BP OIL

BP Oil Company
Aetna Bldg., Suite 360
2868 Prospect Park Drive
Rancho Cordova, California 95670-6020
(916) 631-0733

February 26, 1992

5510 624
Larry

Mr. Thomas Peacock
Alameda County Department of Health Services
80 Swan Way, #200
Oakland, California 94621

RE: BP FACILITY #11266
1541 PARK STREET
ALAMEDA, CALIFORNIA

Dear Mr. Peacock,

Attached please find a copy of the **Remedial Action Plan** for the above referenced facility.

Please call me at 916/631-6919 with any questions regarding this submission.

Respectfully,

Peter J. DeSantis

Peter J. DeSantis
Environmental Resources Management

PJD:lk

Attachment

cc: Fred Moss-HETI
Tom Callaghan-Regional Water Quality Control Board
Dave Baker-Mobil Oil Corporation
Site file

HYDRO
ENVIRONMENTAL
TECHNOLOGIES, INC.

REMEDIAL ACTION PLAN

For

BP OIL COMPANY #11266
1541 PARK STREET
ALAMEDA, CALIFORNIA

Presented to:

BP OIL COMPANY
2868 PROSPECT PARK PARK DRIVE
RANCHO CORDOVA, CALIFORNIA 95670-6020

Presented by:

HYDRO-ENVIRONMENTAL TECHNOLOGIES, INC.
2363 MARINER SQUARE DRIVE #243
ALAMEDA, CALIFORNIA 94501

February 28, 1992

CERTIFICATION/LIMITATIONS

This report was prepared under the supervision of a registered professional engineer. All statements, conclusions and recommendations are based solely upon field observations and analytical test results related to the work performed by Hydro-Environmental Technologies, Inc.

Site conditions are subject to change with time; therefore, our conclusions results only from the interpretation of the present conditions and available site information. This report was prepared in accordance with accepted professional standards and technical procedures as certifies below.

HYDRO-ENVIRONMENTAL TECHNOLOGIES, INC.

Prepared by:

Tina Soerensen for

Frances H. Maroni III
Staff Engineer

Reviewed by:

Frederick Moss

Frederick G. Moss
Senior Engineer

REGISTERED PROFESSIONAL ENGINEER
FREDERICK G. MOSS
No. 35162
CIVIL
STATE OF CALIFORNIA

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1.0 INTRODUCTION

The purpose of this Remedial Action Plan (RAP) is to evaluate existing environmental conditions at the site to date and to recommend an appropriate remedial approach for removal of dissolved fuel hydrocarbons present in the groundwater beneath the site.

Hydro-Environmental Technologies, Inc. (HETI) was retained by BP Oil Company (BP Oil) to prepare a RAP for the subject site, a service station, located at 1541 Park Street, Alameda, California. The site is located on the island of Alameda which is situated on the east side of San Francisco Bay (Figure 1). The topography is nearly level and the site is approximately 22 feet above mean sea level (MSL).

A series of site assessment projects have been performed at the site to characterize the extent of hydrocarbons impacting soil and groundwater. A total of six monitoring wells have been installed at the site since 1988 (Figure 2). **The maximum hydrocarbon concentrations detected in soil samples collected during tank removal operations were 3,200 parts per million (ppm) as gasoline and 81 ppm** as benzene (Table 1). **The maximum hydrocarbon concentrations detected in groundwater samples were 95,000 parts per billion (ppb) of gasoline and 2,000 ppb for benzene (Table 2).**

Recent groundwater monitoring was performed by HETI in January 1992, to obtain groundwater samples from monitoring wells MW-1 through MW-6. Laboratory analysis of hydrocarbon concentrations in groundwater detected **10,000 ppb as** gasoline and 260 ppb of benzene in MW-1 and 1.4 ppb of benzene in MW-2 respectively. Results of the laboratory analysis from January 1992 are presented in Appendix C. **A decrease in hydrocarbon concentrations with time has occurred since March 8, 1989 in well MW-1 (Table 2).**

2.0 SUMMARY OF SUBSURFACE INVESTIGATION

2.1 Soil Conditions

In October 1987 the underground fuel storage tanks were replaced and the excavation was supervised by Kaprealian Engineering, Inc. (KEI). Soils sampled from the tank excavation consisted of unconsolidated fine to medium grained sand to a depth of 11.5 feet bgs. Total Petroleum Hydrocarbon as gasoline (TPHg) and benzene were greater than 100 mg/kg (ppm) in the easterly portion of the excavation at a depth of 11.5 feet bgs. Laboratory results of soil samples indicated a maximum concentration of 3,200 ppm as TPHg from sample C-1, located on the easterly sidewall of the excavation. A figure showing soil sampling locations and a table listing laboratory results, prepared by KEI, is included in Appendix A.

Following evaluation of the laboratory results from the excavation samples, Kaprealian Engineering, Inc. (KEI) directed the removal of approximately 400 cubic yards of soil containing the TPH impacted soil, which was reportedly disposed of at a Class III landfill (KEI report dated 10/87)

Subsequent to completion of excavation, Alameda County Department of Health Services (ACDEH), directed KEI to further define the extent of hydrocarbon impacted soil and to evaluate the potential impact of TPHg upon groundwater. KEI installed three shallow monitoring wells on the site in March 1988. Laboratory results reported by KEI for soil samples collected during installation of these monitoring wells are included in Table 1. Only monitoring well MW-1 contained any detectable amounts of hydrocarbons. The soil sample collected at a depth of 10 feet bgs. contained concentrations of benzene (0.1 ppm), toluene (0.2 ppm), xylene (0.7 ppm) and TPH (2.1 ppm). This well was located near the easterly sidewall of the excavation about 12 feet northeast of the tank excavation.

