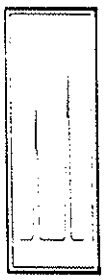
APPENDIX D

Tracer Report of Soil Gas Survey and Ground-Water Investigation (In Stratigraphy Report)



Prepared for:

LAW ENVIRONMENTAL
Corporate Plaza West
Washington Avenue Extension
Albany, New York 12203

Telephone: (518) 869-0364

Attention: Mr. Mike Patenaude

Telephone: (518) 869-0364

Prepared by:

TRACER RESEARCH CORPORATION
3855 North Business Center Drive
Tucson, Arizona 85705-2944

(602) 888-9400

FAX (602) 293-1306

Shallow Soil Gas and Groundwater Investigation

Aro Corporation
Life Support Division

March 9 - 13, 1992

Submitted by:

C. Wesley Peterson

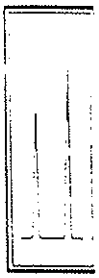
Peter Kelley

Tracer Research Corporation

1-92-201-S

TABLE OF CONTENTS

Tables



1.0 ARO CORPORATION SURVEY

Tracer Research Corporation (TRACER) performed a shallow soil gas and groundwater investigation at the Life Support Division of the Aro Corporation, 3685 Broadway, Buffalo, New York. The investigation was conducted March 9 through 13, 1992, for Law Environmental. Field representatives for Law Environmental were Steve Boulton and Jim Peterson.

1.1 Objective

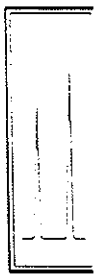
The purpose of the investigation was to assess and delineate the extent of possible subsurface contamination plume by screening shallow soil gas for the presence of volatile organic chemicals (VOCs). Shallow soil gas and water samples were collected and analyzed for the following halocarbons (chlorinated solvents):

trans-1,2-dichloroethene (trans-1,2-DCE)
1,1,1-trichlorethane (TCA)
trichloroethene (TCE)
tetrachloroethene (PCE)
vinyl chloride

1.2 Overview of Results

For this investigation 14 soil gas and 12 groundwater samples were collected at depths of 2.5 to 6 feet below grade from 25 sampling locations in Building 3695 and southeast of Building 3695. These samples were analyzed for the selected compounds.

No trans-1,2-DCE was detected in any soil gas or water sample. TCA was detected in all of the soil gas samples in concentrations ranging from 0.0003 to 0.03 micrograms per liter (ug/L). TCA was also detected in all but one of the water samples in concentrations of 0.003 to 0.1 ug/L.



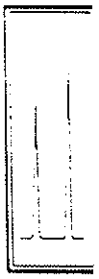
TCE was detected in all but two of the soil gas samples in concentrations ranging from 0.0003 to 120 ug/L. TCE was also detected in all but one of the water samples in concentrations of 0.005 to 1,400 ug/L.

PCE was detected in all but four of the soil gas samples in concentrations ranging from 0.0008 to 0.1 ug/L. PCE was also detected in all but two of the water samples in concentrations of 0.001 to 0.04 ug/L.

Vinyl chloride was not detected in any of the soil gas samples. Concentrations of vinyl chloride were detected in four water samples in ranges from 0.1 to 14 ug/L.

1.3 Out-of-Control Events

Very tight, clay soil prevented the collection of soil gas and water samples at sampling locations 4 and 8. Also, sampling was discontinued on March 10, 1992, at 3:40 pm because of heavy weather.



2.0 SITE DESCRIPTION

The Aro Corporation site is a manufacturing complex. The surface cover is mostly concrete and asphalt.

Law Environmental reported the groundwater flows in a southerly direction. Water samples were collected at depths of 3 to 6 feet below ground surface (bgs).

3.0 SOIL GAS SAMPLING PROCEDURES

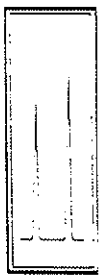
The 7-foot sampling probes of 3/4-inch diameter hollow steel pipe were fitted with detachable drive tips and advanced 2.5 to 6 feet bgs. Because of very tight clay soil, fifty-two attempts were made to collect 14 soil gas and 12 water samples. However, generally the soil gas samples were obtained at shallow depths in spite of the tight clay. Inside the building, the probes were hand pounded to the desired depth and outside the building, a hydraulic pounding mechanism was used to pound the probes to the desired depth.

Once inserted into the ground, the aboveground end of each probe was fitted with an aluminum reducer and a length of polyethylene tubing leading to a vacuum pump. Soil gas was pulled by the vacuum pump into the probe. A vacuum gauge measured the volume of gas pulled into the probe to make sure the flow was adequate.

The volume of air within each probe was purged by evacuating 2 to 5 liters of gas. The evacuation time in minutes versus the vacuum in inches mercury (Hg) was used to calculate the necessary evacuation time. The vacuum was measured and recorded at each sampling location.

Probe vacuums ranged from 2 to 18 inches Hg. The maximum vacuum reading was 25 inches Hg.

The sample was collected in a glass syringe by inserting a syringe needle through a silicone rubber segment (manifold) in the evacuation line and down into the steel probe. Up to ten milliliters (mL) of gas were collected for immediate analysis in the Tracer Research analytical van.



