SHALLOW SOIL GAS SURVEY
AT
MARTIN MARIETTA ENERGY SYSTEMS FACILITY
PADUCAH, KENTUCKY

AUGUST 1986

Prepared For:

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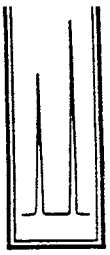

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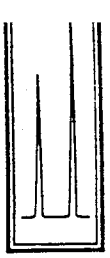


EXECUTIVE SUMMARY

- A total of 28 soil gas samples were taken and analyzed during an investigation at the Martin Marietta Energy Systems, Inc. facility in Paducah, Kentucky.

- The data indicate a source of TCE contamination at the location where the sewer line leaves building C-400.

- Given the limited time for the investigation, the areal extent of contamination could not be determined.

- Further soil gas investigation downgradient from the source would quickly establish the potential for extended contaminant migration.

INTRODUCTION

A shallow soil gas survey was conducted by Tracer Research Corporation at the Martin Marietta Energy Systems, Inc. facility in Paducah, Kentucky. The investigation was conducted August 25 through 28, 1986 under contract to Martin Marietta. The primary purpose was to identify locations along a sewer line which may have been leaking contaminants into the subsurface.

For this survey soil gas samples were taken and analyzed for the following compounds:

1,1,1-Trichloroethane (TCA)
Trichloroethene (TCE)
Tetrachloroethene (PCE)

The sewer line was known to service an area which used TCE. An area near the line was excavated and TCE was found in soil samples in concentrations as high as 7,000 mg/L. TRC was to use its soil gas technology to aide in determining areas along the line which may have leaked.

The approximate depth to groundwater at the site is 60 feet with a hydraulic gradient to the north or northwest. The vadose zone consists of dry to moist medium silt with some trace of sand and gravel.

BACKGROUND ON THE METHODOLOGY

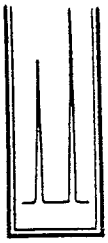
The presence of volatile organic chemicals (VOCs) in shallow soil gas indicates the observed compounds may either be in the vadose zone near the probe or in groundwater below the probe. The soil gas technology is most effective in mapping low molecular weight halogenated solvent chemicals and petroleum hydrocarbons possessing high vapor pressures and low aqueous solubilities. These compounds readily partition out of the groundwater and into the soil gas as a result of their high gas/liquid partitioning coefficients. Once in the soil gas, VOCs diffuse vertically and horizontally through the soil to the ground surface where they dissipate into the atmosphere. The groundwater acts as a source and the above ground atmosphere acts as a sink, and typically a concentration gradient develops between the two. The concentration gradient in soil gas between the water table and ground surface may be locally distorted by hydrologic and geologic anomalies (e.g. clays, perched water); however, soil gas mapping generally remains effective because distribution of the contamination is usually broader in areal extent than the local geologic barriers and is defined using a large data base. The presence of geologic obstructions on a small scale tends to create anomalies in the soil gas-groundwater correlation, but generally does not obscure the broader areal picture of the contaminant distribution.

SAMPLING AND ANALYTIC PROCEDURES

Tracer Research Corporation utilized an analytical field van which was equipped with one Varian 3300 gas chromatograph, one Tracor 540 gas chromatograph and two Spectra Physics SP4270 computing integrators. A gas chromatograph equipped with an electron capture detector was used for analyses of TCA, TCE and PCE. In addition, the van has two built-in gasoline powered generators which provide the electrical power (110 volts AC) to operate all of the gas chromatographic instruments and field equipment. A specialized hydraulic mechanism consisting of two cylinders and a set of jaws was used to drive and withdraw the sampling probes. Probes consist of 7-foot lengths of 3/4 inch diameter steel pipe which are fitted with detachable drive points. A hydraulic hammer was used to assist in driving probes past cobbles and through unusually hard soil.

Soil gas samples were collected by driving a hollow steel probe from 2 to 7 feet into the ground. The above-ground end of the sampling probes were fitted with a steel reducer and a length of polyethylene tubing leading to a vacuum pump. Five to 10 liters of gas was evacuated with a vacuum pump. During the soil gas evacuation, samples were collected by inserting a syringe needle through a silicone rubber segment in the evacuation line and down into the steel probe. Ten milliliters of gas were collected for immediate analysis in the TRC analytical field van. Soil gas was subsampled (duplicate injections) in volumes ranging from 1 ul to 2 ml, depending on the VOC concentration at any particular location.