Three additional monitoring wells were installed by KEI in March 1989 to complete the definition of impacted soil. The soil samples collected from wells MW-2 through MW-6 did not contain any detectable concentrations of fuel hydrocarbons. KEI therefore concluded that hydrocarbon impacted soils remaining in place were not extensive.

During station remodeling activities conducted in September 1990 several areas of the station were renovated, including the pump dispenser islands and piping lines to the underground storage tanks. While excavating trenches to replace these piping lines several cubic yards of soil were removed and stockpiled on the site. Although no report or sample location map was available describing the work performed, KEI reported the results of soil samples to Katherine Chesick of the ACDEH. KEI reportedly collected four samples from the piping trenches and one sample from the soil stockpile. All sample results were below laboratory detection limits (Table 1).

2.2 Groundwater Conditions

Groundwater exists at depth of approximately 10 to 12 feet bgs. **No separate phase hydrocarbon liquid has been detected in any of the monitoring wells.** Groundwater flow is generally towards the east with a gradient of 0.013 foot per foot (ft/ft) as shown in Figure 3.

Groundwater monitoring and sampling was performed by HETI on January 8, 1992. The groundwater sample collected from well MW-1 contained a concentration of 10,000 ppb of TPHg and 260 ppb of benzene (Figure 4). The laboratory analysis report is provided in Appendix B. A decrease in the dissolved hydrocarbon concentration present in well MW-1 is evident since sample results were first reported in March 8, 1988 (Table 2).

Petroleum hydrocarbons have also been detected in monitoring wells MW-2 and MW-4 occasionally. The concentrations of TPHg and benzene in these wells has been consistently less than the concentrations found in MW-1. Chlorinated hydrocarbons have been detected in samples collected by EMCON from wells MW-1, MW-4 and MW-6 . Because these compounds have been detected only sporadically and were detected at very low concentrations (<3.0 ppb) they probably reflect laboratory error or field sampling procedure problems possibly resulting from improper decontamination techniques.

2.3 Pump Test Results

A step-drawdown test and a 24 hour constant discharge test was conducted on MW-5 by EMCON to determine the zone of influence for long term extraction and to obtain an average discharge rate. A flow rate of 1.0 gallons per minute (gpm) was determined to be optimal. Transmissivity values were calculated to be approximately 220 gpd/ft with a hydraulic conductivity of 7.1×10^{-4} centimeter per second (cm/sec).

Based on the pump test results (from MW-5), EMCON calculated a capture zone of approximately 40 feet in diameter. The data presented in their report dated March 15, 1990 supports this conclusion. An effective groundwater extraction program could therefore be installed utilizing only one 6-inch diameter recovery well located between MW-1 and MW-2 as shown in Figure 2.

3.0 ALTERNATIVE EVALUATION

3.1 Soil Remediation

Soils impacted with TPH can be remediated successfully by utilization of in-situ methods or by removal and surface treatment. The following three options were considered for the subject site:

Vapor Extraction (Option 1)

Vapor extraction is an effective method for removal of subsurface volatile organic compounds from soils. This method induces volatilization of hydrocarbons from the soils by establishing a negative pressure (vacuum) beneath the ground surface. The process components consist of a well or series of wells placed in the vadose (unsaturated soil) zone to induce air to flow out of the soil matrix to the surface. The air containing hydrocarbon vapors can then be treated by carbon adsorption or thermal oxidation. The method of treatment selected is based upon the concentration of hydrocarbon vapors in the air extracted from the subsurface.

Based upon soil sample results (Table 1) any hydrocarbon soils remaining in the vicinity of the former tank excavation are either very close to or beneath the shallow water table. There are no soil sample results for depths less than 10 feet bgs.

suggesting that soils shallower than 10 feet are not impacted. A system of vapor extraction wells would therefore not be very effective or practical because of the shallow depth of groundwater and location of impacted soils.

To enhance water recovery rates from a pumping system and to provide a mechanism for soil venting when a pumping depression is established, a spare PVC pipe will be installed for future considerations. This line will be connected to the recovery well and installed in the trench connecting to the treatment equipment (Figure 2), in the event that vapor recovery would be beneficial in the future.

Excavation (Option 2)

Based upon the soil conditions described above, removal of additional soil by excavation is not a practical or feasible option. The sandy soils would also required shoring in order to excavate to the water table. The use of shoring and displacement of existing facilities, necessary to access impacted soils, would greatly increase the cost to remove a limited volume of impacted soil.

No Action (Option 3)

Due to the shallow groundwater condition and limited extent of impacted soil, removal of hydrocarbons from soils is not a feasible remedial approach. Groundwater fluctuations have probably dissolved a portion of the remaining hydrocarbons from the soil to a limited extent. It would therefore be more effective to implement a groundwater recovery system to remove the hydrocarbons. **HETI therefore recommends that no further action is a reasonable approach to soil remediation.**

3.2 Groundwater Remediation

Groundwater impacted by volatile hydrocarbons (TPHg) can be remediated successfully by utilization of in-situ methods or by groundwater removal and surface treatment. A pumping system could remove 1 gpm. for surface treatment by bioremediation, air stripping, or carbon adsorbtion. The remediation method selected for the subject site must be amenable to the following site conditions:

- Volatile hydrocarbons (gasoline) have impacted groundwater in the vicinity of MW-1;
- Groundwater occurs at a depth of approximately 10 feet bgs;
- Unconsolidated sandy soils occur to a depth of approximately 25 feet bgs based upon the limited subsurface investigation by KEI;

Based upon these site conditions the following options have been evaluated and are discussed below:

Air Stripping (Option 1)

This method of water treatment would result in a release of volatile hydrocarbons to the atmosphere. Because of stringent air emission regulations, additional permits and vapor treatment of hydrocarbon emissions would be required. This would result in a substantial cost increase compared to other options.