4.0 GROUNDWATER SAMPLING PROCEDURES

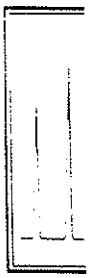
When groundwater was encountered at shallow depths, water samples were collected. Twelve water samples were collected from the site and analyzed for the target compounds.

Sampling probes consisted of 7- and 14-foot lengths of 3/4-inch diameter hollow steel pipe. Groundwater samples were collected at a depth of approximately 2.5 to 6 feet bgs.

The hollow probes with detachable drive points were driven below the water table. Once at the desired depth, the probes were withdrawn several inches to permit water to flow into the resulting hole. The aboveground end of the sampling probes were fitted with a vacuum adaptor (metal reducer) and a length of polyethylene tubing leading to a vacuum pump. A vacuum of up to 25 inches Hg was applied to the interior of the probe for 10 to 15 minutes or until water was drawn up the probe. The water accumulated in the hole was removed by vacuum through a 1/4-inch polyethylene tube inserted down into the probe to the bottom of the hole. Because the water is induced to flow into a very narrow hole, it can be sampled with little exposure to air and, consequently, the loss of volatile compounds by evaporation is reduced. The polyethylene tubing was used only once and discarded to avoid cross contamination.

Groundwater samples were collected in 40 mL VOA vials that were filled to exclude air and capped with Teflon-lined septa caps. Approximately half of the liquid in the bottle was decanted, the vials were shaken vigorously, and a sample of the headspace from the container was injected into the gas chromatograph (GC).

Headspace analysis is the preferred technique when a large number of water samples are to be performed daily. The method is more time efficient for the measurement of volatile organics than direct injection of the water sample into the GC because there is less chance of semi-volatile and non-volatile organics



contaminating the system. Depending upon the partitioning coefficient of a given compound, the GC may be more sensitive to headspace analysis than to direct injection analysis. The precision and accuracy of both methods are similar.

5.0 ANALYTICAL PROCEDURES

For this investigation 14 soil gas and 12 groundwater samples were collected from 25 sampling locations. Ten mL of each soil gas sample and 40 mL of each groundwater sample were collected for immediate analyses in the TRACER analytical van.

The GC was calibrated for headspace analysis by decanting 10 to 20 mL of the known standard, leaving approximately the same amount of headspace as in the water headspace samples. The standard bottle was resealed and shaken vigorously for 30 seconds. An analysis of the headspace in the bottle determined the Response Factor (RF) which was then used to accurately estimate the standard concentrations.

5.1 Analyte Class

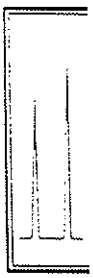
The samples were analyzed for the following analyte class and compounds:

Analyte Class: Halogenated Hydrocarbons

Chlorinated solvents -	trans-1,2-dichloroethene (trans-1,2-DCE)
	1,1,1-trichlorethane (TCA)
	trichloroethene (TCE)
	tetrachloroethene (PCE)
	vinyl chloride

5.2 Chromatographic System

A Varian 3300 gas chromatograph was used for the soil gas and groundwater analyses. The halocarbons, except for vinyl chloride, were separated on a 6' by 1/8" outside diameter (OD) packed column with chromosorb (OV-101), 80/100 mesh, as the stationary phase in a temperature controlled oven and detected with an ECD. Vinyl chloride was separated on a 6' by 1/8" OD packed column with carbopack (SP-1000), 60/80 mesh, and detected with a FID. Nitrogen was used as the carrier gas.



The target compounds detected in the soil gas and groundwater samples were identified by chromatographic retention time. The compounds were quantified by comparing the detector response of the sample with the detector response measured for calibration standards (external standardization). Instrument calibrations were checked periodically throughout the day and system blanks were analyzed at the beginning of the day to check the groundwater sampling equipment for contamination. Air samples were also routinely analyzed to check for background levels of the target compounds in the atmosphere.

GC Process

The sample is injected into the GC where it is swept through the analytical column by the carrier gas. The detector senses the presence of a component different from the carrier gas and converts that information to an electrical signal. The components of the sample pass through the column at different rates, according to their individual properties, and are detected by the detector. They are identified by the time it takes them to pass through the column (retention time).

ECD Process

The ECD captures low energy thermal electrons that have been ionized by beta particles. The flow of these captured electrons into an electrode produces a small current, which is collected and measured. When the halogen atoms (halocarbon) are introduced into the detector, electrons which would otherwise be collected at the electrode are captured by the sample, resulting in decreased current. The current causes the computing integrator to record a peak on a chromatogram. The area of the peak is compared to the peak generated by a known standard to determine the concentration of the analyte.

FID Process

The FID utilizes a flame produced by the combustion of hydrogen and air. When a component, which has been separated on the GC analytical column, is introduced into the flame, a large increase in ions occurs. A collector with a polarizing voltage is applied near the flame and the ions are attracted and produce a current, which is proportional to the amount of the sample compound in the flame. The electrical current causes the computing integrator to record a peak on a chromatogram. By measuring the area of the peak and comparing that area to the integrator response of a known aqueous standard, the concentration of the analyte in the sample is determined.

