

# **COLISEUM BOULEVARD PLUME SITE**

## **SOIL VAPOR INVESTIGATION**



**DEPARTMENT OF TRANSPORTATION**

April 19, 2001

Prepared by:  
TTL, Inc.  
4154 Lomac Street  
Montgomery, Alabama 36106



**Table of Contents**

<b>Section</b>	<b>Page</b>
INTRODUCTION .....	1
LITHOLOGIC / HYDROGEOLOGIC SETTING .....	2
PROCEDURES .....	2
PHASE I .....	2
Construction of Vapor Implants .....	2
Collection and Analysis of Samples from Vapor Implants .....	4
Results of Vapor Analyses .....	5
PHASE II .....	5
Verification Samples from Vapor Implants .....	5
Collection and Analysis of Samples from Vapor Implants .....	5
Results of Vapor Analyses .....	7
CONCLUSIONS .....	9

**TABLES**

Table 1.	Construction characteristics of vapor implants
Table 2.	Results of analyses of vapor samples
Table 3.	Results of analyses of vapor samples - exclusive of gasoline and diesel-fuel compounds and freons

**FIGURES**

Figure 1.	Stratigraphy, ground-water elevations, and concentrations of PCE and TCE in ground-water samples
Figure 2.	Shallow and deep vapor implants, shallow stratigraphy, and concentrations of TCE in ground-water samples at the intersection of Broadway Street with Fairground Road
Figure 3.	Shallow and deep vapor implants, shallow stratigraphy, and concentrations of TCE in ground-water samples at the intersection of Chisholm Street with Fairground Road



**Soil Vapor Investigation  
Coliseum Boulevard Plume Site  
April 19, 2001**

- Figure 4. Shallow and deep vapor implants, shallow stratigraphy, and concentrations of TCE in ground-water samples at the intersection of Gardendale Drive with Fairground Road
- Figure 5. Shallow and deep vapor implants, shallow stratigraphy, and concentrations of TCE in ground-water samples at the intersection of East Park Avenue with Chelsea Drive

**PLATE**

- Plate 1. Locations of soil-vapor implants, stratigraphic cross-section A-A', probeholes, piezometers, and monitoring wells

**ATTACHMENT**

Attachment A - Probehole Logs



**Soil Vapor Investigation  
Coliseum Boulevard Plume Site  
April 19, 2001**

---

**INTRODUCTION**

Ground-water samples have been collected at the water table and at the first distinct clay beneath the water table as part of investigations at the Coliseum Boulevard Plume site. Review of the analyses of these samples revealed that shallow ground water immediately west of Fairground Road contains elevated concentrations of TCE (trichloroethylene). The greatest concentrations of TCE at the water table are at the intersection of Broadway Street with Fairground Road. There are lesser but elevated concentrations of TCE in the ground water at and near the intersections of Chisholm Street and Gardendale Drive with Fairground Road. The concentrations of the TCE at the water table diminish northward along this general traverse of the intersections. The ground water that contains the TCE is at least 20 feet BLS (below land surface) in these areas.

There is a shallow, surficial clay within the area between Fairground Road and Lower Wetumpka Road. The clay probably retards or prevents migration of TCE vapors to the land surface. To verify this conclusion, vapor "implants" were constructed for collecting samples of vapors (gases) from within the shallow, surficial clay and from the unsaturated sands beneath the surficial clay.

This report comprises summaries of the constructions of the "vapor implants," methods of collecting the vapor samples, analytical results, and conclusions. Comparisons of the concentrations of chlorinated hydrocarbons, especially TCE, in vapor samples from the unsaturated sand to the concentrations in samples from the surficial clay indicate that the clay prevents harmful concentrations of the chlorinated hydrocarbons from reaching the land surface.



**Soil Vapor Investigation  
Coliseum Boulevard Plume Site  
April 19, 2001**

---

**LITHOLOGIC / HYDROGEOLOGIC SETTING**

There is a surficial sandy clay between Fairground Road and Lower Wetumpka Road. This sandy clay extends to approximately 7 to 12 feet BLS in the area between, and immediately west of, the intersections of Fairground Road with Broadway Street and East Park Avenue with Chelsea Drive. Beneath the clay within this area are sands to at least about 40 feet BLS. The top of the saturated zone is 20 to 25 feet BLS in this area. The relationships of the surficial clay, unsaturated sands, saturated sands, water table, and the first distinct clay in the area are depicted on Figure 1, which is a stratigraphic cross section generally along Fairground Road. Also shown on the cross section are the results of field screening and laboratory analyses, for TCE and PCE, of ground-water samples. The location of this stratigraphic cross section is shown on Plate 1.