Carbon Adsorption (Option 2)

This method of water treatment is viable for short time duration remediation or for reduction of of hydrocarbon concentrations from a primary treatment process. Use of granular activated carbon can become very costly due to waste disposal requirements. The adsorption capacity of the carbon is often limited by biological or mineral fouling in the carbon unit. Changing and replacing spent carbon units is also labor intensive and costly.

Bioremediation (Option 3)

Bioremediation is a process that utilizes microorganisms in the cleanup of contaminated soil and/or groundwater. Biodegradation, the biological process by which this is accomplished, is the catabolism (break down) of chemical compounds by living organisms as a direct function of cellular physiology. Biodegradable compounds are those which generally afford energy to the cell and /or components for cellular structure, and are typically carbon based. These substances can be anything from single carbon molecules (methane) to larger more complex compounds (ethylbenzene). The end result of this process is the bioconversion of these substances to nontoxic substances, effectively neutralizing the environmental threat.

In-situ remediation of soil and groundwater would involve placement of numerous extraction and recovery wells to flush the soil with oxygen-rich water. Oxygen can stimulate the in-situ development of hydrocarbon degrading bacteria in the subsurface. It is difficult to maintain a stable biological system in-situ because of numerous factors which can impede efficient biodegradation.

Water may be treated biologically to remove dissolved hydrocarbons in an aboveground bioreactor system. Bioreactors, in general terms, are holding vessels of varying capacities capable of providing an enclosed environment in which controlled biological processes may be precisely monitored and adjusted. Temperature and oxygen can be more easily regulated when the system is accessible. Bioreactors themselves can be functionally of many different types. The two most commonly used are fixed-film and suspended cell (culture) reactors.

Fixed-film bioreactors contain internal plates or projections with large surface areas on which microorganisms can colonize forming a fixed biofilm. Suspended culture reactors rely on the microorganisms in a suspended free floating form.

Due to the limited space available at the site and the low hydrocarbon concentrations anticipated in the extracted groundwater this option is feasible. Also, no waste products are generated which would require disposal. HETI therefore recommends implementation of this option.

No Action (Option 4)

No extraction and treatment of ground water could be a viable option. However, since the ground water in MW-1 is above the State of California Drinking Standards, it is unlikely that monitoring of groundwater quality only would be allowed.

3.3 Groundwater Discharge

Several options for groundwater discharge following treatment have been reviewed for the subject site. The three most viable options are:

- Subsurface Reinjection
- Storm Drain
- Sewer System

Subsurface Reinjection (Option 1)

This option would be practical if space was available. Secondly shallow groundwater would prohibit the recharge of the water back to the saturated zone. Effluents limitations for reinjection would be very stringent and the associated additional treatment required would greatly increase the cost of this option.

Another disadvantage would be the numerous utility lines present around the site. These utilities could possibly be damaged if hydraulic control is not maintained and utility trenches are flooded.

Discharge to Storm Drain (Option 2)

In 1972 the Clean Water Act (CWA) prohibited discharge of any pollutant to surface waters from a point source discharge unless authorized by a National Pollutant Discharge Elimination System (NPDES) permit. In Alameda, urban runoff enters the combined sewer and storm drain system. Connecting a discharge pipe to a storm drain would be costly since there are no onsite drainage inlets. The storm drain is often close to hydraulic capacity due to groundwater infiltration.

Discharge to Sanitary Sewer

This option has several advantages over the other options. A sewer lateral is accessible on the site and no street trenching would be required. Allowable concentrations in the water discharged are greater for each volatile hydrocarbon (ie. toluene at 15 ppb) than for the other options and are easily obtained with a bioreactior.

Since it is anticipated that the systems' discharge is 1440 gallons per day (gpd) and the sewer system can accept up to an additional 748 gpd, disposed into the sewer system is the preferred option.

4.0 PROPOSED REMEDIATION SYSTEM

HETI proposes to construct a pumping system connected to a fixed film bioreactor (Figure 5). A drum containing activated carbon would be used to reduce effluent concentrations to acceptable discharge conditions until the water flowing out of the bioreactor has reached stabilized concentrations of hydrocarbons. This flow could then bypass the carbon drum as shown in Figure 5. The treatment units would be located at the southwest corner of the site (Figure 6) The elements for construction are as follows:

HETI proposes to install a six (6) inch recovery well approximately 10 feet east of MW-1 and 7 feet west of MW-2. The soil boring will be advanced to depth of 25 feet bgs and converted to a extraction well. The well will be constructed using six-inch diameter poly-vinyl-chloride (PVC) casing. A screened section will extend from five (5) foot bgs to 25 feet bgs. Perforations will be factory machined to a size of 0.020 to allow water to flow into the well. Based upon the the pump study from EMCON, the anticipated rate of extraction of 1.0 gpm should be sufficient to contain the groundwater plume and to remediate the dissolved volatiles. The well will be placed in a subgrade vault as shown in Figure 7. A low flow pneumatic pump set in the well (Figure 5) would be capable of achieving the design flow rate. A conduit pipe will terminate at the vault (Figure 7) and will be installed in a buried trench (Figure 8) connected to the treatment system (Figure 6).

Extracted groundwater would be passed through a fixed film reactor. Water passing through a system of baffles within the reactor will be aerated to allow an aerobic condition to be maintained. An accelerated biological breakdown of carbon molecules (TPHg and benzene) can be achieved by adjusting the concentration of dissolved oxygen.

