GW - 1

REPORTS

YEAR(S):

1988

Bloomfield Refining Company
A Gary Energy Corporation Subsidiary

September 16, 1988

Mr. David G. Boyer
New Mexico Oil Conservation Division
P.O. Box 2088
Land Office Building
Sante Fe, NM 87501

RE: Progress Report for Groundwater Remedial Action

Dear Dave:

We have been proceeding with the work required to implement groundwater remediation at our facility as we discussed in our meeting of June 22, 1988.

We have completed the following tasks to date:

1. Soil vapor survey (see attached letter)

2. Installation of two recovery wells, three piezometers, and one additional monitoring well (see attached work plan)

3. Initial sampling of the wells in the area of recovery for background determinations. The samples were submitted on September 9, 1988.

Tasks to follow are:

1. Install electricity, compressed air, and discharge lines for the recovery pumps.

2. Install and calibrate the air-lift hydrocarbon recovery pumps in three wells.

The current plan is to start the recovery system concurrent with the completion of installation of new sewers and slabs for some of the process areas that is underway at this time and projected for November completion. These sewers and slabs are part of our source reduction program. The recovered groundwater will be discharged into one of the new sewer lines that is routed to the API separater. After startup, the produced groundwater will be further evaluated to see if air stripping is required.

Please call me if you have any questions.

Sincerely yours,

Chris Hawley
Environmental Engineer

cc: Joe Warr
Mike Macy
Richard Traylor

CH/cp

SAMPLING

RW-1, RW-2, RW-3, MW-11, MW-13, P-1, P-2, and P-3 were sampled for BTEX and halogenated hydrocarbons (EPA Methods 601 and 602)

RW-1, RW-2, RW-3, MW-11, and MW-13 were sampled for Phenols, Sulfates, Nitrate as N, and TDS

BLOOMFIELD REFINING COMPANY
GROUNDWATER ELEVATIONS
9-9-1988

	WELL DESIGNATION	1 T.O.P. ELEVATION (FT)	2 TOTAL DEPTH OF WELL FROM T.O.P. (FT)	3 DEPTH TO WATER FROM T.O.P. (FT)	4 ELEVATION OF TOP OF WATER (FT)
2	MW-1	5515.77	22.84	15.52	5500.25
4	MW-2	5519.45	26.67	18.31	5501.14
6	MW-3	5535.85	36.90	33.44	5502.41
8	MW-5	5545.10	44.40	42.17	5502.93
10	MW-6	5551.23	49.60	DRY	DRY
12	MW-7	5524.09	62.10	24.87	5499.22
14	MW-8	5531.12	34.94	29.33	5501.79
16	MW-9	5519.70	33.90	19.89	5499.81
18	MW-13	5538.42	53.00	37.91	5500.51
20	MW-4	5524.30	31.44	24.10	5500.20
22	RW-2	5523.48	38.03	23.37	5500.11
24	P-2	5523.73	38.33	23.67	5500.06
26	RW-3 (MW-10)	5516.86	33.92	17.80	5499.06
28	P-3	5507.20	22.80	8.31	5498.89
30	RW-1	5525.92	40.98	26.69	5499.23
32	P-1	5524.62	39.17	25.53	5499.09
34	MW-11	5506.83	24.73	9.24	5497.59
36	MW-12	5498.36	14.22	8.18	5490.18
38	HAMMOND AT SULLIVAN RD.	5504.82	–	6.62	5498.20
40	HAMMOND NEAR MW-9	5522.95	–	22.99	5499.96

Geoscience Consultants, Ltd. GCL

500 Copper Avenue NW, Suite 200
Albuquerque, New Mexico 87102
(505) 842-0001 FAX (505) 842-0595

1109 Spring Street, Suite 706
Silver Spring, Maryland 20910
(301) 587-2088

August 9, 1988

Mr. Chris Hawley
Bloomfield Refining Company
P.O. Box 159
Bloomfield, NM 87413

RE: RESULTS OF SOIL VAPOR SURVEY

Dear Chris:

A soil vapor survey was conducted at the Bloomfield Refining Company (BRC) during the week of July 18. The survey involved sampling of 25 points, with 3 of those samples collected on BRC property and the remaining 22 samples collected on U.S. Bureau of Land Management (BLM) land. Locations of the soil vapor sample points are shown in Figure 1. All vapor samples were collected from approximately 5 feet below land surface in order to maintain consistency between samples.

Concentrations of benzene, toluene, ethylbenzene, total xylenes, tetrachloroethylene (PCE) and trichloroethylene (TCE) observed in the vapor samples are listed in Table 1. Plots of vapor concentrations and the logarithms of concentrations are shown in Figures 2 through 13. The distribution of log concentration is useful when vapor concentrations vary over several orders of magnitude because the logged concentration data are less subject to averaging during machine contouring than raw concentration data. X- and y-coordinates used for plotting were referenced to monitor well MW-11. Locations of the monitoring wells with respect to the vapor sample points are approximate and will be more accurately defined following topographic survey of well head locations.

The largest concentrations of benzene, toluene, total xylenes, and PCE were observed at sample point 1 (MW-9). Although the area near well MW-9 is not considered to be the sole source of hydrocarbons, it appears to have been the site of significant hydrocarbon release during the history of the refinery. An air blank analysis was performed at point 1 because of the strong odor evident at this sample point. Results of the air blank analysis, which are presented in Table 1, indicate the presence of toluene, ethylbenzene, total xylenes, and TCE in the ambient air. However, the observed air concentrations are not sufficient to explain the high subsurface concentrations of these constituents beneath the site. Therefore, it was assumed that the source of high vapor concentrations of these volatile organic constituents was hydrocarbons and solvents in ground water beneath the site or in the unsaturated zone overlying the water table.

Analysis of a soil blank sample collected on BLM land at a point 700 feet west and 600 feet south of well MW-11 indicated the presence of benzene, toluene, and xylenes at elevated concentrations in the subsurface (see Table 1). The location of the soil blank was outside of the area of hydraulic influence associated with the perched system underlying the site. Background concentrations of 0.02 ppm, 0.55 ppm, and 0.36 ppm for benzene, toluene, and xylenes were defined on the basis of these soil blank concentrations. The occurrence of elevated concentrations of volatile organic compounds outside of the area potentially impacted by BRC operations is attributed to the large amount of oil-field activity in the area and to the presence of a natural gas pipeline east of the soil blank sampling point. Although the background concentrations of benzene, toluene, and xylenes in soil vapor are well below the Threshold Limit Values (TLV's) established by the National Institute for Occupational Safety and Health (NIOSH) for airborne contaminants, background concentrations of these organic compounds in ground water could be higher if the source of organics in the soil vapor is the deep ground water in the Nacimiento Formation. Concentrations of these compounds that would cause acute or chronic health problems when ingested in water have not been defined. Based on the current information, it is not possible at this time to assess the health impacts associated with background levels of volatile organic constituents present beneath BLM property.

Concentrations of volatile organics depend on local geology, moisture conditions, the pH-redox environment in the subsurface, and the unique physical characteristics of the organic compound. The concentration distributions presented in Figures 2 to 13 suggest that hydrocarbons in the subsurface primarily occur beneath the site and do not extend more than a few hundred feet beneath BLM property. The tendency for vapor concentrations to decrease from north to south is related to the large concentrations observed at sample point 1 (MW-9) and the absence of data in an east-west direction through the center of the site, where samples were not collected because of chemical interference from normal refinery operations. In general, concentrations less than or of the same order of magnitude as background were observed west and south of well MW-11 and east of the sample point located 300 feet east of well MW-11. In the case of toluene, the sample collected at MW-11 was roughly equal to background. The consistent tendency for volatile organic concentrations in soil vapor to rapidly decrease to background levels west and south of MW-11 and east of the sample point located 300 feet east of MW-11 is evidence that strong geologic controls influence the presence of soil vapor on BLM property.

The distribution of benzene vapors was considered to be most indicative of the shape of the hydrocarbon plume in the underlying ground water. Given the high solubility and vapor pressure characteristic of benzene, this constituent has likely migrated most easily with the ground water and diffuses more rapidly into the soil compared to other volatile constituents present beneath the site (see Table 2). Although the Henry's

Law constant for benzene is somewhat smaller than for other organic constituents observed at the site, benzene vapor that partitions out of water is rapidly diffused upward into the soil, creating a disequilibrium at the soil-water interface and allowing further partitioning of benzene at the interface. Assuming that the benzene vapor plume is the best representation of the distribution of hydrocarbons in the underlying ground water, the off-site benzene plume shown in Figure 2 may reflect the presence of a paleo-channel that was once tributary to the San Juan River. It is possible that the edge of the perched alluvial system occurs as a buried stream channel in the vicinity of well MW-11, producing the elongated shape of the benzene vapor plume as it migrates beneath BLM land. If this is the case, further movement of hydrocarbons southward toward BLM property may be constrained by the low-conductivity Nacimiento Formation that underlies the stream channel.

The absence of elevated concentrations of volatile organic constituents at sample points located along Hammond Ditch, including a point at MW-12 where no constituents have previously been observed in the perched ground water, suggests that flow in the Ditch is very effective in flushing out organic compounds that may have migrated beneath BLM land. The occurrence of below-detection levels of tetrachloroethylene (PCE) or trichloroethylene (TCE) at the soil blank location and the presence of large concentrations of these compounds near MW-4 and west of the LPG bullet/terminal area is an indication that PCE and TCE are limited to the subsurface directly beneath the site or near the site boundary. PCE and TCE were presumably released from solvents used for degreasing equipment in the LPG bullet/terminal area.

Concentrations of volatile organic compounds observed in ground water sampled from wells MW-4, -9, and -10 during January of 1987 and from wells MW-11 and -12 in September of 1987 were compared to concentrations observed in soil vapor sampled near the wells during the survey. The January and September ground water quality samples represented the most recent ground water samples available for comparison to current soil vapor concentrations. Both the water concentration (C_W) and soil vapor concentration (C_V) for these samples are listed in Table 3. Comparison of the data indicates that there is no direct, systematic relationship between ground water and soil vapor concentrations. The lack of a systematic relationship between ground water and soil vapor concentrations suggests that geologic, soil moisture, and pH-redox conditions, which vary over the site, play a significant role in controlling the transfer of volatile organic compounds from ground water to the overlying unsaturated zone.

Given the limited extent of organic compounds in soil vapor underlying BLM property, the existing and proposed monitor/recovery wells are considered to be adequate with respect to capture of organic constituents in the underlying ground water. The southern extent of the capture zones induced by operation of recovery wells north of Sullivan Road will be

the determining factor when deciding the need for additional recovery of ground water near well MW-11. Hydraulic head and water quality data observed at a piezometer located south of Sullivan Road will be used to estimate the effectiveness of the proposed recovery system with respect to capture of hydrocarbons from BLM land.

Yours very truly,
GEOSCIENCE CONSULTANTS, LTD.

