samples and 2 breathing zone open air samples

The air and soil vapor samples will be collected over a period of twenty-four (24) hours. The goal is to sample and analyze the air within the crawlspace, the soil gas, the ambient air in the yard, the air and soil gas under and around the selected houses, and ambient air at other central locations.

The shallow soil gas will be sampled at each home according to the methods in the Appendix D protocol. Where a soil gas sample is not collected at the same time as the crawlspace space air sample under or

near the house, a repeat crawlspace air sample will be taken in approximately 30 percent of the cases.

Details of the project quality control program are presented in the Data Integrity Plan in Appendix C.

3.0 Data Evaluation and Report

The air and soil gas samples will be analyzed according to the modified USEPA TO-14A Method described in Appendix C. After a sufficient number of sample results have been received, correlations among the soil gas, ambient air, and the crawlspace samples, the geology (i.e. clay thickness and type), the plume depth and the concentrations of TCE in the groundwater will be evaluated. The data will be evaluated to determine whether the concentrations of TCE in the groundwater can be used to predict potential effects on specific properties and associated structures, if any. The ALDOT will review the results of these evaluations with ADEM and the Alabama Department of Public Health **(**ADPH**)** to determine what, if any, actions will be needed to protect the public health. If any of the results of the air samples collected from crawlspaces or ambient air exceed 20 ppbv (ADEM Air Division screening level), ALDOT will sample indoor air at those houses. At the conclusion of this project, a report will be prepared that describes all of the above activities.

4.0 Implementation Schedule

Upon acceptance of this document by the ADEM, the ALDOT is prepared to initiate the work described herein within 14 days. Upon approval, we will begin notifying residents of a public meeting and contacting owners of the initial fifteen (15) selected sites.

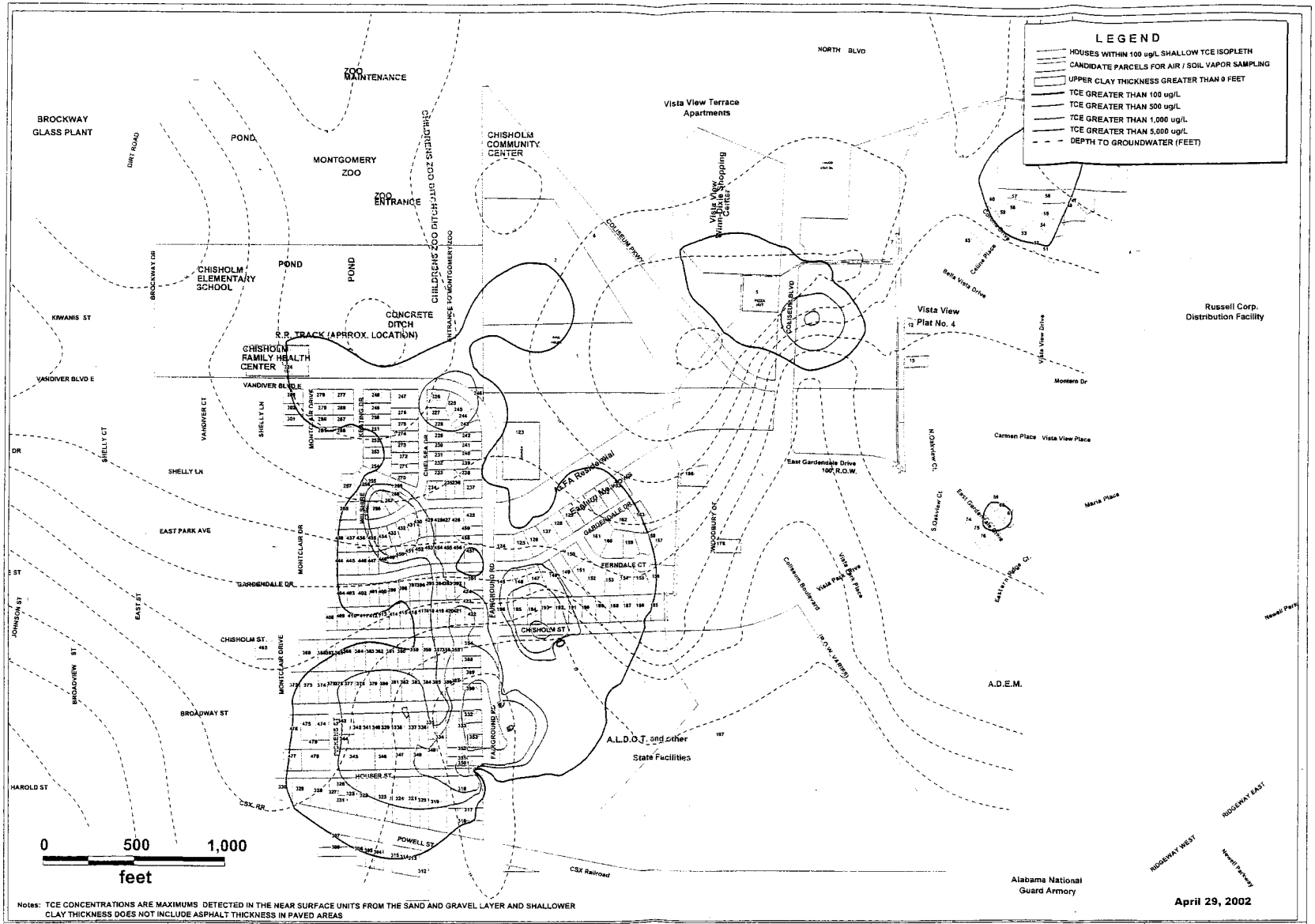
Following the public meeting and receipt of signed access agreements, we will set up sampling equipment at three (3) to five (5) locations per day, thus, sampling at each set of fifteen (15) locations should take about one

(1) week. The second week will be for equipment decontamination and repair, before resuming sample collection at the second set of fifteen (15) houses. The third set will be scheduled, if any ambient air or crawlspace concentrations exceed the 20ppbv screening level, following review of the results. Initiation of sampling activities will be based on the success of completing the property surveys and obtaining property access agreements.

ALDOT proposes to conduct the sampling during three (3) different events, based on seasonal variations. A summary report of activities will be submitted to the ADEM within 45 days of receipt of all final analytical data generated as part of this investigation.

Table 1.
Coliseum Boulevard Plume
Alabama Department of Transportation
Proposed Air Sample Locations

Priority	Parcel ID	Street Address
1	390	3705 Fairgrounds Road
2	332	3667 Fairgrounds Road
3	389	3709 Fairground Road
4	333	406 Broadway Street
5	353	3655 Fairgrounds Road
6	352	3651 Fairgrounds Road
7	351	3647 Fairgrounds Road
8	387	409 Broadway Street
9	234	4002 Chelsea Drive
10	270	4001 Chelsea Drive
11	430	446 Park Avenue
12	266	425 Park Avenue
13	63	1713 Celina Place
14	129	517 Gardendale Drive
15	131	529 Gardendale Drive
16	434	430 Park Avenue
17	436	422 Park Avenue
18	226	4036 Chelsea Drive
19	248	4058 Keating Drive
20	388	3713 Fairgrounds Road
21	401	426 Gardendale Drive
22	364	414 Chisholm Street
23	393	458 Gardendale Drive
24	399	434 Gardendale Drive
25	358	508 Chisholm Street
26	338	328 Broadway Street
27	345	19 Houser Street
28	477	319 Houser Street
29	463	336 Chisholm Street
30	305	2112 Powell Lane
31	447	427 Gardendale Drive
32	273	4019 Chelsea Drive
33	408	409 Chisholm Street
34	413	429 Chisholm Street
35	324	10 Houser Street
36	319	2 Houser Street
37	380	539 Broadway Street
38	163	554 Gardendale Drive
39	Chisholm Church of Christ	
40	Family Health Center	
41	194	609 Chisholm Street
42	166	3828 Woodbury Court
43	176	3813 Woodbury Court
44	12	1625 Celina Place
45	15	1607 Celina Place
46	148	512 Gardendale Drive



Notes: TCE CONCENTRATIONS ARE MAXIMUMS DETECTED IN THE NEAR SURFACE UNITS FROM THE SAND AND GRAVEL LAYER AND SHALLOWER CLAY THICKNESS DOES NOT INCLUDE ASPHALT THICKNESS IN PAVED AREAS