A carbon canister will be available to polish the effluent prior to disposal to the sewer system (if needed). to acceptable regulatory discharge limits A complete system schematic is shown as Figure 5

Power for the pump and aeration system will be supplied from an existing air compressor at the adjacent garage. The pneumatic (air) and water tubing will be pulled through the 4-inch casing to the well vault. It is anticipated that the system will require minimal energy to perform this pumping operation.

5.0 PROPOSED IMPLEMENTATION SCHEDULE

The system designed for site remediation could be installed within 6 to 8 months following approval by the ACDEH of this plan, pending receipt of essential permits.

5.1 Monitoring

HETI estimates that the remediation system will require daily monitoring for the first week of operation after start up. After the start up period, monitoring of the influent and effluent should continue on a monthly or quarterly basis for the duration of the remedial operation. Groundwater samples will obtained from the existing groundwater monitoring wells and the treatment system to evaluate the performance of the remediation system. EBMUD requires the following analysis on a regular basis:

- EPA Method 8015 for TPH as gasoline
- EPA Method 8020 for BTEX

Additional analysis will occasionally be required for the following:

- EPA Method 6010 for waste metals
- EPA Method 624 for Purgable Organics
- EPA Method 239.2 for Total Lead

The actual "site specific" monitoring requirements for the treatment system will be evaluated by the City of Alameda and EBMUD. HETI will modify the monitoring schedule, if necessary, to comply with all permitting requirements. Reports to the respective agencies will be submitted in accordance with the conditions of the permit to "Construct and Operate", which will be issued by the City of Alameda..

5.2 Permits

HETI will submit permit applications to construct and operate the proposed remediation system . The agencies involved with approval of this system will be EBMUD, the Alameda County Department of Environmental Health, City of Alameda Fire Department and Public Works, and the San Francisco Bay Region Water Quality Control Board.

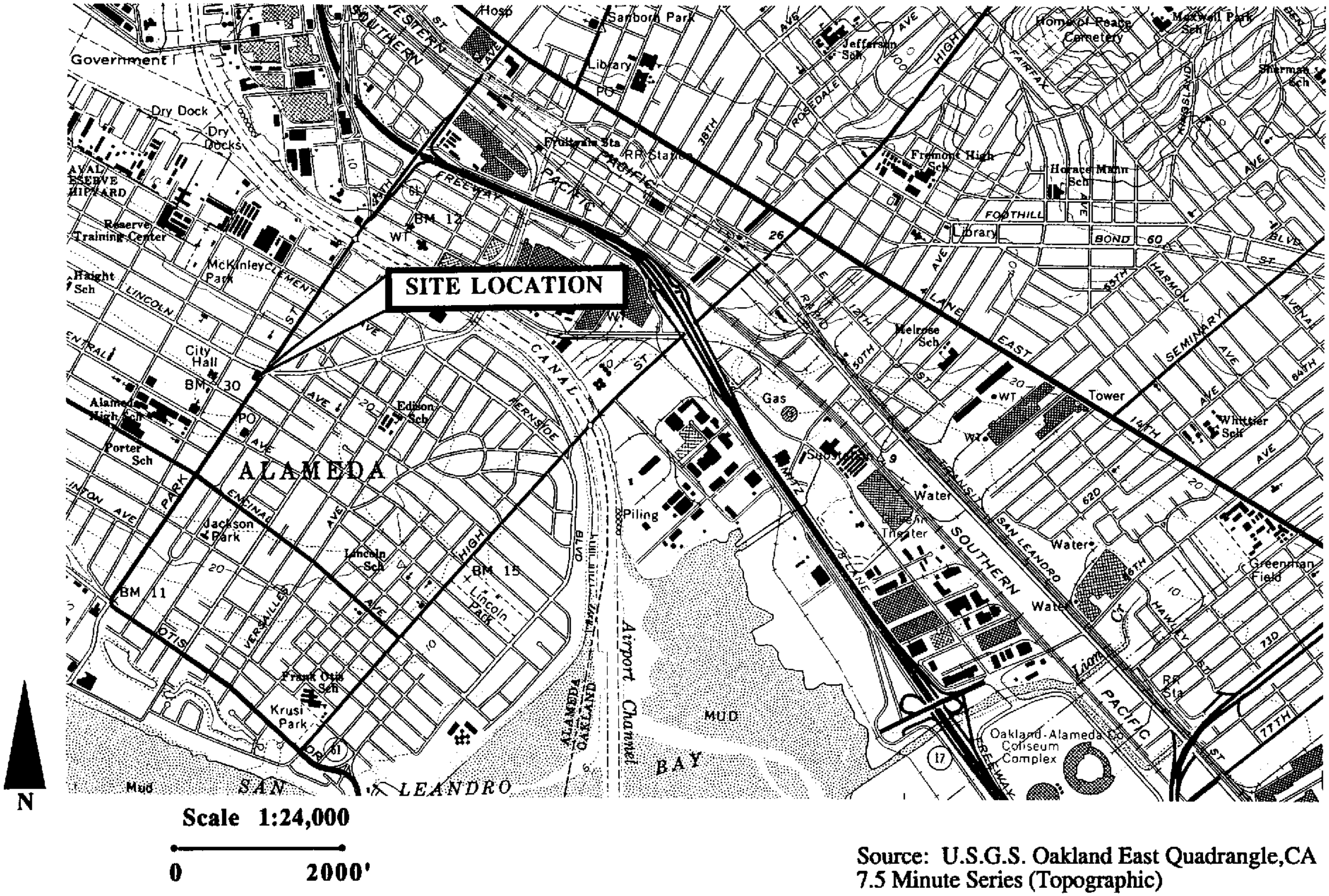
6.0 CONCLUSIONS

Based on the previous subsurface investigations performed by others, we conclude the following:

- Vertical and lateral extent of soil and groundwater has been defined;
- The pump test data reported by EMCON indicates that a pump and treat system would be sufficient to remediate groundwater from a recovery well located between monitoring wells MW-1 and MW-2;
- Expected remediation time to treat the impacted groundwater should be 6 months to 3 years;

The proposed remediation system will provide a cost effective method for treatment of groundwater with dissolved hydrocarbons. Due to the limited extent of soil and groundwater impacted by petroleum hydrocarbons and the anticipated time required for remediation, an extensive complex system is not appropriate. It should be noted than during the past four years the lateral extent of dissolved hydrocarbons has remained relatively unchanged as evident by the water sample results from MW-1, MW-2 and MW-6. The relatively flat groundwater gradient and limit extent of impacted soils are probably the most significant factors impeding plume migration.

Although this remediation system is designed to capture and remove petroleum hydrocarbons from groundwater only, it could be possible to accelerate the rate of hydrocarbon removal in the future. If subsurface conditions are amenable to vapor recovery in the future, the system could be enhanced to achieve better removal efficiency. The continued monitoring of groundwater following startup of the remediation system will provide better information to assess system performance.



Source: U.S.G.S. Oakland East Quadrangle,CA
7.5 Minute Series (Topographic)

HYDRO-
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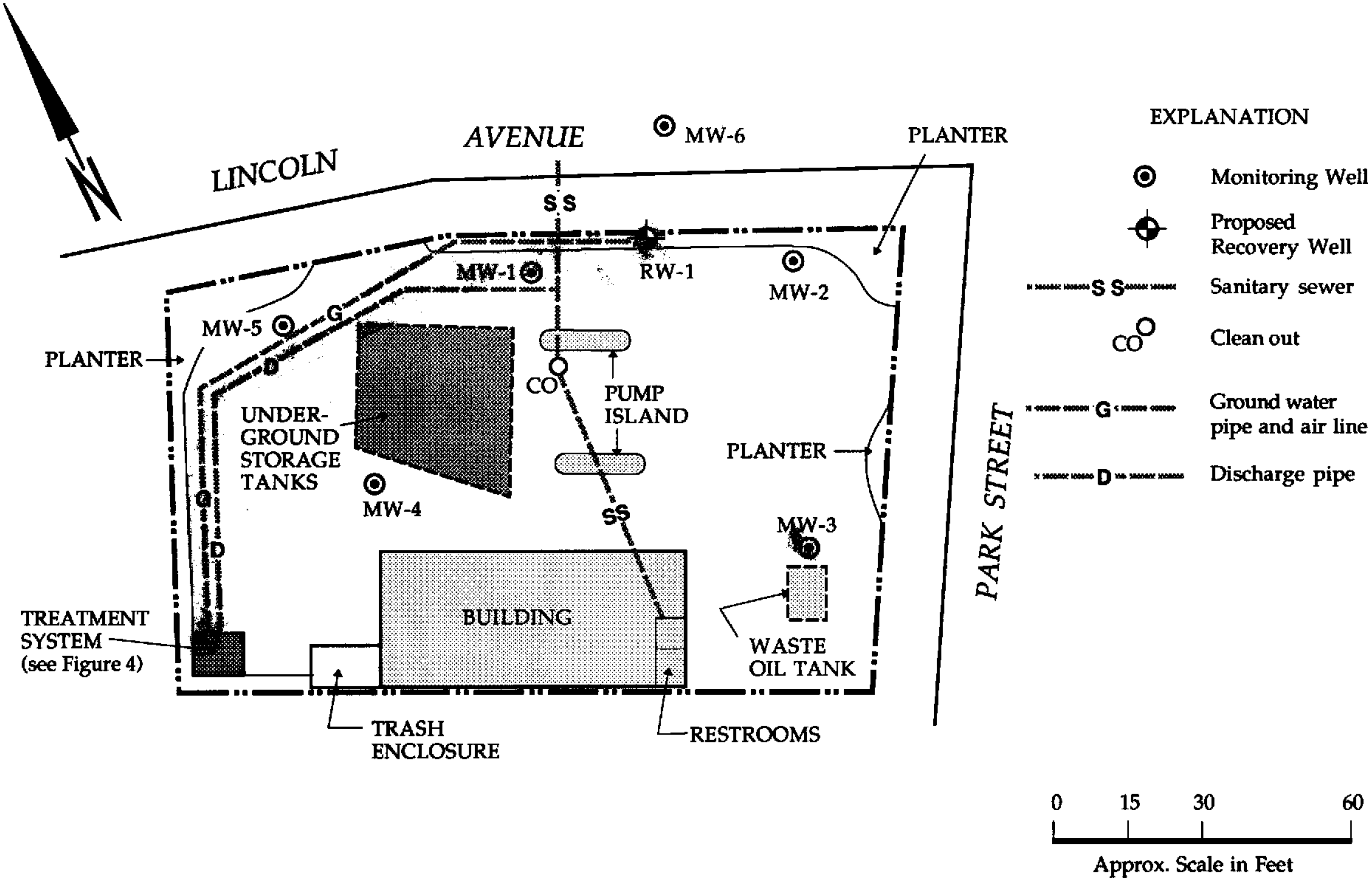
SITE LOCATION MAP