Detection limits are a function of the injection volume as well as the detector sensitivity for individual compounds. Thus, the detection limit varies with the sample size. Generally, the larger the injection size the greater the sensitivity. However, peaks for compounds of interest must be kept within the linear



range of the detector. If any compound has a high concentration, it is necessary to use small injections, and in some cases to dilute the sample to keep it within linear range. This may cause decreased detection limits for other compounds in the analyses. The detection limits range down to 0.00005 ug/l for compounds such as TCA and PCE depending on the conditions of the measurement, in particular, the sample size. If any component being analyzed is not detected, the detection limit for that compound in that analysis is given as a "less than" value (e.g. <0.0001 ug/l). This number is calculated from the current response factor, the sample size and the estimated minimum peak size (area) that would have been visible under the conditions of the measurement.

Tracer Research Corporation's normal quality assurance procedures were followed in order to prevent any cross-contamination of soil gas samples. Prior to sampling, syringes were purged with nitrogen (i.e. carrier gas) and checked for contamination by injection into the gas chromatograph. System blanks were run periodically to confirm that there was no contamination in the probes, adaptors or 10 ml syringes. Soil gas probes, syringes and adaptors were used only once during the course of a working day and then thoroughly cleansed before use on the subsequent day. Analytical instruments were continuously checked for calibration by the use of chemical standards. Soil gas pumping was monitored with a vacuum gauge to insure that an adequate flow from the vadose zone was maintained.

RESULTS

A total of 28 soil gas samples were taken and analyzed during an investigation at the Martin Marietta Energy Systems, Inc. facility in Paducah, Kentucky. Analytical results are summarized in appendix A. Maps which show soil gas sampling locations and isoconcentration contour lines are attached as Figures 1 and 2. Because TCE is the major contaminant, and the other compounds (TCA and PCE) are likely present because they were an impurity in the industrial grade TCE, only the distribution of TCE is plotted.

TCE Distribution

Figures 1 and 2 show two possible scenarios for the distribution of TCE. Because the TCE distribution was found to be more widespread than was predicted before the TRC investigation, not enough time was given to properly delineate the plume. For this reason there are two different contours for the same compound. Figure 1 represents a minimum amount of contaminant migration and Figure 2 leaves the contour lines open, allowing for a "worst case scenario" of contaminant migration of greater than a mile. The true distribution is most likely to be something in between the two figures. The analysis made at SG-17 showing <0.00002 ug/L TCE is important in establishing a level of TCE which can be considered significant. A background less than the detection level for TCE (this is consistent with most of the sites at which TRC has experience) means that any detection of TCE is likely to have been caused by a contaminant release. A level 3 to 5 times greater than the detection limit (0.001 ug/L) is used in this case to indicate significant TCE concentrations in the soil gas.

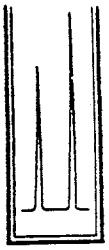
Figure 1 Scenario:

Figure 1 represents a case of the most limited possible

distribution of TCE. The data indicates a source of TCE contamination around the area where the sewer line leaves building C-400 and continues south along that line with the flow of the sewer. An area of concentrations at or above 100 ug/L as large as what is shown usually indicates at least some groundwater contamination. The remainder of the contour lines are drawn to indicate a plume with slight migration with the hydraulic gradient to the north/northwest. Concentrations in the soil gas at the 0.01 ug/L level extend 500 feet from the source area. Concentrations greater than 0.001 (which should be considered significant) may extend another 400 feet. Limiting the distribution of measurable contamination to approximately 900 feet from the source area. The Figure 1 scenario indicates an area approximately 900 feet wide and 900 feet long to be significantly contaminated. It assumes point SG-24, 600 feet downgradient from the source to be a separate problem.

Figure 2 Scenario:

Figure 2 leaves the contours around the source open. This allows for interpretation to include the possibility of greater downgradient migration. The experience of TRC indicates that this is more likely than the limited distribution shown in Figure 1. As mentioned before a "worst case scenario" would include measurable contamination that has migrated greater than a mile, possibly as far as two miles. The Figure 2 scenario indicates an area 900 feet wide and at least 2,000 feet long being a part of a groundwater contamination plume. It assumes that the higher TCE level found at SG-24 is part of the plume eminating from the source. Further soil gas investigation would be useful in determining the actual extent of migration.

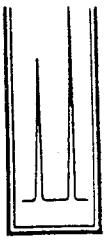


CONCLUSIONS

The results of the investigation indicate that TCE releases into a sewer line that leaked probably caused some degree of groundwater contamination. Because the survey was limited to just three days, the actual extent of contamination could not be determined. Given the data that was obtained, two cases were proposed which are likely bracket the actual situation.