Susan J. Colarullo

Susan J. Colarullo
Senior Hydrogeologist

SJC/pe/GARY/HAWLE013.LTR

Enclosures

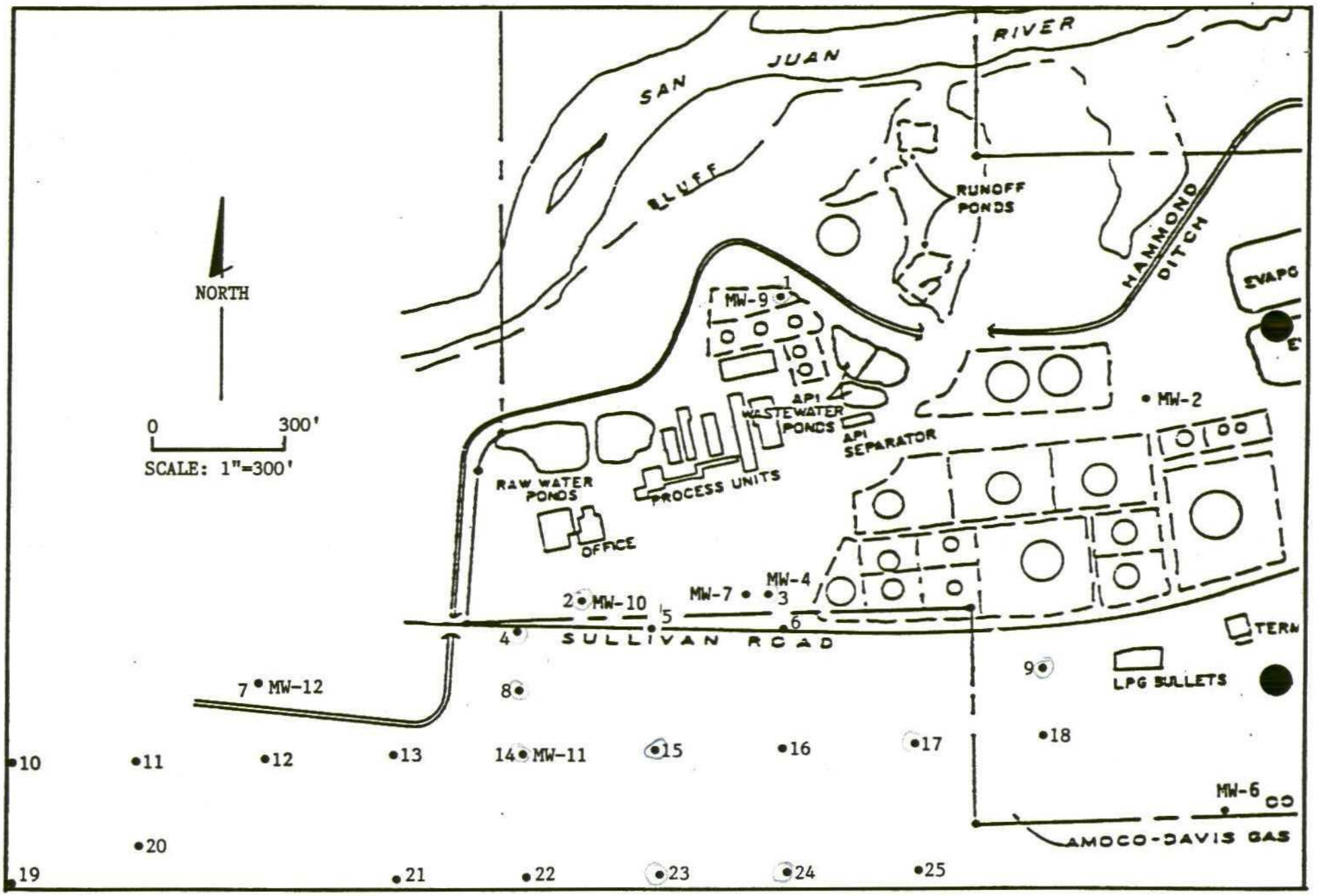

FIGURE 1

LOCATIONS OF SOIL VAPOR SAMPLING POINTS

TABLE 1

BLOOMFIELD REFINING COMPANY
SOIL VAPOR SURVEY RESULTS

Point or Sample	x(ft)[a]	y(ft)[b]	Concentration (ppm) Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	PCE	TCE
1(MW-9)	600	1070	2995	4655	ND	634	8284	110	ND
2(MW-10)	150	350	38.2	11.9	74.5	ND	124.6	ND	ND
3(MW-4)	570	350	ND	710	102	20.6	832.6	78	ND
4	0	300	ND	1025	ND	10195	11220	ND	ND
5	300	300	0.062	0.149	ND	0.071	0.28	0.011	[illegible]
6	600	300	ND	0.041	ND	0.006	0.05	ND	0.086
7(MW-12)	-610	150	ND	0.285	ND	ND	0.28	ND	ND
8	0	150	ND	1.95	ND	25.58	27.5	ND	6.49
9	1200	150	ND	0.448	0.349	0.442	1.24	0.513	0.380
10	-1200	0	ND	0.085	ND	0.038	0.12	ND	0.034
11	-900	0	ND	0.125	ND	0.430	0.56	ND	2.14
12	-600	0	ND	0.130	ND	0.037	0.17	ND	ND
13	-300	0	ND	0.100	ND	0.042	0.14	ND	0.037
14(MW-11)	0	0	0.560	10.9	ND	9.70	21.16	ND	ND
15	300	0	0.230	1.24	ND	0.126	1.60	ND	ND
16	600	0	0.072	0.584	0.146	ND	0.80	ND	ND
17	900	0	ND	1.88	9.27	0.979	12.13	ND	23.8
18	1200	0	ND	0.143	ND	0.107	0.25	0.003	0.082
19	-1200	-300	ND	0.061	ND	0.028	0.09	0.002	0.003
20	-900	-200	ND	0.060	ND	0.033	0.09	0.004	0.072
21	-300	-300	ND	0.088	ND	0.127	0.22	ND	0.0[illegible]
22	0	-300	ND	0.044	ND	0.016	0.06	ND	[illegible]
23	300	-300	ND	0.925	ND	0.661	1.59	ND	ND
24	600	-300	ND	0.979	ND	0.310	1.29	ND	ND
25	900	-300	0.014	0.107	ND	0.055	0.18	0.006	0.067
Air Blank	-----	----	ND	0.049	0.008	0.091	0.15	ND	0.074
Soil Blank	-----	----	0.016	0.547	ND	0.037	0.60	ND	ND

ND = not detected
a approximate distance east from well MW-11
b approximate distance north from well MW-11

TABLE 2

PHYSICAL PROPERTIES OF VOLATILE ORGANIC CONSTITUENTS OBSERVED AT BLOOMFIELD REFINING COMPANY

	Solubility in Water (mg/l)	Vapor Pressure (torr)	Henry's Law Constant ($atm*m^3/mole$)	Log of Octanol/ Water Partition Coefficient
Benzene	1780-1800	95.2	5.55×10^{-3}	2.13
Toluene	535	28.7	5.93×10^{-3}	2.69
Ethylbenzene	206	7	6.44×10^{-3}	3.15
Xylenes	insoluble	10(O-Xylene)	6.12×10^{-3}	----
PCE	150	14	28.7×10^{-3}	2.88
TCE	1100	57.9	11.7×10^{-3}	2.29

Source: U.S. EPA, 1981, Treatability Manual, Volume I. Treatability Data, Office of Research and Development, Washington, D.C.

TABLE 3

CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUND WATER AND SOIL VAPOR AT MONITOR WELL LOCATIONS

		Concentration									
		Benzene		Toluene		Ethylbenzene		PCE		TCE	
	Well	C_w(mg/l)	C_v(ppm)	C_w(mg/l)	C_v(ppm)	C_w(mg/l)	C_v(ppm)	C_w(mg/l)	C_v(ppm)	C_w(mg/l)	C_v(ppm)
20.6	MW-4	1.91	ND	1.78	710	4.48	102	ND	78	ND	ND
634	MW-9	1.49	2995	0.754	4655	0.504	ND	ND	110	ND	ND
ND	MW-10	14.4	38.2	7.4	11.9	0.030	74.5	ND	ND	ND	ND
9.70	MW-11	5.4	0.56	<0.025	10.9	-----	ND	0.070	ND	0.225	ND
ND	MW-12	ND	ND	ND	0.285	-----	ND	ND	ND	ND	ND

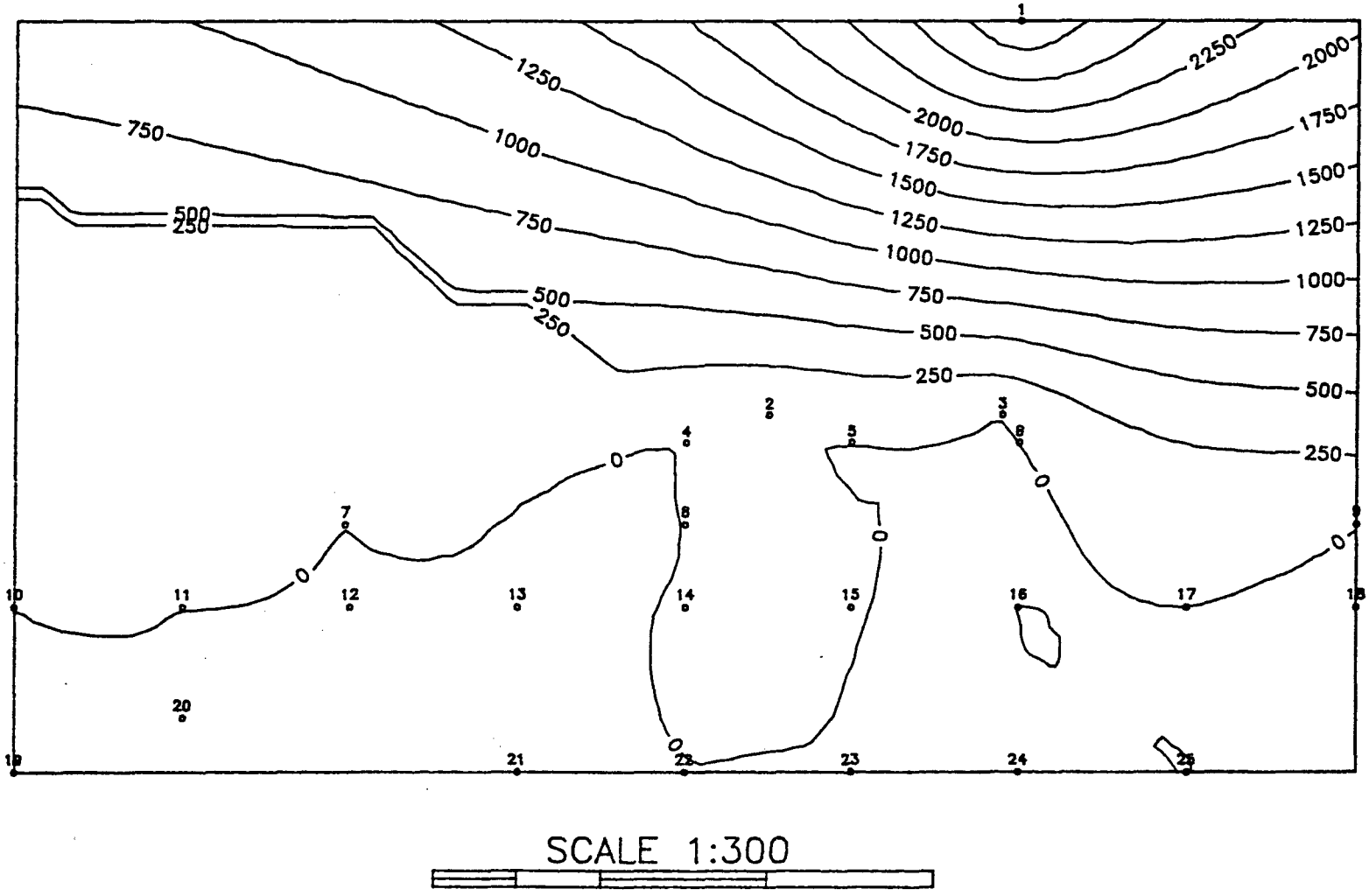

FIGURE 2
BENZENE VAPOR CONCENTRATION DISTRIBUTION

LOG OF BENZENE VAPOR CONCENTRATION (LOG PPM)