BP SERVICE STATION No. 11266
1541 PARK STREET
ALAMEDA, CALIFORNIA

FIGURE:
1
Job No. 9-031



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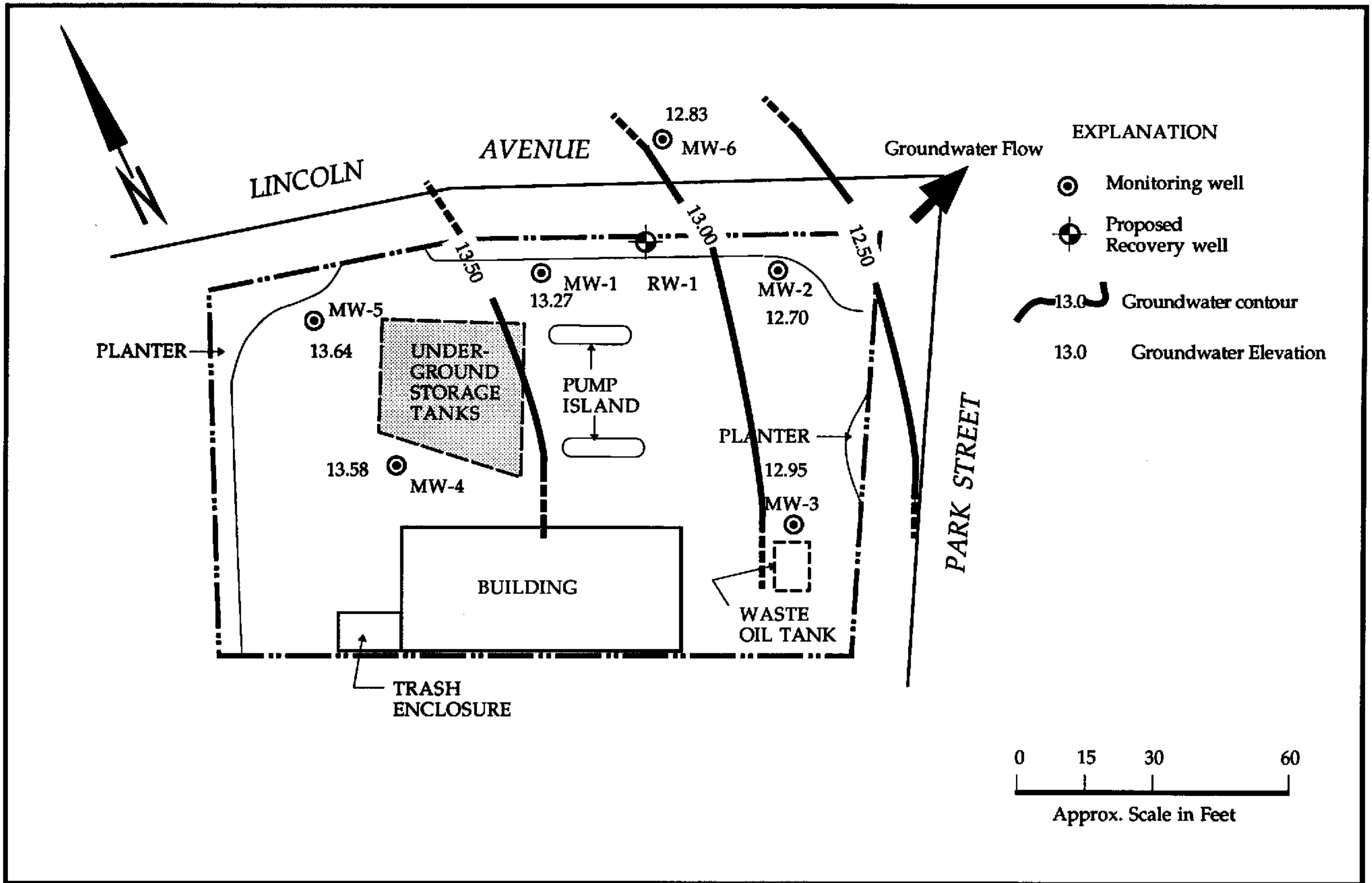
SITE PLAN