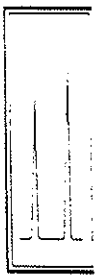
5.3 Analyses

Subsamples (duplicate injections) of the soil gas samples were injected into the GC in volumes of 200 to 1,000 microliters (uL). Subsamples of the water headspace samples were injected into the GC in volumes ranging from 1 to 500 uL.

Detection Limits

Detection limits depended on the volume of the injection as well as the sensitivity of the detector to the individual compound. Generally, the larger the injection size, the greater the sensitivity. However, the peaks for target compounds had to be kept within the linear and operating ranges of the analytical equipment.

If target compounds are present at high concentrations, it is necessary to dilute the sample or to decrease the volume of the injection in order to measure the compound's peak on the chromatogram. This sometimes causes decreased detection of other target compounds. It is necessary to analyze the largest sample possible while staying within the operating and linear ranges of the equipment. Tracer Research performs a minimum of two injections for each soil gas sample collected.

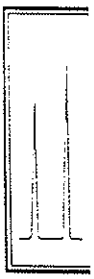


The detection limits of the target compounds were calculated from the response factor, the sample size, and the calculated minimum peak size (area) observed under the conditions of the analysis. If any compound was not detected, the detection limit for that compound in that analysis was given as a "less than" value, e.g., <0.1 ug/L.

The detection limits for each of the targeted halocarbon compounds are listed in the table below:

Table 1. Detection Limits for Target Compounds

Type of Sample	Compound	Detection Limit
Soil Gas	trans-1,2-DCE	0.02 ug/L
Water	trans-1,2-DCE	0.1 ug/L
Soil Gas	TCA	0.0003 ug/L
Water	TCA	0.001 ug/L
Soil Gas	TCE	0.0001 ug/L
Water	TCE	0.007 ug/L
Soil Gas	PCE	0.0001 ug/L
Water	PCE	0.0006 ug/L
Soil Gas	vinyl chloride	0.06 ug/L
Water	vinyl chloride	0.06 ug/L



6.0 QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC)

TRACER's QA/QC program was followed to maintain data that was reproducible throughout the investigation. An overview presenting the significant aspects of TRACER's QA/QC program is presented below.

Soil Gas and Groundwater Sampling Quality Assurance

To ensure consistent collection of samples, the following procedures are performed:

- Sampling Manifolds

  TRACER's custom designed sampling manifold connects the sample probe to the vacuum line and pump. The manifold is designed to eliminate sample exposure to the polymeric (plastic) materials that connect the probe to the vacuum pump.

  The sampling manifold attaches to the end of the probe, forming an air tight union between the probe and the silicon tubing septum. The septum connects the manifold to the pump vacuum line and permits syringe sampling.

  This system allows the sample to be taken upstream of the sampling pump, manifold, and septum. Since cross contamination of sampling equipment is a major problem, TRACER replaces the materials (probe and syringe), between sampling points, that contact the sample before or during sampling. If the equipment is contaminated, all the components are replaced. At the end of each day the manifold is cleaned with soap and water and baked in the GC oven.

- Sampling Probes

  Steel probes are used only once each day. To eliminate the possibility of cross contamination, they are washed with high pressure soap and hot water spray, or steam-cleaned. Enough sampling probes are carried on each van to avoid the need to re-use any during the day.

- Glass Syringes

  Glass syringes are usually used for only one sample a day and are washed and baked out at night. If they must be used twice, they are purged with carrier gas (nitrogen) and baked out between probe samplings.

- Polyethylene Tubing and VOA Vials

  Polyethylene tubing and VOA vials used for the collection of groundwater samples are used only once and then discarded to avoid cross contamination.

- Sampling Efficiency

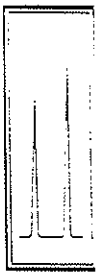
  Soil gas/groundwater pumping is monitored by a vacuum gauge to ensure that an adequate gas flow from the vadose zone is maintained. A reliable gas sample can be obtained if the sample vacuum gauge reading is at least 2 inches Hg less than the maximum vacuum of the vacuum pump.

Analytical Quality Assurance Samples

Quality assurance samples are performed at the below listed, or greater, frequencies according to the number of samples analyzed:

Table 2. Quality Assurance Samples

Sample Type	Frequency
Ambient Air Samples	2 per day or per site
Analytical Method Blanks	5% (1 per 20 samples or 1 a day)
Continuing Calibration Check	20% (1 every 5 samples)
Field System Blank	10% (1 every 10 samples or 1 per day)
Reagent Blank	1 per set of working standards
Duplicate Samples	20% to 100% of all samples



The ambient air samples are obtained on site by sampling the air immediately outside the analytical van and directly injecting it into the GC. Analytical method blanks are taken to demonstrate that the analytical instrumentation is not contaminated. These are performed by injecting carrier gas (nitrogen) into the GC with the sampling syringe. Subsampling syringes are also checked in this fashion.

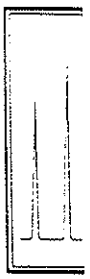
The injector port septa through which samples are injected into the GC are replaced daily to prevent possible gas leaks from the chromatographic column. All sampling and subsampling syringes are decontaminated after use and are not used again until they have been decontaminated by washing in anionic detergent and baking at 100°C.