**PROCEDURES**

**PHASE I**

**Construction of Vapor Implants**

Four (4) sets of vapor implants were constructed to investigate the effectiveness of the surficial clay as a barrier to vapors from chlorinated hydrocarbons within the unsaturated sands. There is a set of implants at the intersections of Fairground Road with Broadway Street, Chisholm Street, Gardendale Drive, and at the intersection of East Park Avenue with Chelsea Drive. There is a deep and a shallow implant at each of these intersections so that the concentrations, if any, of TCE within the unsaturated parts of the sand could be compared to the concentrations of TCE, if any, within the overlying clay.

On March 30 and 31, 2000, direct-push equipment was used to construct nine (9) vapor implants within eight (8) probeholes. Soils/sediments were retrieved during the constructions of the implants and described by an on-site geologist. Three (SVI 1, 4, and 7; see Plate 1) of the implants were placed at 4.5 feet BLS, which is within the surficial clay that is immediately beneath the land surface. Four (4) of



**Soil Vapor Investigation  
Coliseum Boulevard Plume Site  
April 19, 2001**

the nine (9) implants were constructed within the unsaturated part of the sand that is immediately beneath the surficial sandy clay. These deeper implants (SVI 2, 3, 6, and 8; see Plate 1) are between 15.5 and 17.5 feet BLS. Vapor implants SVI 5A and SVI 5B are within the same probehole and within the surficial clay. The shallow implant (SVI 5A) is 4.5 feet BLS and the intermediate implant (SVI 5B) is 9.5 feet BLS. Placement of two implants within the same probehole provided for comparisons of the attenuation of chlorinated hydrocarbon vapors within the surficial clay.

The anchor for each of the implants is 2-3/8 inches long and has eight (8) holes. Each of the holes is about 3/32-inch in diameter. At the upper end of each implant is a barbed connector to which is attached polyethylene tubing, which extends from the implant to the land surface. Each implant is within about one foot of medium, commercial-grade sand. Except for the two implants that are within one probehole, a bentonite seal extends from the top of the sand to the land surface, where the tubing from the implant is secured within a short section of two (2) inch diameter PVC protective casing. The tip of the tubing is coiled within the PVC and the PVC is sealed with a lockable cap. The PVC tubing is protected within a well cover that is flush-mounted to the surrounding asphalt. There are bentonite seals between the intermediate (SVI 5B) and shallow (SVI 5A) implants and above the shallow implant within the probehole that contains these two implants.

After reviewing the results of analyses from two sets of samples from the vapor implants, SVI 1 was replaced with SVI 1R and an additional implant (SVI 9) was constructed on October 11, 2000. SVI 1 was replaced because the tubing was damaged below the bentonite seal. SVI 9 was constructed because of peculiar variations in the concentrations of chlorinated hydrocarbons in the samples from implants SVI 7 and SVI 8, which are at the intersection of East Park Avenue with Chelsea Drive. A hand auger was used to create the boreholes for implants SVI 1R and SVI 9. The implants were constructed with 6-inch-long screens that are within about 1 foot of glass beads. The other construction characteristics (for example; bentonite seal, tubing) are similar to those of the initial implants.

The constructions of all the vapor implants are provided in Table 1 and on the construction logs in Attachment A. Also shown on each of the logs are the lithologies at each of the probeholes. Figure 2 depicts the construction of deep implant SVI 3 and shallow implant SVI 4, the shallow stratigraphy, and



**Soil Vapor Investigation  
Coliseum Boulevard Plume Site  
April 19, 2001**

the concentrations of TCE in ground-water samples collected in February 2000 at the intersection of Broadway Street and Fairground Road. Depictions of the implants at the other three locations are provided in Figures 3, 4, and 5.

**Collection and Analysis of Samples from Vapor Implants**

The vapor samples were collected by connecting the tubing from each implant to an electric peristaltic pump, which could produce a vacuum of at least twenty (20) inches of mercury. A rotometer was placed between the pump and the tubing from the implant so that the rate of flow of gases from each implant could be measured. A Landtec GA90 was connected to the effluent side of the peristaltic pump and used to measure the percents of carbon dioxide and oxygen in the gases being recovered from the implants. The sand pack, implant, and tubing were evacuated until three volumes of vapors were recovered and the percentages of carbon dioxide and oxygen had stabilized at percentages that were different from ambient percentages. Stabilization of these gases was used as an indicator that each implant and its associated tubing had been purged and that vapor samples were being collected from the subsurface.