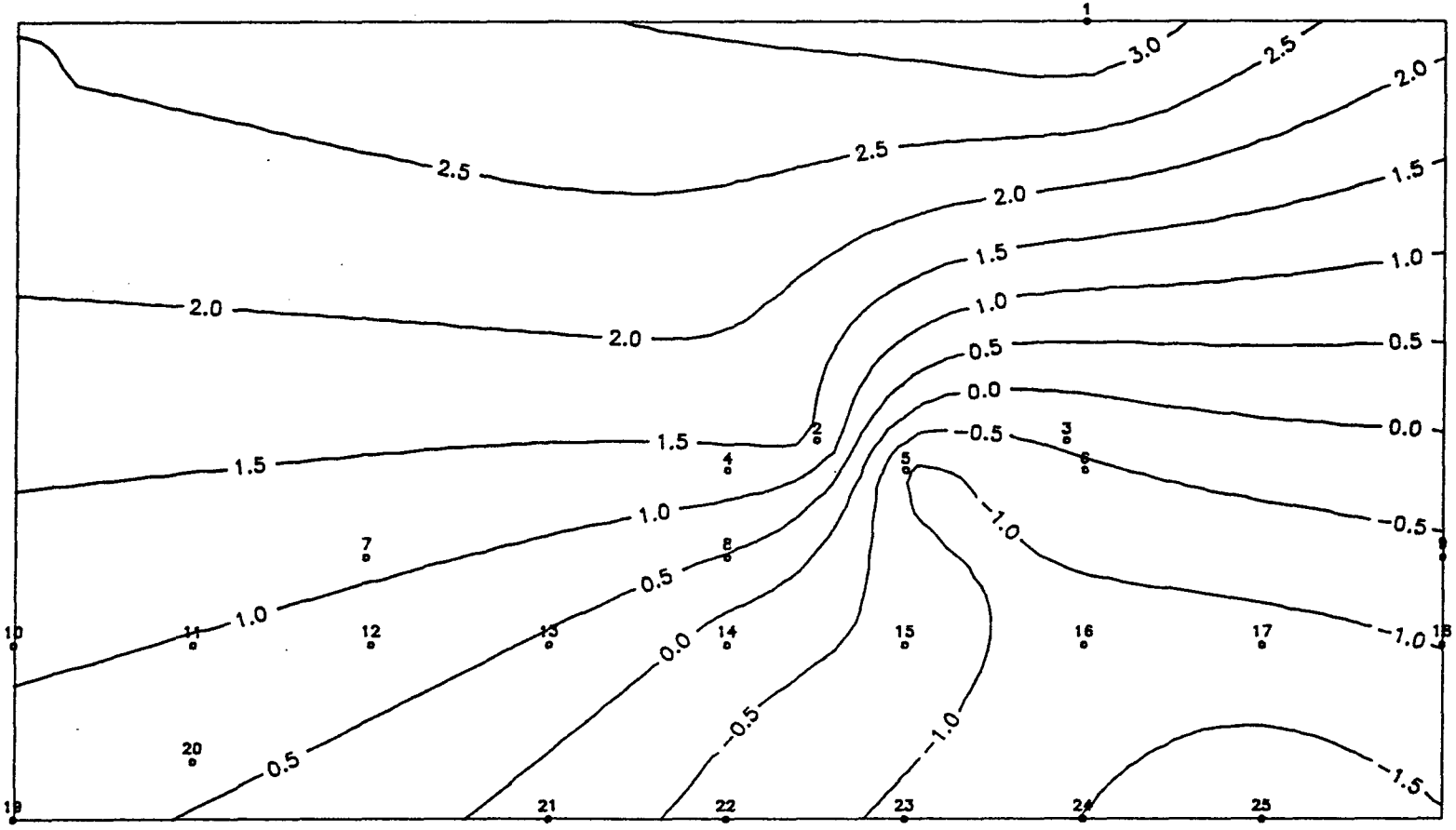

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FIGURE 3

BENZENE VAPOR LOG CONCENTRATION DISTRIBUTION

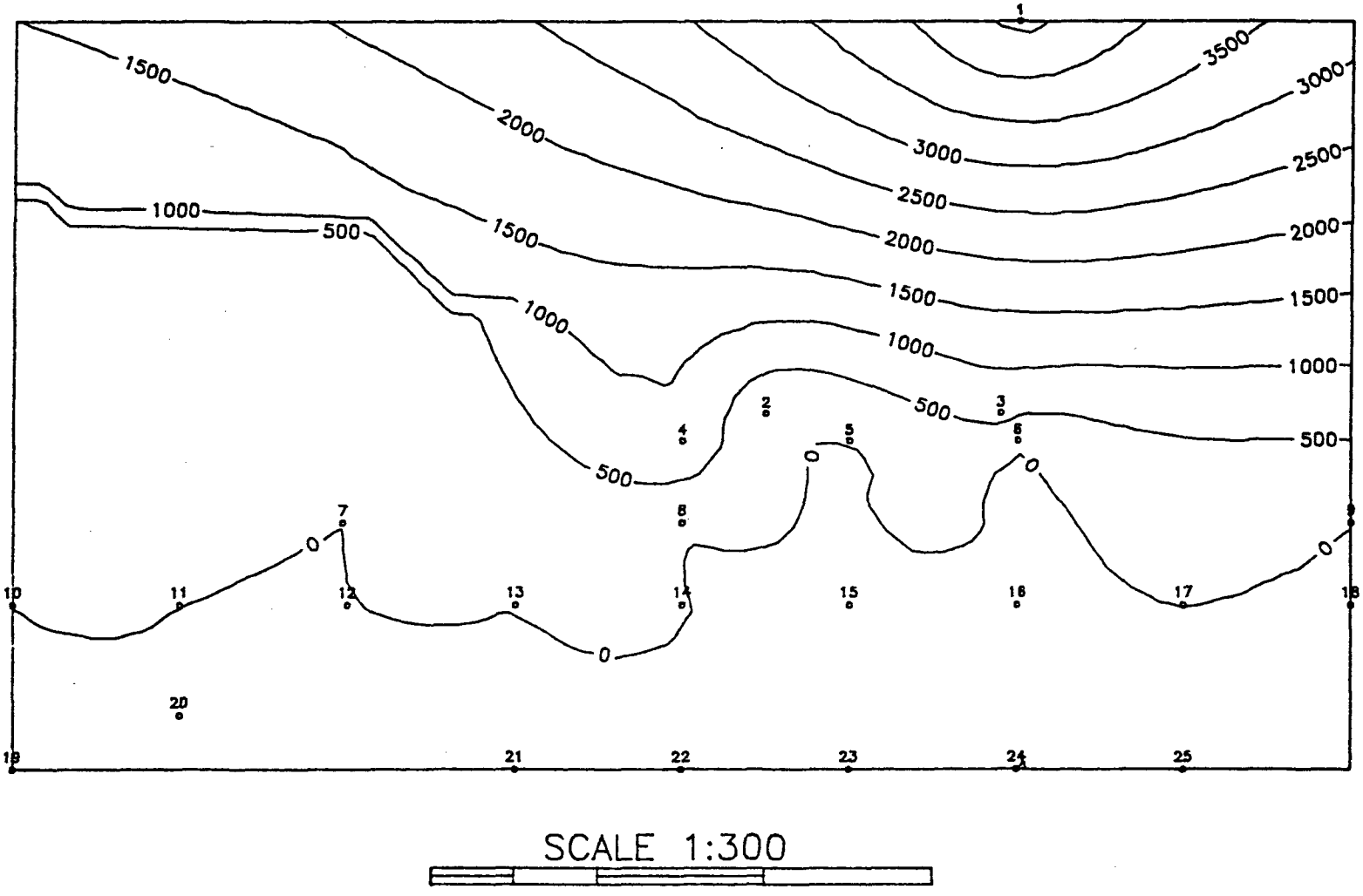

FIGURE 4

TOLUENE VAPOR CONCENTRATION DISTRIBUTION

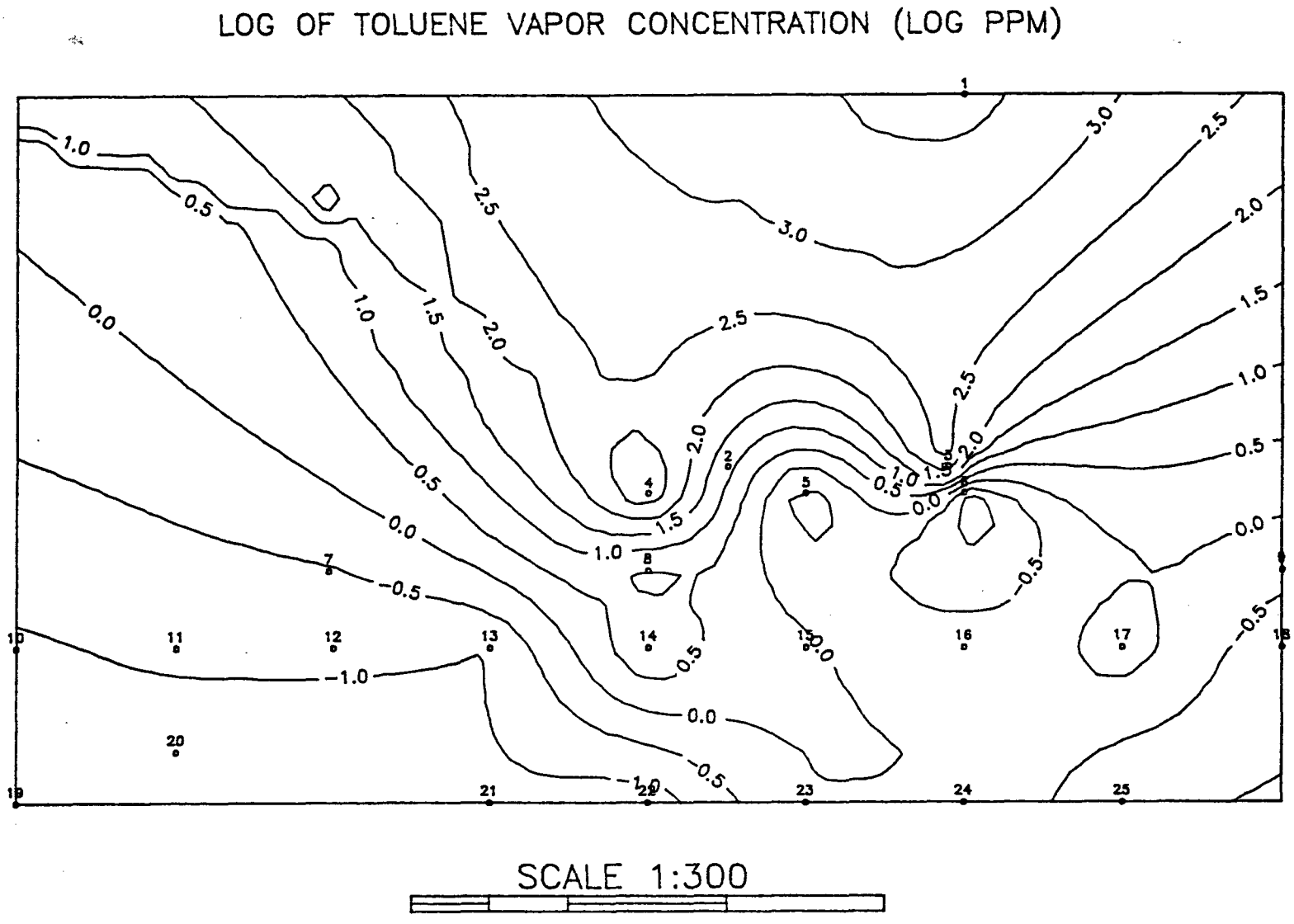

FIGURE 5

TOLUENE VAPOR LOG CONCENTRATION DISTRIBUTION