Field blanks are analyzed to check for contamination of the sampling apparatus, e.g., probe, sampling manifold, sampling pump, and vacuum line. A sample is collected using standard sampling procedures, but without putting the probe into the ground. The results are compared to those obtained from a concurrently sampled ambient air analysis.

If the blanks detect compounds of interest at concentrations that indicate equipment contamination or concentrations that exceed normal background levels (ambient air analysis), corrective actions are performed. If the problem cannot be corrected, an out-of-control event is documented and reported.

A reagent blank is performed to ensure that the solvent used to dilute the stock standards is not contaminated. Analytical instruments are calibrated daily using fresh working standards made from National Institute of Sciences and Technology traceable standards and reagent blanked solvents.

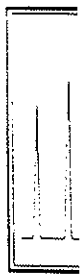
Quantitative precision is assured by duplicating analysis of at least 20 percent of the samples. Duplicate analyses are performed by subsampling vapors from the original syringe. If short analysis times are involved, 100% of the samples are analyzed in duplicate.



7.0 RESULTS

The analytical results from this soil gas investigation are condensed in Appendix A. The data are presented by location and by analyte concentration. When the compound was not detected, the detection limit is presented as a "less than" value, e.g., <0.0001 ug/L.

Law Environmental provided the site map. TRACER field personnel spent the first day on the site (March 10) attending a safety meeting and walking the site to predetermine sampling locations. Maps of these sampling locations are included in Appendix B.



APPENDIX A Condensed Data

LAW ENVIRONMENTAL/ARO CORP./BUFFALO, NEW YORK/JOB #1-92-201-S

03/10/92

CONDENSED DATA

SAMPLE	TRANS -1,2 DCE ug/l	TCA ug/l	TCE ug/l	PCE ug/l	VINYL CHLORIDE ug/l
AIR	I	0.002	<0.001	0.001	<0.08
WS-1-6'	<0.5	0.005	<0.007	<0.002	<0.2
WS-2-6'	<0.5	0.007	290	0.04	<0.2
WS-3-6'	<0.1	0.009	0.1	0.007	<0.2
AIR	<0.1	0.003	<0.002	<0.0006	<0.08
SG-5-5'	<0.04	0.0005	0.3	<0.0002	<0.2
SG-6 3.5'	<0.04	0.0007	<0.0001	<0.0002	<0.2
WS-7-6'	<0.3	0.01	3	<0.0006	<0.2
AIR	<0.04	0.0007	<0.0001	0.0004	<0.08

I = Interference from adjacent peaks

Analyzed by : J. Maisch

Proofed by : AP

LAW ENVIRONMENTAL/ARO CORP./BUFFALO, NEW YORK/JOB #1-92-201-S
03/11/92
CONDENSED DATA

SAMPLE	HS TRANS -1,2 DCE ug/l	HS TCA ug/l	HS TCE ug/l	HS PCE ug/l	TRANS -1,2 DCE ug/l	TCA ug/l	TCE ug/l	PCE ug/l	VINYL CHLORIDE ug/l
AIR	NA	NA	NA	NA	<0.01	0.001	<0.0002	0.0006	<0.06
SG-12-3'	NA	NA	NA	NA	<0.02	0.003	0.0003	0.001	<0.06
WS-10-6'	<0.3	0.01	0.4	0.005	NA	NA	NA	NA	<0.06
AIR	NA	NA	NA	NA	<0.01	0.002	<0.0002	0.0007	<0.06
WS-11-6'	<0.5	0.01	3	0.009	NA	NA	NA	NA	<0.06
SG-13-4'	NA	NA	NA	NA	<0.02	0.003	0.001	0.001	<0.06
WS-2A-6'	<10	0.03	240	0.1	NA	NA	NA	NA	0.1
SG-14-3'	NA	NA	NA	NA	<0.02	0.003	<0.0003	0.001	<0.06
SG-9-5'	NA	NA	NA	NA	<0.02	0.003	0.08	0.0008	<0.06
AIR	NA	NA	NA	NA	I	0.02	0.1	0.0007	<0.06
SG-15-5'	NA	NA	NA	NA	<0.4	0.03	120	0.1	<0.06
SG-16-5'	NA	NA	NA	NA	<1	0.02	0.3	<0.008	<0.06