After the purging, a sample was collected by discharging the effluent from the peristaltic pump into a two-liter Tedlar bag. Vapor samples were collected from implants 2, 3, 4, 6, and 8 on April 26 and 27, 2000. Samples could not be collected from implants 5A, 5B, and 7 because the clays that surround these implants are "tight" and had not yielded sufficient vapors to fill the Tedlar bag after one hour of vacuum with the peristaltic pump. As noted above, a vapor sample was not collected from SVI 1 because the tubing was damaged below the bentonite seal.

The Tedlar bags were shipped to the Environmental Services Network, Southeast Laboratory in Kennesaw, Georgia for analysis. The samples were analyzed for 64 VOC compounds by GC/MS (gas chromatography/mass spectrometry) in accordance with U. S. EPA Method 8260B.



**Soil Vapor Investigation  
Coliseum Boulevard Plume Site  
April 19, 2001**

---

**Results of Vapor Analyses**

Not one of the 64 VOCs was detected in the vapor samples. The absence of the detections in all of the samples was considered unlikely because there were elevated concentrations of TCE in the ground water immediately beneath some of the vapor implants.

**PHASE II**

**Verification Samples from Vapor Implants**

ALDOT consultants reviewed constructing and sampling methodologies for the implants and concluded that the volume of sample being collected with each Tedlar bag may not have been providing sufficient mass of TCE for the GC/MS to detect the compound. Therefore, Summa canisters were selected for collecting a set of verification samples because the canisters would provide for collecting four (4) to five (5) liters of sample from each implant. The samples collected with the Summa canisters were submitted to Coast to Coast Analytical Specialists in Dallas, Texas for analysis by U. S. EPA TO-14/15 protocols.

**Collection and Analysis of Samples from Vapor Implants**

Vapor samples were collected on July 17 and 18, 2000. A "repeatability" set of samples was collected from the implants on November 1-3, 2000. Except for the use of the Summa canisters, the purging protocol that was used during the Phase I sampling was repeated. A sample was not collected from implant SVI 1 because, as described above, the tubing was damaged. (This implant was replaced [SVI 1R] so that a vapor sample could be collected at the location during the November 2000 sampling event.)

In accordance with QA/QC procedures for collecting vapor samples in Summa canisters, the initial and final vacuums of each of the Summa canisters were recorded when the July and November



**Soil Vapor Investigation  
Coliseum Boulevard Plume Site  
April 19, 2001**

samples were collected. Each Summa cannister was fitted with a flow controller, which limited the rate of flow of vapors into the cannister. The flow controllers were provided by Coast to Coast Analytical Services. Selection of the flow controller for each cannister was based on the rotometer flow rates recorded during purging of the implants prior to collecting the Phase I vapor samples, as described above. Controllers that provided for vapor-flow rates of about 100 milliliters per minute were used for the implants within the unsaturated sand. Controllers that provided for vapor-flow rates of about 10 milliliters per minute were used for the implants within the sandy clay.

Vapor samples were collected after confirming that the vacuum on each Summa cannister was at least about 27 inches of mercury prior to the beginning of sample collection. The sampling of each implant in July 2000 was terminated when, based on the rotometer flow rate measured during the purging and based on lapsed time, the field technician concluded that four (4) to five (5) liters of sample had accumulated in each cannister. The field technician also reviewed the post-sample-collection vacuum on each Summa cannister to determine the likelihood that there was sufficient volume of sample and to determine that there had not been leakage of ambient gases into the cannister during the sample collection. The procedure was modified for the November 2000 samples so that the residual vacuum within each Summa canister could be monitored during sample collection. Also, a duplicate sample was collected from one of the implants (SVI 2), on November 2, 2000, by using a Summa cannister that did not have a flow controller so that the results could be compared to a sample that was collected with a flow controller.

A sample of the ambient air was collected on July 18, 2000. This sample was collected at the intersection of Fairground Road and Broadway Street. The sample was collected with a Summa cannister that was equipped with a 100-millimeter per minute flow controller. The flow controller was used so that a composite sample of the ambient air could be collected. An equipment blank was collected on July 18, 2000 by collecting a sample of ambient air through the sampling valve and flow controller. Vapors collected through two sampling gauge assemblies used for the November 2000 sampling event were analyzed as equipment blanks.



**Soil Vapor Investigation  
Coliseum Boulevard Plume Site  
April 19, 2001**

---

**Results of Vapor Analyses**

The results of the analyses of the July and November 2000 vapor samples are compiled in Table 2. The "target" compounds for this investigation were TCE and compounds that result from the degradation of TCE. Benzene; ethylbenzene; toluene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; meta- and para-xylenes, and ortho- xylene, which are in gasoline and diesel fuel and are not chlorinated compounds, were not considered. Freons also were not a concern and were not considered. Table 3 provides a summary table wherein the gasoline compounds, freons, and "non detects" that are tabulated in Table 2 have been deleted.

