SOIL VAPOR EXTRACTION PILOT TEST REPORT

PROJECT SITE:

MOTOR PARTNERS
1234 40TH AVE.
OAKLAND, CALIFORNIA
StID #3682

PREPARED FOR:

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SUBMITTED TO:

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PROJECT NO. 1004

December 16, 1996

ENVIRONMENTAL PROTECTION
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December 16, 1996

REF: 1004-SVE.RPT

Mr. Barney Chan
Environmental Health
Alameda County
1131 Harbor Bay Pkwy
Alameda, CA 94502-6577

SUBJECT: REPORT OF SOIL VAPOR EXTRACTION PILOT TEST COMPLETED AT 1234 40TH AVE., OAKLAND, CALIFORNIA.

Dear Barney:

I have enclosed a copy of the Soil Vapor Extraction Pilot Test Report for the Motor Partners site, 1234 40th Avenue, Oakland, California.

The results of this test suggest that Soil Vapor Extraction is of limited value at the site. The pilot test results showed little vacuum response at any of the observation well location. The reason for the poor response are because of the tight clay soil and high groundwater table.

If you have any questions or comments, please give me a call.

Sincerely,

Gary Rogers

Gary Rogers, Ph.D.
Environmental Consultant

cc: Bill Owens

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

This project addresses a soil vapor extraction (SVE) pilot test conducted at the Motor Partners site in Oakland. The SVE pilot test was conducted to evaluate the potential for use of *in situ* soil vapor extraction remediation at the site.

1.2 PROJECT SITE

The project site is known as Motor Partners, located at 1234 40th Avenue, Oakland, California (Figure 1). It is a commercial/light industrial area, with residential properties close to the site. The elevation of the site is approximately 25 feet above mean sea level.

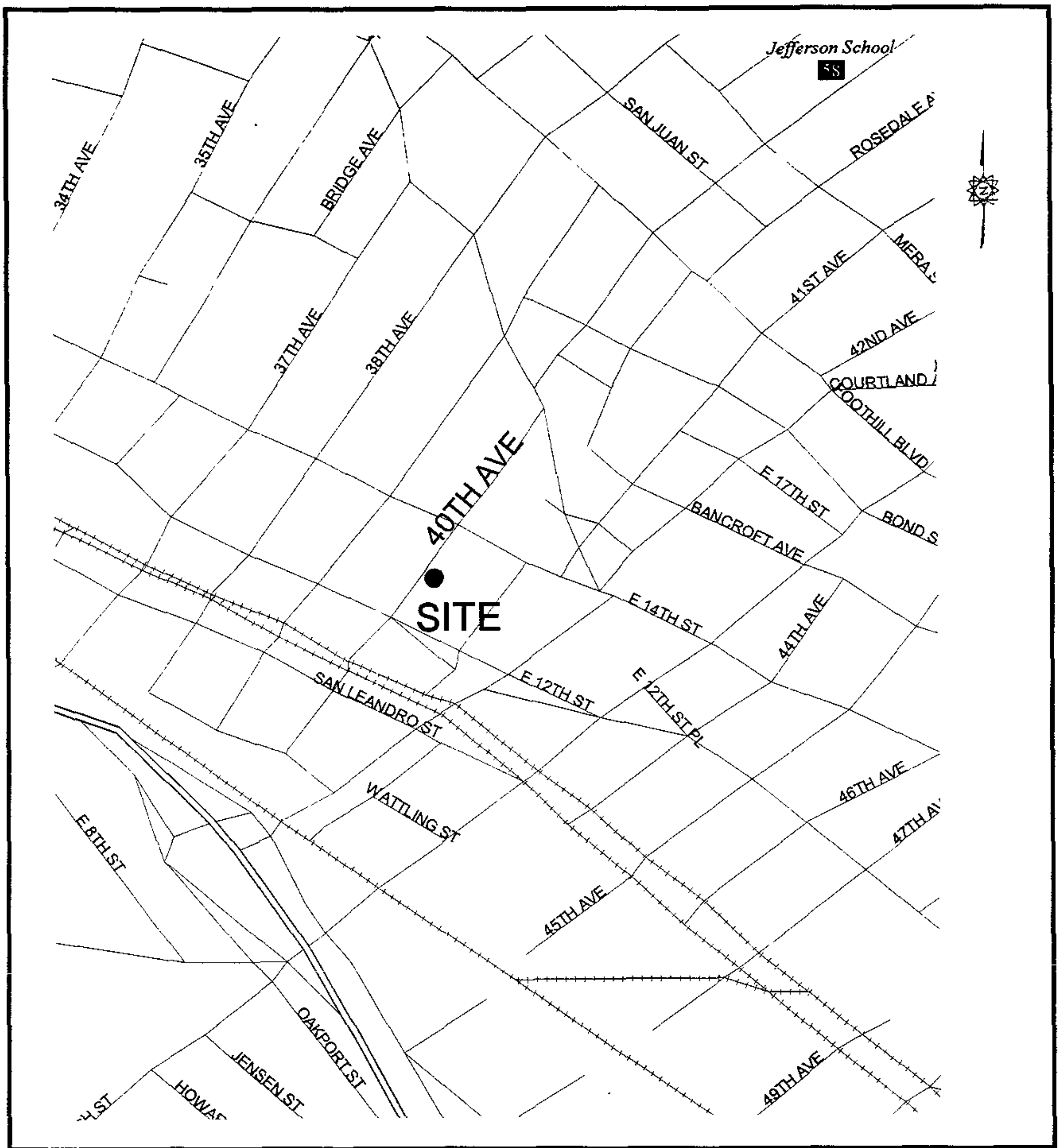
Motor Partners is located at 1234 40th Avenue near Nimitz Highway (880) in the Fruitvale District of Oakland, California (Figure 1). The BART rail tracks are about 500 ft. west of the site and San Leandro Bay is less than one mile to the southwest. The elevation of the site is approximately 25 feet above mean sea level.

Motor Partners utilized the site for auto repair shops. Two underground storage tanks were maintained outside the 1234 40th Avenue building. A 1,000-gallon underground gasoline tank and a 500-gallon underground waste oil tank were located below the sidewalk (Figure 2). No reliable records exist to determine if inventory was lost.

1.3 BACKGROUND

On Oct. 12, 1990, Semco, Inc. of Modesto, California removed both the 1,000-gallon gasoline tank and the 500-gallon waste oil tank. The concentration of total petroleum hydrocarbons in the gasoline range (TPH-G) below the 1,000-gallon tank was 1,600 mg/Kg. The TPH-G and TPH-D concentrations below the 500-gallon tank were 570 mg/Kg and 650 mg/Kg, respectively. There was no record of groundwater in the excavations. The excavations were backfilled to grade with original spoils.

In January, 1994, SEMCO re-excavated the area to remove contaminated soil, and dispose of the contaminated backfill. During the course of over excavation, it was noted that contamination extended beneath the building and into the street. Utilities prevented further excavation. The over excavation was halted and samples taken from the sidewalls of each excavation. An extraction well casing was installed in each excavation. Clean imported soil was used to backfill the two areas and the sidewalk was resurfaced with Christy boxes housing the two extraction casings.



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Description: Site Location

Figure: 1

Project/Location: Motor Partners
1231 40th Ave Oakland CA

Drawn by	Drawing date	Project number	File name	Project manager
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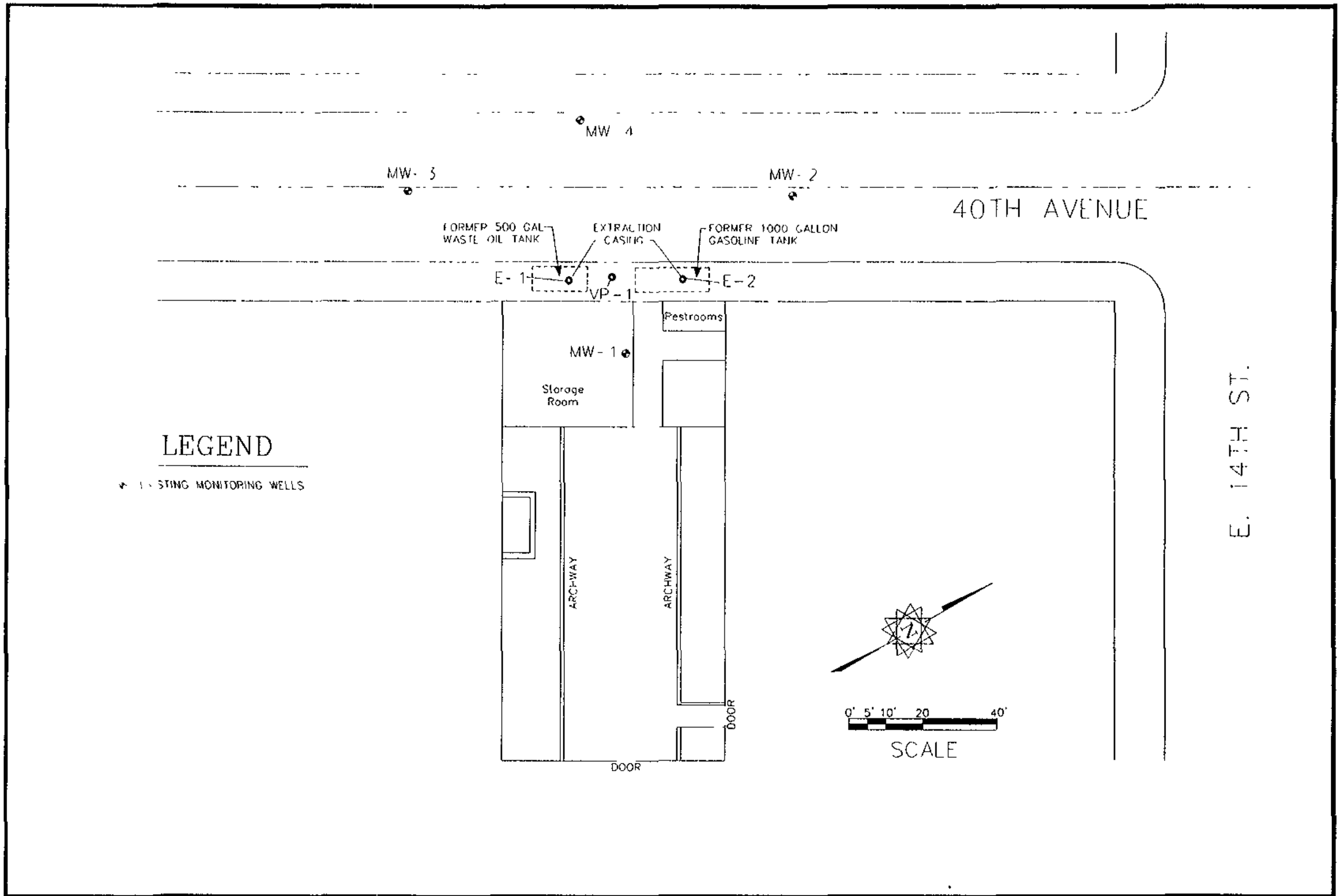

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DRAWN BY GLR	PROJECT NUMBER 1004	DESCRIPTION Site Layout	FIGURE 2
DRAWING DATE 12/16/96	FILE NAME 1004-SVE DWG		
REVISION BY	PROJECT MANAGER GLR	PROJECT/LOCATION Motor Partners 1234 40th Ave., Oakland	
REVISION BY	CHECKED BY		

Sampling conducted on January 11, 1994 indicated levels of TPH-gasoline for the former waste oil tank area between 100 and 700 ppm. Levels of TPH-gasoline for the former gasoline tank area ranged from 150 to 1,200 ppm.

GROWTH Environmental completed soil borings at the property between May and June of 1994. Eleven borings were drilled and three monitoring wells were installed. Both soil and groundwater samples were collected from the borings. Soil and groundwater contamination was found in nearly every boring. Levels of TPH-D up to 2,700 ppm were observed on the west side of the building. A sample from inside the building had a TPH-D level of 520 ppm.

Groundwater samples had highest concentrations near the former tank excavations. The highest level of TPH-G was 64,000 ppb. BTEX compounds were found in groundwater samples from all the borings.

Three monitoring wells were installed at the site in June, 1994 (see Table 1, Well Construction Data). The monitoring wells were sampled on June 17, 1994 and December 7, 1994. Contamination was reported in all three wells. Levels of TPH-G were up to 17,000 ppb and Benzene levels were up to 1,200 ppb in MW-1. Additional quarterly monitoring sampling events have been completed since November, 1995. The groundwater gradient has been shown to be in a southwesterly direction.