One case allows for only limited distribution of the TCE. Figure 1 was generated to illustrate such a case. It shows that the extent of measureable contamination would be less than 1000 feet downgradient from the source area. Figure 2, with the contour lines left open, allows interpretation to include migration as far as two miles from the source.

It appears that further soil gas data downgradient would be extremely helpful in determining the actual extent of contaminant migration. Several data points along 10th Street on one hundred foot centers, would very quickly identify the potential for the plume to continue further than the limited distribution shown in Figure 1.



APPENDIX A: CONDENSED DATA

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CONDENSED DATA

CONTAMINANT			TCA	TCE	PCE	
sample	depth	date	mean ug/l concentration	mean ug/l concentration	mean ug/l concentration	mean ug/l concentration
SG1	5.5'	8/25	<0.3	370	30	
SG2	3'	8/25	0.2	6	0.1	
SG2	7'	8/25	<0.3	2	<0.01	
SG3	3.5'	8/25	<0.003	0.5	<0.001	
SG4	3.5'	8/25	0.05	0.8	0.03	
SG5	3.5'	8/25	0.001	<0.00003	<0.00001	
SG6	5'	8/26	2	290	0.5	
SG7	3.5'	8/26	0.4	280	0.2	
SG8	4.5'	8/26	0.6	60	0.08	
SG9	3'	8/26	0.1	2	0.002	
SG10	4.5'	8/26	0.05	130	0.04	
SG11	3'	8/26	0.1	40	0.1	
SG12	2'	8/26	<0.03	100	0.04	
SG13	3.5'	8/26	0.03	14	0.02	
SG14	3.5'	8/26	0.003	0.02	0.0007	
SG15	3'	8/26	0.0006	0.004	0.0009	
SG16	3.5'	8/26	0.03	0.3	0.001	
SG17	2.5'	8/27	0.002	<0.00002	<0.00001	
SG18	2'	8/27	0.01	0.3	0.0008	
SG19	5'	8/27	0.003	0.006	0.0002	
SG20	4.5'	8/27	0.002	0.03	0.0001	

Notations:
- RF response factor
- I interference with adjacent peaks
- NA not analyzed
- E estinmated peak area

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Proofed by: L. Laplander

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CONDENSED DATA

CONTAMINANT			TCA	TCE	PCE	
sample	depth	date	mean ug/l concentration	mean ug/l concentration	mean ug/l concentration	mean ug/l concentration
SG21	4.5'	8/27	0.002	0.004	0.0004	
SG22	5'	8/27	0.5	2	0.002	
SG23	3.5'	8/27	0.003	0.003	0.0004	
SG24	5'	8/27	0.004	0.003	0.0004	
SG25	4.5'	8/27	0.003	0.007	0.0004	
SG26	3.5'	8/27	0.002	0.04	0.0003	
SG27	4'	8/27	0.005	0.005	0.0003	
SG28	4.5'	8/27	0.006	0.004	0.0003	

Notations:
- RF response factor
- I interference with adjacent peaks
- NA not analyzed
- E estinmated peak area

Summarized by: L. Lawlor

Checked by: G.Kalfayan

Proofed by: L. Laplander

SAMPLING SCHEDULE

DATE	SAMPLE Nº		LOCATION	TCE (Mg/g)	PCB (PPM)	URANIUM (PPM)
6/18	779	FIRST SAMPLES	SOUTH EAST	3030		
6/18	780		SOUTH WEST	262		
6/18	781		NORTH EAST	7720		
6/18	782		NORTH WEST	191		
6/18	783		EAST CENTER	18		
6/19	802	SECOND SAMPLES	NORTH EAST	135		
6/19	803		NORTH WEST	27		
6/19	804		SOUTH EAST	4		
6/19	805		SOUTH WEST	22		
6/19	806		EAST CENTER	5		
6/19	807		WEST CENTER	145		
6/23	826	THIRD SAMPLES	SOUTH WEST	229		
6/23	827		EAST CENTER	81		
6/23	828		WEST CENTER	202		
6/23	829		NORTH WEST	375		
6/23	830		NORTH EAST (TOP)	<.1		