The results of the analysis of the sample of the ambient air are not included in Table 2 because VOCs were not detected in the sample. The equipment blank collected on July 18, 2000, contained Freon 12 and tetrachloroethylene. The equipment blanks from the November sampling event both contained Freon 12 and one contained methylene chloride. The laboratory reported that the methylene chloride and freon from the November sampling event were from the laboratory. The source of the tetrachloroethylene in the July equipment blank could not be determined.

Review of Table 3 indicates that there are elevated concentrations of vapor-phase chlorinated hydrocarbons in the samples from the implants at the intersection of Broadway Street and Fairground Road and the intersection of Chisholm Street and Fairground Road. However, the chlorinated hydrocarbons were only in the "deep" samples, which are from implants that are between the surficial clay and the water table. The absences of chlorinated hydrocarbons in the samples from the implants that are within the clay at these two intersections are indicative that the clay is a barrier to migration of the vapor-phase chlorinated hydrocarbons. There were elevated concentrations of TCE in the samples of the shallow ground water from the probeholes at these intersections (see Figures 2 and 3). Thus, the elevated concentrations of TCE in the vapor samples from the deep implants at these intersections might have resulted from the elevated concentrations of TCE in the shallow ground water beneath the implants.



**Soil Vapor Investigation  
Coliseum Boulevard Plume Site  
April 19, 2001**

November 2000 sample from the new shallow implant (SVI 9), but TCE was not detected in the sample from nearby shallow implant SVI 7. Implants SVI 7, SVI 8, and SVI 9 are at the intersection of East Park Avenue and Chelsea Drive. Shallow implant SVI 7 is very near the base of the surficial clay, near the sanitary sewer, and within a street recently (relative to the time of sample collection) resurfaced by the City of Montgomery. The peculiar variations of the concentrations of TCE in samples from SVI 7 led to construction of implant SVI 9. SVI 9 is about 1 foot shallower than SVI 7. Occurrences of TCE in some of the vapor samples at the East Park Avenue/Chelsea Drive location also are peculiar because TCE was not detected in the ground-water sample from the upper saturated zone (see Figure 5).

The concentration ( $20 \mu\text{g}/\text{M}^3$ ) of TCE in the November sample from SVI 9 was about the same as the concentrations of 18 and  $27 \mu\text{g}/\text{M}^3$  in the July and November samples from the deep (16 feet BLS; SVI 8) implant at the location. Interestingly, chlorinated hydrocarbons were not detected in the November sample from implant SVI 7. Also, TCE was not detected in the shallow ground-water sample from the probehole (PH5) at this site (see Figure 5). Additional investigations at this location will be needed to understand the reason(s) for the variations and relationships among the concentrations of TCE in samples of vapor from the shallow and deep implants at the location. The additional investigations at this location should include collection of additional ground-water samples for analysis for chlorinated hydrocarbons.

## **CONCLUSIONS**

- At the soil-vapor sample points, the surficial clay is an effective barrier to the migration of vapor-phase chlorinated compounds that might originate from elevated TCE in the shallow ground water and/or from the overlying unsaturated sands at the intersections of Broadway Street, Chisholm Street, and Gardendale Drive with Fairground Road. The general absence of chlorinated hydrocarbons in vapor samples from the clay and the small to nil flow rates from implants within this clay are indicative of its effectiveness as a barrier at these locations.

TABLE 1. Construction characteristics of vapor implants; Site Investigation; Coliseum Boulevard Area; Montgomery, Alabama.