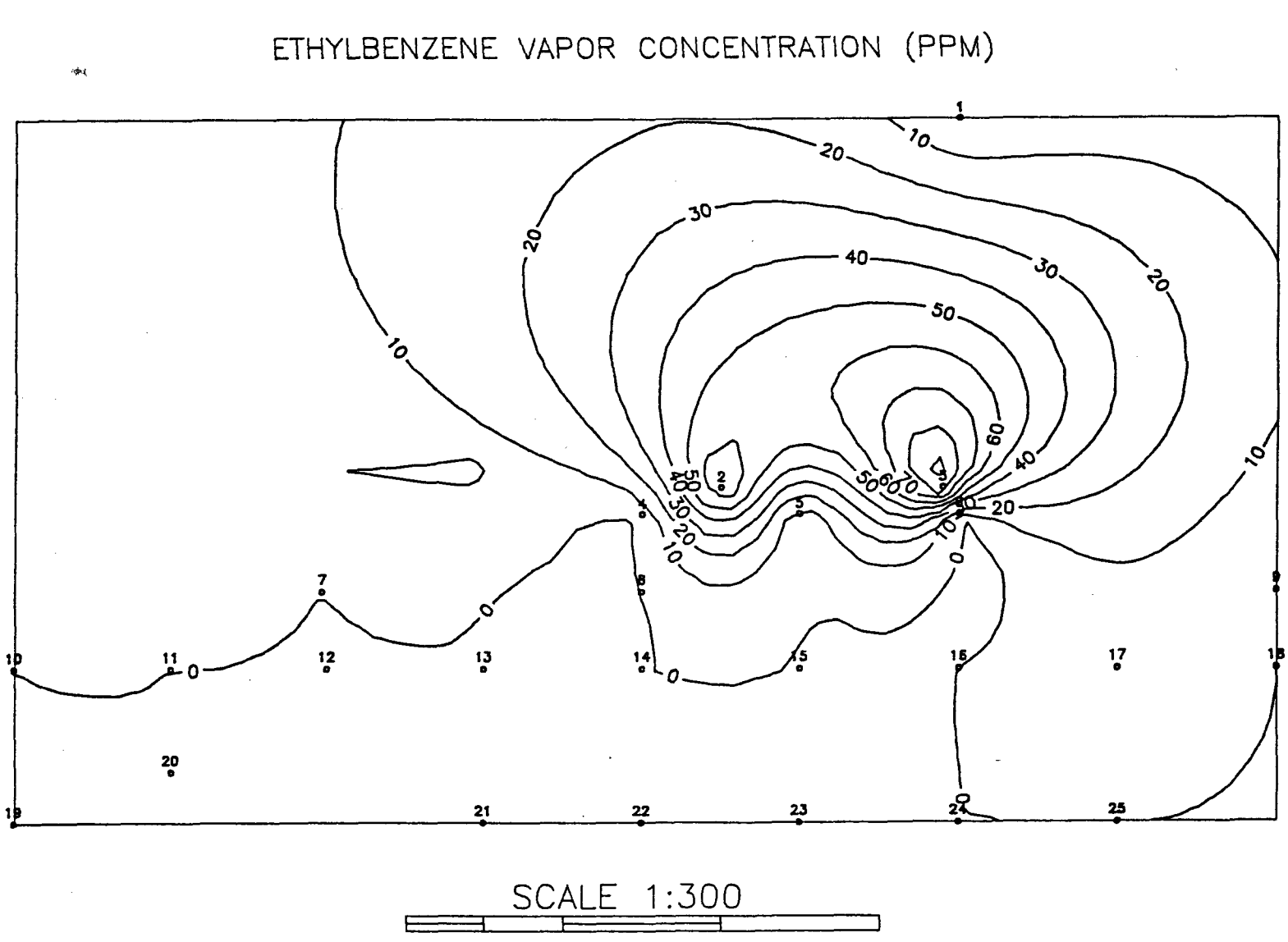

FIGURE 6
ETHYLBENZENE VAPOR CONCENTRATION DISTRIBUTION

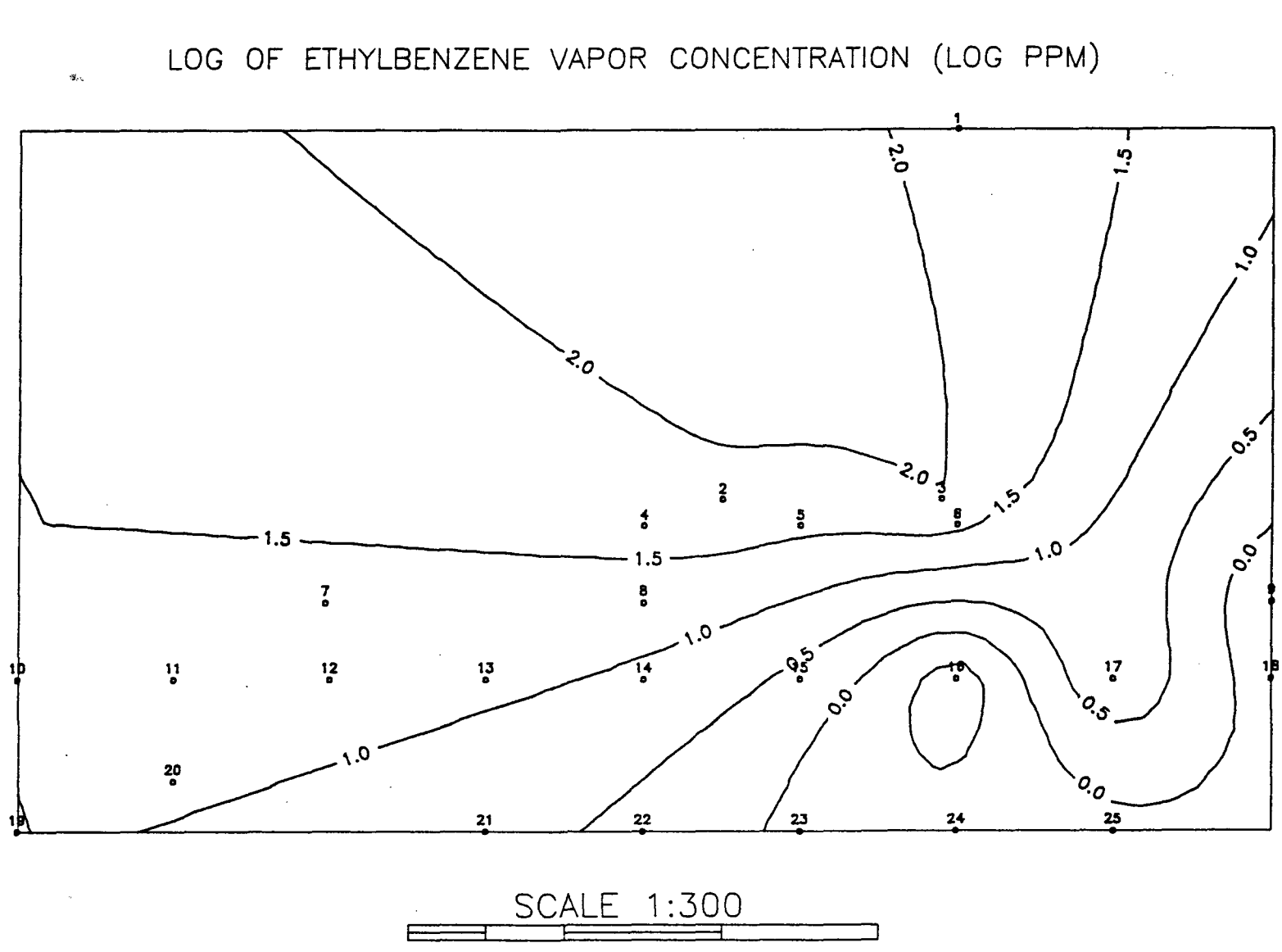

FIGURE 7

ETHYLBENZENE VAPOR LOG CONCENTRATION DISTRIBUTION

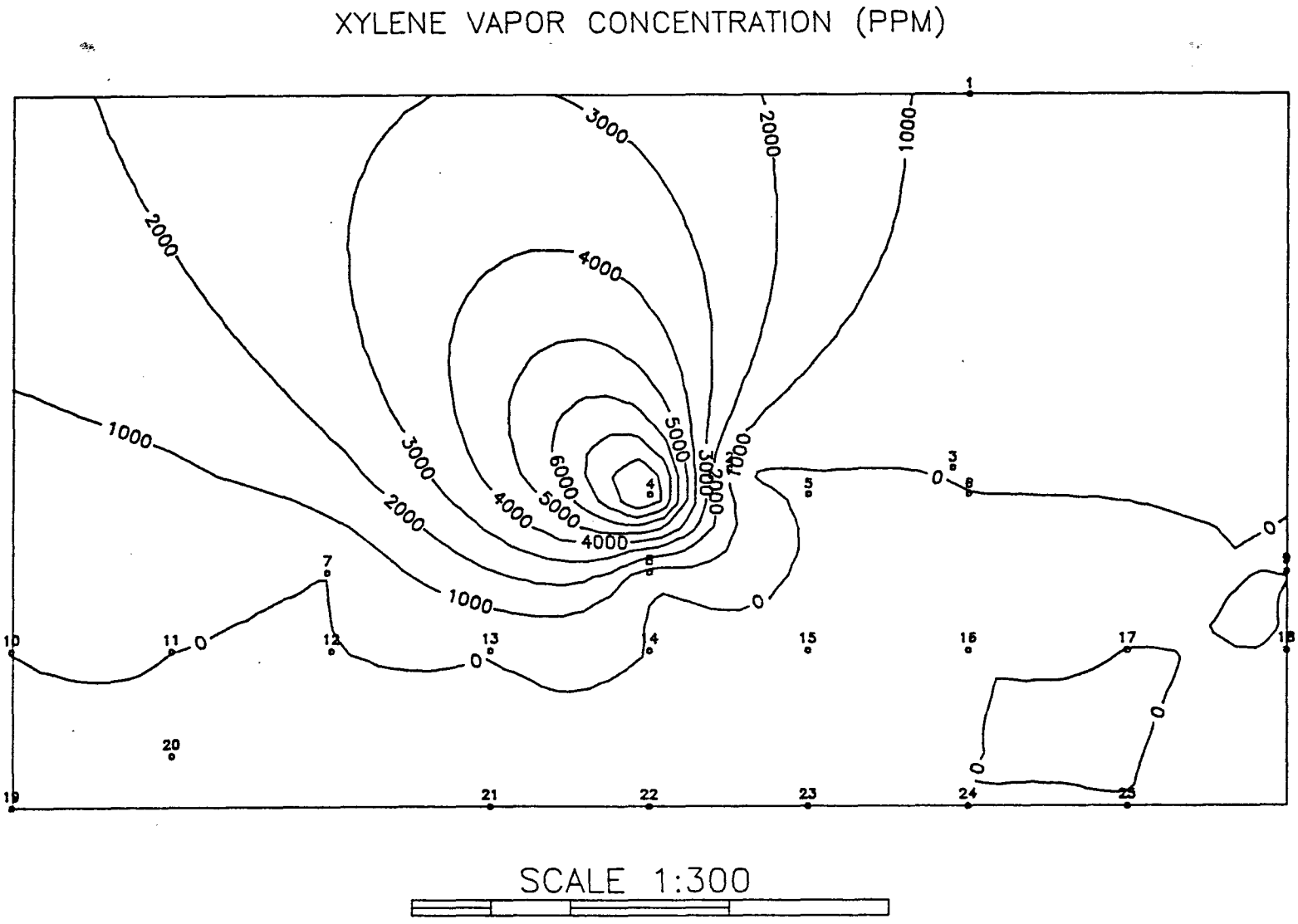

FIGURE 8

XYLENE VAPOR CONCENTRATION DISTRIBUTION

LOG OF XYLENE VAPOR CONCENTRATION (LOG PPM)