Additional geoprobe borings were completed along 40th Avenue between November, 1995 and February, 1996 to determine the extent of contamination.

no reports?

On February 1, 1996, Bay Area Exploration drilled a soil boring across the street from the former underground storage tank excavations at the Motor Partners site (location shown in Figure 2). A two-inch groundwater monitoring well (MW-4) was installed in the boring. The monitoring well was installed according to State of California Water Resource Control Board standards to a depth of 25 feet below grade surface (bgs) and screened from 5 to 25 feet bgs.

Table 1
Monitoring Well Construction Data for Motor Partners
1234 40th Avenue, Oakland, California

	MW-1	MW-2	MW-3	MW-4
Date Drilled	6/15/94	6/14/94	6/14/94	2/1/96
Total Depth	22.5 ft.	22.0 ft.	23.0 ft.	23.0 ft.
Bore Diameter	10 inches	10 inches	10 inches	10 inches
Casing Diameter	2 inch	2 inch	2 inch	2 inch
Well Seal Type	Bentonite Pellets	Bentonite Pellets	Bentonite Pellets	Bentonite Pellets
Well Seal Interval	5.0 - 6.0 bgs	5.0 - 6.0 bgs	5.0 - 6.0 bgs	3.0 - 4.0 bgs
Filter Pack Material	2/14 Lonestar Sand	2/14 Lonestar Sand	2/14 Lonestar Sand	2/14 Lonestar Sand
Filter Pack Interval	6.0 - 17.0 bgs	9.0 - 20.0 bgs	6.5 - 20.0 bgs	4.0 - 25.0 bgs
Screen Slot Size	0.020 in.	0.020 in.	0.020 in.	0.010 in.
Screened Interval	7.0 - 17.0 bgs	10.0 - 20.0 bgs	7.0 - 20.0 bgs	5 0 - 25.0 bgs
Well Elevation[1]	28.43 ft.	28.03 ft.	27.41 ft.	27.34 ft.

[1] TOC -Top of Casing Elevations for MW-1, MW-2, and MW-3 were surveyed on 11/17/95 to a City of Oakland benchmark at the northwest corner of the block using an elevation of 29.07 feet above mean sea level. The Top of Casing Elevation for MW-4 was surveyed on 2/14/96 to the TOC Elevations for MW-2 and MW-3.

1.4 GEOLOGY AND HYDROGEOLOGY

Regional Geology. The site is located on the East Bay Plain about 1.0 mile west of the Oakland Hills, about 1.0 mile east of the San Francisco Bay, and about 0.5 miles north of San Leandro Bay. The property is bounded on the northeast by 14th Street.

The site rests on Quaternary Deposits of various physical and compositional properties. The predominant formation is the Temescal Formation consisting of contemporaneous alluvial units of different origin, lithology, and physical properties. The material ranges from irregularly bedded clay, silt, sand and gravel to lenses of clay, silt, sand, and gravel with Claremont Chert.

The Hayward Fault is approximately 1.5 miles East of the site and is an active historic Fault. The Hayward Fault is the only active fault in the Oakland East Quadrangle.

Regional Hydrogeology. The site is located within the East Bay Plain which makes up the ground water reservoir in the area. The water bearing capacity varies within the area due to the juxtaposed positions of the various types of soils and strata encountered underneath the East Bay Plain.

In General the water bearing capacities of the Younger Alluvium range from moderately permeable to low permeable soils. Below the Younger Alluvium at a depth of approximately 70 feet lies the Older Alluvium, which yields large to small quantities of well water.

Site Geology. The site soils were characterized using the United Soil Classification System (USCS). During on-site subsurface drilling, CEC (GROWTH) encountered up to two feet of baserock (fill) followed by a 4 to 5 foot layer of dark sandy clay (CL). Below the dark clay to a depth between 7 and 15 feet, a grey sandy gravel was found. Below the sandy gravel the soil varied between a clayey sand to a sandy silty clay (SC). The gravels are poorly sorted, angular to rounded clasts ranging in size from 0.2 cm to 3.0 cm.

Site Hydrogeology. The depth of first water ranged from 8 to 10 feet below the ground surface (bgs) in the borings. Groundwater was encountered within the grey clayey sandy gravel layers. The groundwater gradient is in a southwesterly direction.

1.5 PREVIOUS SAMPLING RESULTS

Table 2 presents a summary of the quarterly monitoring groundwater sampling data from the four monitoring wells installed on the property. The highest levels of both TPH-G and Benzene are centered around MW-1.

Table 2

Summary of Monitoring Well Sampling Results at Motor Partners 1234 40th Avenue, Oakland, California

Sample I.D. Number	Date Collected	TPH-D (μg/L)	TPH-G (μg/L)	Benzene (μg/L)	Toluene (μg/L)	Ethyl Benzene (μg/L)	Total Xylenes (μg/L)
MW-1	6/17/94	2,400	17,000	1,200	220	1,000	2,600
	11/29/95	53,000	67,000	860	180	1,300	3,100
	2/23/96	25,000	16,000	360	ND	370	740
	5/21/96	650	11,000	290	37	600	1,300
	8/22/96	ND	13,000	270	51	540	1,400
	11/21/96	5,500	15,000	810	79	680	1,700
MW-2	6/17/94	370	990	ND	1.3	2.3	4.4
	12/07/94	ND	170	2.1	0.70	0.60	1.7
	11/29/95	200	400	ND	ND	ND	3
	2/23/96	ND	500	ND	ND	ND	ND
	5/21/96	ND	62	ND	ND	ND	1
	8/22/96	ND	120	0.58	0.62	ND	0.62
	11/21/96	89	89	0.60	0.78	ND	ND
California Drinking Water MCL		None Listed	None Listed	1.0	1,000	680	1,750
Reporting Limit		50	50	0.5	0.5	0.5	1.0

Notes: All results in μg/l (ppb)
ND = Not Detected
NA = Not Analyzed

Table 2 Continued
Quarterly Groundwater Sampling Results at Motor Partners
1234 40th Ave., Oakland, California

Sample I.D. Number	Date Collected	TPH-D (μg/L)	TPH-G (μg/L)	Benzene (μg/L)	Toluene (μg/L)	Ethyl Benzene (μg/L)	Total Xylenes (μg/L)
MW-3	6/17/95	2,200	9,500	330	40	100	74
	12/07/94	1,700	7,500	380	42	130	72
	11/29/95	14,000	9,000	300	49	300	16
	2/23/96	14,000	13,000	270	83	260	67
	5/21/96	350	6,600	220	48	160	66
	8/22/96	ND	4,800	120	34	44	44
	11/21/96	3,300	8,700	220	51	150	68
MW-4	2/23/96	3,000	6,000	58	36	6	28
	5/21/96	78	1,200	18	2.5	6.2	12
	8/22/96	ND	400	8.6	3.4	1.8	2.6
	11/21/96	87	170	3.6	1.1	1.7	2.3
California Drinking Water MCL		None Listed	None Listed	1.0	1,000	680	1,750
Reporting Limit		50	50	0.5	0.5	0.5	1.0

Notes: All results in μg/l (ppb)
ND = Not Detected
NA = Not Analyzed

2.0 SOIL VAPOR EXTRACTION (SVE) PILOT TEST

2.1 DESCRIPTION OF SVE PILOT TEST

In-situ soil venting or soil vapor extraction (SVE) has proven to be an effective technology for unsaturated zone soil remediation. SVE is ideally suited for the removal of volatile compounds from permeable soils. A critical factor used to determine the feasibility of SVE is the vapor flow rate that may be induced at a particular site. The vapor flow rate is directly dependent upon the soil's permeability to air flow (soil air permeability) along with the applied vacuum.

Soil permeability is simply a measure of the ability of vapors to flow through porous media and is analogous to the permeability of water flow in the saturated zone. The soil air permeability is the single most important parameter for the feasibility and success of SVE. It is also a critical parameter in the design of SVE systems.

The most effective method of measuring soil air permeability is by conducting a field SVE test, since using parameters or other laboratory measurements may provide misleading results and lead to poor system design. The purpose of the SVE pilot test is to obtain site-specific design parameters including:

- Flow-Vacuum Relationship
- Radius of Influence
- Vapor Concentration

The methods and procedures are presented below with a summary of the data collected and a preliminary analysis of the data. Additional data analysis, including an evaluation of cleanup time and associated costs will be performed as part of the feasibility and remedial design phase.

2.2 SVE TEST WELLS AND POINTS

One existing monitoring well, MW-1, and an additional extraction well, E-1, were used as the vapor extraction wells. Monitoring Wells, MW-1 and MW-4, extraction well, E-2, and a Vapor Well Point, VP-1 were used as vapor observation wells. The well and probe locations are shown in Figure 2. Well construction details for the vapor wells and the other monitoring wells used as observation wells during the SVE Pilot Test are summarized in Tables 1 and 3. The wells and well point were constructed according to Standard Field Procedures presented in Appendix D.

The vapor extraction and observation wells (MW-1, E-1, and VP-1) were constructed of Schedule 40 PVC casing with 0 02 inch slot screen (see well schematics, Appendix B) Screened intervals are shown in Table 1 The construction details are provided in Table 3

Vapor well point, VP- 1, was installed between the former tank locations using the Geoprobe push-core equipment. This well point was constructed with a filter pack consisting of sand placed around the well point. The well point boring was sealed with hydrated powdered bentonite clay. The purpose of the vapor well point was to help evaluate whether vapor extraction from MW-1 and E-1 would be effective in remediating shallow soil and groundwater contamination located near MW-1 and E-1. General protocols for vapor point installation are presented in Appendix D.

Table 3

Summary of Well Construction Data for SVE Pilot Test

Well ID	Test Status	Well Dia. (in.)	Screen Int. (ft.)	Total Depth*	S.W.L.$^{\#}$ (ft)
E-1	Observation Extraction.	4	0.5 - 13	13.3	7.90
E-2	Observ.	4	0.5 - 13	13.0	7.85
MW-4	Observ.	2	5 - 25	25.0	7.45
MW-1	Observation Extraction.	2	7 - 17	19.0	8.51
VP-1	Observation	1	2 - 7	7	-

Notes:

\# In the tight soil the initial water level in the monitoring wells rises to approximately 8 feet below grade at this time of year.

2.3 TEST PROCEDURES AND EQUIPMENT

On November 14, 1996 the SVE pilot tests were performed utilizing MW-1 and E-1 as the vapor extraction wells. The test was conducted in two parts. The first test involved extracting vapors from E-1 Vacuum response was observed in MW-1, MW-4, VP-1 and E-2. The observation wells were located 25 feet, 43 feet, 12 feet, and 32 ft from E-1, respectively. A second test was performed with MW-1 The test involved extraction of vapor from MW-1 and observing the vacuum response in vapor observation wells E-1, E-2, MW-4, and VP-1. These wells were located 25 ft, 25 ft, 63 ft, and 20 ft from MW-1, respectively

The SVE pilot test utilized an IC Engine from Remediation Service International (RSI). Vacuum readings were measured at the extraction well head. The test was conducted using the patented S.A.V.E. ™ technology. Air/vapor flow rates were measured using a g~~u~~aage mounted near the extraction well head manifold. Observation well vacuum readings were measured using magnehelic gages attached by polyethylene tubing to air tight caps mounted at each well head.

A total of three vapor samples were collected in Tedlar bags from a manifold sampling port during the tests. The vapor samples were submitted to Chroma Lab, a California-certified analytical testing laboratory under a chain of custody protocols, and analyzed for TPH-G and BTEX (see Appendix A for results).

2.4 RESULTS

2.4.1 Vacuum vs. Flow

Vacuum response and air flow data for the two tests are summarized in Table 4 (extraction well E-1) and Table 5 (extraction well MW-1). A comparison of the data sets presented in Tables 4 and 5 does not show that an increase in well head vacuum will consistently increase the extraction well flow rate. The well head vacuum ranged from 5 to 10 inches of water. The flow rates ranged from 30.5 to 58.9 cfm. In general the vacuum was greater at the start of the test and decreased with time as subsurface pressure potentials are developed. An effort was made to increase flow rates with time until equilibrium was achieved.