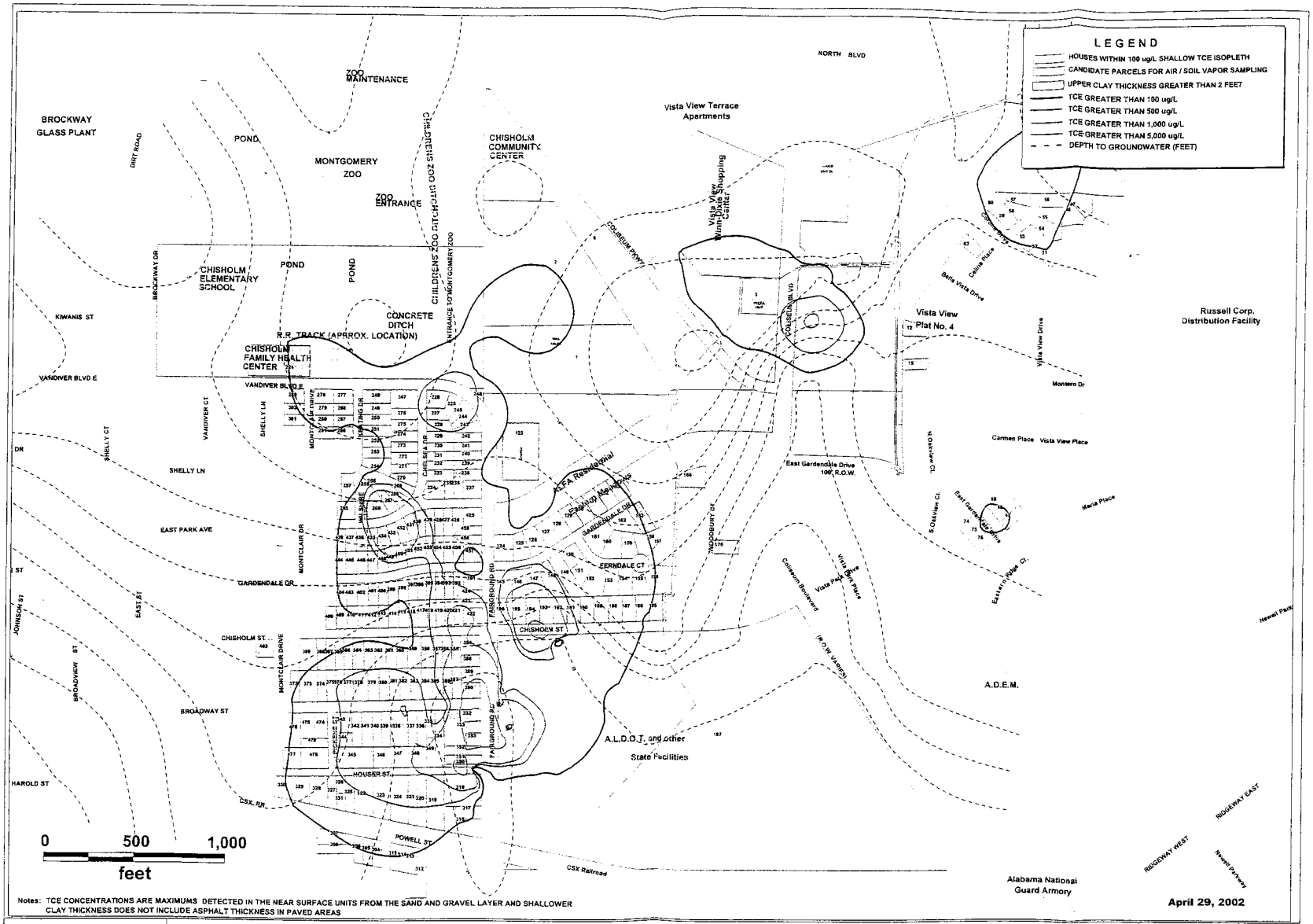
April 29, 2002

MALCOLM PIRNIE

ALABAMA DEPARTMENT OF TRANSPORTATION
COLISEUM BOULEVARD PROJECT

CANDIDATE PARCELS FOR AIR / SOIL VAPOR MONITORING NEAR SURFACE CLAY THICKNESS EXCEEDING 0 FEET

Department Of Transportation

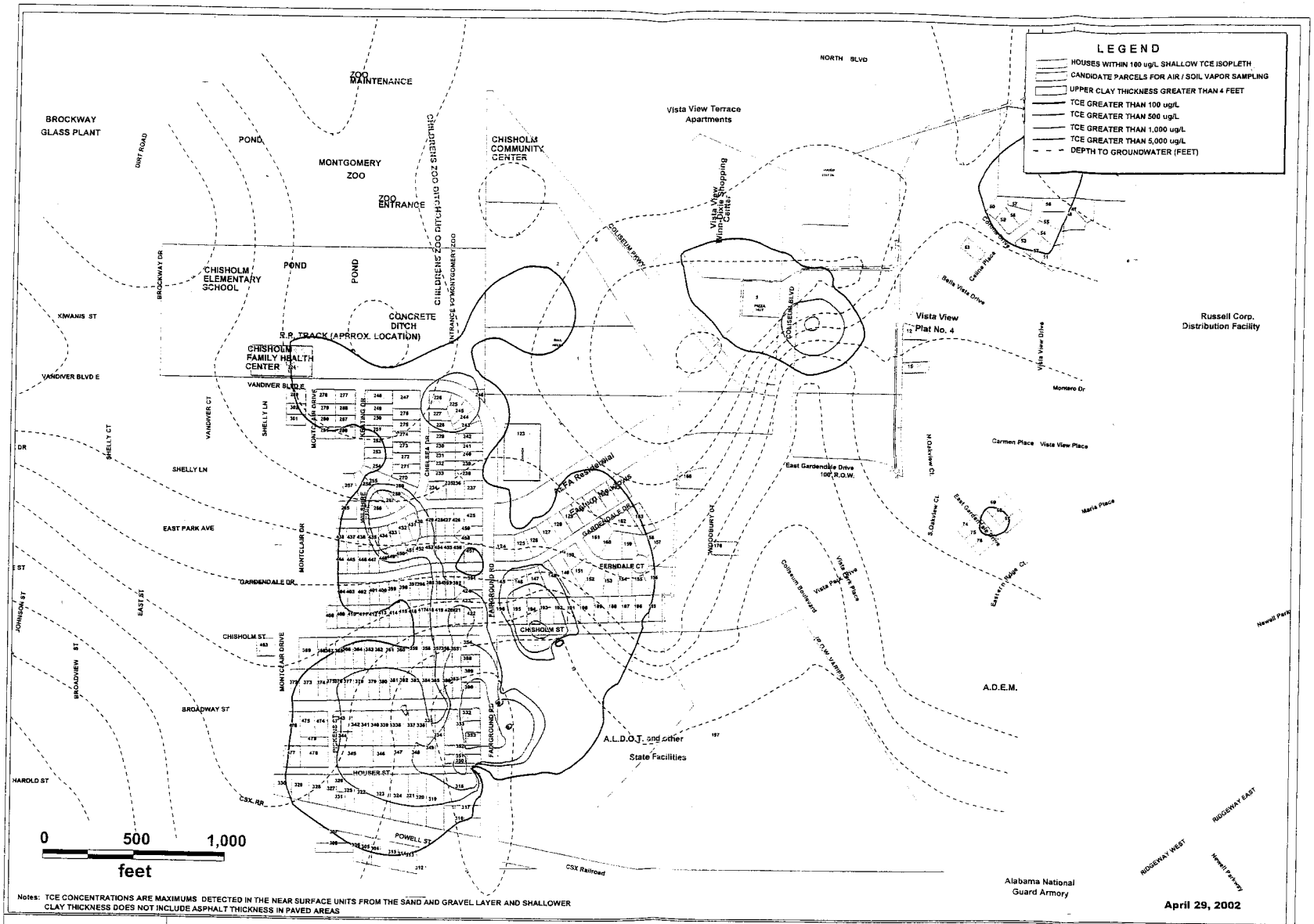


MALCOLM PIRNIE

ALABAMA DEPARTMENT OF TRANSPORTATION
COLISEUM BOULEVARD PROJECT

CANDIDATE PARCELS FOR AIR / SOIL VAPOR MONITORING
NEAR SURFACE CLAY THICKNESS EXCEEDING 2 FEET

DEPARTMENT OF TRANSPORTATION



Notes: TCE CONCENTRATIONS ARE MAXIMUMS DETECTED IN THE NEAR SURFACE UNITS FROM THE SAND AND GRAVEL LAYER AND SHALLOWER CLAY THICKNESS DOES NOT INCLUDE ASPHALT THICKNESS IN PAVED AREAS

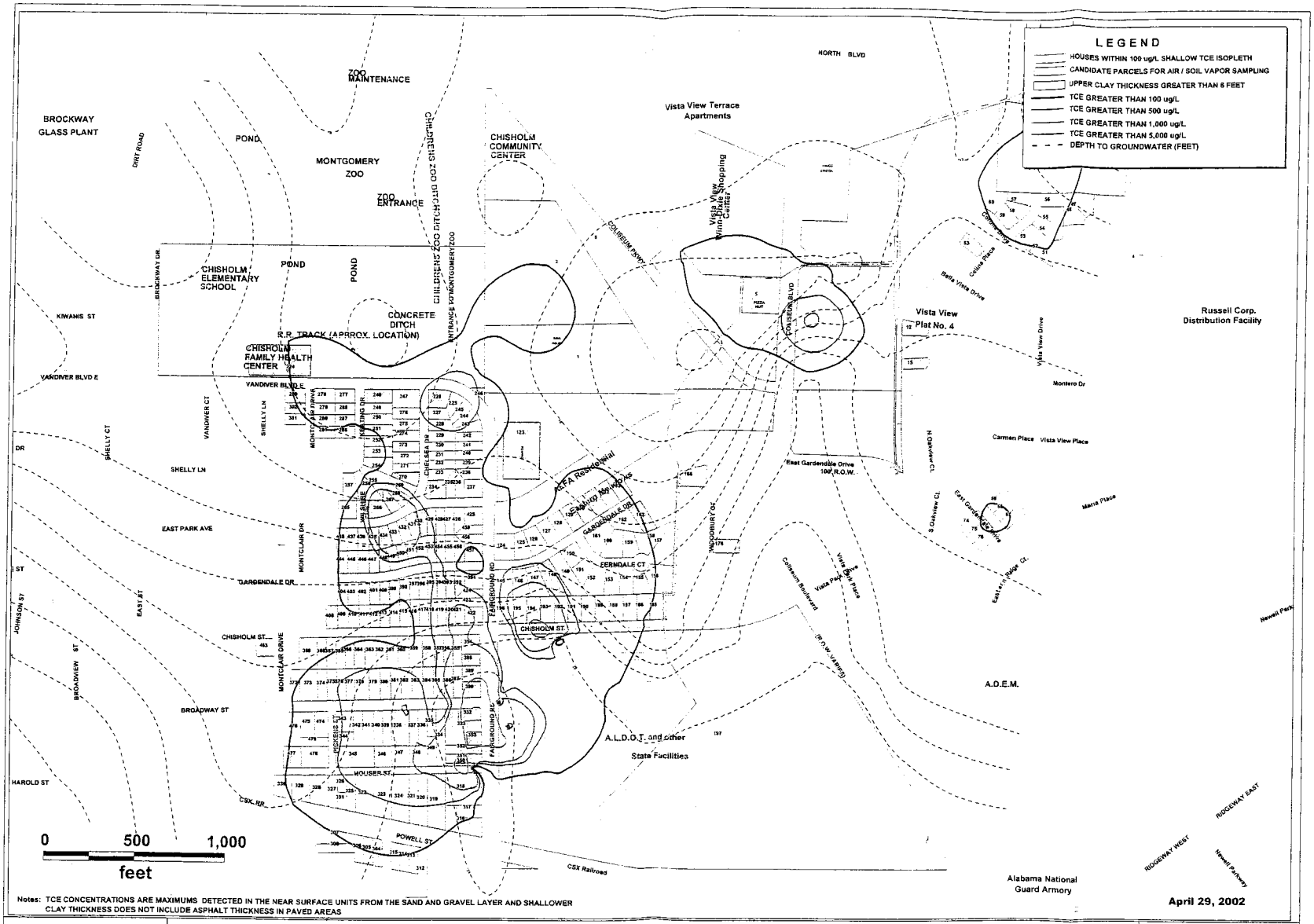
April 29, 2002

MALCOLM PIRNIE

ALABAMA DEPARTMENT OF TRANSPORTATION
COLISEUM BOULEVARD PROJECT

CANDIDATE PARCELS FOR AIR / SOIL VAPOR MONITORING NEAR SURFACE CLAY THICKNESS EXCEEDING 4 FEET

ALABAMA DEPARTMENT OF TRANSPORTATION



Notes: TCE CONCENTRATIONS ARE MAXIMUMS DETECTED IN THE NEAR SURFACE UNITS FROM THE SAND AND GRAVEL LAYER AND SHALLOWER CLAY THICKNESS DOES NOT INCLUDE ASPHALT THICKNESS IN PAVED AREAS

April 29, 2002

MALCOLM PIRNIE

ALABAMA DEPARTMENT OF TRANSPORTATION
COLISEUM BOULEVARD PROJECT

CANDIDATE PARCELS FOR AIR / SOIL VAPOR MONITORING NEAR SURFACE CLAY THICKNESS EXCEEDING 6 FEET

DEPARTMENT OF TRANSPORTATION

Appendix A—Johnson and Ettinger Model Evaluation

Malcolm Pirnie, Inc. (Malcolm Pirnie) conducted a model evaluation of potential trichloroethylene (TCE) vapors in the indoor air of residential buildings using the Johnson and Ettinger model (JEM). This evaluation was conducted at the request of the Alabama Department of Transportation (ALDOT) for the Coliseum Boulevard Plume (CBP) site located in Montgomery, Alabama.