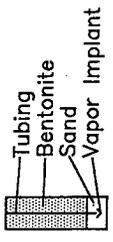
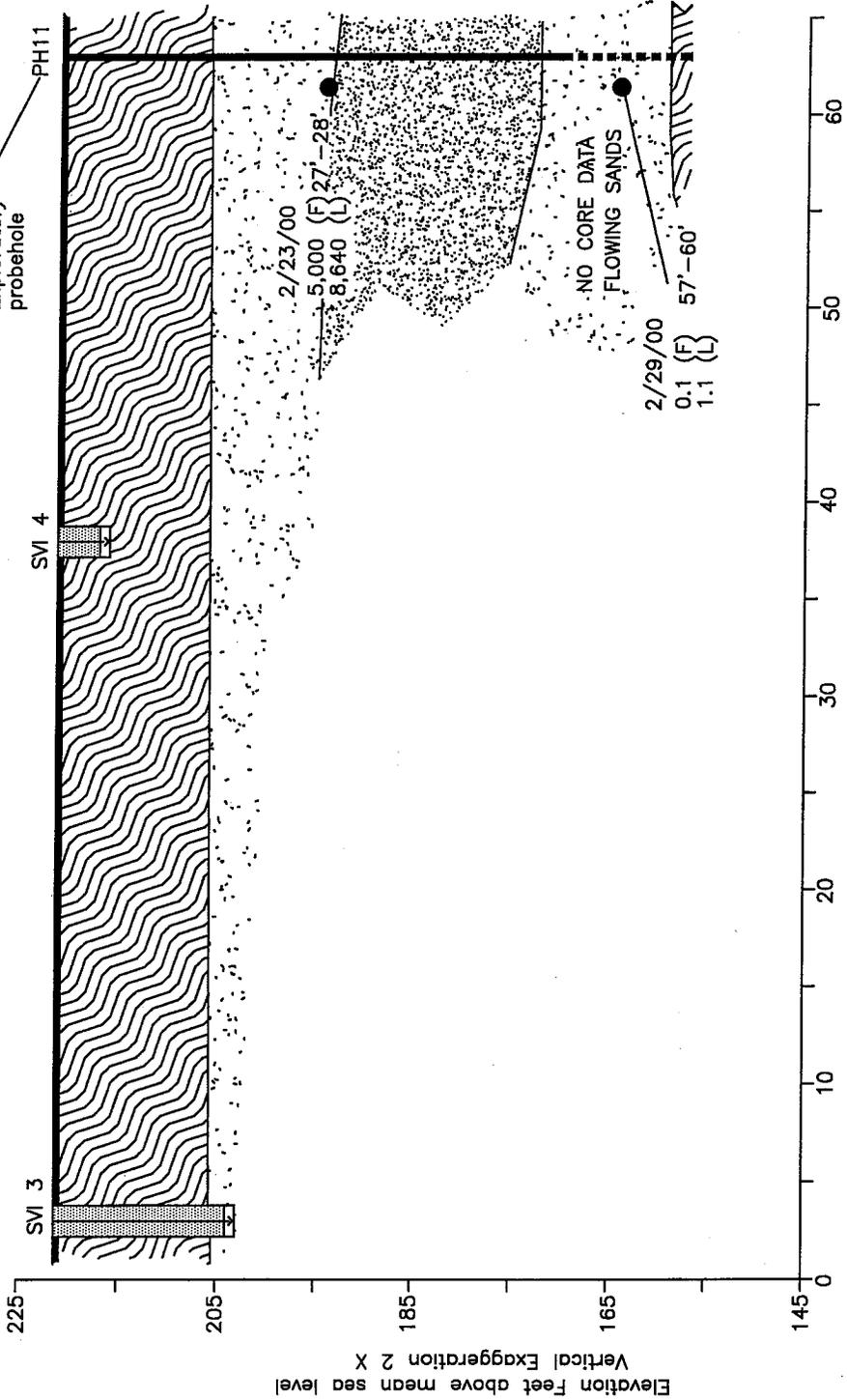
Soil Vapor I.D.	Location	Date Constructed	Total Depth (ft. BLS) <sup>1</sup>	Diameter of Probehole (Inches)	Soil Vapor Implant (tip) (ft. BLS)	Sand Pack/ Glass Beads* (ft. BLS)	Bentonite Pellet Seal (ft. BLS)	Grout Seal
SVI 1	Chisholm Street at Fairground Road	3/30/00	5	2.25	4.5	4-5	0-4	--
SVI 2	Chisholm Street at Fairground Road	3/30/00	16	2.25	15.5	15-16	0-15	--
SVI 3	Broadway Street at Fairground Road	3/30/00	18.2	2.25	17.5	17-18.2	0-17	--
SVI 4	Broadway Street at Fairground Road	3/30/00	5.2	2.25	4.5	4-5.2	0-4	--
SVI 5A / SVI 5B	Gardendale Drive at Fairground Road	3/31/00	5 / 10.2	2.25	4.5 / 9.5	4-5 / 9-10.2	0-4 / 5-9	--
SVI 6	Gardendale Drive at Fairground Road	3/31/00	17.2	2.25	16.5	16-17.2	0-16	--
SVI 7	East Park Avenue at Chelsea Drive	3/31/00	5	2.25	4.5	4-5	0-4	--
SVI 8	East Park Avenue at Chelsea Drive	3/31/00	16	2.25	15.5	15-16	0-15	--
SVI 1R	Chisholm Street at Fairground Road	10/11/00	5	3.25	4.7	3.5-5*	0.3-3.5	0-0.3
SVI 9	East Park Avenue at Chelsea Drive	10/11/00	4	3.25	3.8	2.3-4*	0.7-2.3	0-0.7

<sup>1</sup> Feet below land surface.