Table 4

Summary of SVE Pilot Test Data for Extraction Well E-1

Time (minutes)	Air Flow (CFM)	Vacuum (Inches, H_20)				
	E-1	E-1	MW-1	E-2	MW-4	VP-1
0	0	0.0	0.0	0.0	+0.06	+0.05
14	17.7	0.5				
20	25.5	0.55				
23	35.0	1.0	0.0	0.0	-0.22	0 0
Distance from Extraction Well (feet)			25 ft	32 ft	43 ft	12 ft

Table 5

Summary of SVE Pilot Test Data for Extraction Well MW-1

Time (minutes)	Air Flow (SCFM)	Vacuum (Inches, H_20)				
	MW-1	MW-1	E-1	E-2	MW-4	VP-1
0	0	10	0.0	0.0	0.00	0.0
6	6.7	50	0.0	0.0	+0.21	0.0
19		50	0.0	0.0	+0.18	0.0
31	6.7	50	0.0	0.0	+0.15	0.0
48	10.6	55	0.0	0.02	+0.05	0.0
58	12.4	60	0.0	0.01	+0.06	0.0
83	10.8	40	0.0	0.0	+0.2	0.0
103	7.6	42	0.0	0.0	>+0.25	0.0
138	7.6	40	0.0	0.0	>+0.25	0.0
168	7.6	40	0.0	0.0	+0.03	0.0
193	7.6	40	0.0	0.0	+0.03	0.0
223	7.6	40	0.0	0.0	+0.03	0.0
Distance from Extraction Well (feet)			25 ft	25 ft	63 ft	20 ft

Tables 4 and 5 present vacuum response data and distance between observation wells and extraction wells E-1 and MW- 1. At 23 minutes for E-1, no vacuum response was observed in the observation wells.

Similar results were achieved in MW-1, where run #2 showed only slight vacuum response (0.01 to 0.02 in. H_2O) at E-2.

Neither E-1 nor MW-1 functioned well as a soil vapor extraction wells. The tight soil and relatively high water table both affected the test and prevented vacuum response. The low vacuum responses observed in the observation wells indicate a poor communication through the soil either above or in the saturated zone. VP-1 was located above the anticipated groundwater level.

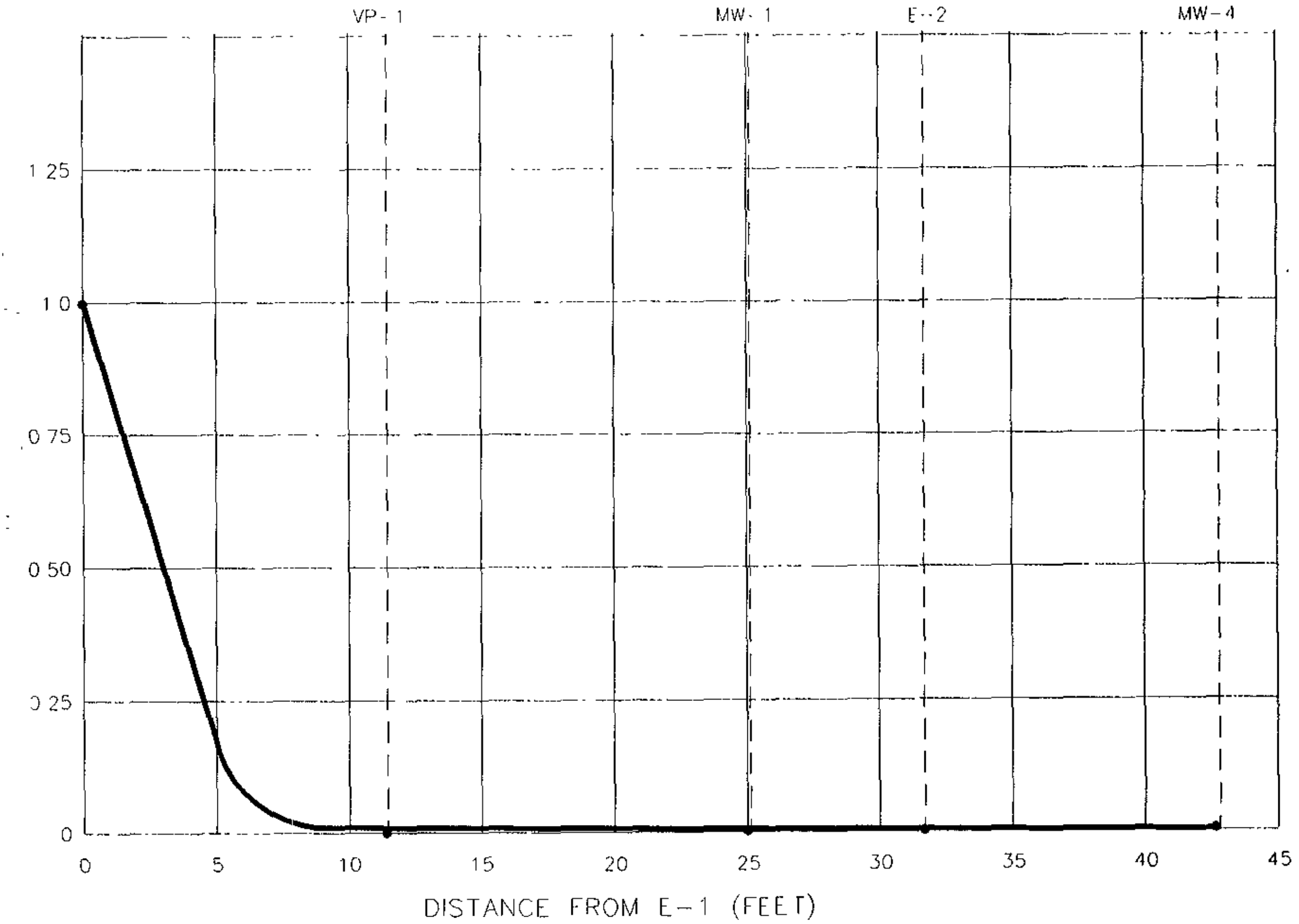
Figures 3 and 4 represent the plots of vacuum versus distance from the extraction well for the two tests (E-1 and MW-1). The vacuum decreases exponentially with increasing distance from the extraction well.

2.4.2 Radius of Influence

The radius of influence defines the region in which the vapor in the vadose zone flows to the extraction well under the influence of a vacuum. The radius of influence depends on soil properties of the vadose zone, depth and screened interval of the extraction well, and the presence of any impermeable boundaries such as clay layers and the water table.

An estimate of the radius of influence is difficult, in part, due to the non-linear relationship between the distance and vacuum draw down measured at the vapor observation wells. Figure 5 presents an estimate of the vacuum influence for extraction well MW-1.

The radius of influence is a function of the induced vacuum at the extraction well and its influence on the observation wells. The radius of influence and flow rate are dependent on the soil permeability in the screened portion of the extraction well. Theoretically, all of the air in the connected pores within the radius of influence can be transported to the extraction well under convective air flow. The driving force of the air flow is the pressure gradient. Because the air flows radially towards the extraction well, its velocity is much slower at points farther from the extraction well. This is because the pressure gradient decreases as the radial distance increases. Thus, in order to accomplish soil remediation in a reasonable time frame, extraction well spacing should be less than the estimated radius of influence to insure adequate vapor flow through the contaminated zone. As discussed below, however, the concept of "effective radius of influence" is a more important concept in determining well spacing and estimation of cleanup times (Mohr and Merz, 1995). The effective radius of influence is defined as the distance from the extraction well where the cleanup rate is sufficient to meet the project goals In other words, the effective radius of influence is determined primarily by the flow rate of air per volume of soil, the type and amount of hydrocarbons to be removed, and the time available for cleanup



EXTRACTION WELL E-1, RUN #1 AT 23 MINUTES

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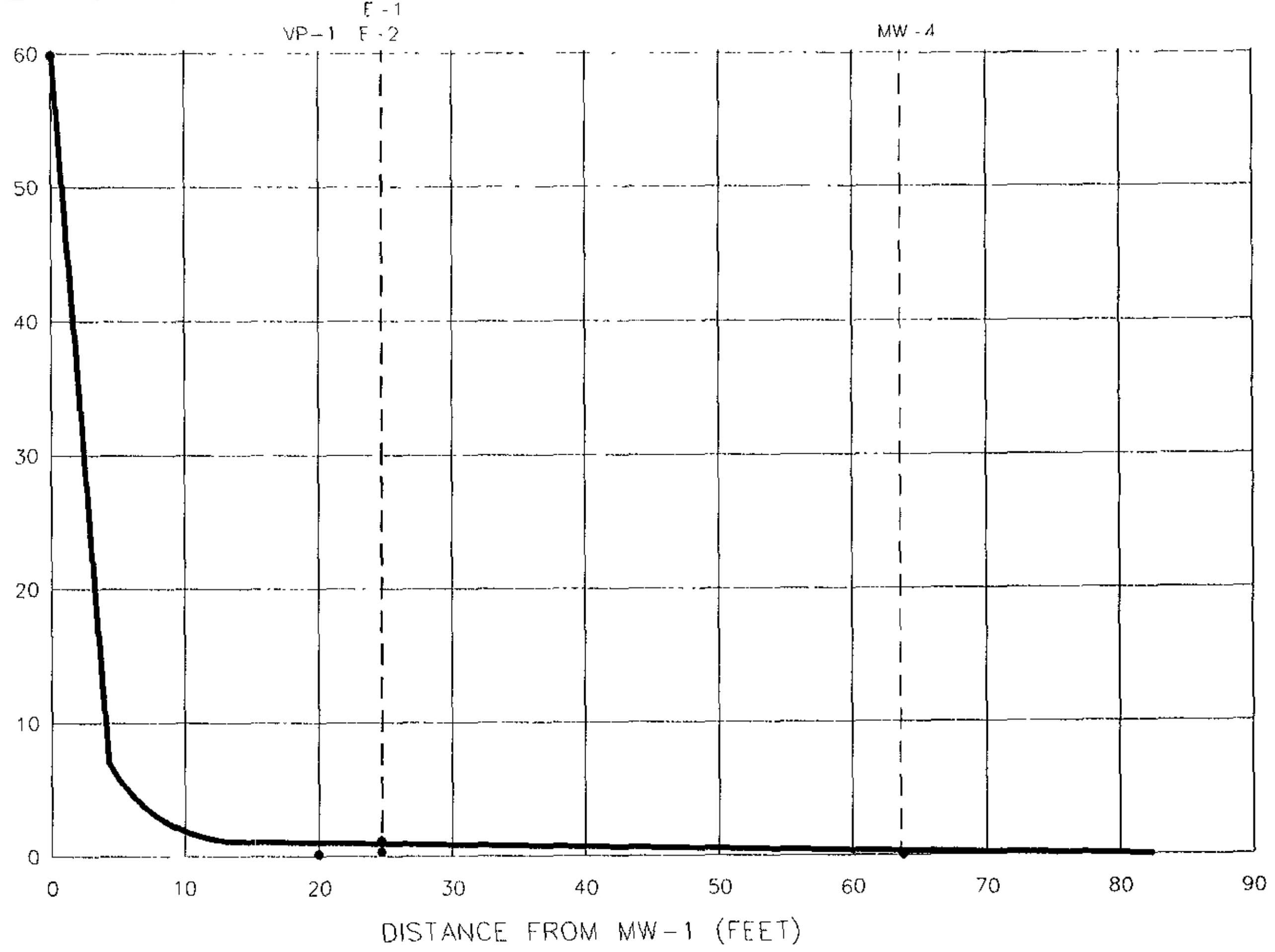
DRAWN BY GLR	PROJECT NUMBER 1004	DESCRIPTION Vacuum v. Distance – Run #1	FIGURE 3
DRAWING DATE 12/16/96	FILE NAME 1004 SVE DWG		
REVISION BY	PROJECT MANAGER GLR	PROJECT/LOCATION Motor Partners 1234 40th Avenue, Oakland	
REVISION BY	CHECKED BY		