A computerized version of the JEM, prepared by the United States Environmental Protection Agency (USEPA), was used for this effort. The JEM, which is a screening-level model, incorporates both convective and diffusive mechanisms for estimating the transport of contaminant vapors emanating from either subsurface soils or groundwater into indoor spaces located directly above or in close proximity to the source of contamination. The JEM can model up to three soil strata between the soil surface and the top of contamination. Inputs to the JEM include physicochemical properties of the chemical, saturated and unsaturated zone soil properties, and structural properties of the building.

This document presents model results using information provided to the Malcolm Pirnie JEM modeler(s) in June 2001 and April 2002. The June 2001 model was based on a groundwater TCE concentration of 8,640 μg/L (the maximum detected shallow groundwater concentration up to June 2001) with a range in surficial sandy clay thickness of up to 20 feet, range in the depth to groundwater up to 20 feet below land surface (bls), and multiple lithologies present at the site. Model assumptions for the June 2001 analysis were based on general site conditions and were not specific to any one area of the CBP site.

In late 2001 through April 2002, numerous additional soil conductivity measurements and groundwater samples were collected throughout the CBP site. The April 2002 model was based on the maximum TCE shallow groundwater concentrations in the Wilshire and Chelsea Drive area (300 μg/L and 1,200 μg/L) with surficial sandy clay variation between 0.5 to 1.8 feet. The depth to groundwater in this area is approximately 13 feet bls. Table 1 presents a list of model inputs for both the June 2001 and April 2002 JEM evaluations. Figure 1 depicts the Wilshire and Chelsea Drive area with the "thin" surficial sandy clay, shallow depth to groundwater, and elevated TCE concentrations.

The indoor air calculations are based on a residence construction with a slab-on-grade foundation. For each model run, the relative thickness of each soil layer and the associated soil properties (i.e., bulk density, total soil porosity, and soil water-filled porosity) were obtained from site-specific data collected by TTL, Inc.

Table 1

JEM Model Assumptions

Model Run	Maximum Shallow Groundwater TCE Concentration μg/l	Depth to Groundwater ft.	Lithology		
			Surficial Sandy Clay Thickness ft.	Silty Sand Thickness ft.	Sand Thickness ft.
1	8,640	20	0-8	8-11	11-20
2	8,640	7	0-7	N/A	N/A
3	8,640	7	0-4	4-7	N/A
4	8,640	15	0-2	2-15	N/A
5	300	13	0-0.5	0.5-13	N/A
6	1200	13	0-1.8	1.8-13	N/A

Note: N/A – Not applicable

The estimated indoor air concentrations from the JEM were used in conjunction with exposure parameters for adult and children receptors and toxicological criteria for TCE to estimate potential health effects from exposure to TCE via inhalation. The exposure parameters, obtained from USEPA guidance, are provided in Table 2:

Table 2

JEM Model Exposure Parameters

Exposure Parameter	Adults	Children
Inhalation rate (m^3/hour)	0.55	0.31
Exposure time (hours/day)	16.4	16.4
Exposure frequency (days/year)	350	350
Exposure duration (years)	30	6
Body weight (kg)	70	15
Averaging time (days) noncarcinogenic / carcinogenic	10,950 / 25,550	2,190 / 25,550

The USEPA has not established verified toxicological criteria to evaluate the noncarcinogenic effects of TCE. In addition, the USEPA has withdrawn its carcinogenicity assessment of TCE. A provisional toxicological criterion (6E-03 per mg/kg-day), obtained previously from the USEPA's National Center for Exposure Assessment (NCEA), is used to evaluate the potential for increased cancer risk from inhalation of TCE. The NCEA has recently withdrawn its recommendation of this provisional criterion and is now recommending new provisional criteria to assess both the potential for noncarcinogenic health effects and cancer risk based on their reassessment of TCE toxicity. As these criteria are in an external review draft of the TCE reassessment, they have not been used in this analysis.

The estimated cancer risks for adult and children receptors for each model run are provided in Table 3:

Table 3

JEM Model Results

Model Run	Maximum Shallow Groundwater TCE Concentrations ug/l	Cancer Risk	
		Adult	Children
1	8,640	4E-07	2E-07
2	8,640	5E-07	3E-07
3	8,640	8E-07	4E-07
4	8,640	1E-06	8E-07
5	300	2E-07	8E-08
6	1,200	2E-07	1E-07

Appendix B—Questionnaire

GENERAL:

To accurately assess the results from the air monitoring, information about the occupants' use of the house is needed. A questionnaire and personal data sheet have been developed and divided into two parts—Primary and Follow-Up. An initial list of information (Part A-Primary) will be developed prior to the first round of testing at any house. If a target level is met or exceeded from the air monitoring, then it may become necessary to conduct air monitoring inside the houses. In this event, additional information and screening may be needed which will be obtained through the Follow-up list (Part B).

Primary Data Sheet

Date/Time:_____

Occupant name:_____

Street Address:_____ Zip:_____

Phone Number:_____

Contact time:_____

Talked with:_____ Male ( ) Female( ) Adult: Y ( ) N ( )

Language barrier: Y ( ) N ( ) Describe:_____
_____

Will the occupant participate in survey/monitoring? Y( ) N( ) If no, discussion:
_____
_____

Length of time at residence:_____ Foundation type:_____

Number of individuals currently living at this location:_____

Does the occupant own the property? Y ( ) N ( ) If no, please answer the following:

Owner name:_____

Owner mailing address:_____

_____

Owner phone number:_____

Associated with First Round Sampling

Check List for Air Quality Screening:
(Primary)

Please Answer Each Question or Check Each Item Applying to Residence or Occupant:

1. **Has the exterior or any interior room(s) been painted since January 1, 2001?**

   YES ( ) NO ( ) If Yes, please describe: _____

   _____

2. **Does The Occupant Use Cleaning Compounds in Such Activities As:**

Cleaning Firearms	**YES ( ) NO ( )**
Cleaning Car	**YES ( ) NO ( )**
Cleaning Lawn Mower Engines	**YES ( ) NO ( )**
Degreasing Compounds	**YES ( ) NO ( )**
WD40:	**YES ( ) NO ( )**
OTHERS:	**YES ( ) NO ( )**

   If Yes, please list:

   _____

   _____

3. **Has the Exterior of the Residence been cleaned of Molds or Mildew since January 1, 2001?**

   YES ( ) NO ( )

4. **Is there a Water Well on the Property? YES ( ) NO ( )**
   Is it in Use, How Many Years in Use? _____

5. **Is there a Septic Tank on the Property? YES ( ) NO ( )**
   Is It In Use, How Many Years in Use? _____

6. **What compounds or chemical containers have you stored or are currently storing in the crawlspace or basement?**_____
   _____

To Be Completed if Components Detected in First Round Only and Indoor Testing is Required.

Follow-up Data Sheet

Name	Age	M/F	Time at Residence

Name of previous residence owner or tenants:

Name:_____
Current Street Address:_____
Current City:_____
Period of ownership or occupation:_____

Name:_____
Current Street Address:_____
Current City:_____
Period of ownership or occupation:_____

Name:_____
Current Street Address:_____
Current City:_____
Period of ownership or occupation:_____

Other pertinent information that current occupant may have:_____

Check List for Indoor Air Quality:
(Secondary)

Please Answer Each Question or Check Each Item Applying to Residence or Occupant:

1. Does any occupant use air fresheners? **Yes ( ) No ( )**

2. Is a washer and dryer located in the residence? **Yes ( ) No ( )**

3. Do you use bleach in your laundry or for cleaning? **Yes ( ) No ( )**

4. Has any room been re-carpeted since January 1, 2001? **Yes ( ) No ( )**

5. Are pesticides used at the residence? **Yes ( ) No ( )**

6. Has the residence been treated for termites in the last 5 years? Yes ( ) No ( )

7. Are lawn care products used at the residence? **Yes ( ) No ( )**

8. Has any pet been treated for fleas or ticks? **Yes ( ) No ( )**

9. If a water well is located on the property and in use, are any chemicals used to disinfect the water? **Yes ( ) No ( )**

10. Do you use Products in Aerosol Cans Such As:

Hairspray	**Yes ( ) No ( )**
Deodorants:	**Yes ( ) No ( )**
Furniture Polish:	**Yes ( ) No ( )**
Cleaning Agents for Home:	**Yes ( ) No ( )**
Others:	**Yes ( ) No ( )**

11. If a septic tank is present on the property, are any chemicals used to maintain the septic systems? **Yes ( ) No ( )**

Appendix C—Data Integrity Plan

1.0 INTRODUCTION

The purpose of this investigation is to perform an assessment of this site to determine if vapors from the plume are penetrating the surficial sandy clay layer. The work is intended to investigate for the presence of contaminants of concern as a result of the plume. This will include taking air samples under selected houses located over the area of highest trichloroethylene within the plume as well as collection of soil gas samples adjacent to the location of the air samples. The constituents of concern are vinyl chloride (VC), trichloroethylene (TCE), chloroethane, 1,1-dichloroethylene, cis-1,2-dichloroethylene (c-1,2-DCE), and trans-1,2-dichloroethylene (t-1,2-DCE).

This Data Integrity Plan (DIP) has been prepared to address field sample collection procedures, laboratory analysis of samples, and data evaluation of the laboratory sample results. In addition, this DIP address all components that influence these processes and provides a detailed plan to ensure that decisions being made from the analytical data are valid, accurate, and usable in support of subsequent recommendation.

2.0 FIELD ACTIVITIES

Field activities for this project are discussed in the Work Plan and Appendix D. In addition, analytical methods are also outlined below and shall be requested and documented on the chain-of-custody record; however, in the event that the analytical laboratory selected cannot perform the methods identified, or, subcontract the samples to another analytical laboratory, alternate methods may be selected as long as the laboratory quality assurance/quality control (QA/QC) is performed in accordance with the published EPA methodologies.

3.0 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data to support decisions, and are developed to address specific procedures for collecting, analyzing, and evaluating results to meet overall project objectives. The project objectives and associated DQOs are discussed in the Work Plan and Appendix D.

3.1 Quality Assurance and Quality Control

Quality assurance and quality control checks will be utilized to ensure the data collected are scientifically sound, defensible, and of known acceptable documented quality. The field quality control procedures will include canister measurements and collection of duplicate samples. Quality assurance samples will be collected to compare analytical results from collecting a duplicate sample (soil gas, ambient air, and/or enclosed area air)

and submitting the samples to the confirmatory laboratory to compare with results obtained from the primary laboratory. The results from the two laboratories will be compared by calculating the Relative Percent Difference (RPD) for the samples.

Quality control procedures employed in the laboratory will include calibration checks, method blanks, duplicates, matrix spike/matrix spike duplicates, and laboratory control spikes.

The field samples will be accompanied to the laboratory by travel blank samples supplied by each laboratory. Travel blank sample results will be used to monitor cross-contamination during sample shipment.

Field precision will be assessed through the collection and measurement of replicate samples. Calculation of the RPD will be used to assess the quality of replicate data. Accuracy in the field will be determined through the use of field blanks and through adherence to all sample handling, preservation, and holding times as specified in the work plan. Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the field-sampling plan is followed and that proper sampling techniques are used.