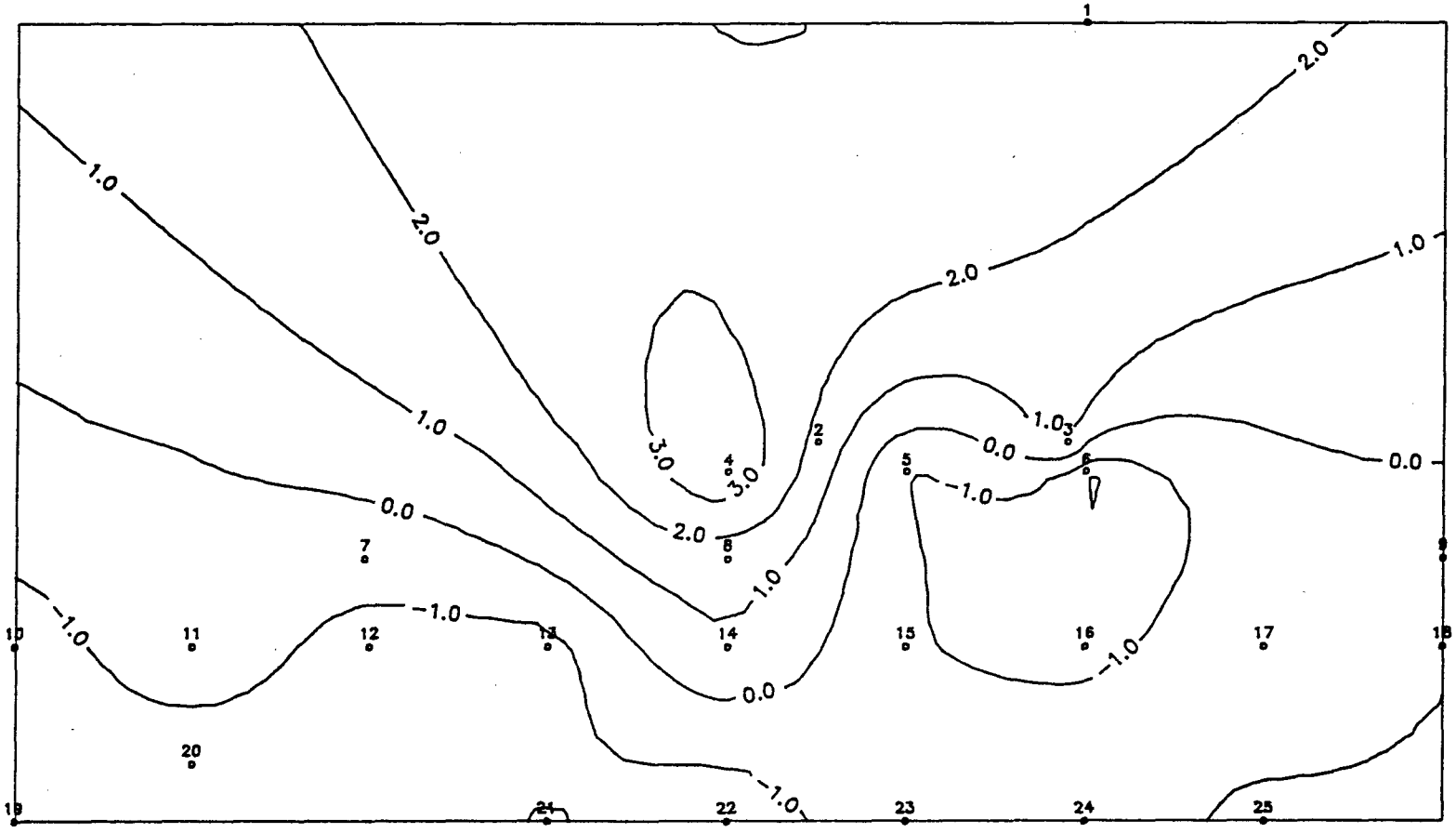

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FIGURE 9

XYLENE VAPOR LOG CONCENTRATION DISTRIBUTION

PCE VAPOR CONCENTRATION (PPM)

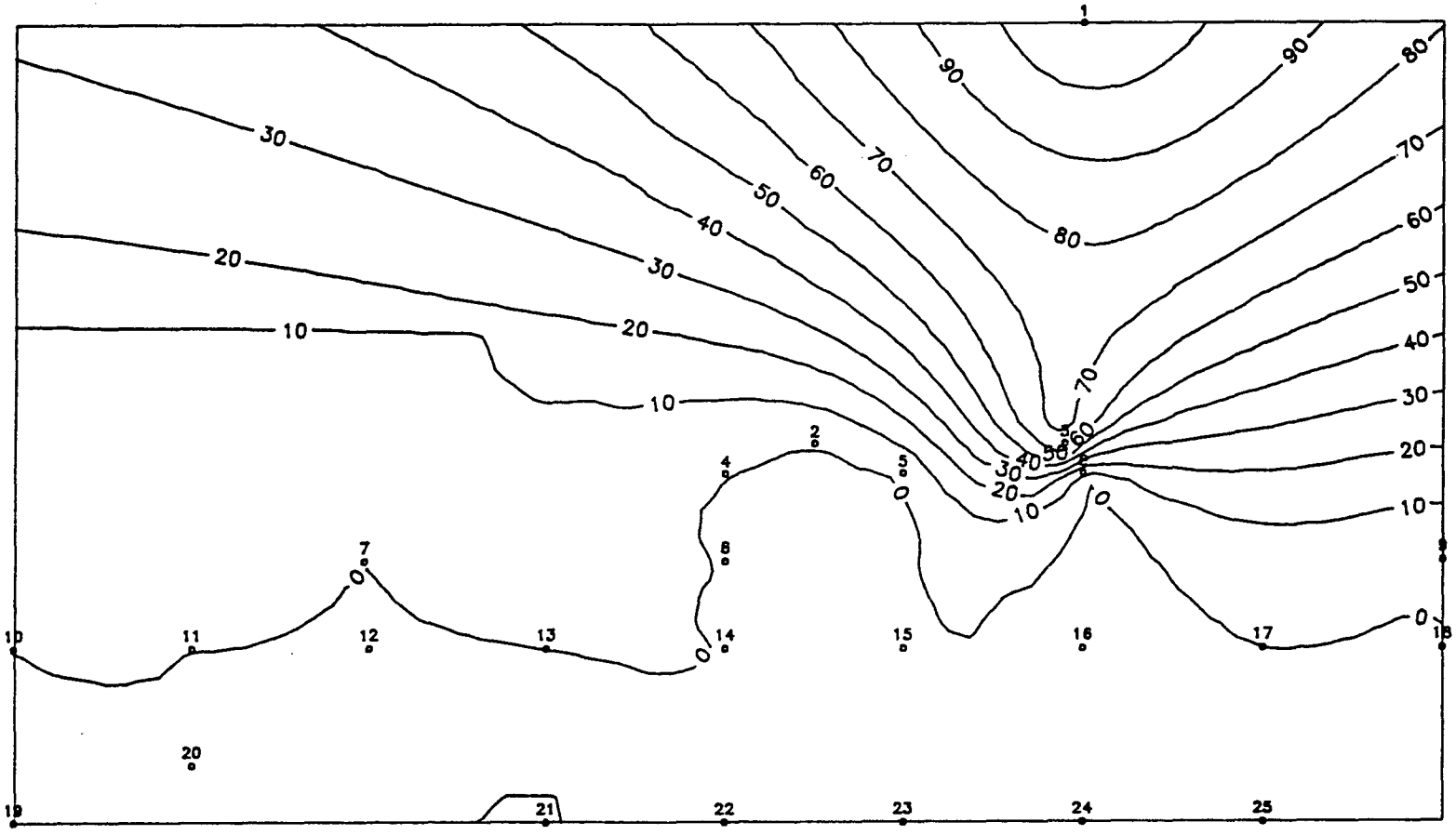

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FIGURE 10

PCE VAPOR CONCENTRATION DISTRIBUTION

LOG OF PCE VAPOR CONCENTRATION (LOG PPM)

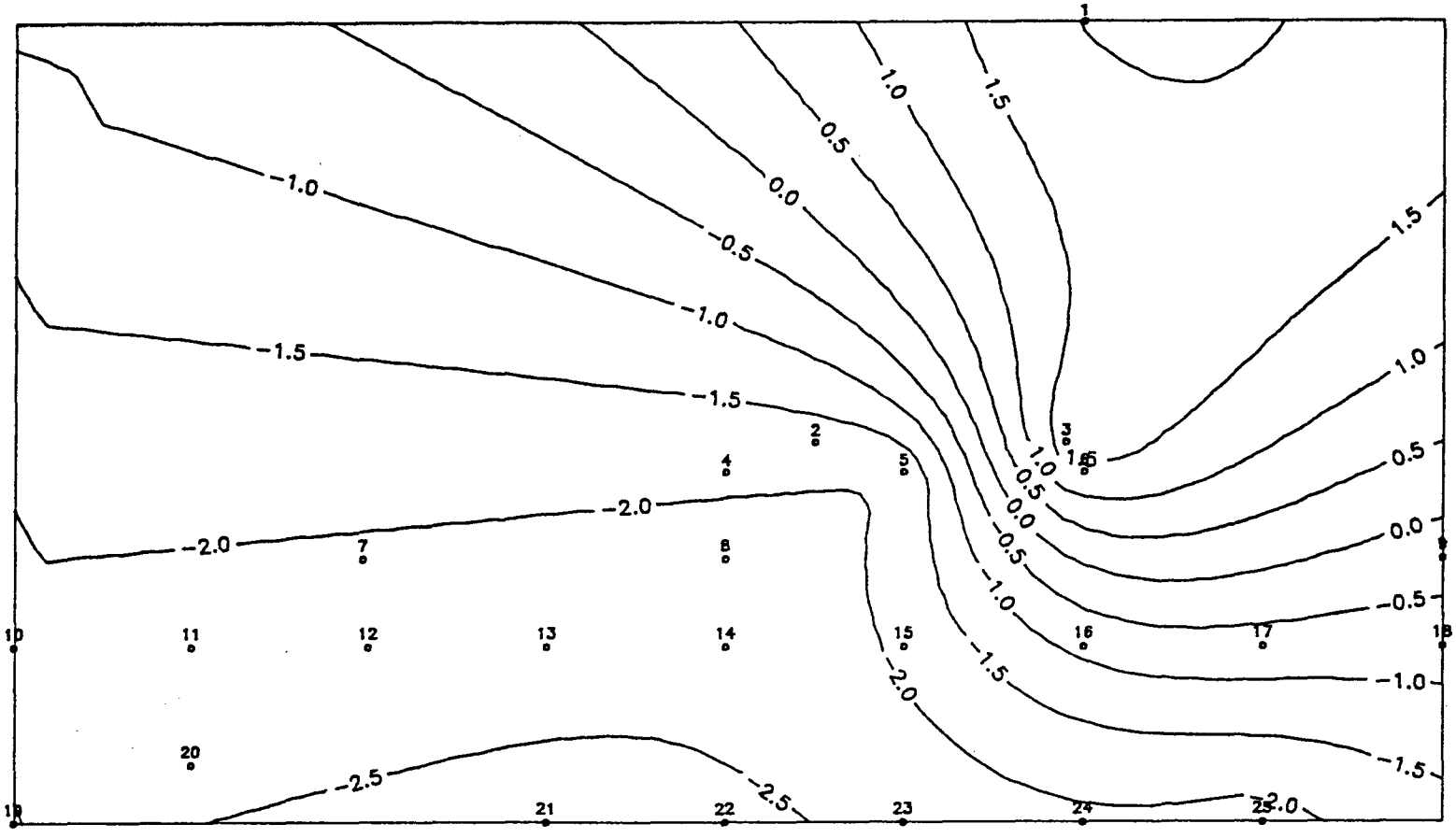

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FIGURE 11

PCE VAPOR LOG CONCENTRATION DISTRIBUTION

TCE VAPOR CONCENTRATION (PPM)