EXTRACTION WELL MW-1, RUN #2 AT 58 MINUTES

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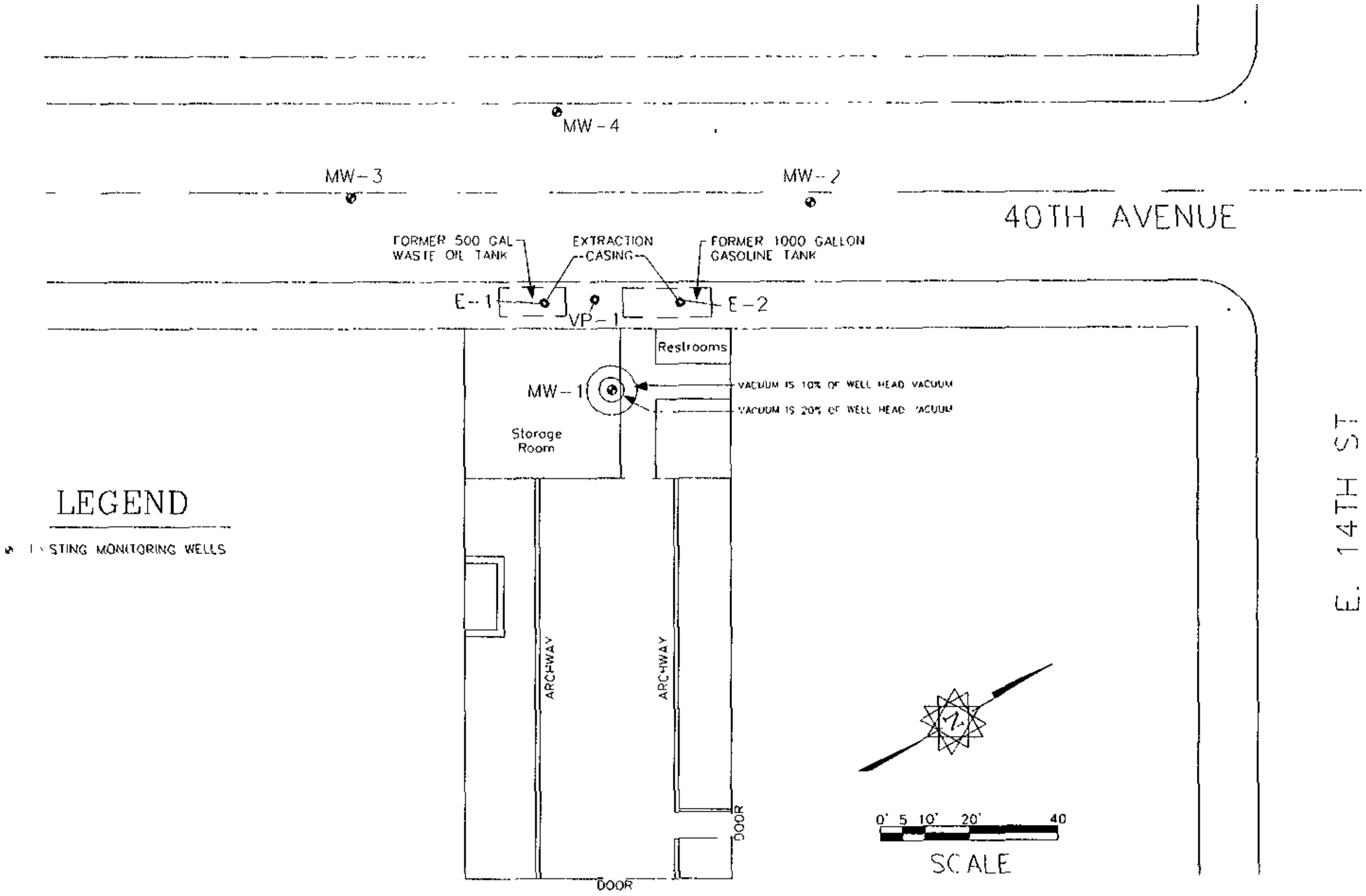
DRAWING DATE 12/16/96
REVISION BY
REVISION BY
PROJECT NUMBER 1004
FILE NAME 1004-SVE DWG
PROJECT MANAGER GLR
CHECKED BY
DESCRIPTION Vacuum v. Distance - Run #2
FIGURE 4
PROJECT/LOCATION Motor Partners
1234 40th Avenue, Oakland



GARY ROGERS, PH.D. ENVIRONMENTAL CONSULTANT 2657 BAILEY CT. FREMONT CA 94536 (510) 791 7157	DRAWN BY GLR	PROJECT NUMBER 1004	DESCRIPTION Vacuum Influence Extraction Well-MW-1, Run #2	FIGURE 5
	DRAWING DATE 12/16/96	FILE NAME 1004-SVE DWG		
	REVISION BY	PROJECT MANAGER GLR	PROJECT/LOCATION Motor Partners 1234 40th Avenue, Oakland	
	REVISION BY	CHECKED BY		

The spacial distribution of well head vacuum for the MW-1 test is illustrated in Figure 5. The figure shows the low level of vacuum influence. The low air/vapor extraction flow rate and small radius of influence suggests low permeability for this site. The low relative permeability is also supported by lithologic descriptions and gradation analyses for samples from this site. The estimated radii of influence is less than 5 feet for the MW-1 portion of the test. This value is considered the maximum values for well spacing, and is not necessarily the most ideal extraction well spacing for the final well field.

2.4.3 Vapor Recovery

Table 6 presents the results of chemical analyses performed on Tedlar bag vapor samples collected during the SVE pilot testing. During the E-1 portion of the test, no hydrocarbon contaminates were detected in the vapors. At the beginning of the MW-1 portion of the test, the TPH-G concentrations in the vapor sample were 19,000 μg/L and the Benzene was 39 μg/L. At the end of the MW-1 test, the TPH-G concentrations in the vapor sample were 1,200 μg/L and the Benzene was 3.8 μg/L.

Table 6

Vapor Extraction Well Off-Gas Sampling Results at Motor Partners 1234 40th Avenue, Oakland, California

AIR SAMPLES						
Sample I.D. Number	**Date Collected**	**TPH-G (μg/L)**	**Benzene (μg/L)**	**Toluene (μg/L)**	**Ethyl Benzene (μg/L)**	**Total Xylenes (μg/L))**
MW-1 Start	11/14/96	19,000	39	20	33	21
MW-1 End	11/14/96	1,200	3.8	1.9	14	16
E-1 End	11/14/96	ND	ND	ND	ND	ND
Reporting Limits		50	0.5	0.5	0.5	0.5

Notes: All results in mg/L (ppm)
ND = Not Detected
NA = Not Analyzed

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 CONCLUSIONS

The principal environmental issue at the site is the hydrocarbon concentrations in the groundwater and is primarily located around MW-1. Additional contamination has been reported under the sidewalk and 40th Avenue. Groundwater direction has been shown to be to the southwest.

The clayey soil at the site is very tight and does not permit a high mobility of soil vapors. Although the vapor samples collected during the second test (extraction from MW-1) did contain significant levels of hydrocarbons, it is unlikely that direct vapor extraction will remove significant hydrocarbons from this site.

Air sparging provides a possible method for treating the groundwater, especially if nutrients and/or microbes are injected. This method would required a small number of injection points and continued monitoring of monitoring wells, MW-1, MW-2, MW-3, and MW-4.

3.2 RECOMMENDATIONS

The following are the recommendations of this investigation, if it is found necessary to proceed with additional site remediation activities.

1. Quarterly monitoring of the four on site wells should be continued.
2. An evaluation should be made in the future regarding the use of air sparging to complete the remediation effort and treatment of the area of groundwater contamination around MW-1. The existing wells could be used as injection points.

4.O REFERENCES

1. Marshack, J.B., 1991. A Compilation of Water Quality Goals, Staff Report of the California Regional Water Quality Control Board, Central Valley Region, 15 p.
2. Mohr, D.H., and P.H. Merz, 1995, Application of a 2D Air Flow Model to Soil Vapor Extraction and Bioventing Case Studies, in Ground Water, v 33, No 3., AGWSE.

5.0 LIMITATIONS

This report has been prepared in accordance with generally accepted environmental, geological and engineering practices. No warranty, either expressed or implied is made as to the professional advice presented herein. The analysis, conclusions, and recommendations contained in this report are based upon site conditions as they existed at the time of the investigation and they are subject to change.

The conclusions presented in this report are professional opinions based solely upon visual observations of the site and vicinity, and interpretation of available information as described in this report. The scope of services performed in execution of this investigation may not be appropriate to satisfy the needs of other users and any use or reuse of this document or its findings, conclusion or recommendations presented herein is at the sole risk of the said user.

Stanley L. Klemetson Ph.D., P.E.
P.E No. 40087

REGISTERED PROFESSIONAL ENGINEER
STANLEY LOUIS KLEMETSON
No. 40087
Exp. 3/31/98
CIVIL
STATE OF CALIFORNIA

APPENDICES

APPENDIX A

Analytical Results

PILOT TEST DATA SHEET

PAGE 1 OF

LOCATION 1234 40th AVE, OAKLAND

CONSULTANT. GARY ROGERS, ROGERS ENV.

EXTRACTION WELL E - 1 (4" WELL IN SIDEWALK - WEST)

DATE: 14 NOV. '96
TECHNICIAN: DVA w/ GARY ROGERS
UNIT #: 113

TIME	HR MTR	RPM	FUEL FLOW (CFH)	AIR FLOW (CFM)	WELL FLOW (ΔP)	WELL FLOW (SCFM)	VAC @ EXTR. WELL ("H20)	VAC MEASUREMENTS. ACROSS STREET MW 4	(FAST) E-2	INSIDE MW 1	VAPOR PROBE VP 1			HORIBA ppm HC	HORIBA % CO2	HORIBA % O2	SOIL VPR TEMP (°F)	COMMENTS:
11:33							0	+.06	0	0	+.05"						60.4	
11:40																		FIRE UP UNIT, WARM UP
E-1 11:44	12,657.0																	OPEN WELL # E-1
11 47		2000	105	0	.12"	17.7	.5"							0				INCREASE WELL FLOW
11:53		2000	100	0	.25"	25.5	.55"							0				INCREASE WELL FLOW
11:56		2300	110	0	.47	35.0	1.0"	+.22	0	0	0			0	.02	18.8	61.4	
				END	test	OF		E-1										
								MW 4	E2	E1	VP1							
12:10																		open WELL MW 1
MW 12:12		2000	65	.25	0		10							0	0	18.8		INCREASED WELL FLOW
1 12:18		2000	65	.25	.02	6.7	50	+.21	0	0	0			← HIGH	VAC		66.0	REDUCED WELL VAC/FLOW: DRAWING H2O
12:31		2000	85	.20	0		5.0	+.18	0	0	0		DIRECT READING →	10,490	5.27	3.4	65.0	12:35 took BAG SAMPLE → INCREASE WELL FLOW
12:43		2000	75	.18	.02	6.7	50"	+.15	0	0	0						65.8	PHY 2000 SEMI [illegible] $\overset{\wedge}{50}$ $\overset{F}{47}$ - $\overset{YL}{22}$
13:00		2000	80	.19	.05	10.6	55"±	+.05	0	0	0						66.0	2000 " " 50- 48 30
13:10		2200	90	.21	.07±	[illegible]	60±	+.06	.02	0	0						66.0	2200 " · 52-52-40
13:25		2000	85	.17	.05±	10.8	40±	+.20	.01	0	0						65.6	REDUCED FLOW, WAS DRAWING H2O
13:55		2000	85	.15	.025±	7.6	42±	>+.25	0	0	0						65.4	2000 SEMI 48-50-20
14:30		2000	85	.18	.025±	7.6	40±	>+.25	0	0	0						65.6	2000 SEMI 46-50-20
15:00		2000	90	.16	.025±	7.6	40±	+.03	0	0	0						65.6	2000 " 48-50-20
15:25		2000	85	.16	.25±	7.6	40±	+.03	0	0	0						65.6	
15:55		2000	90	.14	.025±	7.6	40±	+.03	0	0	0			3270	4.2	8.5	65.6	← 2000 " 42-50 20
16:00																		TOOK FINAL BAG SAMPLE @ 15:55 CONDITIONS (& HORIBA)
E-1 16:10																		
PART 16:45					?		.45											
II																		

REMEDIATION SERVICE, INT'L.

CHROMALAB, INC.
Environmental Services (SDB)

November 22, 1996 *Submission #:* [redacted]1195

ROGERS ENVIRONMENTAL SERVICES .

Atten: Gary Rogers

Project: MOTOR PARTNERS *Project#:* 1004.95
Received: November 15, 1996

re: One sample for Gasoline and BTEX compounds analysis.
Method: EPA 5030/8015M/8020A

Client Sample ID: **MW-1 START**
Spl#: 107548 *Matrix:* AIR
Sampled: November 14, 1996 *Run#:* 4081 *Analyzed:* November 16, 1996

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
BENZENE	39	0.50	N.D.	95.3	1
TOLUENE	20	0.50	N.D.	99.6	1
ETHYL BENZENE	33	0.50	N.D.	98.3	1
XYLENES	21	0.50	N.D.	98.6	1
GASOLINE	19000	1000	N.D.	112	20

Note: Surrogate recovery was outside QA/QC limits due to matrix interference. See Surrogate Summary page.