4.0 SAMPLE DOCUMENTATION AND CHAIN OF CUSTODY

Sample custody during the field investigations will be completed in two phases. The first phase encompasses sample collection, pre-laboratory treatment procedures (preservation), packaging, and field custody procedures. The second custody phase involves sample shipment, method of shipment, and date and time documentation. Both phases of sample custody will be conducted to provide that:

- All samples are uniquely identified;
- The correct samples are tested and traceable to their source;
- Vital sample characteristics are preserved;
- Samples are protected from loss or damage; and
- A record of sample custody and integrity is established and maintained through the entire custody process.

4.1 Field Documentation

A bound field logbook will be maintained to record daily activities. Entries will be made in indelible ink and the pages will be consecutively numbered. Incorrect entries will be corrected by a single stroke through the error and will be verified with the recorder's initials and date of correction. Entries to the logbook will include:

- Date
- Start and finish times
- Summary of work performed (included samples collected)
- Names of personnel present

- Names of visitors
- Testing integrity of each Summa canister before and after sampling
- Observations and remarks

The following information will be recorded in the field logbook at the time of sampling:

- Sample designation
- Name of sampler
- Method of collection
- Time and date of sampling
- Type of sample
- Analyses
- Field measurements and canister integrity (if applicable)
- Observed conditions which may impact the chemistry of the sample

4.2 Photo Documentation

Progress photographs will be taken during the investigation. These photographs may include the sample itself, collection activities, and surrounding areas. Photographs taken to document sampling points should include two or more reference points to facilitate relocating the sample location at a later date.

4.3 Field Custody Procedures

All samples collected from the site must be identified with a sample label or tag and recorded on a chain-of-custody form. Indelible ink will be used to complete sample labels, then labels will be covered with clear plastic waterproof tape.

If an error is made on an accountable document, corrections should be made simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered on a document should be corrected by the person who made the entry. All corrections must be initialed and dated.

4.4 Sample Labels

Sample labels are required to include the following information:

- Site Name
- Sample Number
- Sample Type
- Sample Canister identification (ID)
- Date of Collection
- Time of Collection
- Sampler(s) Name

4.5 Sample Numbering

Each sample shall be identified using a unique sample number. A sample numbering system shall be developed subsequent to the initial site survey, which will be designed to reflect the sample location, sample type, and date of sample collection.

If conditions require resampling of a sample location (i.e., sample is not retrieved properly), the sample shall be labeled as described above with a "RESP" placed at the end of the sample number, indicating resampling had occurred.

4.6 Chain-of-Custody Record

The chain-of-custody provides an accurate written record that can be used to trace the possession and handling of the sample from the time of collection to analysis. The chain-of-custody form will be completed for each sample at the time of collection and will be maintained while shipping the sample to the laboratory. Each laboratory shall supply chain-of-custody records to the field sampling crew. The following information must be entered on the chain of custody form.

- Project number - enter the alpha-numeric designation that uniquely identifies the project site (e.g., 4197002);
- Project name – Coliseum Boulevard Plume Site;
- Signature of sampler(s);
- Sample number - enter the sample identification number for each sample in the shipment;
- Date - enter a six-digit number indicating the month, day and year of sample collection (MM-DD-YY, e.g., 02-25-2002);
- Time - enter a four digit number indicating the time of collection based on the 24-hour clock (e.g., 1300);
- Sample matrix - enter the matrix (e.g., air versus soil gas) of the sample;
- Parameters for analysis - enter the analytical method number for each sample collected;
- Remarks - enter any appropriate remarks.

5.0 Analytical Method

To identify the target constituents of concern analyzed using EPA Method TO-14A *"Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters With Subsequent Analysis By Gas Chromatography"* (January 1999).

5.1 Method Summary

A sample of ambient air is drawn through a sampling train comprised of components that regulate the rate and duration of sampling into a pre-evacuated specially prepared passivated canister. Upon closing the canister valve, the canister valve is closed. The air sampling is complete, the ID tag and chain-of-custody record are filled-out, and the

canister is transported to the laboratory for analysis. Upon receipt at the laboratory, the canister tag data is recorded, the chain-of-custody record completed, and the canister is attached to the analytical system. During analysis, water vapor is reduced in the gas stream by a dryer (Nafion, if applicable), and the VOCs are then concentrated by collection in a cryogenically-cooled trap. The cryogen is then removed and the temperature of the trap is raised. The VOCs originally collected in the trap are revolatilized, separated on a GC column, and then detected using a mass spectrometer (MS). The MS is located at the end of the GC column and is utilized to 1) detect a chemical compound and the 2) identify the chemical compound. Detection by MS is a destructive process that involves bombardment of a chemical compound with energy, which results in fragmentation of the chemical compound. Identification by MS occurs by comparing the fragmentation pattern of known chemical compounds that are stored in a computer database, or library, within the computer driven software.

The GC/MS allows positive compound identification, thus lending itself to more certain identifications than any other method. The MS may be operated in either the selected ion monitoring (SIM) mode or the SCAN mode. In the SIM mode, the GC is coupled to a MS programmed to acquire data for only specified ions and to disregard all others. This is performed using SIM coupled to retention time discriminators. In the SCAN mode, the GC is coupled to a MS programmed in the SCAN mode to scan all ions repeatedly during the GC run; this procedure serves as a qualitative identification and characterization of the sample.

For SIM operation, the MS is programmed to acquire data for a limited number of targeted compounds while disregarding other acquired information, however, while operating in the SIM mode, the MS provides lower detections limits, but its flexibility is limited. In the SCAN mode, however, the MS becomes a universal detector, often identifying compounds, which cannot be defensibly identified by any other approach. The GC/MS/SCAN provides positive identification, while the GC/MS/SIM procedure provides a more sensitive quantitation of a restricted "target compound" list. It is recognized within the industry, that even low concentrations of VOCs encountered in ambient air (typically less than 4 ppbv and the majority below 1 ppbv) can be satisfactorily determined in the SCAN mode.

After careful consideration of SIM and SCAN mode options available, it was determined that the SCAN mode would provide sufficient qualitative and quantitative accuracy of the project-specific constituents to satisfy the objectives of this program.

5.2 Interference, Limitation, and Corrective Action

The following discussion pertains to the known interference and limitation associated with collection and analysis of samples for Method TO-14A:

- Interferences will occur in sample analysis if moisture accumulates within the sample transfer system. The implementation of an automated cleanup procedure that periodically heats the system to approximately 100.^{0}C while purging with

zero air controls moisture buildup without jeopardizing sample integrity.

- Contamination may occur during sampling if canisters are not properly cleaned before use. In addition, other sources of contamination may occur from associated sampling equipment (pumps and flow controllers). All equipment must be thoroughly cleaned to ensure that the filling apparatus will not contaminate the samples. Each laboratory must adhere to the instructions for cleaning the canisters and certifying the field sampling system noted within Method TO-14A.

- Very volatile compounds, such as vinyl chloride, can display peak broadening and co-elution with other species if the compound is not delivered to the GC column in a small volume of carrier gas. To address this problem, refocusing of the sample after collection on the primary trap, either on a separate focusing trap or at the head of the GC column may mitigate this problem.

- Significant contamination of the analytical equipment can occur whenever samples containing high VOC concentrations are analyzed. This in turn can result in carryover contamination in subsequent analyses. In instances when a sample analyzed contains a high concentration (> 200 ppbv of a trace species on the quant report), it should be followed by an analysis of humid zero air to check for carry-over contamination. Each laboratory must perform the appropriate procedure at the bench and in-house corrective action policy prior to subsequent sample analysis. All related documentation must be maintained within the laboratory and submitted upon request.

5.3 Reagents and Materials

The following type and grade of materials must be used during analysis of the project samples:

- Gas cylinders of helium, hydrogen, nitrogen, and zero air must be ultrahigh purity grade, best source, and tested before use.

- Gas calibration standards – cylinders containing approximately 1 ppmv of each of the compounds must be prepared by dilution for NIST , traceable mixes.

- Cryogen – liquid nitrogen (bp – 196.^{0}C).

- Gas purifiers – connected in-line between, to remove moisture and organic impurities from gas streams (Alltech Associates, 2051 Waukegan Road, Deerfield, IL, 60015, or equivalent).

- Ultrahigh purity water (for humidifier), boiled immediately before use.

- Bromofluorobenzene (BFB) – used for verification of instrument performance, GC/MS (Matheson, or prepared from neat).

- Hexane/pentane – for cleaning sampling system components, reagent grade, best source.

- Methanol – for cleaning sampling system components, purge & trap grade, best source.

5.4 Canister Cleaning and Certification Requirements

5.4.1 Canister Cleaning and Certification with each Laboratory

Each laboratory must adhere to their in-house Canister Cleaning and Certification Procedures. For this project, the following is required:

- All canisters must be clean and free of any contaminants before sample collection.
- All canisters must be leak tested by pressurizing them to approximately 206 kPa (approximately 30 psig) with zero air.
- The canisters must be used in the field up to 30 days.

5.4.2 Canister Receipt in the Field

- Upon receipt of the Summa canister from the laboratory, the integrity of the canister will be checked by attaching a pressure gauge to the Summa canister and measuring the vacuum. The vacuum should read less than 28 in. Hg; if the canister vacuum does not meet this criterion, discard the canister and return the canister to the laboratory.
- Note the integrity and measurement on the Sample Collection Report Form.

5.4.3 Canister Receipt to the Laboratory

Each laboratory must perform and document the following procedures:

- The overall condition of each sample canister must be observed. Verify that each canister is accompanied with a sample identification tag. Complete the canister chain-of-custody record.

- Each canister is recorded in a dedicated laboratory notebook. Also, noted in the identification tag are date received and initials of recipient.

- The pressure of the canister must be checked by attaching a pressure gauge to the canister inlet. The canister valve is opened briefly and the pressure (in Hg) is recorded.

- Note the final cylinder pressure in the dedicated logbook.

5.5 Analytical Laboratory Selection Process

A formal selection process was implemented to ensure the analytical data generated for this project would consist of accurate, valid, and usable data to assist the recommendation process. The formal selection process consisted of the following three-phased approach: Phase 1) must maintain the appropriate certifications/accreditations; must be recognized within the industry for air analysis; must maintain a formal in-house QA/QC program which they adhere to; must adhere to the procedures cited within their laboratory standard operating procedure; and must be able to achieve the required detection limits; Phase 2) must have a sufficient amount of canisters, flow-controllers, and associated equipment in house; and must be able to meet the sample capacity and turn-around-time requirements requested; and Phase 3) review of information collected in Phase 1 and Phase 2 and a joint decision of the project team to select the laboratories. Other qualified laboratories may be used if either of the pre-selected laboratories are unable to meet the project schedule or capacity.