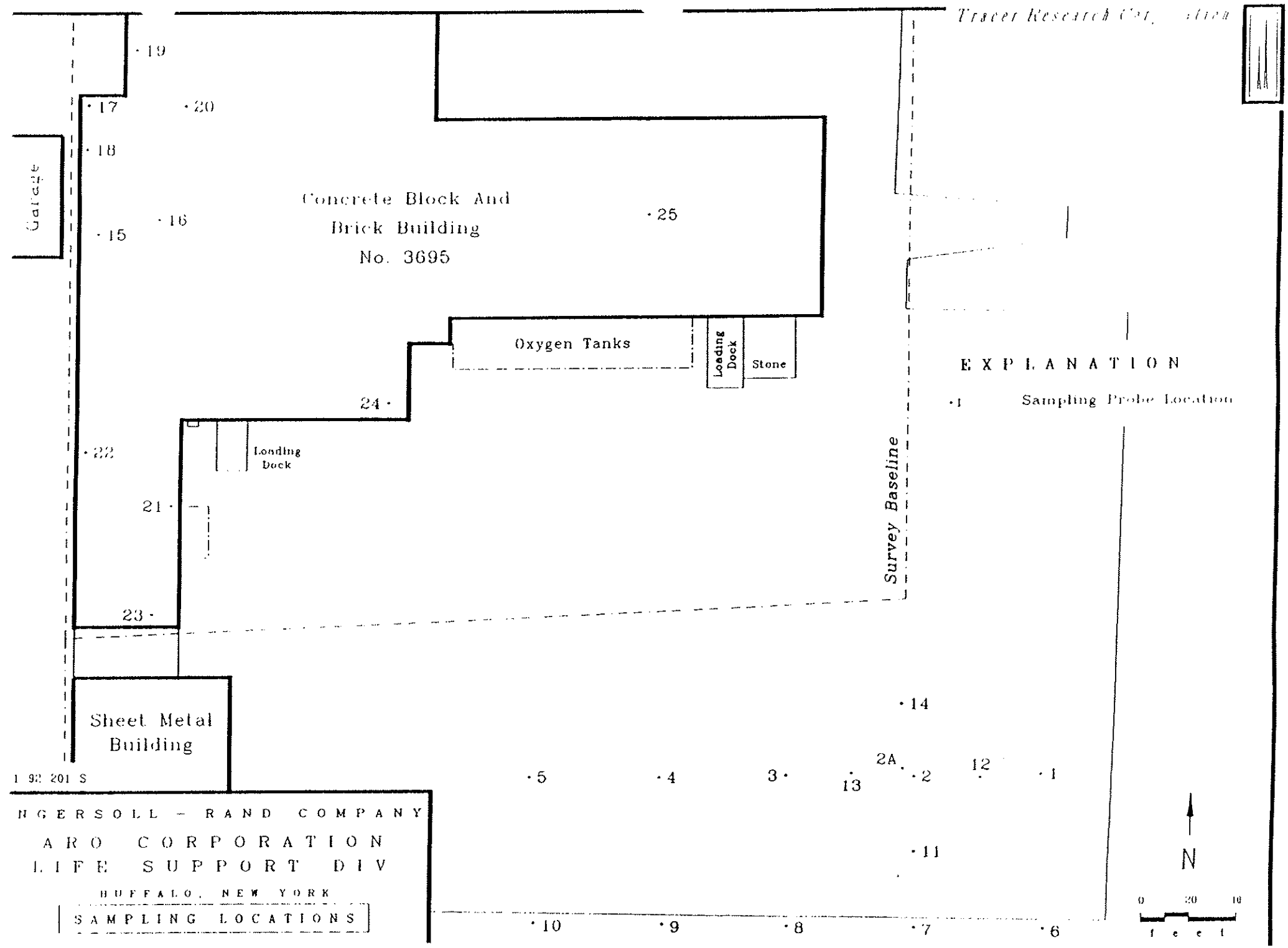
NA = Not analyzed
I = Interference from adjacent peaks
Analyzed by : J. Maisch
Proofed by : _____

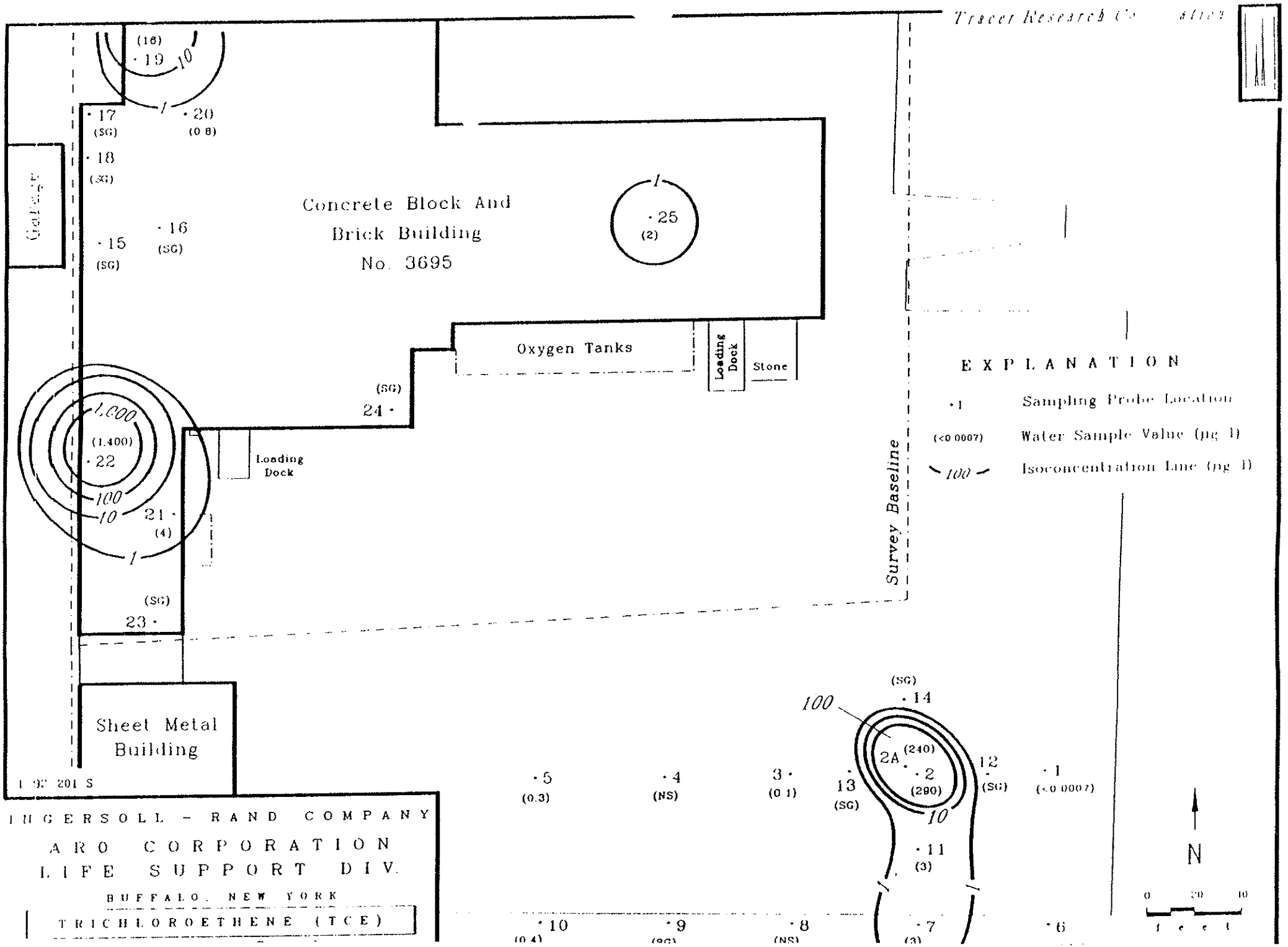
LAW ENVIRONMENTAL/ARO CORP./BUFFALO, NEW YORK/JOB #1-92-201-S
03/12/92
CONDENSED DATA