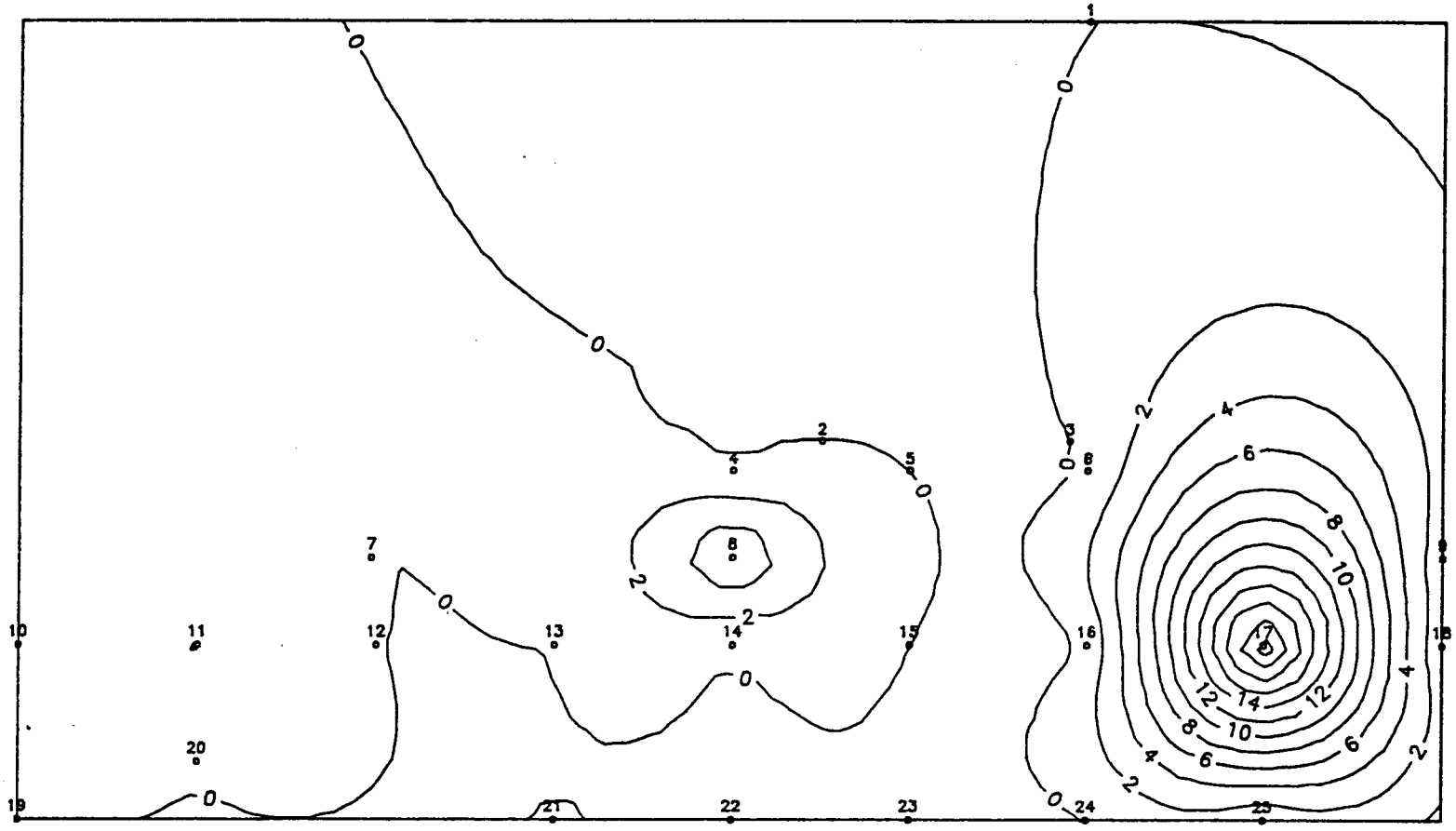

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FIGURE 12
TCE VAPOR CONCENTRATION DISTRIBUTION

LOG OF TCE VAPOR CONCENTRATION (LOG PPM)

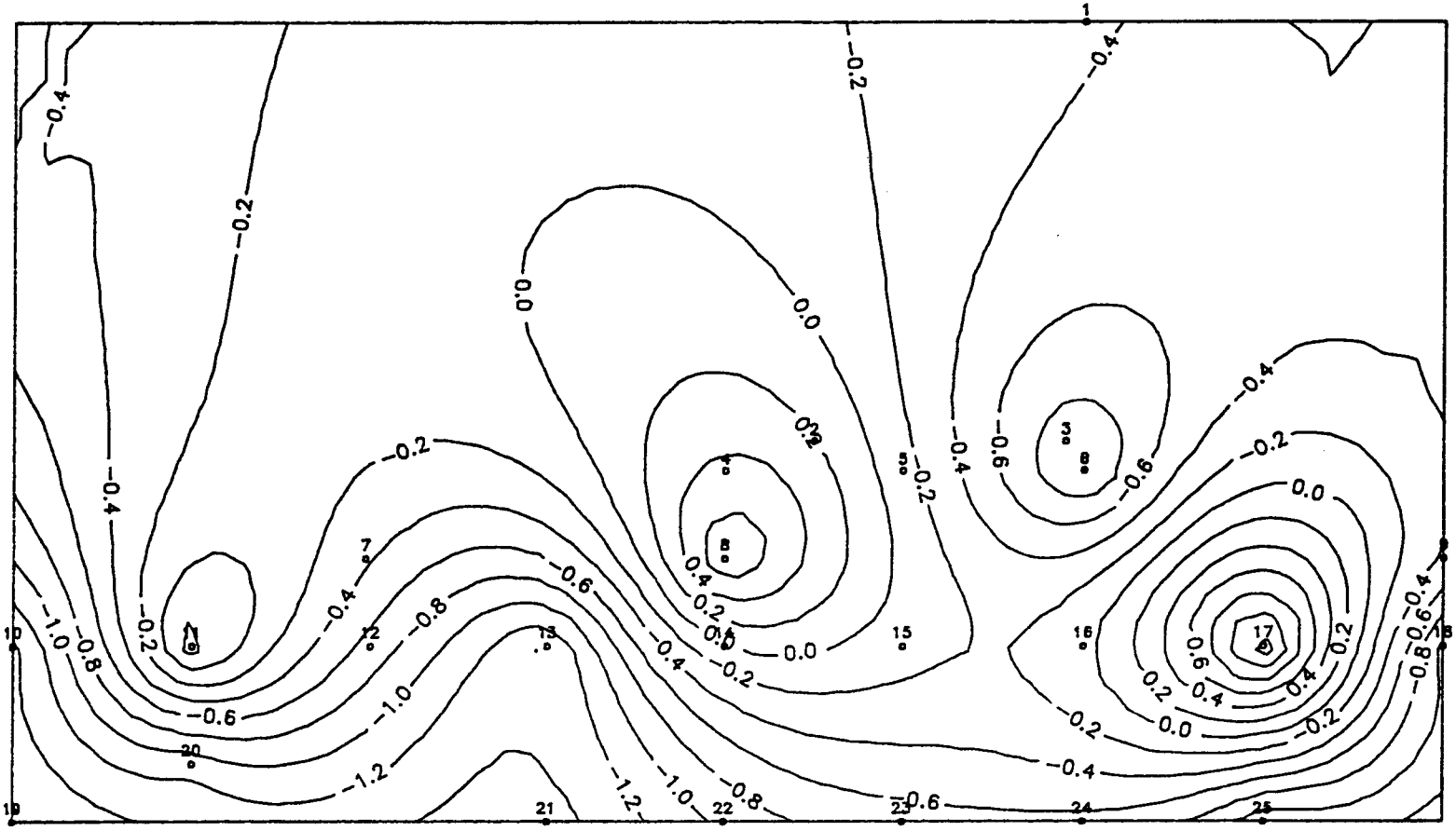

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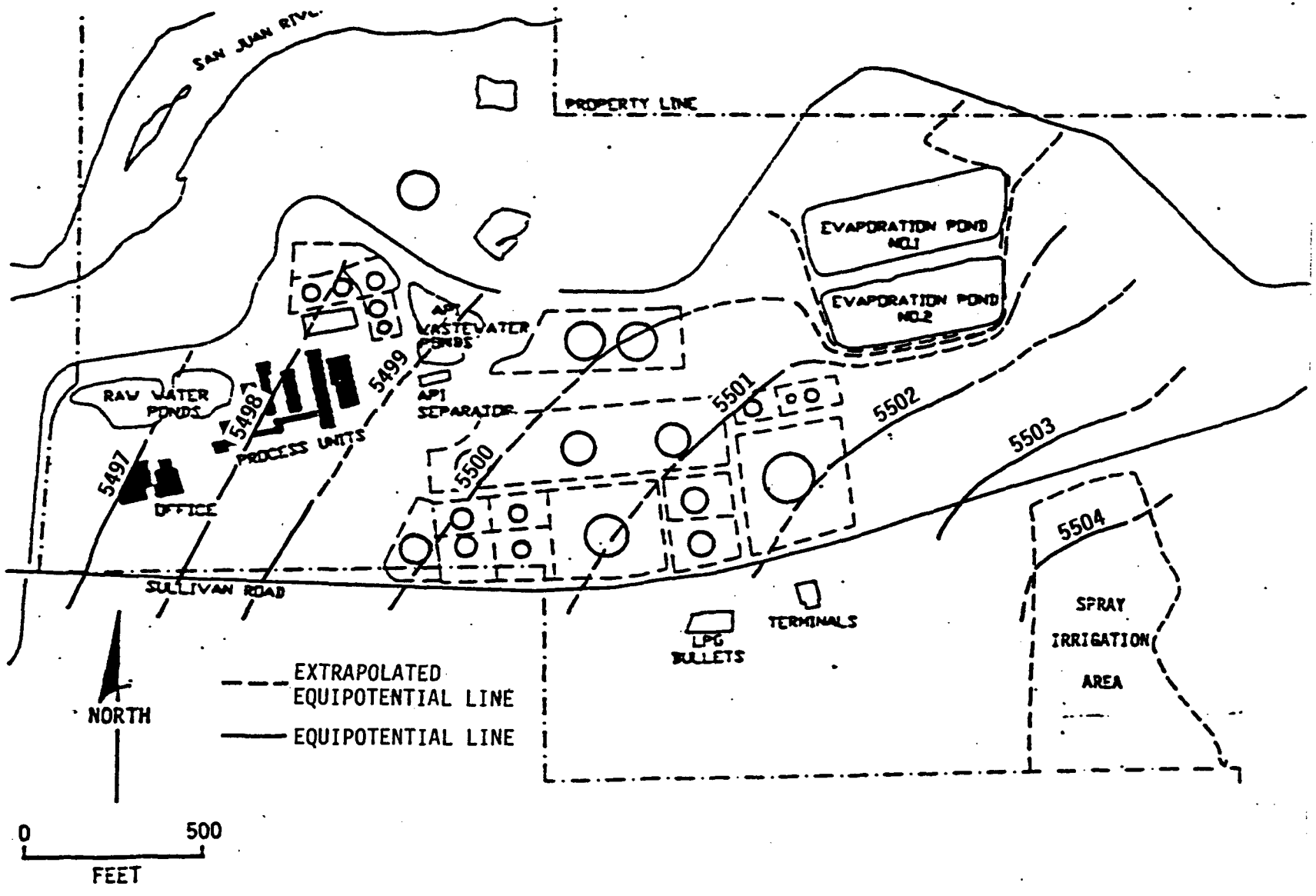
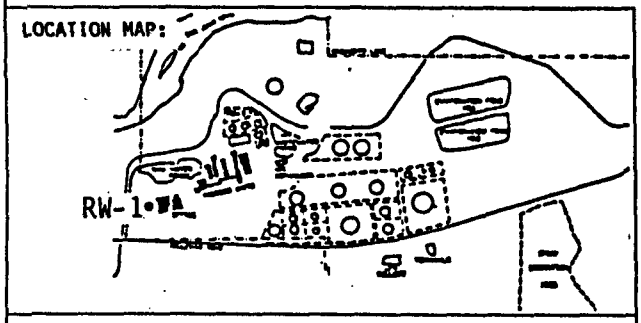
FIGURE 13
TCE VAPOR LOG CONCENTRATION DISTRIBUTION



WATER TABLE BENEATH THE BLOOMFIELD REFINING COMPANY

LITHOLOGIC LOG (SOIL)

LOCATION MAP:



___1/4 ___1/4 ___1/4 ___1/4 S___ T___ R___

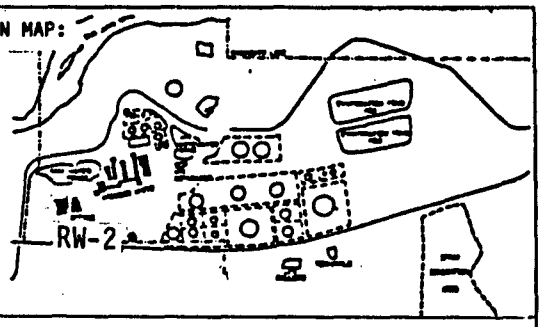
SITE ID: BRC LOCATION ID: RW-1
SITE COORDINATES (ft.):
N E
GROUND ELEVATION (ft. MSL): 5525.92
STATE: New Mexico COUNTY: San Juan
DRILLING METHOD: Casing Driver
DRILLING CONTR.: Beeman Brothers
DATE STARTED: 30 August 1988 DATE COMPLETED: 31 August 1988
FIELD REP.: W.S. Dubyk
COMMENTS: Static on September 2, 1988: 26.65 from TOC.