Coast-to-Coast Analytical Specialists, Inc (CCAS) and York Analytical Services were selected as laboratories for the project. The laboratories have recently performed MDL studies that are noted in Table 1 below:

Table 1: Laboratory MDLs

Target Compound	**CAS #**	**CCAS Laboratory MDL (cited from Feb 2002 SOP) (1,3)**	**York Laboratory MDL (year 2001) (2,3)**
Chloroethane (ethyl chloride)	75-00-3	0.98 ppbv	0.20 ppbv
1,1-Dichloroethene (vinylidene chloride)	75-35-4	0.20 ppbv	0.22 ppbv
cis-1,2-Dichloroethene	156-59-2	0.40 ppbv	0.26 ppbv
trans-1,2-Dichloroethene (4)		TIC search	TIC search
Trichloroethylene	79-01-6	0.23 ppbv	0.15 ppbv
Vinyl chloride	75-01-4	0.30 ppbv	0.24 ppbv

Notes:
(1) CCAS = Coast to Coast Laboratory.
(2) York = York Laboratory.
(3) ppbv = parts per billion by volume.
(4) The degradation compound, trans-1,2-dichloroethene is not commercially available and cannot be quantitated on the instrument; this compound will be identified via a library search (commonly referred to as a TIC search).

The MDL is a level at which the analytical procedure referenced is capable of determining with a 99% probability that the constituent is present. The procedure for determining the MDL includes the complete analytical procedure, including any sample preparation of the sample prior to analysis on the instrument. This procedure involves the replicate analysis (seven replicates as a minimum) of a sample with an analyte

concentration near, but greater than zero. The standard deviation at this concentration is calculated.

The Practical Quantitation Limit (PQL) establishes a limit with a higher level of precision than associated with the MDL, but does not represent the lowest achievable detection limit; the PQL typically serves as the reporting limit. The PQLs for this project are currently being developed.

5.6 Project Quality Assurance and Quality Control (QA/QC) Requirements

The total number, types of matrices, and sample locations are cited within the Work Plan document. The proposed number and frequency of QA/QC samples designed to address the overall quality of the sampling and analysis program are noted below.

Field Sample - The total sample collected at a specific site location. This sample may be any matrix and may be divided to provide material for QA/QC analysis.

Quality Control (QC) Samples - Samples analyzed to help identify potential problems related to sample collection or analysis. QC samples include duplicate and travel blank samples.

Quality Assurance (QA) Samples – QA samples represent approximately 10% percent of all field samples collected.

Matrix Spike/Matrix Spike Duplicates – A 6 liter Summa canister will provide a sufficient volume of air to be spiked, in the analytical laboratory, with a known quantity of target compounds and analyzed. The percent recovery will be used to calculate accuracy. The relative percent difference (RPD) for each component will be used to calculate precision. MS/MSDs represent approximately 10% of all field samples collected.

Duplicate Samples – Duplicate samples are collected and data are used to perform a comparison study between the two sets of data by evaluating the data quality element of precision. Precision is a means to determine the agreement between a set of replicate measurements without assumption of knowledge of the true value, and is calculated by the absolute value of the Relative Percent Difference (RPD) between the two sets of laboratory data using the equation presented in Section 5.7.

Travel Blanks – Each laboratory shall provide one canister that will be kept with the field sample canisters from the time they leave the laboratory until the time they are returned to the laboratory. The travel blank will contain zero air. The purpose of the travel blank is to assess the potential of sample contamination during transit or sample collection. One travel blank sample will accompany each canister shipment from each laboratory.

5.6.1 Laboratory QA/QC

Each laboratory shall adhere to the quality control and quality assurance criteria cited with the published method (TO-14A). In addition, each laboratory must also adhere to the GC/MS system performance criteria prior to sample analysis. Refer to Method TO-14A for specific information regarding the quality control, quality assurance, and system performance requirements.

5.6.2 Laboratory Data Reporting Requirements

All analytical generated from laboratory analyses to be reported in accordance with CLP requirements, with modifications to those requirements to integrate statistically derived laboratory specific control limits, detection limits, reporting limits (PQLs), and additional analytical dilutions.

In addition, each laboratory shall be required to store the electronic files for a minimum of 5 years.

5.6.2.1 Laboratory Data Packages

Data packages submitted must include the following information:

1. Preparation and analysis methods. They should be noted for each analytical fraction.
2. Case narratives. Case narratives should include the following pertinent information:

(a) Comments on holding times;
(b) Comments on blank contamination
(c) A description of the percent recoveries for lab QC samples, noting any deviations from the laboratory established control limits;
(d) A summary of the upper and lower control limits established by the laboratory for each QC sample within each analytical fraction;
(e) An explanation for any biases to the data (this should be noted in the form of a data flag);
(f) A statement from the Quality Assurance Officer, Laboratory Director or equal, verifying that the data has been reviewed and determined to be accurate; and,
(g) A statement indicating the conditions of the samples upon receipt.

1. Chains of custody.
2. Results of QA/QC samples, including instrument blank and method blank results, Laboratory Control Sample (LCS) recoveries, Matrix Spike and Matrix Spike Duplicate (MS/MSD) recoveries, and duplicate analyses (in the form of Relative Percent Difference (RPD) values), specific to each sample batch within each analytical fraction, where applicable.
3. Reporting limits. The laboratory will report all positive detections between the PQL and MDL as an estimated value. The lab will flag all reported results indicating QC is outside of the laboratory-established criteria.

5.6.2.2 Laboratory Data Validation

The Quality Assurance Officer (QAO) shall review data and existing QC associated with all analyses performed for this project. The QAO must sign the data package indicating that the data were reviewed, that all corrective actions, if performed, were done so in accordance with the laboratory SOPs, and that the data are valid as presented in the report.

5.6.2.3 Independent Data Validation

Data validation identifies invalid data and qualifies the usability of the remaining data. The output of data validation is qualitative or quantitative statements of data quality. Once the quality of individual measurements are known, a compilation of all data points into a cohesive statement can be made. The confidence associated with a statement incorporates both the confidence in individual measurements as well as in the decision.

The data review process shall consist of a contractual review that shall include an evaluation of the analysis and specific requirements of the published method in addition to the laboratory Standard Operating Procedure (SOP). Data qualification shall be performed following the intent of the National Functional Guidelines in conjunction with the data validator's professional judgment, where applicable, since there are no formal validation guidelines written for this analysis.

5.7 Data Quality

Data quality is measured by how well the data meet the quality assurance/quality control (QA/QC) goals for the project. Quality control elements include precision, accuracy, representativeness, completeness, comparability, and sensitivity:

- Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed conditions. Assessing precision measures the random error component of the data collection process. Precision is determined by measuring the agreement among individual measurements of the same property, under similar conditions. The degree of agreement, expressed as the relative percent difference (RPD), is calculated using the formula below.

$$\text{RPD} = \frac{(V_1 - V_2)}{\frac{(V_1 + V_2)}{2}} \times 100$$

where: *V1 = value 1*
V2 = value 2

Analytical precision is assessed by analyzing matrix spike/matrix spike duplicate pairs and laboratory duplicate samples. Field precision is assessed by measurement of field duplicate samples. The objective for precision is to equal or exceed the precision demonstrated for similar samples and should be with the established control limits for the methods. Precision control limits and QC RPD limits are noted within each laboratories SOP.

- Accuracy is the degree of agreement of a measurement with an accepted reference or true value. Accuracy measures the bias or systematic error of the entire data collection process. Sources of these errors include the sampling process, field and laboratory contamination, sample preservation and handling, sample matrix interferences, sample preparation methods, and calibration and analytical procedures. To determine accuracy, a reference material of known concentration is analyzed or a sample which has been spiked with a known concentration is reanalyzed. Accuracy is expressed as a percent recovery and is calculated using the following formula:

- Completeness is calculated as follows:

$$\% \text{ Completeness} = 100 \times \frac{V}{n}$$

where: *V = number of measurements judged valid*
n = total number of measurements

The objective is to generate a sufficient database with which to make informed decisions. To help meet the completeness objective, every effort must be made to avoid sample loss through accidents or inadvertence. The completeness goal for this project is 100%.

- Comparability expresses the confidence with which one data set can be compared to another. Comparability shall be performed as described in Section 5.8.1.

- Sensitivity is the capability of a method or instrument to discriminate between small differences in analyte concentration. The sensitivity and detection limits of a method are noted in Table 2.

6.0 Sample Shipment

Custody of samples must be maintained through the shipment of samples to the selected laboratory. Samples will be in the custody of field sampling team until relinquished directly to the laboratory by sampling personnel via the following procedures:

- Place individual canisters back into each box.
- Sign the chain-of-custody under "relinquished by," enter the carrier name under "received by," and retain a copy for field records. Place the chain-of-custody in each box with the associated canister, and tape the box shut.
- Apply signed custody seals to the seals of the box.
- Secure the box by completely wrapping with strapping tape at either end of the box. Do not cover any labels.
- Attached completed shipping label to top of the box.

The laboratory selection process will be based upon sample turn-around-time and sample capacity constraints. The two laboratories selected for this program are presented below:

(1) Coast to Coast Analytical Specialists
11140 Petal Street, #250
Dallas, Texas 75238

Attn: Steven Havlicek

Phone (214) 221-2786
Fax (214) 221-2788

(2) York Analytical Laboratories, Inc.
One Research Drive

Stamford, Connecticut 06906

Attn: Robert Bradley

Phone (203) 325-1371
Fax (203) 357-0166

Special Note: In the event that Coast to Coast Analytical Specialists and/or York Analytical experiences some type of "catastrophic" instrument failure, the laboratory manager from each facility shall contact the Malcolm Pirnie (MP) Project Manager, and MP shall in turn contact the client and discuss the appropriate course of action.

7.0 Performance, System Audits, and Corrective Action Measures

Audits will include a careful evaluation of both field and laboratory quality control procedures and will be performed before or shortly after systems are operational. The audits will be conducted by an individual who is technically knowledgeable about the operation(s) under review. Systems audits provide a quantitative measure of the quality of the data produced by one section or the entire measurement process. Performance audits are conducted by introducing control samples into the data production process. These control samples may include performance evaluation samples, field samples spiked with known amounts of analyte, and split field samples that are analyzed by two or more analysts within or without the organization. Systems audits are onsite qualitative inspections and reviews of the quality assurance system used by some part of or the entire measurement system. The audits are performed against a set of requirements, which may be a quality assurance project plan or work plan, a standard method, or a project statement of work. The primary objective of the systems audits is to ensure that the QA/QC procedures are being followed.

In the event that procedures are not followed, the need for corrective action may be identified by system or performance audits or by standard QC procedures. The essential steps in the corrective action system are:

1. Identifying and defining the problem.
2. Assigning of responsibility for investigating the problem.
3. Investigating and determining the cause of the problem.
4. Determining a corrective action to eliminate the problem.
5. Assigning and accepting responsibility for implementing the corrective action.
6. Implementing the corrective action and evaluating its effectiveness.
7. Verifying that the corrective action has eliminated the problem.

A nonconformance is defined as an identified or suspected deficiency in an approved document (e.g., technical report, analysis, calculation, computer program); an item where the quality of the end item itself or subsequent activities using the document or item would be affected by the deficiency; or an activity that is not conducted in accordance with the established plans or procedures. Any staff member engaged in project work who discovers or suspects a nonconformance is responsible for initiating a nonconformance report (forms in-house). The Project QA/QC Coordinator shall evaluate each nonconformance report and shall provide a disposition, which describes the actions to be taken.