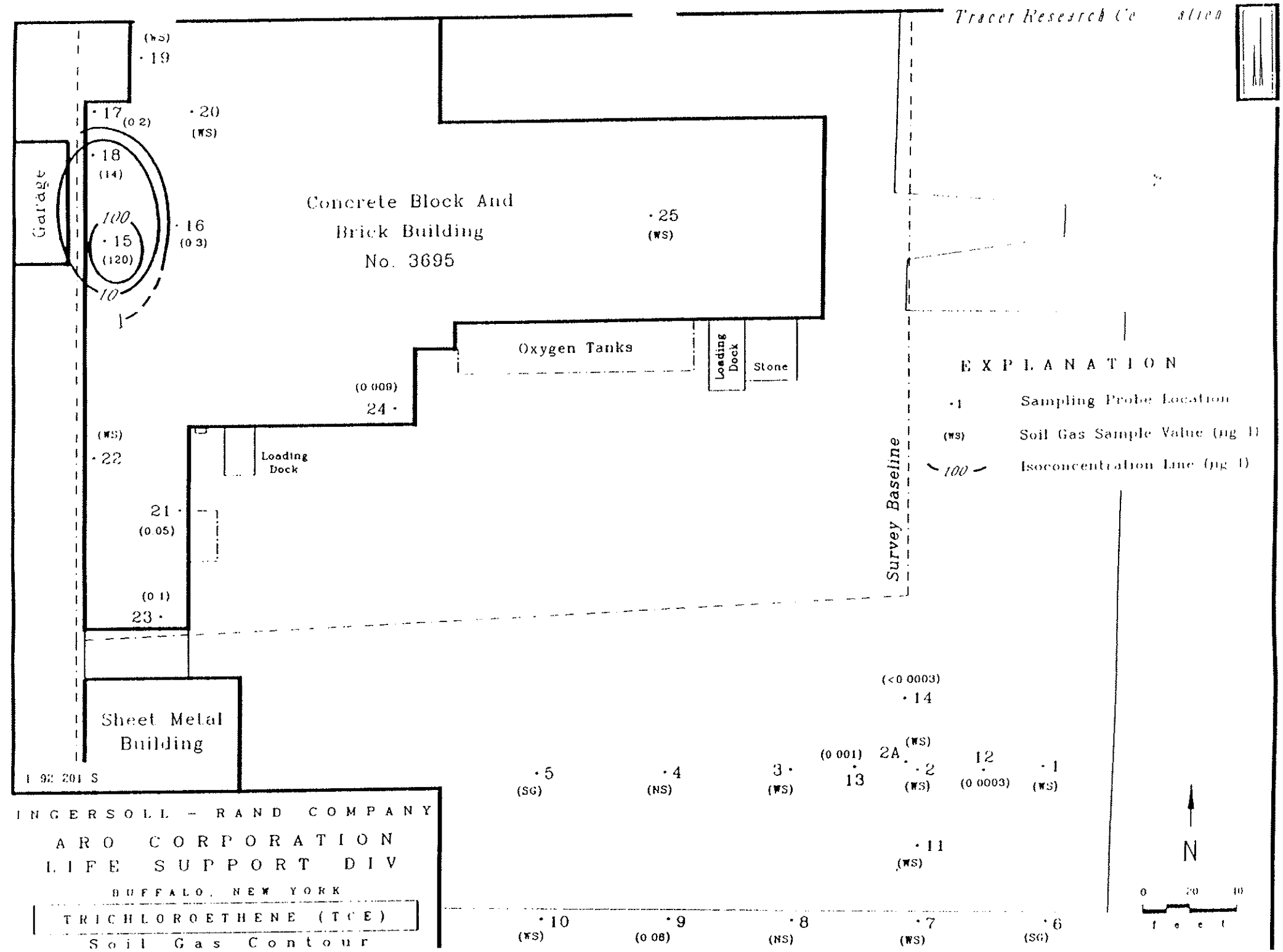
SAMPLE	HS TRANS -1,2 DCE ug/l	HS TCA ug/l	HS TCE ug/l	HS PCE ug/l	TRANS -1,2 DCE ug/l	TCA ug/l	TCE ug/l	PCE ug/l	VINYL CHLORIDE ug/l
AIR	NA	NA	NA	NA	I	0.004	0.03	0.0004	<0.07
*SG-17-4'	NA	NA	NA	NA	<0.07	0.0003	0.2	0.0006	<0.07
*SG-18-3.5'	NA	NA	NA	NA	<0.08	0.004	14	0.009	<0.07
*WS-19-4'	<1	0.07	16	0.01	NA	NA	NA	NA	14
*WS-20-3'	<1	0.01	0.8	0.001	NA	NA	NA	NA	1
*SG-21-3'	NA	NA	NA	NA	<0.2	0.003	0.05	<0.0001	<0.07
*WS-21-5'	<1	0.1	4	0.01	NA	NA	NA	NA	<0.07
*SG-23-3'	NA	NA	NA	NA	I	0.01	0.08	0.005	<0.07
*SG-23-5'	NA	NA	NA	NA	I	0.02	0.1	0.004	<0.07
*SG-24-2.5'	NA	NA	NA	NA	I	0.007	0.5	0.003	<0.07
*WS-25-4'	<1	0.02	2	0.03	NA	NA	NA	NA	<0.07
AIR	NA	NA	NA	NA	<0.07	0.0007	0.0003	0.0003	<0.07
*WS-22-4'	<110	<0.2	1400	<0.3	NA	NA	NA	NA	11