TOLERANCES UNLESS OTHERWISE SPECIFIED	DES C.M. JOHNSON	1986	MARTIN MARIETTA — MARTIN MARIETTA ENERGY SYSTEMS, INC. operated for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE AC 05 84OR21400 Oak Ridge, Tennessee • Paducah, Kentucky
FRACTIONS ± XX DECIMALS ± XXX DECIMALS ± ANGLES BREAK SHARP EDGES MAX. FINISH	DRW D.F. SPENCER	1986	C-400 TRICHLOROETHYLENE LEAK SITE
	CHK C. Johnson	10-17-86	
	SECT	10/17/86	
	DEPT & PLANT	11/4/86	
A-E	DIVISION	11/4/86	
	REQUESTER R.K. DIEROLF/WALT WHINNERY	10-30 10-31	C-400 TCE LEAK SITE — TYPE P
MMES	FIRE / SECURITY JRW/CJV	10-30 10-21	
	SAFETY M. MOORE	10-22-86	1: 3 · 48: C · 49: P · 50: T · PLANT PGDP · BLDG C-400 · FL · SHT. · OF · CLASS U
X	IND. HYGIENE CWT	10-23-86	
CE DOE	MAINT. J.H. RENFRO	10-21-86	SCALE NONE · ID 16646 · C5E16646 · A · REV 8
DRAWING APPROVALS	DATE		

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Figure 1. TRICHLOROETHENE (TCE)