BP SERVICE STATION No. 11266
1541 Park Street, Alameda, California

Figure
2

9-031 | 2/2/92

9-031/FM/Fig.2/2-2-92



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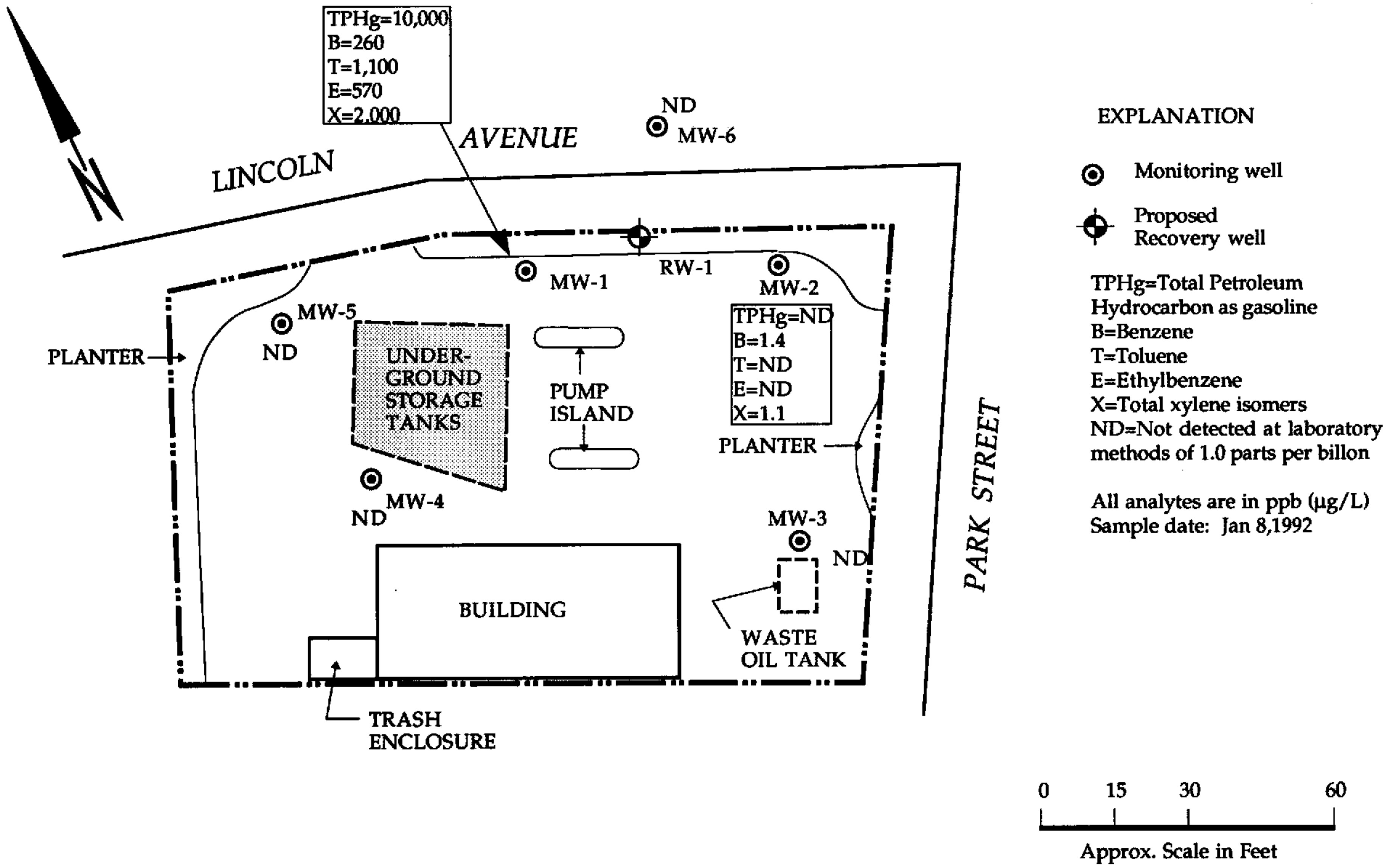
GROUNDWATER FLOW MAP

BP SERVICE STATION No. 11266
1541 Park Street, Alameda, California

Figure
3

9-031 | 2/2/92

9-031/FM/Fig.2/2-2-92



EXPLANATION

TPHg=Total Petroleum Hydrocarbon as gasoline
B=Benzene
T=Toluene
E=Ethylbenzene
X=Total xylene isomers
ND=Not detected at laboratory methods of 1.0 parts per billon

All analytes are in ppb (µg/L)
Sample date: Jan 8,1992

HYDRO-ENVIRONMENTAL TECHNOLOGIES, INC.