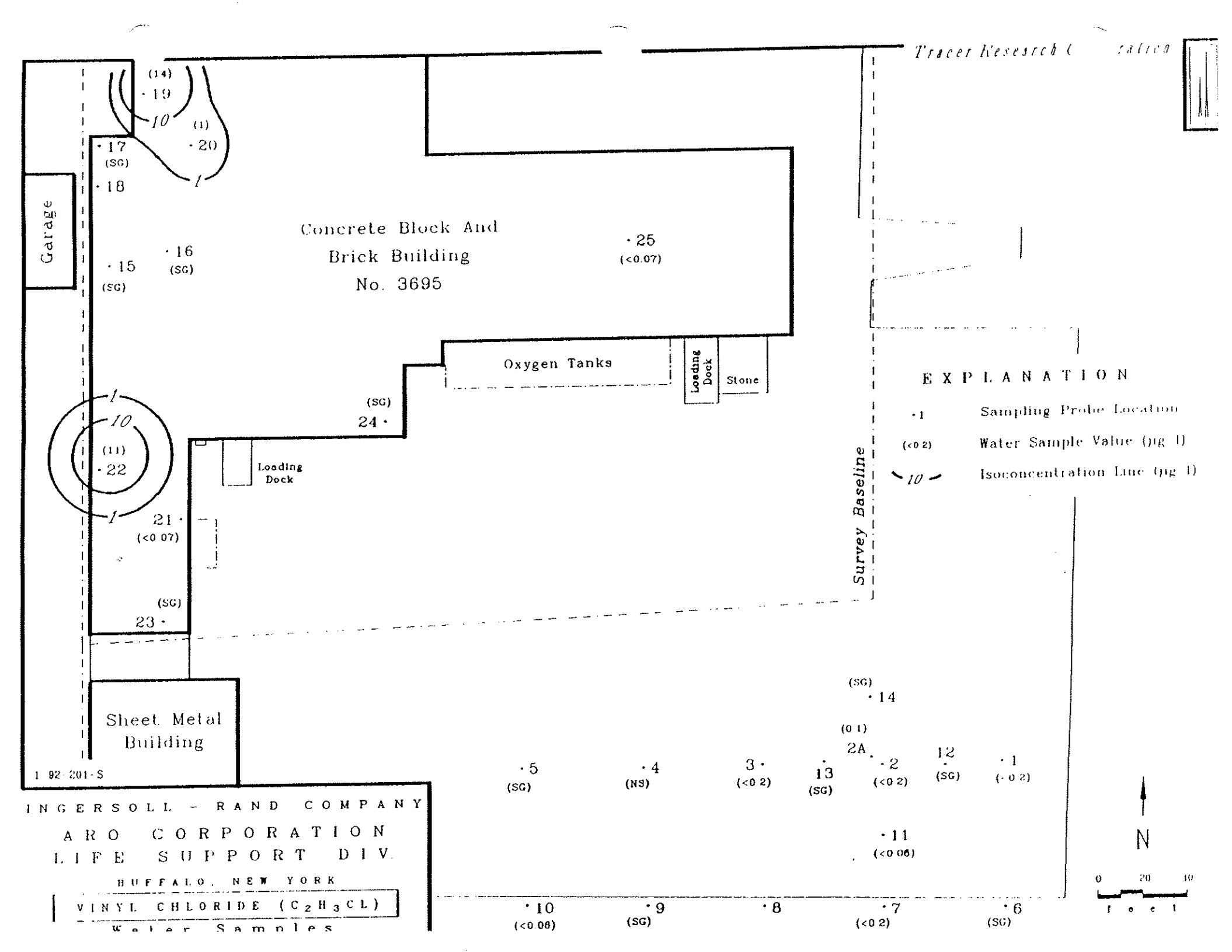
NA = Not analyzed
* = Samples taken inside building
I = Interference from adjacent peaks
Analyzed by : J. Maisch
Proofed by : AD