LOCATION DESCRIPTION:

Depth	Visual %	Lith	Drilling Time Scale:	Sample Type and Interval	Lithologic Description
5			1642		0'-18' Silt and Sand - Dark yellowish brown (10 YR 4/2) to grayish brown (5 YR 3/2). Minor to strong hydrocarbon odor.
10			1646		
15			1710		
20			1720		18'-34' Sand and Gravel - Medium dark gray (N4). Sand is medium to very coarse grained, subangular to subrounded. Gravel is subrounded to well rounded, to 2" diameter. Strong hydrocarbon odor.
25			1725 ▽		~ 9' Aquifer Thickness
30			1730		
35			1738		34'-41' Shale - Nacimiento Formation - Dusky yellow (5 YR 6/4) to light olive gray (5 Y 6/1) shale.
40			1758		
		T.D. 41'			
45					
50					

LITHOLOGIC LOG (SOIL)

LOCATION MAP:



___1/4 ___1/4 ___1/4 ___1/4 S___ T___ R___

SITE ID: BRC LOCATION ID: RW-2
SITE COORDINATES (ft.):
N E
GROUND ELEVATION (ft. MSL): 5523.48
STATE: New Mexico COUNTY: San Juan
DRILLING METHOD: Casing Driver
DRILLING CONTR.: Beeman Brothers
DATE STARTED: 29 August 1988 DATE COMPLETED: 29 August 1988
FIELD REP.: W.S. Dubyk
COMMENTS: Static on September 2, 1988: 23.42 from TOC.

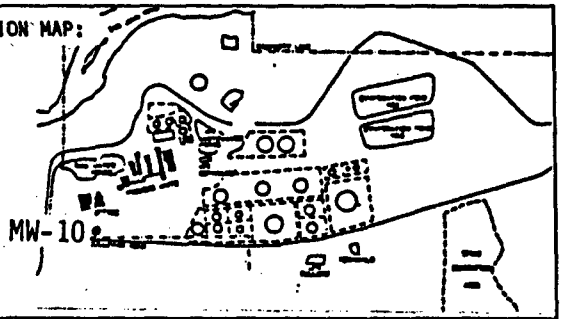
LOCATION DESCRIPTION:

Depth	Visual %	Lith	Drilling Time Scale:	Sample Type and Interval	Lithologic Description
5			0948		0'-10' Silt and Clay - Medium dark gray (N4) to brownish gray (5 YR 4/1). Slightly effervescent in HCl. Faint hydrocarbon odor.
10			0953		10'-15' Sand and Silt - Moderate brown (5 YR 4/4), very fine grained and well sorted.
15			0958		15'-32' Sand and Gravel - Olive gray (5 Y 4/1) to brownish gry (5 YR 4/1). Sand is medium to very coarse grained, subangular to subrounded. Gravel is subangular to well rounded, to 2" diameter. Noticeable hydrocarbon odor below 25'.
20			1024		
25			1029		
30			1033		32'-41.2' Shale - Nacimiento Formation - Dusky yellow (5 Y 6/4) to olive gray (5 Y 3/2).
35			1050		
40		T.D. 41.2'	1100		
45					
50					

~9' Sat Thick

LITHOLOGIC LOG (SOIL)

LOCATION MAP:

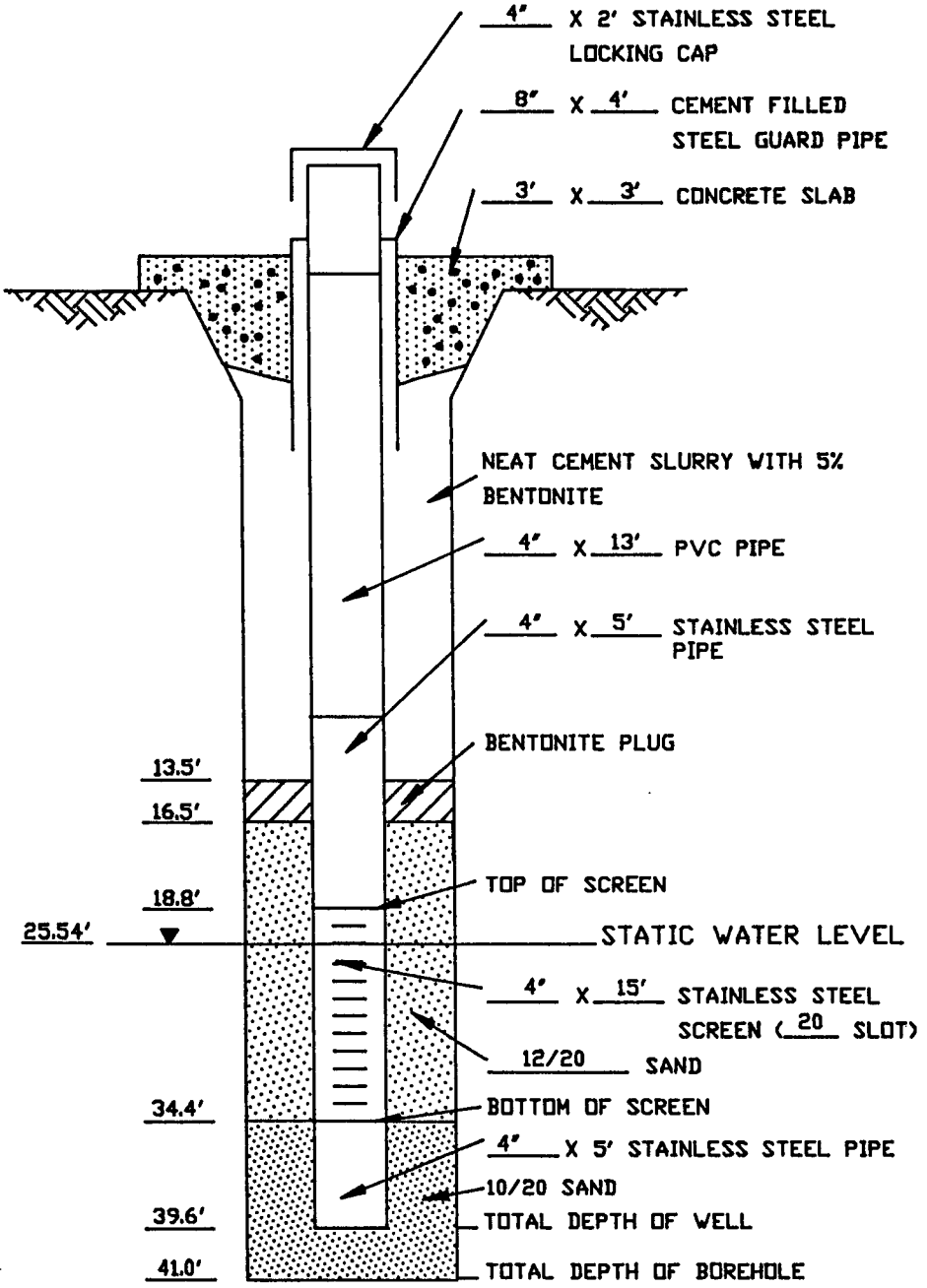


___1/4 ___1/4 ___1/4 ___1/4 S___ T___ R___

SITE ID: BRC LOCATION ID: MW-10
SITE COORDINATES (ft.):
N E
GROUND ELEVATION (ft. MSL): -5516
STATE: New Mexico COUNTY: San Juan
DRILLING METHOD: Auger
DRILLING CONTR.: Earl & Sons, Inc.
DATE STARTED: 4 March 1986 DATE COMPLETED: 4 March 1986
FIELD REP.: Engineering-Science, Inc.
COMMENTS:

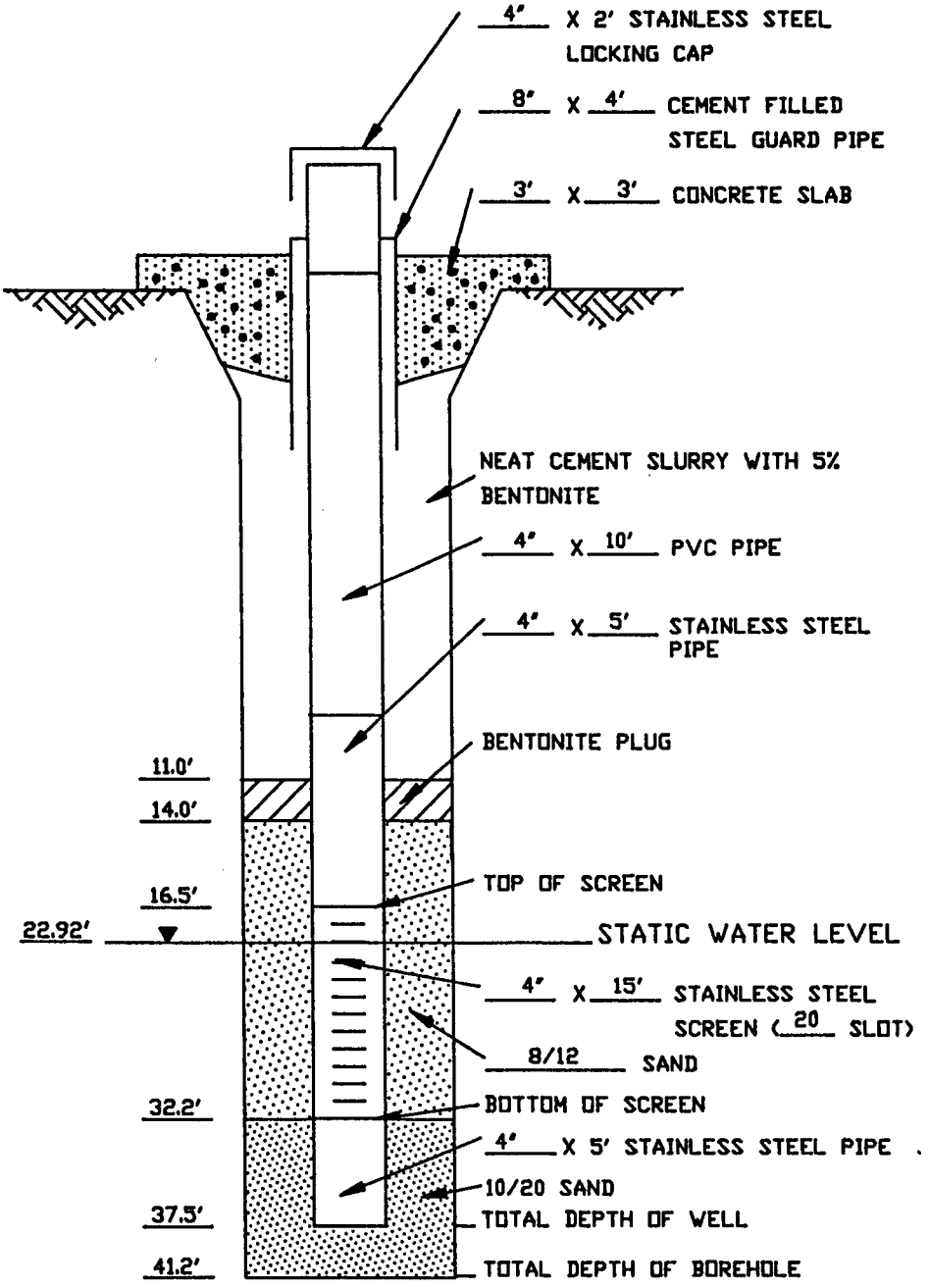
LOCATION DESCRIPTION:

Depth	Visual %	Lith	Drilling Time Scale:	Sample Type and Interval	Lithologic Description
0					0'-5' Topsoil, Roadbase, Sandy Clay
5					5'-10' Silty, Sandy Clay
10					10'-15' Cobbles and Pebbles
15					15'-20' Gravel, Cobbles, and Pebbles
20			▽ 1st aquifer Nacimiento		20'-30' Green Clay; Nacimiento Formation
25					30'-35' Nacimiento Formation - Yellow-green to blue-gray.
30					
35		T.D. 35'			
40					
45					
50					