Kayvan Kimyai
Chemist

Marianne Alexander
Gas/BTEX Supervisor

CHROMALAB, INC.
Environmental Services (SDB)

November 22, 1996 *Submission #:* 9611195

ROGERS ENVIRONMENTAL SERVICES

Atten: Gary Rogers

Project: MOTOR PARTNERS *Project#:* 1004.95
Received: November 15, 1996

re: One sample for Gasoline and BTEX compounds analysis.
Method: *EPA 5030/8015M/8020A*

Client Sample ID: **MW-1 END**
Spl#: 107549 *Matrix:* AIR
Sampled: November 14, 1996 *Run#:* 4081 *Analyzed:* November 15, 1996

ANALYTE	**RESULT (ug/L)**	**REPORTING LIMIT (ug/L)**	**BLANK RESULT (ug/L)**	**BLANK SPIKE (%)**	**DILUTION FACTOR**
GASOLINE	1200	50	N.D.	112	1
BENZENE	3.8	0.50	N.D.	95.3	1
TOLUENE	1.9	0.50	N.D.	99.6	1
ETHYL BENZENE	14	0.50	N.D.	98.3	1
XYLENES	16	0.50	N.D.	98.6	1

Kayvan Kimyai
Chemist

Marianne Alexander
Marianne Alexander
Gas/BTEX Supervisor

CHROMALAB, INC.

Environmental Services (SDB)

November 22, 1996 *Submission #:* 9611195

ROGERS ENVIRONMENTAL SERVICES

Atten: Gary Rogers

Project: MOTOR PARTNERS *Project#:* 1004.95
Received: November 15, 1996

re: One sample for Gasoline and BTEX compounds analysis.
Method: *EPA 5030/8015M/8020A*

Client Sample ID: **E-1 END**
Spl#: 107550 *Matrix:* AIR
Sampled: November 14, 1996 *Run#:* 4081 *Analyzed:* November 15, 1996

ANALYTE	**RESULT (ug/L)**	**REPORTING LIMIT (ug/L)**	**BLANK RESULT (ug/L)**	**BLANK SPIKE (%)**	**DILUTION FACTOR**
GASOLINE	N.D.	50	N.D.	112	1
BENZENE	N.D.	0.50	N.D.	95.3	1
TOLUENE	N.D.	0.50	N.D.	99.6	1
ETHYL BENZENE	N.D.	0.50	N.D.	98.3	1
XYLENES	N.D.	0.50	N.D.	98.6	1

Kayvan Kimyai
Chemist

Marianne Alexander
Gas/BTEX Supervisor

510-742-0552 MD 11:22

V114 3 000405 ALEXANDM 15 C

CHROMALAB, INC.

Environmental Services (SDB)

November 22, 1996 *Submission #:* 9611195

ROGERS ENVIRONMENTAL SERVICES

Atten: Gary Rogers

Project: MOTOR PARTNERS *Project#:* 1004.95
Received: November 15, 1996

re: **Surrogate** report for 3 samples for Gasoline and BTEX compounds
Method: EPA 5030/8015M/8020A
Lab Run#: 4081
Matrix: AIR

Sample#	Client Sample ID	Surrogate	% Recovered	Recovery Limits
107548-1	MW-1 START	TRIFLUOROTOLUENE	884	65-135
107548-1	MW-1 START	BROMOFLUOROBENZENE	656	65-135
107548-2	MW-1 START	TRIFLUOROTOLUENE	131	65-135
107548-2	MW-1 START	BROMOFLUOROBENZENE	143	65-135
107549-1	MW-1 END	TRIFLUOROTOLUENE	161	65-135
107549-1	MW-1 END	BROMOFLUOROBENZENE	238	65-135
107550-1	E-1 END	TRIFLUOROTOLUENE	94.2	65-135
107550-1	E-1 END	BROMOFLUOROBENZENE	104	65-135

Sample#	QC Sample Type	Surrogate	% Recovered	Recovery Limits
107702-1	*Reagent blank (MDB)*	TRIFLUOROTOLUENE	96	65-135
107702-1	*Reagent blank (MDB)*	BROMOFLUOROBENZENE	81	65-135
107703-1	*Spiked blank (BSP)*	TRIFLUOROTOLUENE	56	65-135
107703-1	*Spiked blank (BSP)*	BROMOFLUOROBENZENE	81	65-135

V114
QCSURR1229 ALEXANDM 22-Nov-96

195/107548-

30778

CHROMALAB, INC.

Environmental Services (SDB) (DOHS 1094)

JRN #: 9611195 REP: MD
.IENT: ROGERSENV
1UE: 11/29/96
.F #:30770

Chain of Custody

DATE Nov 14, 1996 PAGE 1 OF 1

PROJ MGR Gary Rogers
COMPANY Rogers Environmental Services
ADDRESS 2657 Bailey Ct
Fremont CA 94536

SAMPLERS (SIGNATURE) Gary Rogers
(PHONE NO.) 510-791-7157
(FAX NO.) Same

ANALYSIS REPORT

SAMPLE ID.	DATE	TIME	MATRIX	PRESERV.	TPH - Gasoline (EPA 5030, 8015)	TPH - Gasoline (5030, 8015) w/BTEX (EPA 602, 8020)	TPH - Diesel, TEPH (EPA 3510/3550, 8015)	PURGEABLE AROMATICS BTEX (EPA 602, 8020)	PURGEABLE HALOCARBONS (EPA 601, 8010)	VOLATILE ORGANICS (EPA 624, 8240, 524.2)	BASE/NEUTRALS, ACIDS (EPA 625/627, 8270, 525)	TOTAL OIL & GREASE (EPA 5520, B+F, E+F)	PCB (EPA 608, 8080)	PESTICIDES (EPA 608, 8080)	TOTAL RECOVERABLE HYDROCARBONS (EPA 418.1)		LUFT METALS: Cd, Cr, Pb, Zn, Ni	CAM METALS (17)	PRIORITY POLLUTANT METALS (13)	TOTAL LEAD	EXTRACTION (TCLP, STLC)				NUMBER OF CONTAINERS
MW-1 Start	11-14-96	12:30	Air	—		X																			1
MW-1 End	11-14-96	3:58	Air	—		X																			1
E-1 End	11-14-96	4:40	Air	—		X																			1

PROJECT INFORMATION

PROJECT NAME Motor Partners
PROJECT NUMBER 1004.95
PO #

SAMPLE RECEIPT

TOTAL NO. OF CONTAINERS	3
HEAD SPACE	
REC'D GOOD CONDITION/COLD	
CONFORMS TO RECORD	

TAT [✓ STANDARD 5-DAY] 24 48 72 OTHER

SPECIAL INSTRUCTIONS/COMMENTS

RELINQUISHED BY 1
Gary Rogers 2:48
(SIGNATURE) (TIME)
Gary Rogers 11-15-96
(PRINTED NAME) (DATE)
Rogers Environmental
(COMPANY)

RELINQUISHED BY 2
9:30
(SIGNATURE) (TIME)
P. Mowette 11-15
(PRINTED NAME) (DATE)
CL
(COMPANY)

RELINQUISHED BY 3
(SIGNATURE) (TIME)
(PRINTED NAME) (DATE)
(COMPANY)

RECEIVED BY 1
2:48
(SIGNATURE) (TIME)
P. Mowette 11-15
(PRINTED NAME) (DATE)
CL
(COMPANY)

RECEIVED BY 2
(SIGNATURE) (TIME)
(PRINTED NAME) (DATE)
(COMPANY)

RECEIVED BY (LABORATORY) 3
1530
(SIGNATURE) (TIME)
Sami Antone 11/15/96
(PRINTED NAME) (DATE)
CL
(LAB)

APPENDIX B

Boring Logs

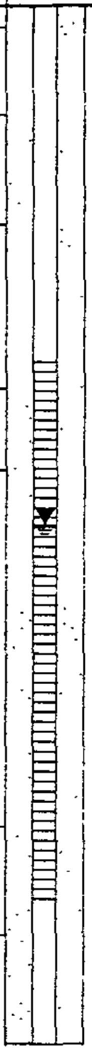
CERTIFIED ENVIRONMENTAL CONSULTING

536 STONE ROAD SUITE J BENICIA CA. 94510
(707) 745-0171 / (800) 228-0171 / (707) 745-0163 FAX

COORDINATES
SURFACE ELEVATION DATUM

BORING NUMBER **MW-1** SHEET **1** OF **1**
PROJECT **Motor Partners**
LOCATION **1234 40th Ave., Oakland, CA**
CONTRACT NUMBER **477-1532**
LOGGED BY **R. Gallardo**

SAMPLE INFORMATION						STRATA	DESCRIPTION	WELL CONSTRUCTION DETAIL	ELEVATION FEET
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery %	HNu (ppm)				
							Concrete from surface to 4" bgs		
							SANDY SILTY CLAY (CL) Dark brown, stiff, moist		
							SANDY CLAY (CL) Brown, stiff, moist		
5							GRAVELLY CLAY (CL) Grey-brown, stiff, moist		
			30 21 22 25				CLAYEY GRAVEL (GC) Brown Grey, dense, moist Gasoline Odor		
10							CLAYEY SANDY GRAVEL (GC) Grey, dense, moist to wet Drilling like gravel		
15			6 11 10				CLAYEY GRAVELY SAND (SC) Brown, dense, saturated		
20			10 12 16				SANDY SILTY CLAY (SC) Brown, stiff, moist leopard texture w/ black carbon nodules		



TOTAL DEPTH OF BORING 22.5'

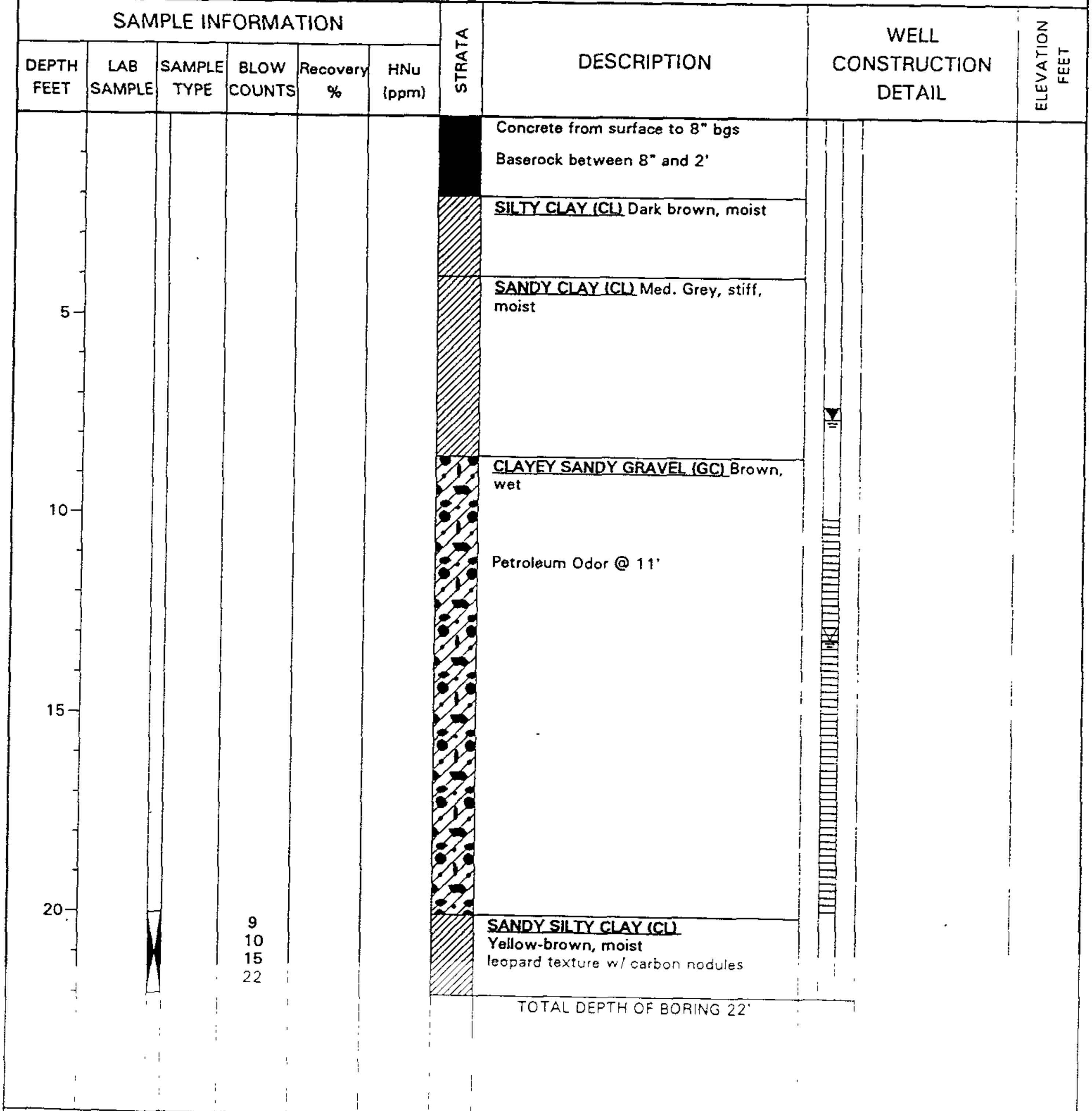
DRILLING CONTRACTOR Clear Heart
DRILLING METHOD Solid Flight Auger
DRILLING EQUIPMENT Giddings Probe
DRILLING STARTED 6/15/94 ENDED 6/15/94