Broadway Street

WEST

EAST



27'-28'

●

Depth/location of ground-water sample

2/23/00 Date of sample

5,000 TCE concentration, in micrograms per liter

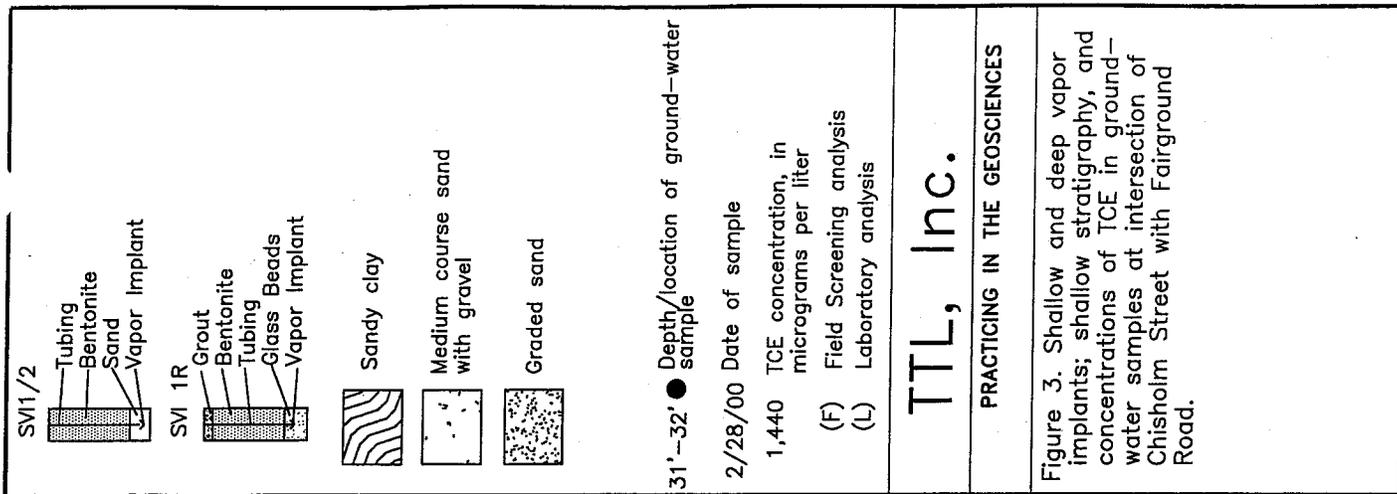
(F) Field Screening analysis

(L) Laboratory analysis

TTL, Inc.

PRACTICING IN THE GEOSCIENCES

Figure 2. Shallow and deep vapor implants; shallow stratigraphy, and concentrations of TCE in ground-water samples at the intersection of Broadway Street with Fairground Road.



WEST EAST

Chisholm Street

PH14 Exploratory Probehole

SVI 2 SVI 1 SVI 1R

225  
215  
205  
195  
185  
175  
165

Elevation Feet above mean sea level

0 10 20 30 40 50

Horizontal Distance (feet)

31'-32'

50'-53'

2/28/00  
1,440 (F)  
1,220 (L)

2/28/00  
3,860 (F)  
4,890 (L)