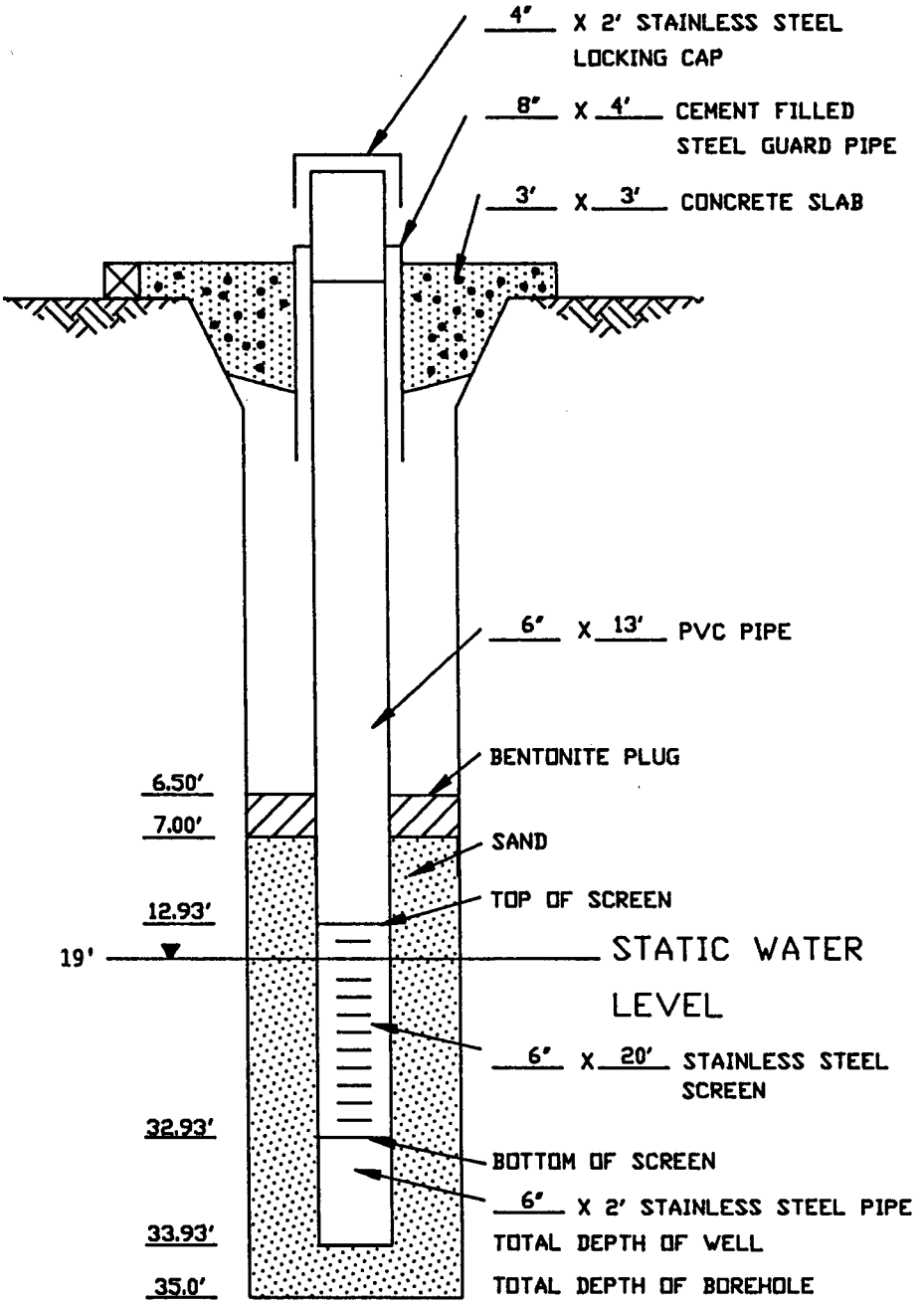
COMPLETION DIAGRAM

RECOVERY WELL RW-1



COMPLETION DIAGRAM

RECOVERY WELL RW-2



COMPLETION DIAGRAM
RECOVERY WELL MW-10
(RECONSTRUCTED FROM VERBAL DESCRIPTION
SUPPLIED BY ENGINEERING-SCIENCE, 1987)

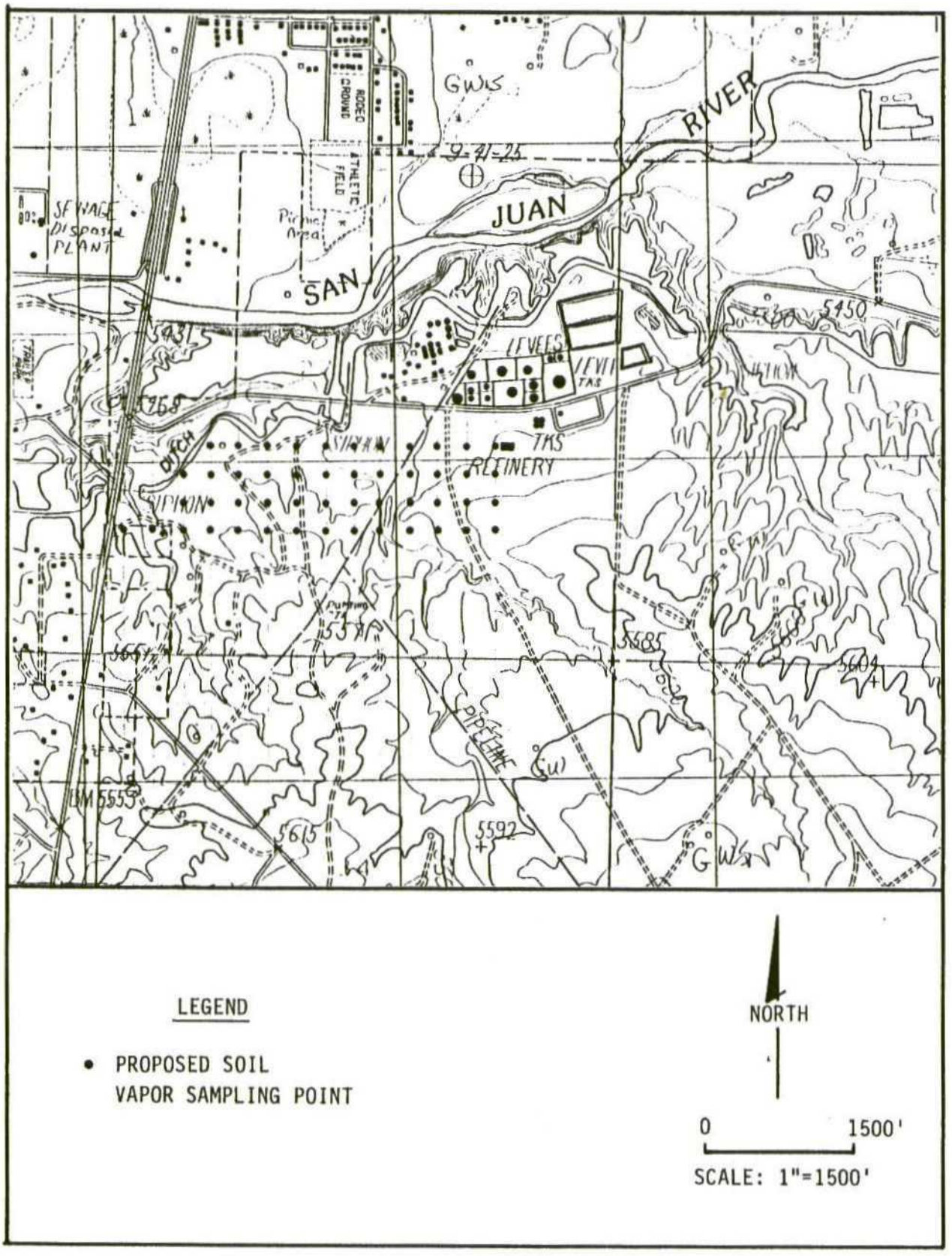
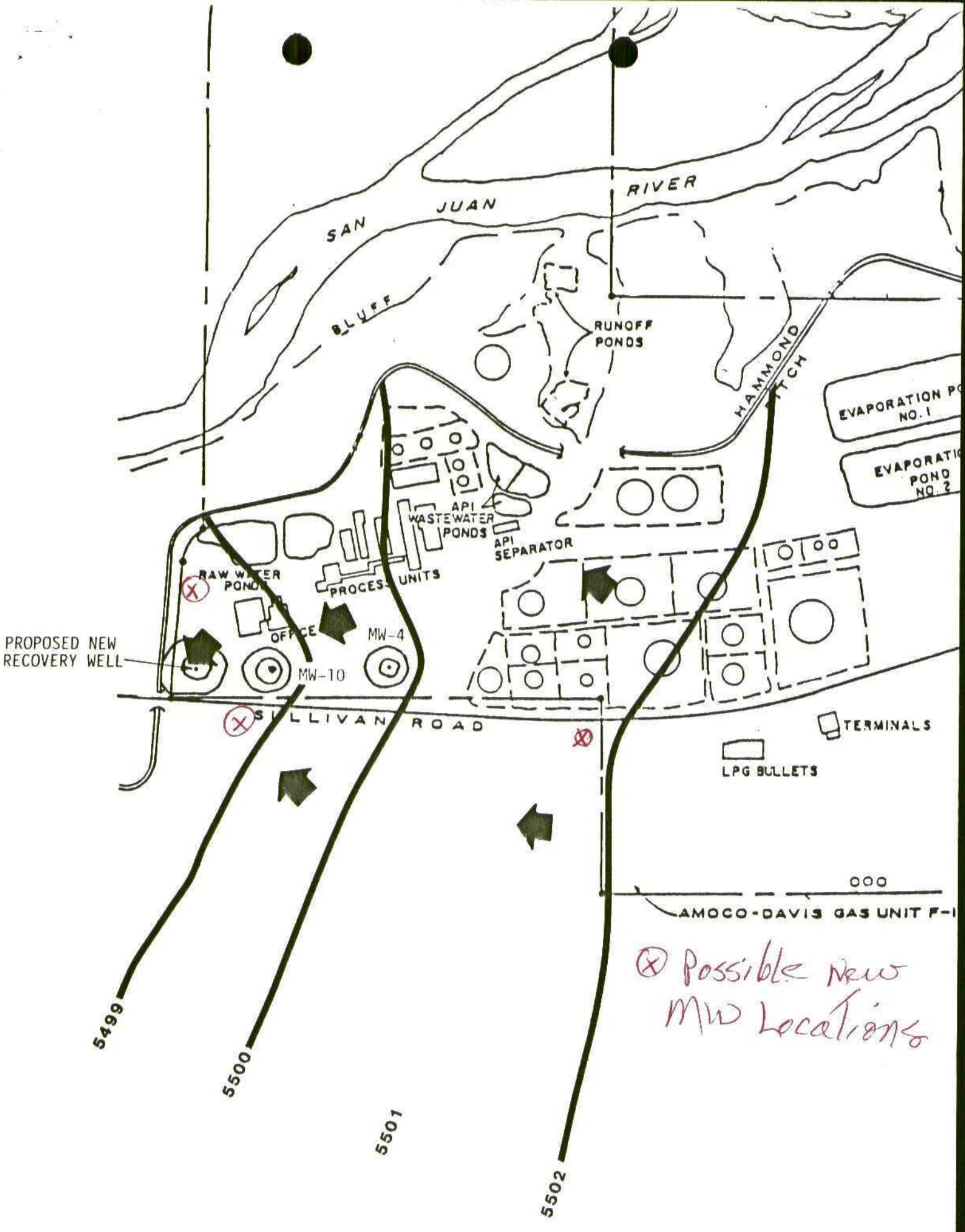


FIGURE 1

PROPOSED SOIL VAPOR SAMPLING GRID

(FIELD CONDITIONS AND RESULTS WILL DETERMINE THE ACTUAL NUMBER OF SAMPLES)


SAN JUAN RIVER
BLUFF
RUNOFF PONDS
HAMMOND DITCH
EVAPORATION PO NO. 1
EVAPORATIO POND NO. 2
API WASTEWATER PONDS
API SEPARATOR
RAW WATER POND
PROCESS UNITS
OFFICE
MW-4
MW-10
PROPOSED NEW RECOVERY WELL
SULLIVAN ROAD
TERMINALS
LPG BULLETS
AMOCO-DAVIS GAS UNIT F-1
5499
5500
5501
5502
⊗ Possible New MW Locations