REMARKS Monitoring Well #1

CERTIFIED ENVIRONMENTAL CONSULTING

536 STONE ROAD SUITE J BENICIA CA. 94510
(707) 745-0171 / (800) 228-0171 / (707) 745-0163 FAX

BORING NUMBER **MW-2** SHEET 1 OF 1
PROJECT **Motor Partners**
LOCATION **1234 40th Ave., Oakland, CA**
CONTRACT NUMBER **477-1532**
LOGGED BY **R. Gallardo**
COORDINATES
SURFACE ELEVATION
DATUM



SAMPLE INFORMATION									
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery %	HNu (ppm)	STRATA	DESCRIPTION	WELL CONSTRUCTION DETAIL	ELEVATION FEET
							Concrete from surface to 8" bgs Baserock between 8" and 2'		
							SILTY CLAY (CL) Dark brown, moist		
							SANDY CLAY (CL) Med. Grey, stiff, moist		
5									
							CLAYEY SANDY GRAVEL (GC) Brown, wet		
10									
							Petroleum Odor @ 11'		
15									
20			9 10 15 22				**SANDY SILTY CLAY (CL)** Yellow-brown, moist leopard texture w/ carbon nodules		
							TOTAL DEPTH OF BORING 22'		

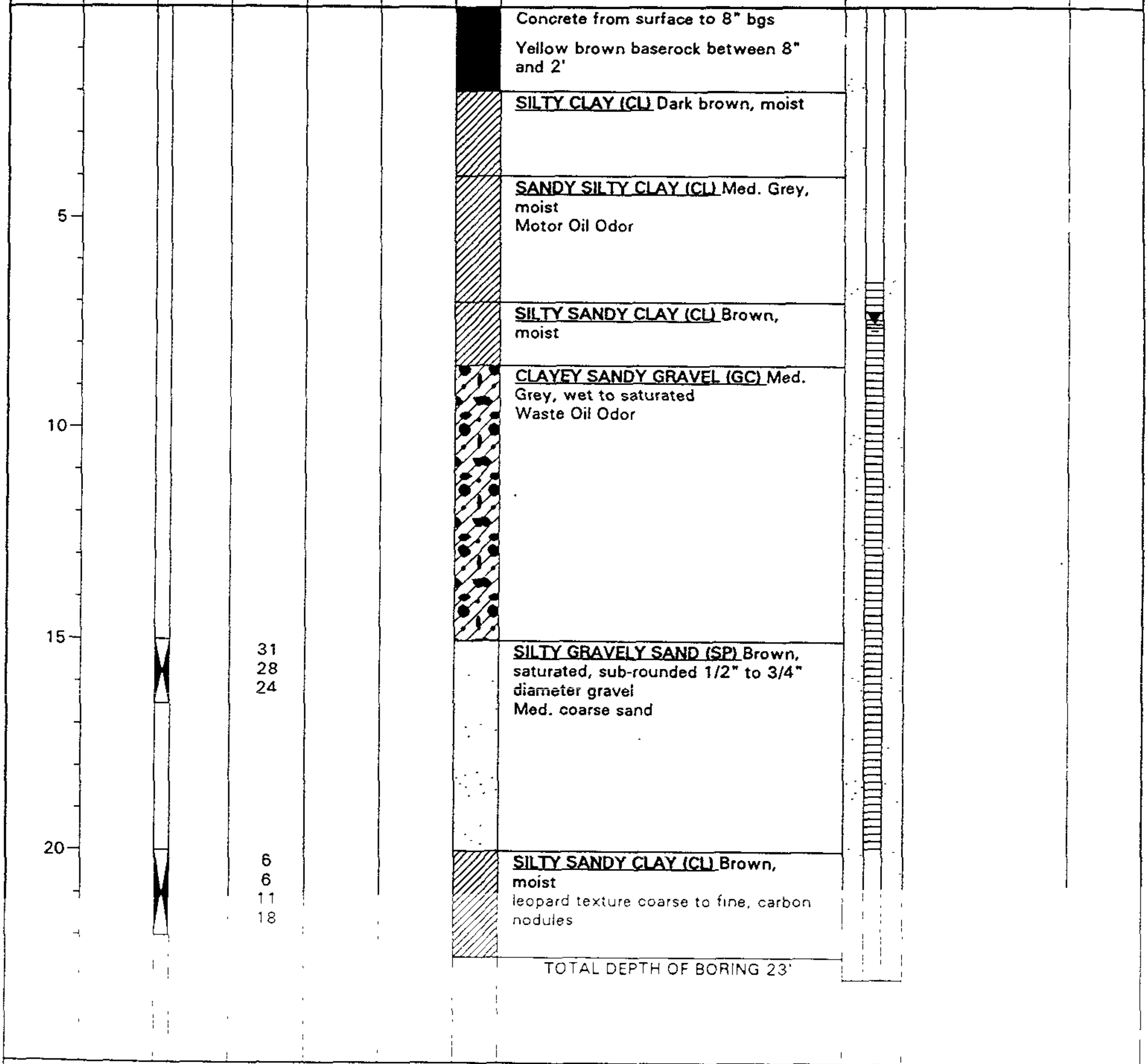
DRILLING CONTRACTOR Clear Heart
DRILLING METHOD Solid Flight Auger
DRILLING EQUIPMENT Giddings Probe
DRILLING STARTED 6/14/94 ENDED 6/14/94

REMARKS Monitoring Well #2

CERTIFIED
ENVIRONMENTAL
CONSULTING
536 STONE ROAD SUITE J BENICIA CA 94510
(707) 745-0171 / (800) 228-0171 / (707) 745-0163 FAX

BORING NUMBER **MW-3** SHEET 1 OF 1
PROJECT **Motor Partners**
LOCATION **1234 40th Ave., Oakland, CA**
CONTRACT NUMBER **477-1532**
LOGGED BY **R. Gallardo**
COORDINATES
SURFACE ELEVATION DATUM

SAMPLE INFORMATION						STRATA	DESCRIPTION	WELL CONSTRUCTION DETAIL	ELEVATION FEET
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery %	HNu (ppm)				



Blow counts at 15': 31, 28, 24

Blow counts at 20': 6, 6, 11, 18

Concrete from surface to 8" bgs

Yellow brown baserock between 8" and 2'

SILTY CLAY (CL) Dark brown, moist

SANDY SILTY CLAY (CL) Med. Grey, moist
Motor Oil Odor

SILTY SANDY CLAY (CL) Brown, moist

CLAYEY SANDY GRAVEL (GC) Med. Grey, wet to saturated
Waste Oil Odor

SILTY GRAVELY SAND (SP) Brown, saturated, sub-rounded 1/2" to 3/4" diameter gravel
Med. coarse sand

SILTY SANDY CLAY (CL) Brown, moist
leopard texture coarse to fine, carbon nodules

TOTAL DEPTH OF BORING 23'

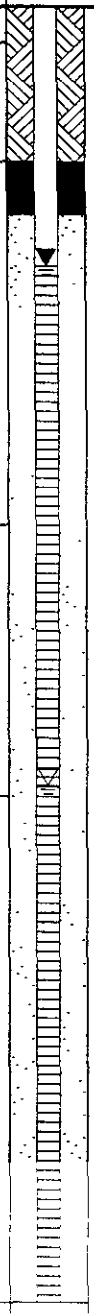
DRILLING CONTRACTOR Clear Heart
DRILLING METHOD Solid Flight Auger
DRILLING EQUIPMENT Giddings Probe
DRILLING STARTED 6/14/94 ENDED 6/14/94

REMARKS Monitoring Well #3

BORING NUMBER	**MW-4**	SHEET	**1** OF **1**
PROJECT	**Motor Partners**		
LOCATION	**1234 40th Ave, Oakland, CA**		
CONTRACT NUMBER	**1004**		
LOGGED BY	**G. Rogers**		
COORDINATES			
SURFACE ELEVATION		DATUM	

SAMPLE INFORMATION						DESCRIPTION
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery %	HNu (ppm)	
						Concrete Surface -- 8" Thick
						Baserock Brown Color
						SILTY CLAY (CL) Dark Black Color Moist
5	MW-4-1	MC	2 5 6		11	Color change to Brown Soil Gravelly Clay (1/2" gravels)
10	MW-4-2	MC	3 8 13		356	Petroleum Odor **CLAYEY SANDY GRAVEL (GC)** Grey Green Color 1/4" to 1/2" Gravels
						Saturated
15	MW-4-3	MC	3 11 15		94	Brown Sandy Soil
20	MW-4-4	MC	4 6 9		24	
25						Bottom of Borehole 25'

WELL CONSTRUCTION DETAIL



ELEVATION FEET

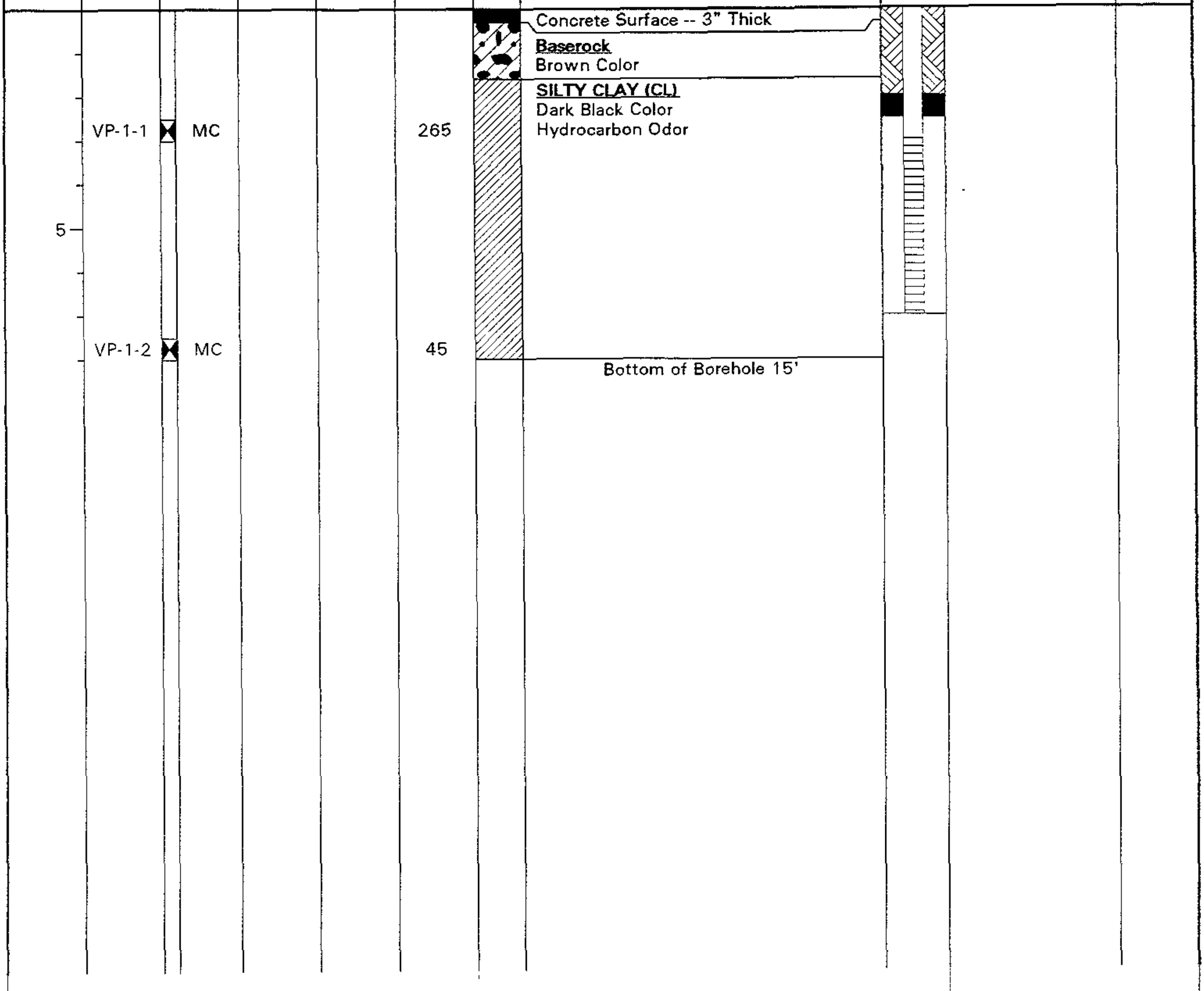
DRILLING CONTRACTOR	Bay Area Exploration		
DRILLING METHOD	Hollow Stem Auger		
DRILLING EQUIPMENT	CME-55		
DRILLING STARTED	2/1/96	ENDED	2/1/96

REMARKS Monitoring Well MW-4

See key sheet for symbols and abbreviations used above.