The Project Manager shall ensure that no further project work dependent on the nonconforming item or activity is performed until approval is obtained and the nonconformance report is closed out. If the nonconformance is related to material, the Project Manager shall be responsible for marking or identifying, with the nonconformance report number, the nonconforming item (if practical) and indicating that it is nonconforming and is not to be used.

Samples that are analyzed prior to the resolution of a nonconforming event will be resampled, and/or reanalyzed once the corrective action has been demonstrated to be effective.

A copy of each closed nonconformance report shall be included in the quality assurance file. Copies of all nonconformance reports shall be maintained by the Project QA/QC Coordinator.

7.1 Field Audits

Field performance audits will be conducted on an ongoing basis during the project as field data are generated, reduced, and analyzed. All numerical manipulations, including manual calculations, will be documented. All records of numerical analyses will be legible, of reproduction-quality, and sufficiently complete to permit logical reconstruction by a qualified individual other than the originator.

Indicators of the level of field performance include the analytical results of the blank and replicate samples. Each blank analysis will be considered an indirect audit of the effectiveness of measures taken in the field to ensure sample integrity (e.g., field decontamination procedures). The results of the field replicate analyses are an indirect audit of the ability of each field team to collect representative sample portions of each matrix type.

System audits of site activities will be accomplished by an inspection of all field site activities. During this audit, the auditor(s) will compare current field practices with standard procedures. The following elements will be evaluated during a field system audit:

1. All activities conducted in accordance with the Work Plan;

2. All procedures and analyses conducted according to procedures outlined in the sampling plan;

3. Sample documentation;

4. Working order of instruments and equipment;

5. Level of QA conducted per each field team;

6. Contingency plans in case of equipment failure or other event preventing the planned activity from proceeding;

7. Decontamination procedures, if applicable;

8. Level of efficiency with which each team conducts planned activities at one site and proceeds to the next; and

9. Sample packaging and shipment.

After completion of the audit, any deficiencies will be discussed with the field staff and corrections identified. If any of these deficiencies could affect the integrity of the samples being collected, the auditor(s) will inform the field staff immediately, so that corrections will be implemented immediately. The audit will be performed by the Project QA/QC Coordinator and/or the Site Field Manager. An example of the audit form is presented in Attachment 3.

7.2 Field Corrective Actions

At the end of each sampling day, the sampling team shall report any problems requiring corrective action that were encountered during the day. Corrective action will be undertaken when a non-conforming condition is identified. A non-conforming condition occurs when QA objectives for precision, accuracy, completeness, representativeness or comparability are not met, or when procedural practices or other conditions are not acceptable. A report shall be filed which documents the problems encountered and the corrective action implemented. An example of the nonconformance and corrective action report is presented in Attachment 4. A stop-work order may be issued by the Project QA/QC Coordinator, upon authorization by the Project Manager, if corrective action does not adequately address a problem, or if no resolution can be reached.

7.3 Laboratory Audit Procedures

7.3.1 System/Internal Audits

As part of its Quality Assurance Program, the Laboratory Quality Assurance Manager shall conduct periodic checks and audits of the analytical systems. The purpose of these is to ensure that the analytical systems are working properly and that personnel are adhering to established procedures and documenting the required information. These checks and audits will also assist in determining or detecting where problems are occurring.

The Quality Assurance Manager will periodically review laboratory control samples. These samples will check the entire analytical method, the efficiency of the preparation method and the analytical instrument performance. The results of the control samples are reviewed by the Quality Assurance Manager. The Quality Assurance Manager reports the results to the analyst and the Laboratory Manager. When a problem is indicated, the

Quality Assurance Manager will assist the analyst and laboratory management in determining the reason and in developing solutions. Rechecking of systems will be conducted by the Quality Assurance Manager as required.

7.3.2 Performance and External Audits

In addition to conducting internal reviews and audits, as part of its established Quality Assurance program, the laboratory is required to take part in regularly scheduled Performance Evaluations and laboratory audits from State and Federal agencies. These are conducted as part of certification processes and to monitor the laboratory performance. These provide an external quality assurance check of the laboratory and provide reviews and information on the management systems, personnel, SOPs, and analytical measurement systems. Acceptable performance on evaluation samples and audits is required for certification and accreditation. The laboratory shall use the information provided from these audits to monitor and assess the quality of its performance. Problems detected in these audits shall be reviewed by the Quality Assurance Manager and laboratory management and corrective action shall be instituted as necessary.

7.3.3 Laboratory Corrective Actions

If a particular analysis is deemed “out of control," corrective action will be taken to ensure continued data quality. Actions which may be taken include, but are not limited to:

- Rechecking calculations,
- Checking QC data on other samples,
- Auditing laboratory procedures,
- Reanalyzing the sample if the holding time requirements have not been exceeded,
- Accepting data with the acknowledged level of uncertainty, and
- Discarding data.

The coordinator of the laboratory's analytical section will be responsible for initiating laboratory corrective action when necessary. Recommendations for corrective actions outside the laboratory will be made by the laboratory QA Manager to the Project Manager.

ATTACHMENT NO. 1 – LABORATORY PRE-AUDIT FORM

Laboratory Quality Assurance Program Evaluation

Daily Operating Procedures Questionnaire

Thank you for participating in this survey of your laboratory operations. Malcolm Pirnie, Inc. is collecting completed questionnaires from several laboratories that provide analytical support for our Federal and Industrial projects. We have limited the information we are requesting to several key indicators of laboratory operations, as well as the general information required to help select laboratories on a project-by-project basis. The responses provided in this questionnaire will serve as a means to become acquainted with daily operations of your laboratory, and will be used as a tool to determine if on-site project-specific audits are necessary.

Please be assured that all information will be kept confidential, with no names of your laboratory or of the other cooperating laboratories being included in any reports, or, shared amongst participating laboratories. Your laboratory will be identified simply as "Facility A" or a similarly generic title.

If you have any questions regarding the survey questions or the project in general, please call me Carole Tomlins of Malcolm Pirnie at (914) 641-2975 and ctomlins@pirnie.com.

Please submit the completed questionnaire to survey to me by February 11, 2002. Submittal directions are included at the end of this questionnaire.

Thank you again for your assistance.

LABORATORY CONTACT INFORMATION

1. Laboratory Name:_____

2. Laboratory Address:_____
   _____

3. Contact Person:_____
   Title: _____
   Phone Number:_____ Fax:_____
   e-mail:_____

(The above information will be kept confidential and will not be disclosed to our client or included in any report, and will not be shared amongst other laboratories that provide support for MPI.)

GENERAL INFORMATION

Question #1

How many laboratory facilities support your operation?

Question #2

What State and/or Federal certifications does each laboratory facility hold?

Question #3

Is there a separate group within your organization that is responsible for collecting samples and delivering them to the Sample Receiving area(s) within the laboratory(ies)? If yes, how does that group relate organizationally to the laboratory? If no, who is responsible within the laboratory(ies) for sample collection and delivery?

SAMPLE TRACKING

Question #4

Is there a Laboratory Information Management System (LIMS) within the laboratory facility(ies)?

Question #5

If a LIMS is in place, has it been customized to meet the operating needs of the laboratory(ies)?

Question #6

How is the LIMS used to track the status of samples within the laboratory(ies)? If no LIMS is in place, how is sample status tracked?

Question #7

Is the LIMS used as a tool to keep track of control limits and Method Detection Limit (MDL) studies? Is the LIMS used to chart recoveries of control samples (matrix spikes, LCSs, and duplicate RPD values)? If no LIMS is in place, is another method in place to track these items?

Question #8

Is the LIMS used to report sample results? If so, please list all users of your LIMS reports (e.g., in-house water quality planning group, utility customers, external clients, etc.)

POTENTIAL FOR LABORATORY/SAMPLE CONTAMINATION

Question #9

Where is the sample extraction area in relation to the volatile analysis area?

Question #10

Does the volatile analysis area experience contamination from the solvents used during the extraction process? If either yes or no, has this been confirmed with data?

DATA REVIEW PROCESS

Question #11

Is there a multi-tiered data review process? If so, please briefly describe the review process within the laboratory(ies) including the staffing levels involved.

Question #12

Does the review process identified in Question 11 apply to each area of the laboratory (i.e., do the metals, organic, and classical chemistry data undergo the same review process?) If there are multiple laboratory facilities within your organization, is this data review process followed uniformly by all laboratory facilities?

QUALITY ASSURANCE

Question #13

Do(es) your laboratory(ies) have (a) designated Quality Assurance (QA) Officer(s)? If so, please briefly describe the function and role of the QA Officer(s). If there is not an exclusive position for QA Officer activities, who performs the QA duties within the laboratory(ies)?

Question #14

Is the analysis of internal proficiency samples (PEs) part of the training program for new laboratory employees?

Question #15

Are Laboratory Standard Operating Procedures (SOPs) up-to-date in each area of the laboratory(ies)? If there is more than one laboratory facility, are there separate SOPs for each facility (facility-specific SOPs)?

Question #16

Are Laboratory Quality Assurance Manuals (LQAMs) up-to-date for the laboratory facility(ies)? If there is more than one laboratory facility, are there separate LQAMs for each facility (facility-specific SOPs)?

Question #17

Please briefly describe the training program for analysts and other laboratory personnel. Are laboratory employees allowed, and encouraged, to participate in outside training classes (e.g., classes given by HP or other companies)?

Thank you very much for completing the survey. Please submit the completed survey to me by February 11, 2002. Please submit the completed survey by whichever of the following three methods is most convenient for you.