APPENDIX B Maps


Tracer Research Cor. ation
Garage
Concrete Block And
Brick Building
No. 3695
Oxygen Tanks
Loading Dock
Stone
Loading Dock
Sheet Metal Building
Survey Baseline
EXPLANATION
1 Sampling Probe Location
1 92 201 S
INGERSOLL - RAND COMPANY
ARO CORPORATION
LIFE SUPPORT DIV
BUFFALO, NEW YORK
SAMPLING LOCATIONS
N
0 20 40
feet


Tracer Research Co
(16)
· 19
10
1
· 17
(SG)
· 20
(0 8)
· 18
(SG)
Garage
Concrete Block And
Brick Building
No. 3695
· 15
(SG)
· 16
(SG)
1
· 25
(2)
Oxygen Tanks
Loading
Dock
Stone
(SG)
24 ·
1,000
(1,400)
· 22
100
10
1
Loading
Dock
21 ·
(4)
(SG)
23 ·
Survey Baseline
EXPLANATION
· 1 Sampling Probe Location
(<0 0007) Water Sample Value (pg l)
100 Isoconcentration Line (pg l)
Sheet Metal
Building
1 90° 201 S
INGERSOLL - RAND COMPANY
ARO CORPORATION
LIFE SUPPORT DIV.
BUFFALO, NEW YORK
TRICHLOROETHENE (TCE)
· 5
(0.3)
· 4
(NS)
3 ·
(0 1)
· 13
(SG)
(SG)
· 14
100
2A
(240)
· 2
(290)
10
12
· (SG)
· 1
(<0 0007)
· 11
(3)
1
1
· 10
(0 4)
· 9
(SG)
· 8
(NS)
· 7
(3)
· 6
N
0
20
10
feet


Tracer Research Co
(NS)
· 19
· 17
(0 2)
· 20
(NS)
· 18
(14)
Garage
100
· 15
(120)
· 16
(0 3)
10
Concrete Block And
Brick Building
No. 3695
· 25
(WS)
Oxygen Tanks
Loading Dock
Stone
(0 009)
24 ·
(WS)
· 22
Loading Dock
21 ·
(0 05)
(0 1)
23 ·
Survey Baseline
Sheet Metal Building
I 92 201 S
EXPLANATION
·1 Sampling Probe Location
(WS) Soil Gas Sample Value (µg l)
100 Isoconcentration Line (µg l)
(<0 0003)
· 14
(WS)
(0 001)
2A
· 2
12
(0 0003)
· 1
(WS)
· 5
(SG)
· 4
(NS)
3 ·
(WS)
13
· 11
(WS)
· 10
(WS)
· 9
(0 08)
· 8
(NS)
· 7
(WS)
· 6
(SG)
N
0 20 40
f e e t
INGERSOLL - RAND COMPANY
ARO CORPORATION
LIFE SUPPORT DIV
BUFFALO, NEW YORK
TRICHLOROETHENE (TCE)
Soil Gas Contour


Tracer Research (
(14)
· 19
10
(1)
· 17
(SG)
· 20)
1
· 18
Garage
Concrete Block And
Brick Building
No. 3695
· 16
(SG)
· 15
(SG)
· 25
(<0.07)
Oxygen Tanks
Loading Dock
Stone
(SG)
24 ·
1
10
(11)
· 22
1
Loading Dock
21 ·
(<0 07)
(SG)
23 ·
Survey Baseline
EXPLANATION
· 1 Sampling Probe Location
(<0 2) Water Sample Value (µg l)
10 Isoconcentration Line (µg l)
Sheet Metal Building
1 92-201-S
(SG)
· 14
(0 1)
2A
· 5
(SG)
· 4
(NS)
3 ·
(<0 2)
· 13
(SG)
· 2
(<0 2)
12 ·
(SG)
· 1
(· 0 2)
· 11
(<0 06)
· 10
(<0 06)
· 9
(SG)
· 8
· 7
(<0 2)
· 6
(SG)
N
0 20 10
f e e t
INGERSOLL - RAND COMPANY
ARO CORPORATION
LIFE SUPPORT DIV.
BUFFALO, NEW YORK
VINYL CHLORIDE (C_2H_3Cl)
Water Samples