WLI MP 2/27/96

BORING NUMBER **VP-1**
SHEET **1** OF **1**
PROJECT **Motor Partners**
LOCATION **1234 40th Ave, Oakland, CA**
CONTRACT NUMBER **1004**
LOGGED BY **G. Rogers**
COORDINATES
SURFACE ELEVATION
DATUM



SAMPLE INFORMATION									
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery %	HNu (ppm)	STRATA	DESCRIPTION	WELL CONSTRUCTION DETAIL	ELEVATION FEET
							Concrete Surface -- 3" Thick		
							Baserock Brown Color		
							SILTY CLAY (CL) Dark Black Color Hydrocarbon Odor		
	VP-1-1	MC			265				
5									
	VP-1-2	MC			45				
							Bottom of Borehole 15'		

DRILLING CONTRACTOR Vironex
DRILLING METHOD
DRILLING EQUIPMENT Geoprobe
DRILLING STARTED 2/7/96 ENDED 2/7/96

REMARKS Inside of Building

See key sheet for symbols and abbreviations used above

BORING NUMBER **E-1** SHEET **1** OF **1**

PROJECT **Motor Partners**

LOCATION **1234 40th Ave, Oakland, CA**

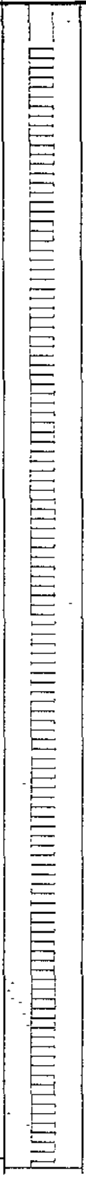
CONTRACT NUMBER **1004**

COORDINATES

SURFACE ELEVATION DATUM

LOGGED BY

SAMPLE INFORMATION						STRATA	DESCRIPTION	WELL CONSTRUCTION DETAIL	ELEVATION FEET
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery %	HNu (ppm)				
							Pea Gravel		
5									
10									
							Bottom of Borehole 13'		



DRILLING CONTRACTOR

DRILLING METHOD

DRILLING EQUIPMENT

DRILLING STARTED ENDED

REMARKS 4" Diameter Extraction Well Casing Installed After Tank Removal

See key sheet for symbols and abbreviations used above

MP 12/23/96

APPENDIX C

Photographs

LIST OF PHOTOGRAPHS

Photo 1
Vapor Extraction
Pilot Test Setup at
Motor Partners

Photo 2
S.A.V.E. ™ Vapor
Extraction Unit

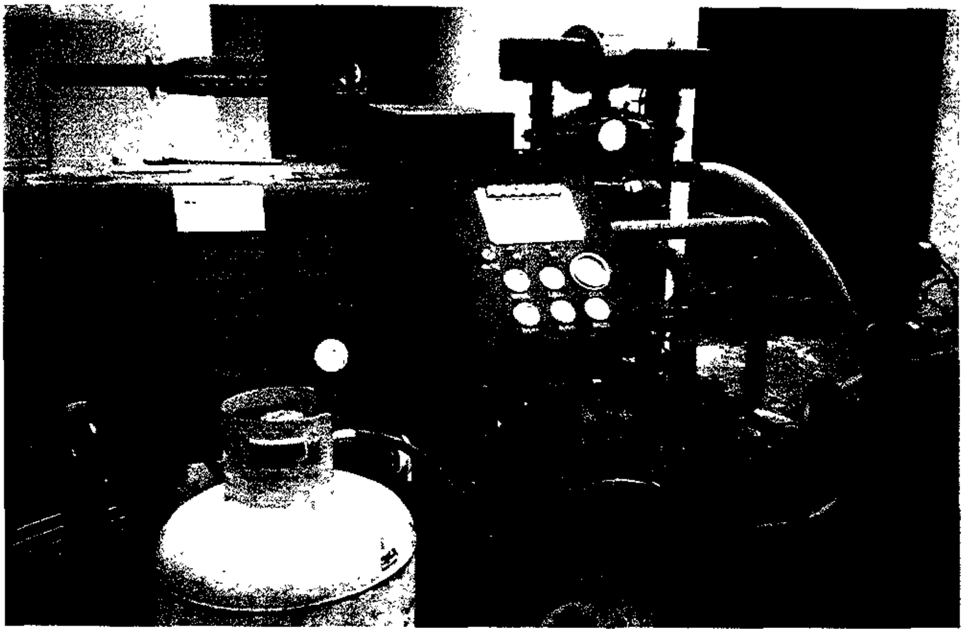
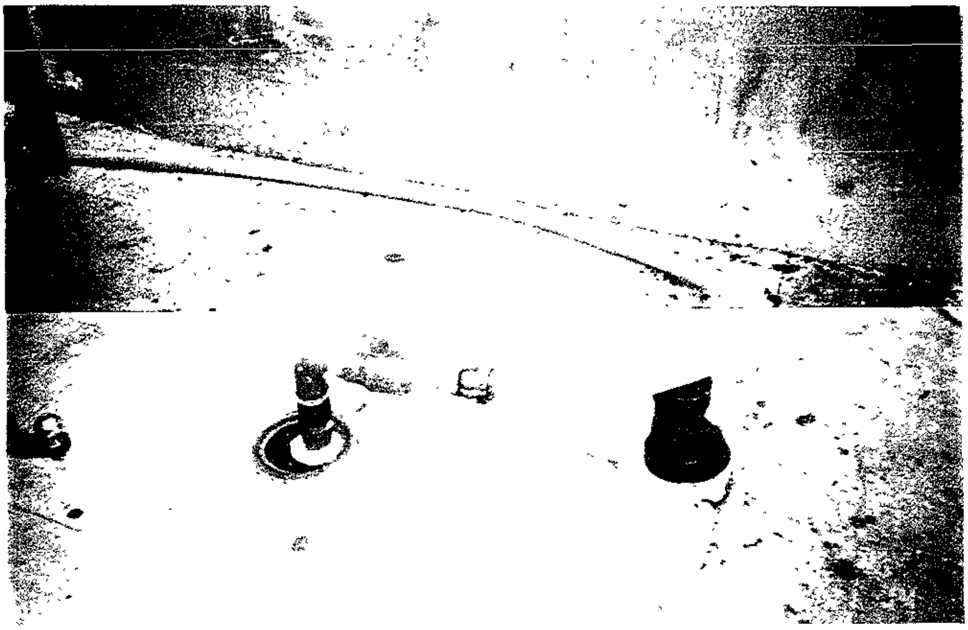