1. **e-mail:** ctomlins@pirnie.com

2. **mail:**
   Malcolm Pirnie, Inc.
   Attn.: Carole Tomlins
   104 Corporate Park Drive
   White Plains, New York 10602

3. **fax:** (914) 641-2455

ATTACHMENT NO. 2 – SAMPLE COLLECTION REPORT FORM

Air Sampling Sheet

Site: _____

Location:

Crawl Space _____

Enclosed Space _____

Outside Ambient Air _____

Soil Vapor _____

Site Conditions:		Day 1	Day 2
Weather:	Temperature:		
	Humidity:		
	Precipitation:		
Other:			

Sample I.D. Number: _____

Flow Controller ID Number: _____

Canister I.D. Number**:** _____

Sample Type: Sample Duplicate to Can. I.D. No. _____

Sampling Flow Rate: _____ ml/min Canister Size: _____ Liters

	Date	Sampling Time, hrs.	Canister Pressure, in. Hg	Sampler
Start				
Finish				

ATTACHMENT NO. 3 – FIELD AUDIT REPORT FORM

QUALITY CONTROL FIELD AUDIT REPORT

SUMMARY INFORMATION

1. PROJECT NAME: _____

2. PROJECT ADDRESS: _____

_____

_____

3. PRELIMINARY ASSESSMENT _____ RI/FS _____ RD _____ CONSTRUCTION_____

OTHER _____

4. DATE(S) OF QC FIELD AUDIT _____

5. AUDITOR'S NAME _____PHONE_____

6. FACILITY CONTACT _____PHONE_____

7. CONTRACTOR CONTACT_____PHONE_____

8. PERSONNEL ON-SITE

NAME	REPRESENTING	PHONE
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

9. AUDITOR'S COMMENTS

_____

_____

_____

_____

10. WEATHER CONDITIONS

SUNNY ; PARTLY SUNNY ; PARTLY CLOUDY ; CLOUDY ; RAIN ; DRIZZLE ; SNOW ; SLEET

TEMPERATURE_____ WIND SPEED_____ WIND DIRECTION_____

AIR SAMPLING PROCEDURES

1. AIR SAMPLED:

OPEN CRAWL SPACE ENCLOSED CRAWL SPACE CLOSED CRAWL SPACE

OUTSIDE AMBIENT AIR SOIL VAPOR

2. TYPE OF SAMPLE: GRAB COMPOSITE

3. SAMPLING TRAIN COMPONENTS

COMPONENT	MODEL	I.D. NUMBER	MATERIAL OF CONSTRUCTION
SUMMA CANISTER	_____	_____	_____
FLOW CONTROLLER	_____	_____	_____
PRESSURE GAGE	_____	_____	_____
PARTICULATE FILTER	_____	_____	_____
SAMPLING LINE	_____	_____	_____
MISC. FITTINGS	_____	_____	_____
OTHER	_____	_____	_____

OBSERVATIONS

_____

-

_____

_____

-

_____

_____

4. WAS THE SAMPLING TRAIN ASSEMBLED CORRECTLY? YES NO

5. DID THE SAMPLING TEAM CHECK THE SAMPLING TRAIN FITTINGS PRIOR TO INITIATING SAMPLING? YES NO

6. LENGTH OF THE SAMPLING LINE _____

7. WAS THE SAMPLING LINE POSITIONED AT THE PROPER ELEVATION ABOVE THE GROUND SURFACE OR ATTACHED TO THE SOIL VAPOR PROBE LINE? YES NO

8. DID THE SAMPLING TEAM CHECK THE PRESSURE WITHIN THE CANISTER PRIOR TO AND FOLLOWING SAMPLING?

YES NO

9. WAS THE SAMPLING EQUIPMENT DEDICATED? YES _____ NO _____

IF NOT, WHY?_____

10. WAS THE SAMPLING EQUIPMENT: LAB DECONTAMINATED? FIELD DECONTAMINATED?

11. DID THE SAMPLING TEAM COMPLETE THE SAMPLING SHEET? YES NO

12. WERE PHOTOGRAPHS TAKEN? YES NO

13. AUDITOR'S COMMENTS:

_____

_____

_____

SOIL VAPOR SAMPLING - IMPLANT SETUP AND EVACUATION

EVACUATION PROCEDURES

1. IMPLANT CASING CONSTRUCTION STAINLESS STEEL TEFLON PVC OTHER _____-_____

2. DIAMETER OF IMPLANT CASING 2" 4" 6" OTHER _____

3. DEPTH OF IMPLANT: _____ FEET

4. IMPLANT ENCLOSURE MATERIAL: MEDIUM. COMMERCIAL-GRADE SAND OTHER: _____

5. WAS A BENTONITE SEAL INSTALLED? YES NO

6. WAS THE SEAL INSTALLED PROPERLY? YES NO

7. WAS THE PROTECTIVE CASING INSTALLED WITH A LOCKABLE CAP? YES NO

8. STABILIZATION METHOD;
DID THE IMPLANT SETUP TEAM STABILIZE THE SOIL ACCORDING TO THE PROJECT METHODOLOGY? YES NO

DID THE VACUUM PUMP PROVIDE A MINIMUM VACUUM OF 20 INCHES OF MERCURY? YES NO

WAS A ROTOMETER USED TO MEASURE THE FLOW FROM THE IMPLANT? YES NO

DID THE SETUP TEAM MEASURE THE CARBON DIOXIDE AND OXYGEN LEVELS IN THE PUMPED AIR FLOW?

YES NO

IF SO, WHAT INSTRUMENT WAS USED? _____

WHEN WAS IT CALIBRATED?_____

DID THE SETUP TEAM EVACUATE THE PROBE AND TUBING? YES NO

IF SO, HOW MANY VAPOR CHANGES WERE PERFROMED? _____

WHERE THE CARBON MONOXIDE AND OXYGEN LEVELS COMARED TO THOSE IN AMBIENT AIR?

YES NO

9. WAS IMPLANT SETUP AND STABILIZATION DOCUMENTED ONSITE? YES NO

10. AUDITOR'S COMMENTS

_____

_____

_____

QA/QC INFORMATION

1. LABORATORY:

NAME _____ PHONE _____

CONTACT PERSON _____

NELAP CERTIFIED OTHER _____

3. SAMPLE INFORMATION:

MATRIX PARAMETER PRESERVATIVE CONTAINER DESCRIPTION

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

3. WHAT ORDER BY ANALYTICAL PARAMETER ARE SAMPLES COLLECTED: _____-_____

_____

4. FIELD BLANKS: YES NO N/A FREQUENCY _____

METHOD:

_____

WAS IDENTICAL BOTTLE TO BOTTLE TRANSFER OF WATER UTILIZED? YES NO

5. TAVEL BLANKS: YES NO N/A FREQUENCY _____

6. WHAT WAS THE SOURCE OF THE ZERO AIR? LABORATORY OTHER_____

7. SAMPLE PACKAGING AND HANDLING:

SAMPLE CONTAINERS LABELED	YES	NO	N/A
CHAIN-OF-CUSTODY FORMS COMPLETED	YES	NO	N/A
CUSTODY SEALS	YES	NO	N/A

8. AUDITOR'S COMMENTS

_____

_____

_____

_____

ATTACHMENT NO. 4 – NONCONFORMANCE AND CORRECTIVE ACTION REPORT FORM

NONCONFORMANCE AND CORRECTIVE ACTION REPORT

Date _____

NCR No. _____

Description of Nonconformance and Cause

_____

_____

_____

_____

_____

_____

Proposed Disposition

_____

_____

_____

_____

_____

_____

Submitted by: _____ Date: _____

Approved by: _____

DISPOSITION (by Project Manager or Designee)

Implementation of Disposition Assigned to: _____

Actual Disposition

_____

_____

_____

_____

_____

_____

Disposition completed on: _____

Date

_____

Signature

VERIFICATION

Disposition reviewed and work inspected by: _____ on _____
Disposition verified by: _____ on _____
(Use additional sheet or memo if necessary)

Appendix D - Sampling Methods

1.0) Air Sampling Train

As discussed in the workplan, air from various sampling locations will be collected using a Summa canister sampling train. The typical Summa canister sampling train consists of a Summa canister, flow controller, particulate filter, pressure gage, fittings and a sampling line.

- The Summa canister is a stainless steel vessel whose inner surfaces have been made chemically inert using the patented Summa process. The air sample will be collected in the canister by passively drawing the air sample into an evacuated canister. The advantage of passive sampling is that once the canister is placed under a vacuum by the laboratory, sample collection does not require the use of pumps or other powered equipment. However, during composite or integrated sampling over a specific length of time, a flow controller is needed to pace the air being drawn into the canister.
- The flow controller is typically a fixed orifice that allows a preset airflow into the canister.
- The particulate filter prevents particulate matter from blocking the flow controller orifice.
- As needed, a moisture trap will be used to minimize the amount of moisture entering the canister. The moisture can condense on the inner walls of the canister, resulting in polar compounds being removed from the air sample.

Figures 1A and 1B show the passive Summa canister sampling train to be used on this project. For the ambient and soil gas samples, the sampling train will be enclosed in a lockable Pelican Case for security. Each Summa canister will have a capacity of 6-liters, allowing for 24-hour composite sampling. The laboratory will evacuate the canister to a minimum vacuum of negative 28 inches of mercury (in. Hg). The flow controller will be equipped with a 0.0012-inch orifice allowing a flow rate between 2 and 4 milliliters per minute. This will allow the canister to collect approximately 5 liters of sample and have a residual vacuum of approximately 5 in.Hg. This final vacuum is recorded on the chain of custody form and allows the laboratory to confirm sample integrity. Depending on availability, the flow controller will also incorporate a pressure gage for monitoring of vacuum within the canister during the sampling event. Otherwise, a pressure gage will be used to monitor the vacuum before and after sampling. A 7 micron particulate filter will be used upstream of the flow controller. The sampling line will consist of ¼ inch diameter flexible Teflon tubing. All parts of the sampling train coming into direct contact with the air sample will be made of stainless steel or Teflon.

Figure 1A: Typical Summa Canister Sampling Train
(Crawl/Enclosed Space and Outside Ambient Air)

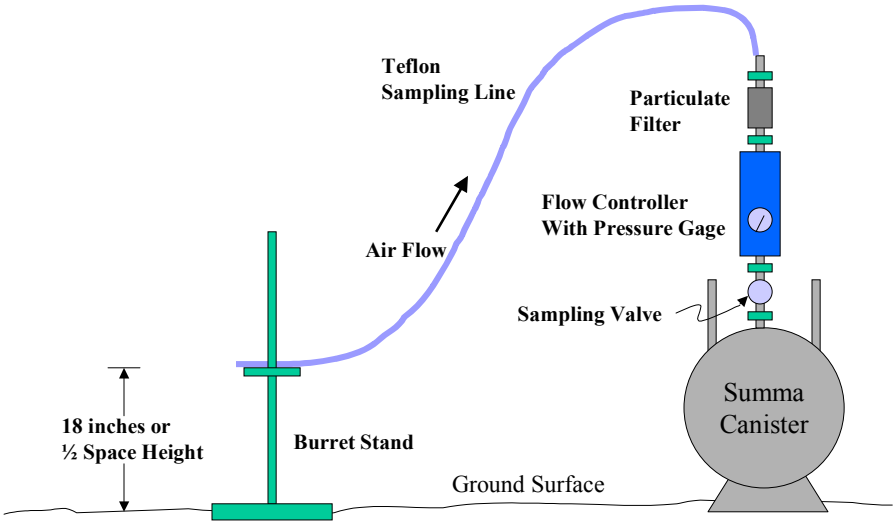
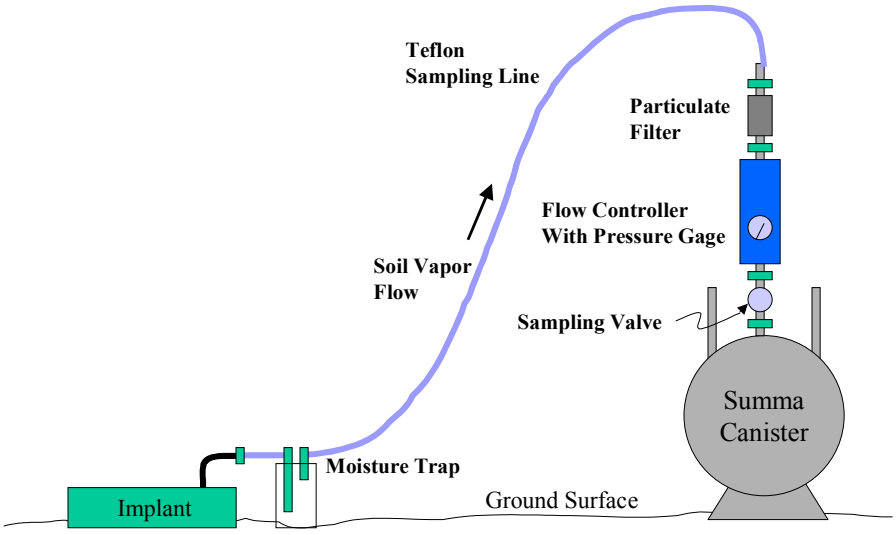