SWI1/2  
Tubing  
Bentonite  
Sand  
Vapor Implant

SVI 1R  
Grout  
Bentonite  
Tubing  
Glass Beads  
Vapor Implant

Sandy clay

Medium course sand with gravel

Graded sand

31'-32' ● Depth/location of ground-water sample

2/28/00 Date of sample

1,440 TCE concentration, in micrograms per liter

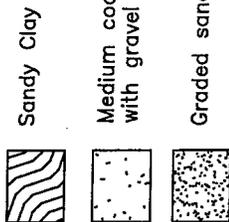
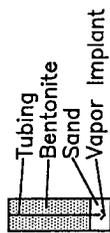
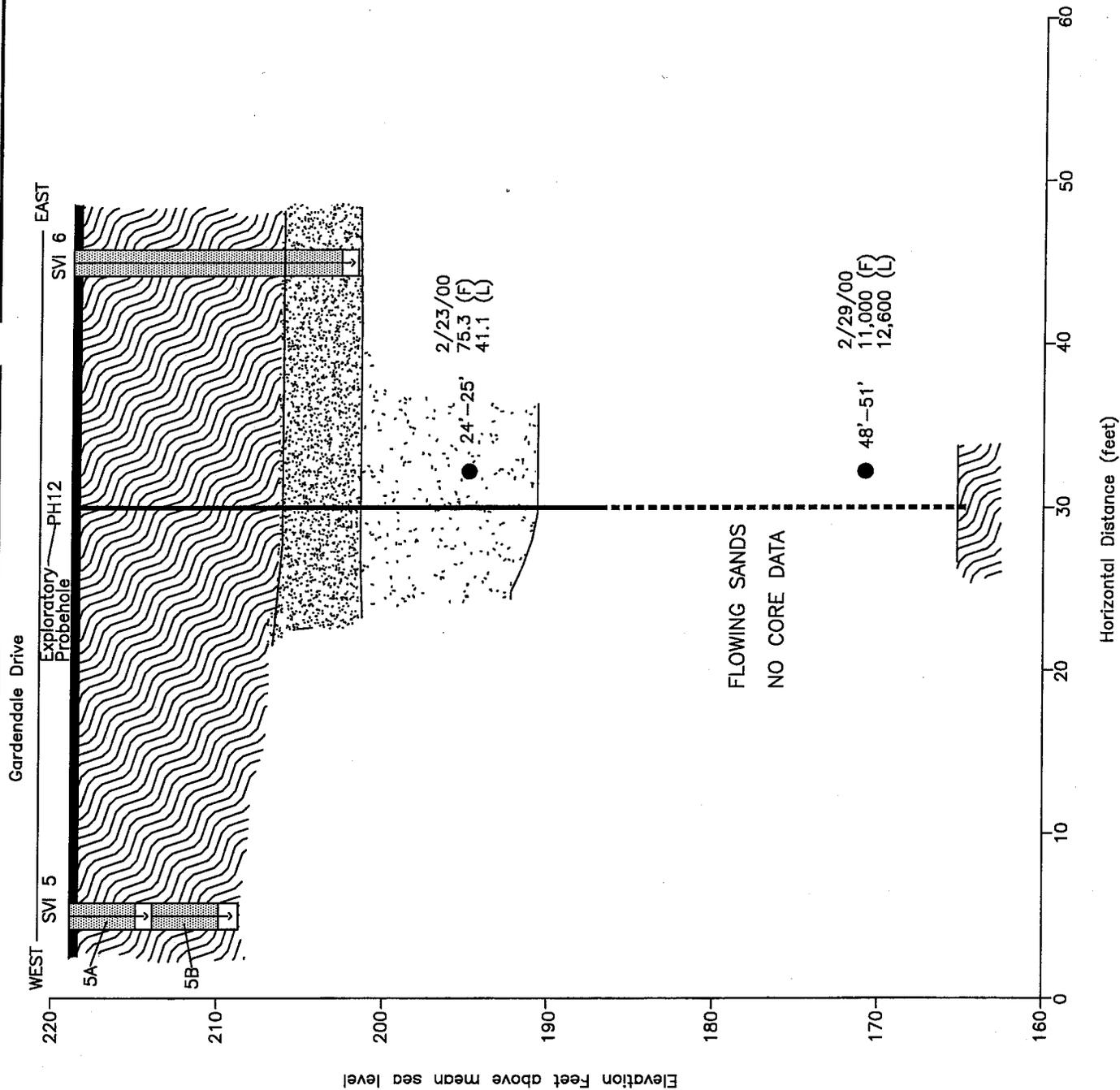
(F) Field Screening analysis

(L) Laboratory analysis

**TTL, Inc.**

PRACTICING IN THE GEOSCIENCES

Figure 3. Shallow and deep vapor implants; shallow stratigraphy, and concentrations of TCE in ground-water samples at intersection of Chisholm Street with Fairground Road.