Photo 3
Connection to
Extraction Well E-1



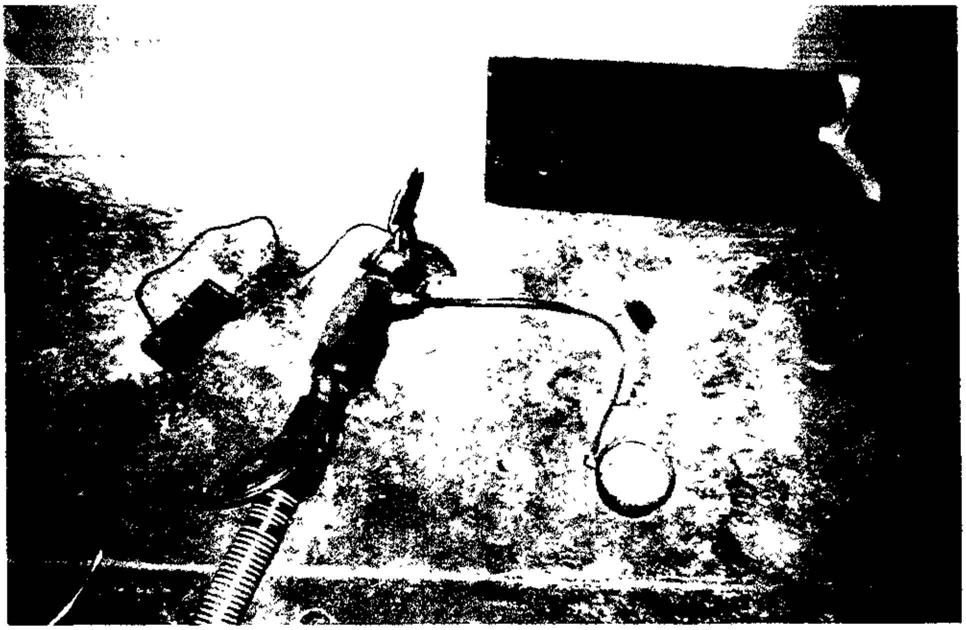


Photo 4
Connection to
Extraction Well
MW-1

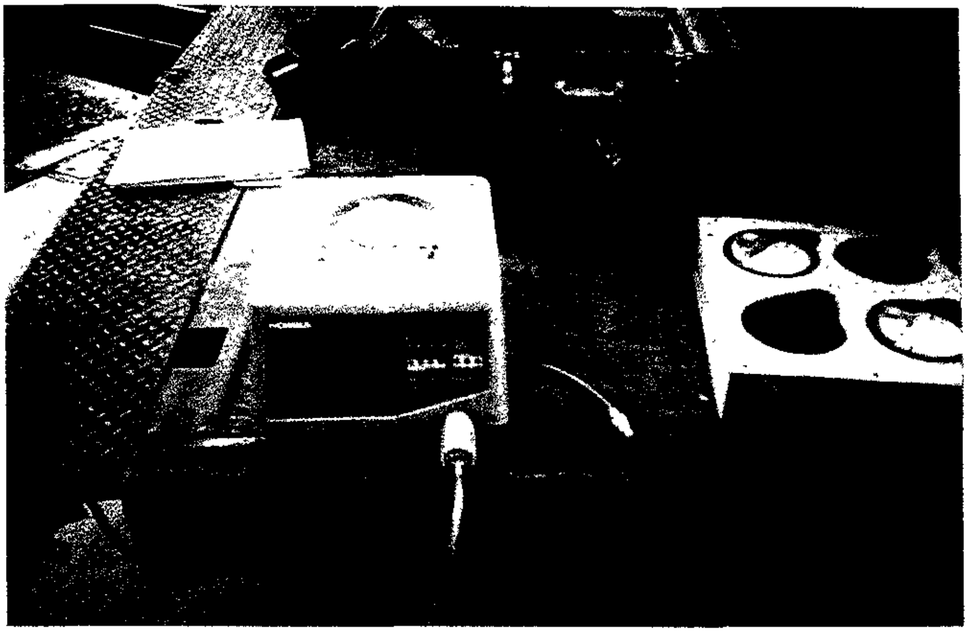


Photo 5
Horiba in-line
Analyzer

Photo 6
Vacuum Sample
Chamber for Air
Sampling

Photo 7
Magnahelic Vacuum
Guage at VP-1

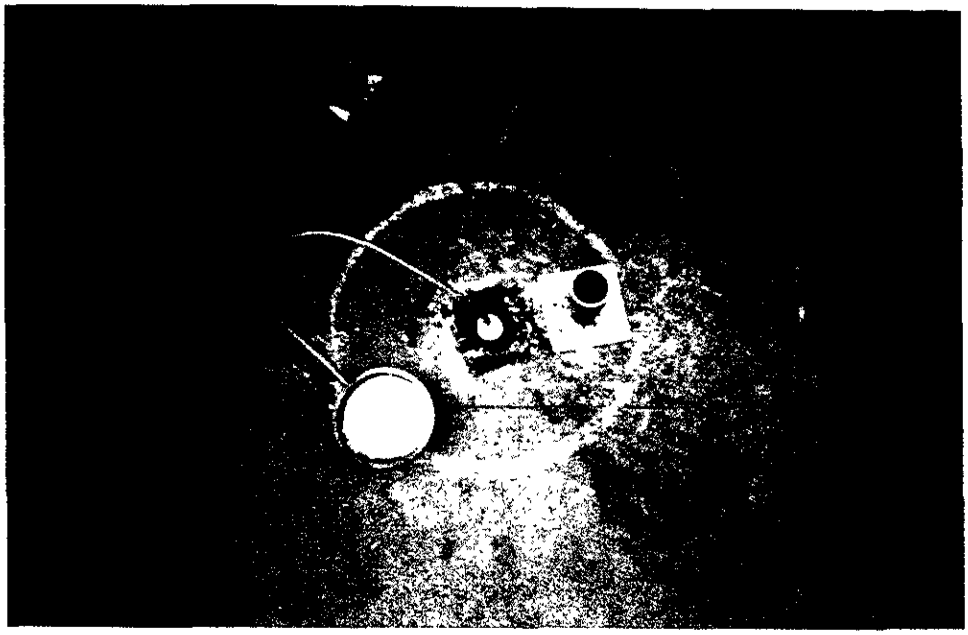


Photo 8
Magnahelic Vacuum
Guage at MW-4

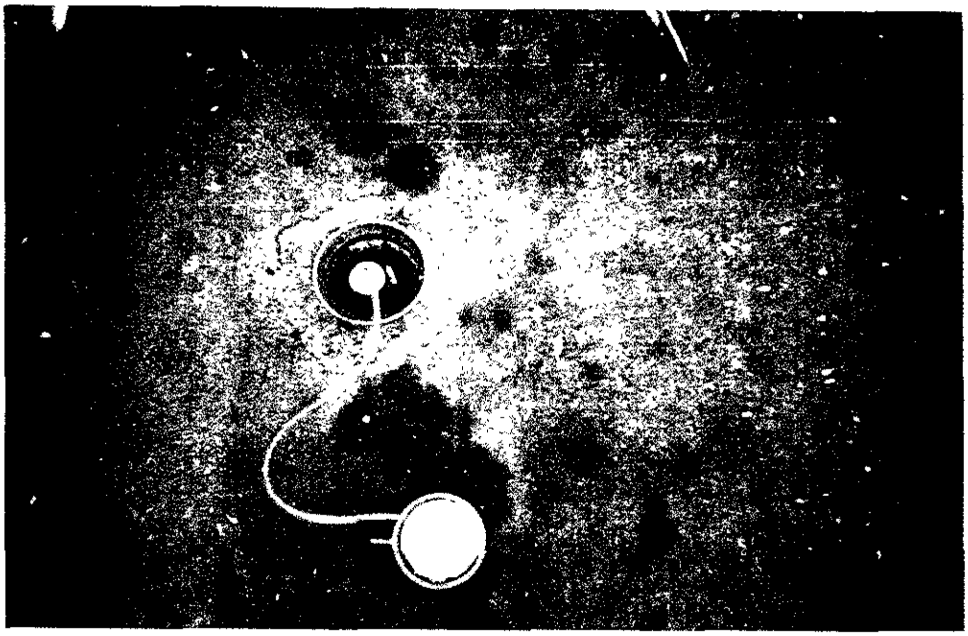
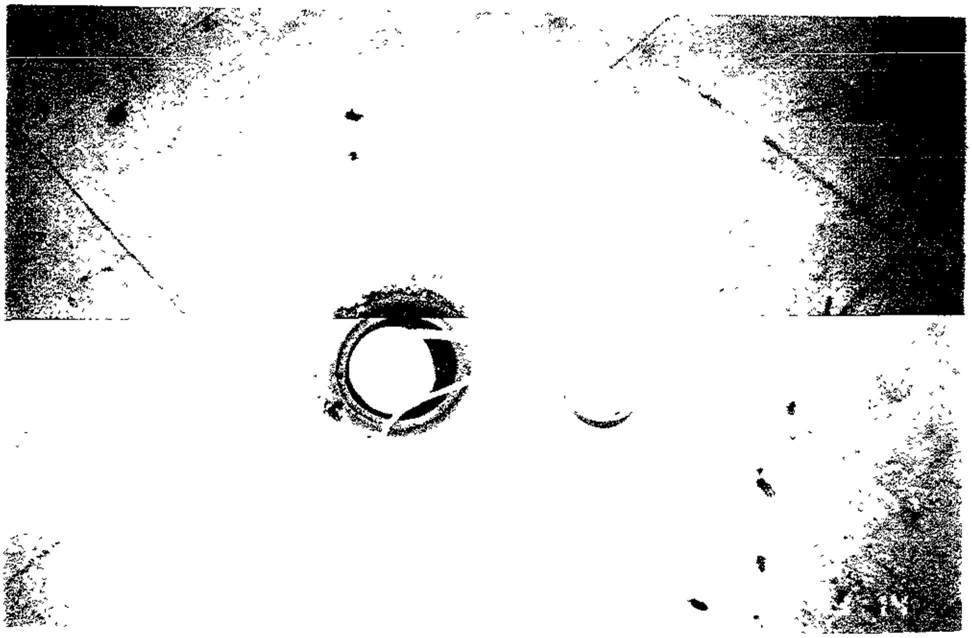


Photo 9
Magnahelic Vacuum
Guage at E-2



APPENDIX D

Standard Field Procedures

SFP-1. GEOPROBE SOIL SAMPLING METHOD

OVERVIEW

The Geoprobe sampling system consists of a hydraulically driven sampler for collecting subsurface samples of soil, groundwater and/or gas vapors. The Geoprobe sampler is a narrow diameter (approximately 1" diameter) direct push probe. Unlike conventional drill rigs, the Geoprobe system does not generate soil cuttings. In addition, the sampling procedure is relatively quick allowing greater amounts of information to be gathered in a shorter period of time.

PROCEDURE

For sample collection, the US EPA standards for field sampling (EPA SW 846) will be followed. Samples will be collected every 5 feet or at changes in lithology using the Geoprobe sampler. The samples will be collected in 1-in. i.d., 6-in. long tubes.

Each of the sample tubes will be sealed at the ends with Teflon sheeting and PVC end caps. Samples will be labeled with the project name (or number), sample number, boring/well number, sample depth, date and time, and sampler's initials. All of the samples will be stored in an ice chest with ice, maintained at approximately 4° C, and transported under chain-of-custody to a State-certified laboratory.

DOCUMENTATION

A sample location sketch will be recorded in the field notebook. In addition, the collection methods, signs of contamination, soil type, names of regulators and contractors, and any other appropriate information will also be recorded.

DECONTAMINATION

The sampler will be decontaminated after each use by washing in a trisodium phosphate solution, followed by tap water rinses. All rinseate used in the decontamination process will be collected in 5-gallon buckets and either returned to the excavation or stored on site in steel, DOT-approved drums. Drums used to store rinseate will be labeled as to contents, suspected contaminants, date container filled, expected removal date, company name, contact and phone number. Drums will then be sealed and left on-site for subsequent disposal pending analytical results.

QUALITY CONTROL

One field duplicate sample will be collected and analyzed for every sample set up to 10 samples. The field duplicate will be collected identically to and immediately after a randomly chosen sample. This will provide second sample confirmation and a means of determining sample precision.

SFP-2. GEOPROBE WATER SAMPLING PROCEDURES

OVERVIEW

The Geoprobe sampling system consists of a hydraulically driven sampler for collecting subsurface samples of soil, groundwater and/or gas vapors. The Geoprobe is a narrow diameter (approximately 1" diameter) direct push probe Unlike conventional drill rigs, the Geoprobe system does not generate soil cuttings. In addition, the sampling procedure is relatively quick allowing greater amounts of information to be gathered in a shorter period of time.

SAMPLE COLLECTION

Borings will be sampled either by using a new, clean, disposable Teflon bailer attached to new, clean string or by drawing groundwater from well points installed in the borings. Sample vials and bottles will be filled to overflowing and sealed so that no air is trapped in the vial or bottle. Once filled, samples will be inverted and tapped to test for air bubbles Samples will be contained in vials and bottles approved by the US EPA and the RWQCB, San Francisco Bay Region. Some analyses may require separate sample containers in accordance with EPA methods described in 40 CFR, Part 136 and SW-846.

Water samples intended for volatile hydrocarbon analysis will be contained in 40 ml VOA vials prepared according to EPA SW-849 and capped with Teflon-lined septa caps. Samples to be analyzed using EPA Method 602/8020 will contain a small amount of preservative (HCl) Samples to be analyzed using EPA Method 601/8010 and EPA Method 624/8240 will not be preserved Water samples to be analyzed for low level TPH-D will be stored in dark glass, 1-liter bottles to reduce degradation by sunlight. Antimicrobial preservative (HCl) may be added to the sample bottle if a prolonged holding time is expected prior to analysis.

Sample containers will be labeled with self-adhesive, preprinted tags. Labels will contain the following information in waterproof ink; 1) project number (or name), 2) sample number (or name), 3) sample location (well number, etc.), 4) date and time samples were obtained, 5) treatment (preservative added, filtered, etc.), and 6) name of sample collector

All purged water will be stored on site in steel, DOT-approved drums. Drums will be labeled as to contents, suspected contaminants, date container filled, expected removal date, company name, contact and phone number. Drums will then be sealed and left on-site for subsequent disposal pending analytical results

DOCUMENTATION

Sampling information will be recorded in ink in a bound notebook with consecutively number pages. Pages may not be removed for any reason. Alternatively, specially formatted field data sheets may be used to record the information collected during water quality sampling Errata may be marked out with a single line, and initials of person making the change. The log book and data sheets will be placed in the project file when sampling is completed.

DECONTAMINATION

All sampling equipment, such as buckets and stands, will be decontaminated after each use by washing in a trisodium phosphate solution followed by tap water rinses. Equipment will be stored in plastic bags or other sealed containers to prevent contact with solvents, dusts or other contamination.

All rinseate used in the decontamination process will be stored on site in steel, DOT-approved drums Drums will be labeled as to contents, suspected contaminants, date container filled, expected removal date, company name, contact and phone number Drums will then be sealed and left on-site for subsequent disposal pending analytical results

SFP-3. SOIL VAPOR EXTRACTION PILOT TEST PROCEDURE

OVERVIEW

A soil vapor extraction pilot test will be conducted to determine soil vapor permeability. This information will be utilized to determine the feasibility of *in situ* soil vapor extraction.

PROCEDURE

Prior to the start of the test, an air permit application will be obtained from Bay Area Air Quality. The soil vapor extraction test will be performed using an existing monitoring well. In addition, two vapor probes will be placed to a depth approximately 16 feet bgs. The locations of the wells and vapor probes are presented in Figure 5.

The test unit consists of a series of air pumps, filters, and scrubbers that will be connected to the vapor extraction well by a system of manifolds and valves. Air from the vapor well will be drawn from the ground and pass through the test unit filters and scrubbers. The test will be run for a period of 4 hours.

The following parameters will be evaluated; 1) flow versus vacuum relationship for the vapor well, 2) radius of influence, 3) induced vacuum at observation points as a function of applied vacuum, 4) soil permeability, and 5) levels of contamination in vapor.

The test procedure will include running the pump for a period of time at the start to stabilize air flow. Several tests will be conducted at the vapor well by incrementally increasing the applied vacuum Air flowrate will be collected at the vapor extraction well Vacuum measurements will be collected at the observation points every 20 minutes. Four, one-hour tests will be completed. Grab samples of the gas vapor will be collected in Tedlar bags for laboratory analysis. One sample will be taken at each of the four air flowrates.

DATA ANALYSIS

Data collected from the tests will be evaluated to determine the radius of influence in which the vapor flow is induced utilizing the pressure data collected at each of the observation points. In addition, the concentration of chemical constituents in the vapor samples will be reported.

From analysis of the data, *in situ* soil vapor extraction feasibility will be determined. In addition, the placement and spacing of vapor wells and specifications for other system components may then be completed.