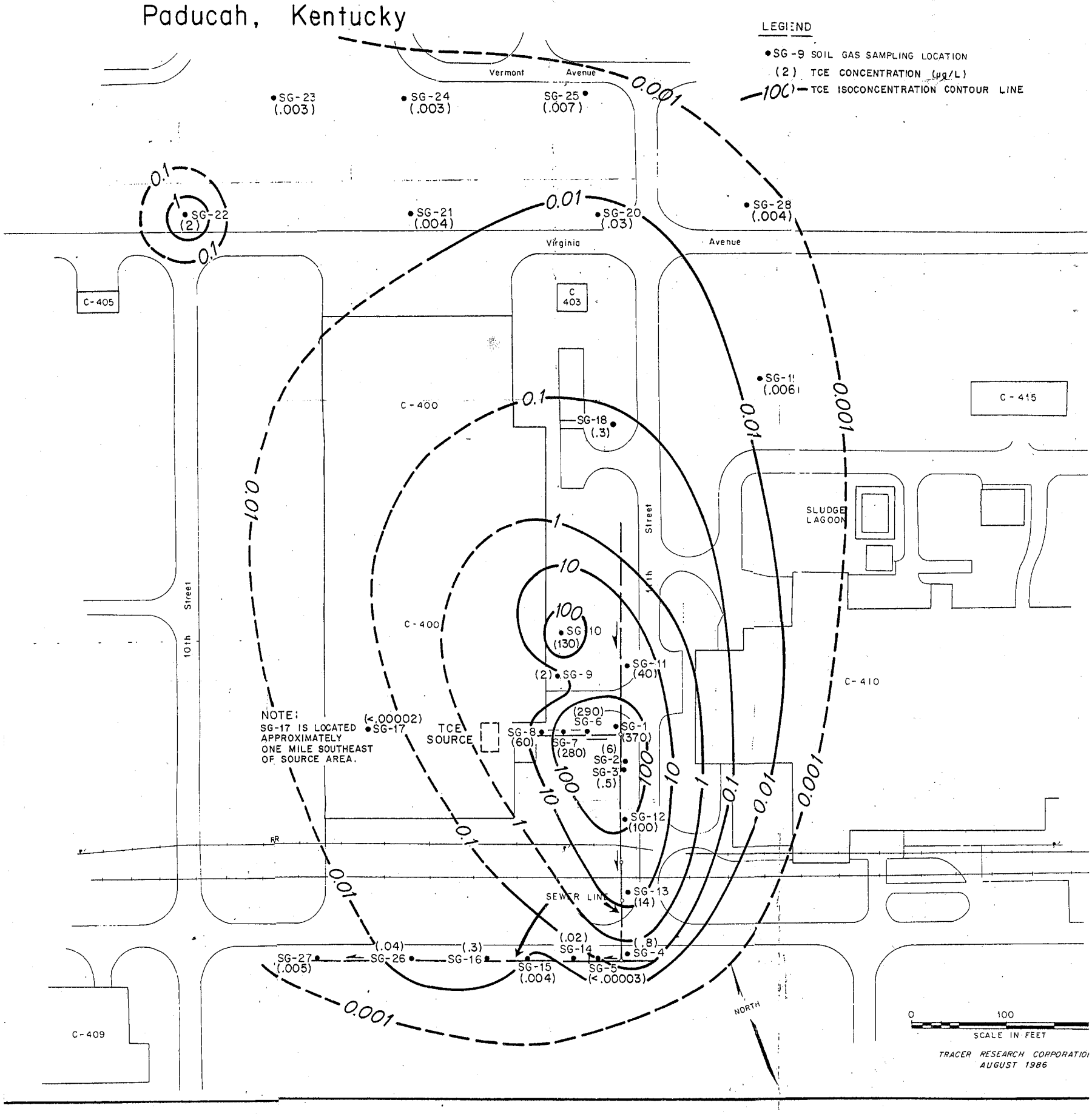

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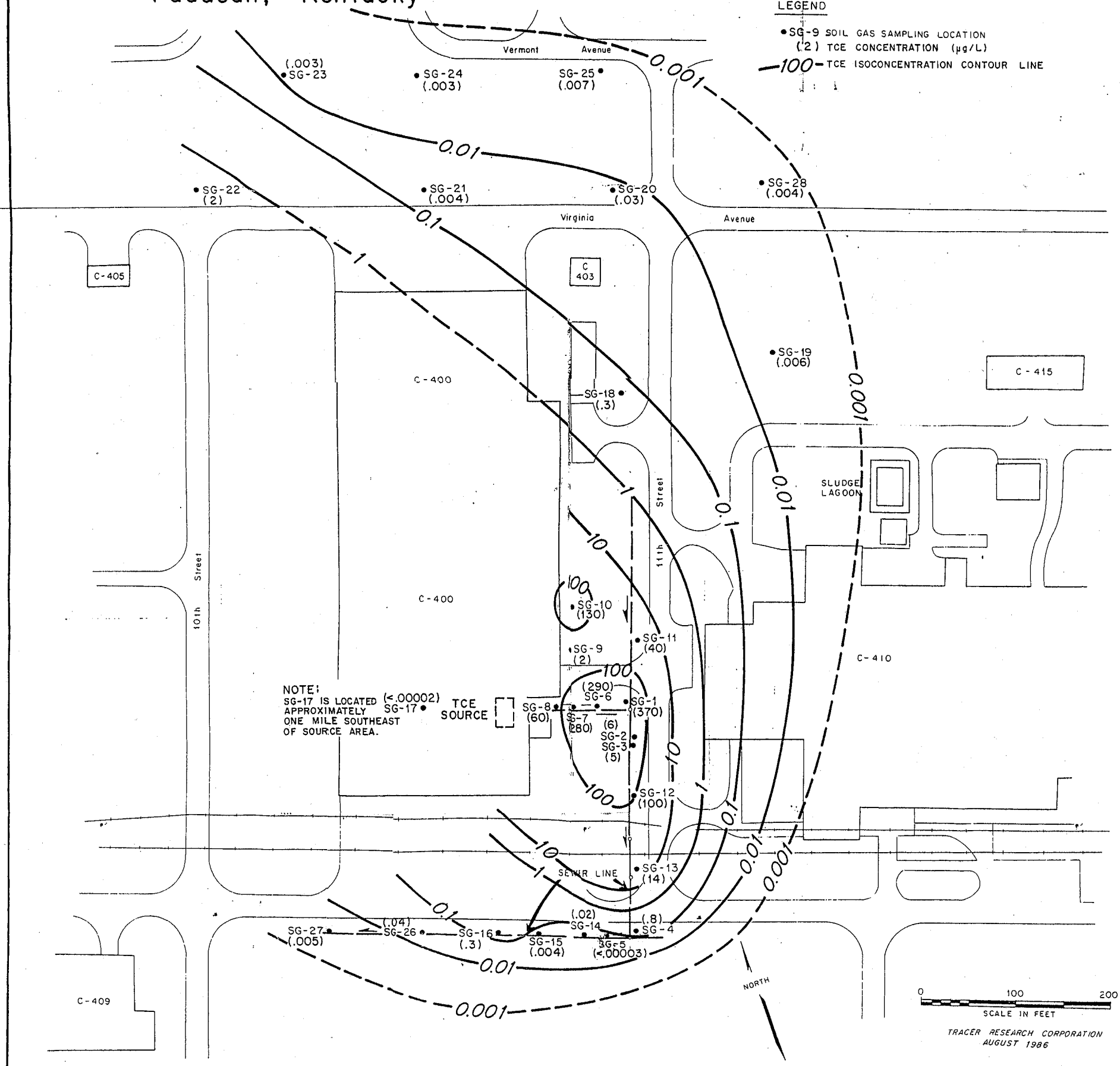
Figure 2. TRICHLOROETHENE (TCE)



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