24'-25' ● Depth/location of ground-water sample

2/23/00 Date of sample

75.3 TCE concentration, in micrograms per liter

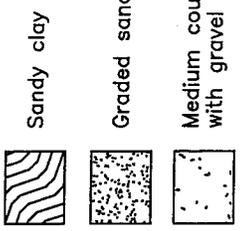
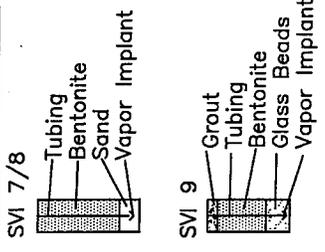
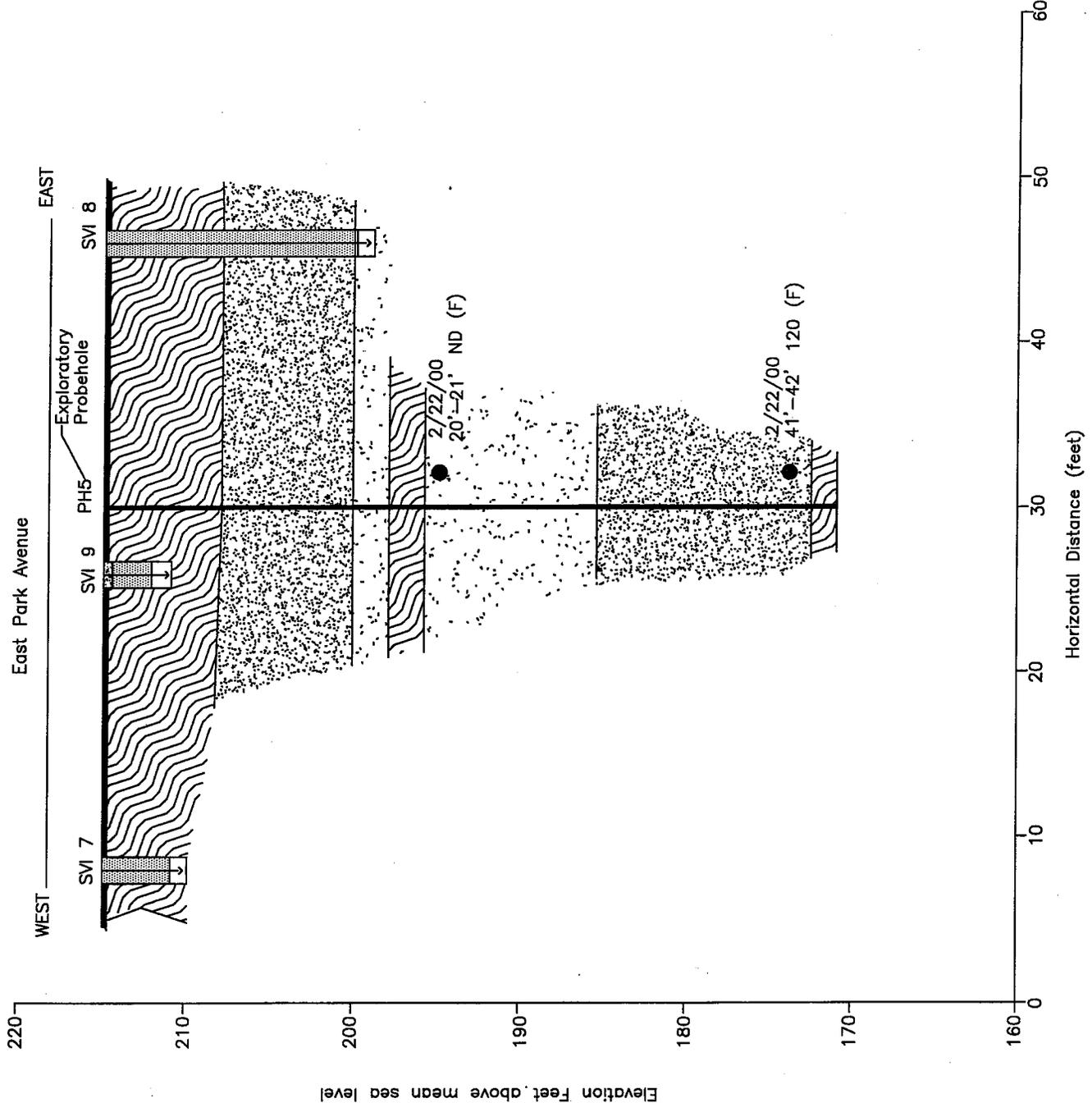
(F) Field Screening analysis

(L) Laboratory analysis

**TTL, Inc.**

PRACTICING IN THE GEOSCIENCES

Figure 4. Shallow and deep vapor implants; shallow stratigraphy, and concentrations of TCE in ground-water samples at intersection of Gardendale Drive with Fairground Road.



20'-21' ● Depth/location of ground-water sample

120 TCE concentration, in (micrograms per liter) (F) Field Screening analysis

ND Non-detect

**TTL, Inc.**

PRACTICING IN THE GEOSCIENCES

Figure 5 Shallow and deep vapor implants; shallow stratigraphy, and concentrations of TCE in ground-water samples at the intersection of East Park Avenue with Chelsea Drive.

Plates

\*Hard Copy available at the Coliseum Boulevard Branch of the Montgomery Public Library

CPB Repository