Figure 1B: Typical Summa Canister Sampling Train
(Soil Vapor, with Optional Moisture Trap)



2.0) Air Sampling Procedure

Summa Canister TO-14 Method

The Summa sampling train described above will be used to collect air samples according to the following procedure:

- An air sampling identification sheet will be completed for each sample collected. This sheet will be used to record sampling activities and conditions. Some of this information will be transferred to the chain of custody forms.
- Remove the brass plug fitting covering the Summa canister sampling port using a wrench.
- Connect the pressure gage or flow controller with integral pressure gage to the Summa canister sampling port. Open the valve on the canister and quickly measure the vacuum within the canister. Close the valve and record the measurement on the sampling sheet. Remove the pressure gage from the canister.
- Assemble the sampling train as shown in Appendix D. Each fitting should be hand tightened and then tightened with a wrench approximately ¼ turn.
- For the open crawl space and ambient air sampling, attach the Teflon sampling line to a burret holder or similar support, as needed, orienting the end of the tube parallel to the ground surface.
- For enclosed and closed crawlspace sampling, sample line placement will be determined on a site-specific basis.
- For the soil gas sampling, attach the sampling line to the soil gas implant/ probe line.
- Initiate sampling by opening the Summa canister valve. Record starting time on the sampling sheet.
- If using a flow controller with integral pressure gage, monitor the vacuum within the canister for several minutes to ensure that the sampling train is connected well, without leaks.
- When almost 24 hours have elapsed since initiation of sampling, close the canister valve. Disassemble the sampling train. Check the vacuum within the canister using the pressure gage and record the measurement on the sampling sheet.
- Since the flow rate into the canister can fluctuate due to variations in atmospheric conditions, the measured final vacuum may range from 4 to 12 in.Hg. If the measured vacuum is above 12 in.Hg or below 3 in.Hg, the sample may be flagged and re-sampling may be needed.
- Place the brass cap on the sampling port of the canister and tighten. The air sampling is complete.
- Place the air sample in the travel box and complete the chain-of-custody forms and identification tag on the canister.
- Send the canister to the laboratory via next day airmail service for analysis.

3.0) Open Crawlspaces

Open crawl spaces are defined as areas underneath houses that are freely accessible and where the atmosphere is readily affected by external factors (e.g., wind). The owner may use these crawl spaces for storage of various items, including paints, automotive supplies, outdoor furniture and tools.

The sampling preparation procedure for open crawl spaces is as follows:

- Examine the crawl space based upon information collected during the initial site visits. Wherever the Summa canister is placed, the environmental conditions will be noted on the sample collection sheet.
- Determine the height of the crawl space.
- Setup the sampling line at approximately ½ the crawl space height, to a maximum of 18 inches above the ground surface and parallel to the ground surface. This may entail use of a laboratory burret holder or suitable device in accessible spaces. For crawl spaces with limited access, the sampling line will be placed at a similar height using a pipe or wooden pole. Sample the air in the crawl space using the Summa canister sampling train in a locking case.

4.0) Enclosed Crawlspaces

Enclosed crawlspaces are defined as areas underneath houses that are not freely accessible and where the atmosphere may not be readily affected by external factors (i.e., wind). Removal of one side of the enclosure or a penetration of a partition may be necessary to allow insertion of sampling lines. The access and sampling of enclosed enclosures will be addressed on a case-by-case basis.

The sampling preparation procedure for enclosed crawl spaces is as follows:

- Gain access to the crawl space in a manner that allows easy restoration of the partition.
- Examine the crawl space based upon information collected during the initial site visits. Wherever the Summa canister is placed the environmental conditions will be noted on the sample collection sheet.
- Setup the sampling line at approximately ½ the crawl space height, to a maximum of 24 inches above the ground surface parallel to the ground surface. This may entail use of a laboratory burret holder or suitable device in accessible spaces. For spaces with limited access, the sampling line will be placed at a similar height using a pipe or wooden pole.
- Sample the air in the crawl space using the Summa canister sampling train in a locking case.

5.0) Closed Crawlspaces

Closed crawlspaces are void and/or sand filled spaces between the floor joists and the original land surface enclosed by a solid foundation wall constructed of block, brick, stone or concrete irrespective of venting. Dwelling construction in the project area may include enclosed spaces below the dwelling that may potentially contain soil emissions. For example, foundation walls may support some dwellings. Within the walls, sand may have been added as filler below the dwelling's lower floor. A void space most likely exists between the sand and the floor joists. The possibility of sampling of the void space air will be determined on a site-specific basis. A confounding factor for these types of spaces may be a previous application of pesticide into this area that may affect analytical results. Each property will be screened for recent and historical pesticide use during the initial survey.

The sampling preparation procedure for enclosed crawl spaces is as follows:

- Examine the exterior of the crawl space based upon information collected during the initial site visits.
- Drill one-inch diameter sampling ports through the box beam at the end of the floor joists.
- Wherever the Summa canister is placed the environmental conditions will be noted on the sample collection sheet.
- Setup the sampling line so that it does not touch any fill material inside the crawlspace. This may include attaching the sampling line to a long rod or pole.
- Sample the air in the crawl space using the Summa canister sampling train in a locking case.
- Seal hole with one-inch dowel.

6.0) Slab-on-grade

Slab-on-grade construction is defined as a house built directly on a concrete slab poured on the surface of the land. In these cases, void spaces underneath the slab are not available for sampling. The ALDOT proposes to use shallow soil gas implants or soil vapor probes placed immediately adjacent to the foundation or driven at an angle under the foundation in areas of non-compacted soil.

6.1) Soil Gas

1. Soil gas samples can be collected from a semi-permanent soil vapor implant or a temporary soil probe. Each property will be evaluated to determine which type of sampling device is most appropriate.

2. A temporary soil vapor probe may be used, rather than installing a permanent implant. The probe will be driven adjacent to a slab or at an angle under the slab.

3. Implant

The implant sampling device allows for the evaluation of potential emissions from a contaminated soil. The implant or probe opens the soils to allow vapors to form, which are drawn into the sampling train by the vacuum in the Summa canister. The procedures for constructing the surficial soil-gas implants that are described below provide for both placing the screen and immediately surrounding permeable "pack" from two (2) to three (3) feet below land surface (BLS). The procedures for constructing each implant and collecting the soil-vapor samples are as follows:

- Gain access to the site.
- Hand auger a boring to three feet BLS. Soils/sediments that are retrieved during the augering will be described by an on-site geologist or soils technician.
- Place three (3) inches of glass beads at the bottom of the borehole.
- Suspend, by means of polyethylene tubing, a six (6)-inch-long screen to the top of the glass beads.
- Add additional glass beads to the borehole until the glass beads extend three (3) inches above the top of the six-inch-long screen.
- Place six (6) inches of bentonite powder on top of the glass beads. Tremie four (4) cups of water to the bentonite powder.
- Fill the remainder of the borehole to within about eight (8) inches of the land surface with a bentonite slurry.
- Complete the implant by installing PVC casing that is equipped with a water tight and lockable cap. The casing will be housed within a flush-mount road box with bolt on cap. The PVC casing and road box will be set in Portland cement grout. The grout will be allowed to harden for at least twenty-four (24) hours prior to sample-collection activities. The polyethylene tubing that is connected to the vapor implant (six-inch screen) will be coiled within the protective PVC casing. At the end of the tubing, a valve will be attached to isolate the tubing from the atmosphere.
- An electric peristaltic pump, capable of producing a vacuum of at least 20 inches of mercury, will be used to purge the vapor implant prior to collection of a soil-vapor sample from the implant or probe. The flow of gases from each implant will be measured by placing a rotometer or other flow calibration device, between the peristaltic pump and the tubing from the vapor implant or probe.
- The effluent from the peristaltic pump will flow into an O_2/CO_2 meter, which will be used to measure the percentages of carbon dioxide and oxygen concentrations in the gases being recovered from the vapor implant. The vapor implant and tubing will be purged until a minimum of one volume of vapors is recovered from the implant.
- Upon completion of purging, close the isolation valve, disconnect the purging apparatus, and connect the Summa sampling train locked in a case.

4. Soil Gas Push Probe

The soil gas push probe consists of one or more three-foot long, stainless steel rods, and a one-foot long tip connected together. The length of the probe can be extended by adding more rods. The tip has a cylindrical, arrow type point that penetrates the soil. Above the arrow point, there are perforations in the tip that allow the soil gas to enter the inside of the probe. This allows the soil gas to be drawn through the rods into the sampling container. The procedures for installing a soil gas push probe implant and collecting the soil-vapor samples are as follows:

- Connect the probe tip and rod(s) to provide sufficient length to reach the sampling depth.
- Drive the probe into the soil vertically or at an angle, using a slam bar. Monitor the angle of insertion and length of the rod(s) to reach the sampling depth.
- Once the depth has been achieved, seal the opening to the soil surface (between the probe and the soil) with bentonite.
- Install a stainless steel fitting at the end of the rod protruding from the soil, attach Teflon tubing the fitting and then attach a isolation valve at the end of the tubing.
- An electric peristaltic pump, capable of producing a vacuum of at least 20 inches of mercury, will be used to purge the probe prior to collection of a soil-vapor sample from the probe. The flow of gases from each implant will be measured by placing a rotometer or other flow calibration device, between the peristaltic pump and the tubing from the probe.
- The effluent from the peristaltic pump will flow into O_2/CO_2 meter, which will be used to measure the percentages of carbon dioxide and oxygen concentrations in the gases being recovered from the vapor implant. The probe and tubing will be purged for at least one probe and sample tubing volume.
- Upon completion of purging, close the isolation valve, disconnect the purging apparatus, and connect the Summa sampling train locked in a case.

7.0) Ambient Air

The ambient air will be sampled to provide a baseline for comparing VOC emissions, if any, detected in the crawl space or soil gas samples. The ambient air sample should be collected in a location where the direct influence of VOC emitters, such as vehicles or a freshly painted structure of any kind, can be minimized. The sampling location for each site will be identified based upon an initial site survey. Preferably, the ambient air sample will be collected on the property at a location farthest from the street.

The sampling preparation procedure is as follows:

- Gain access to the property.
- Examine the property based upon information collected during the initial site visits. Wherever the Summa canister is placed the environmental conditions will be noted on the sample collection sheet.
- Setup the sampling line at approximately 12 to 24 inches above and parallel to the ground surface. This may entail use of a laboratory burret holder or suitable device.
- Setup the locking case containing the Summa canister and sampling train at a location where the enclosure can be actively secured (locked to a post or fence).
- Sample the ambient air using the Summa canister sampling train.