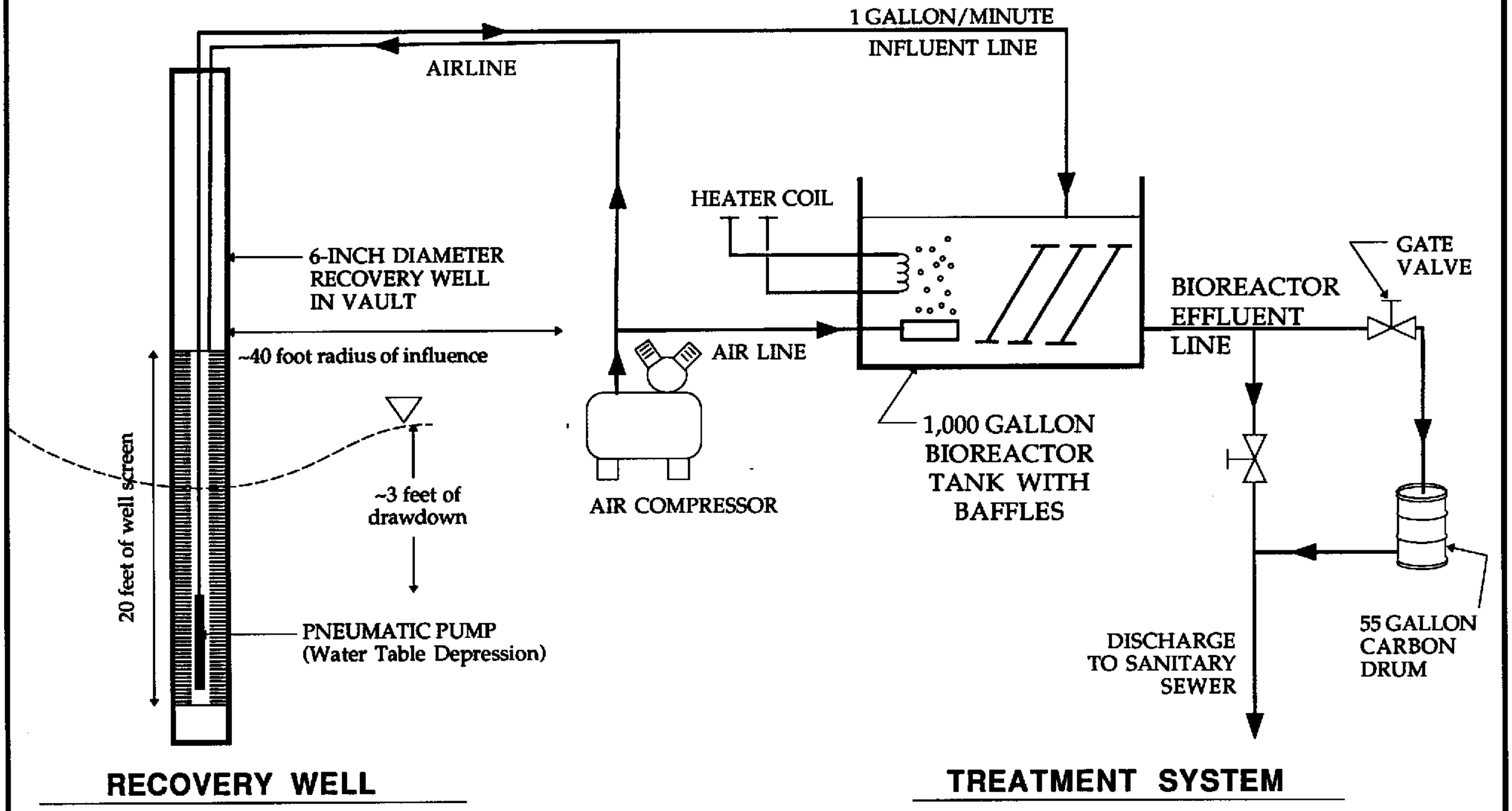
GROUNDWATER CONCENTRATION MAP

BP SERVICE STATION No. 11266
1541 Park Street, Alameda, California

Figure
4

9-031 2/2/92

9-031/FM/Fig.2/2-2-92



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TECHNOLOGIES, INC.**

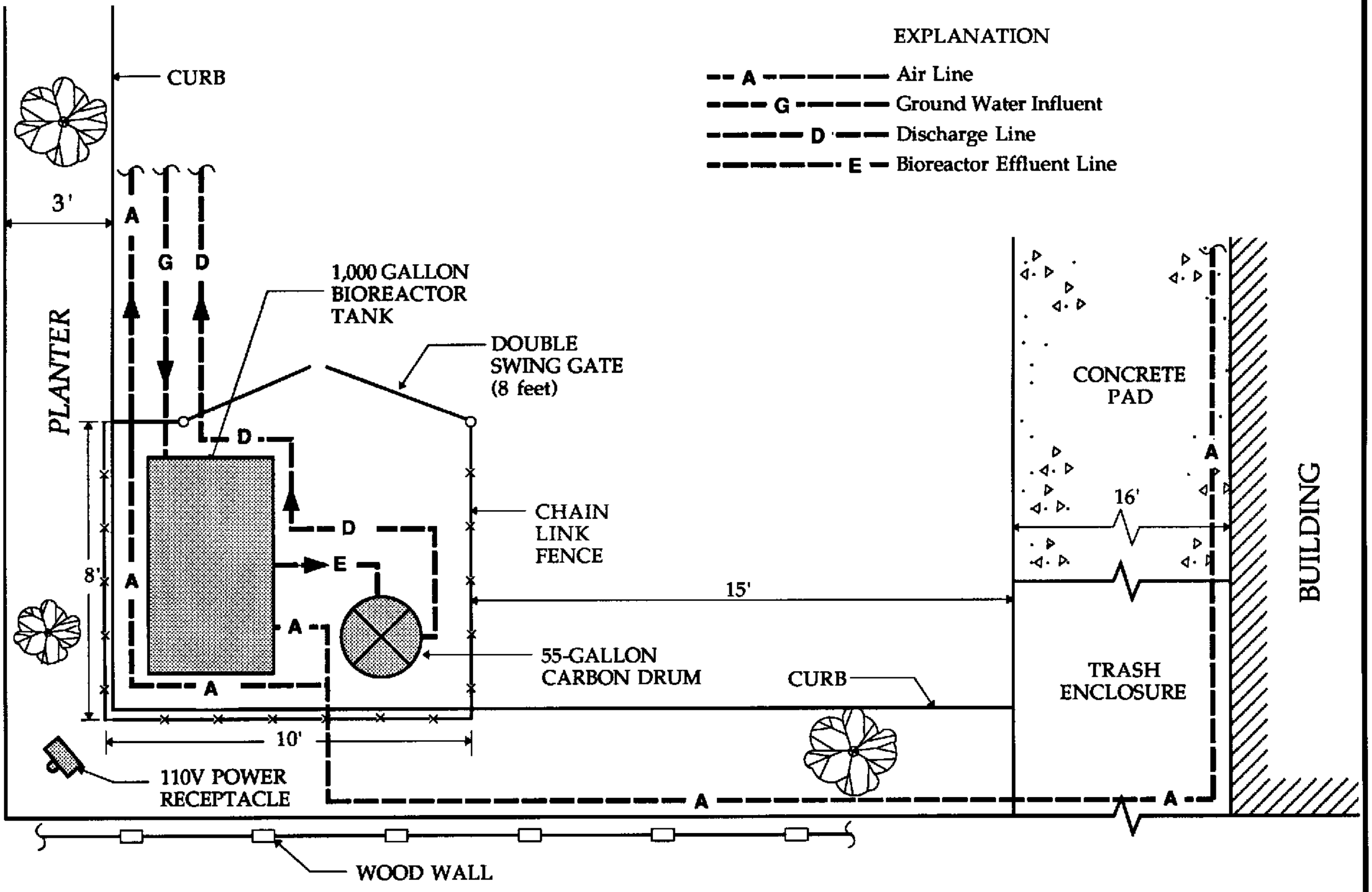
REMEDIATION SCHEMATIC

**BP SERVICE STATION No. 11266
1541 Park Street, Alameda, California**

Figure
5

9-031	2/2/92

9-031/FM/Fig.3/2-2-92



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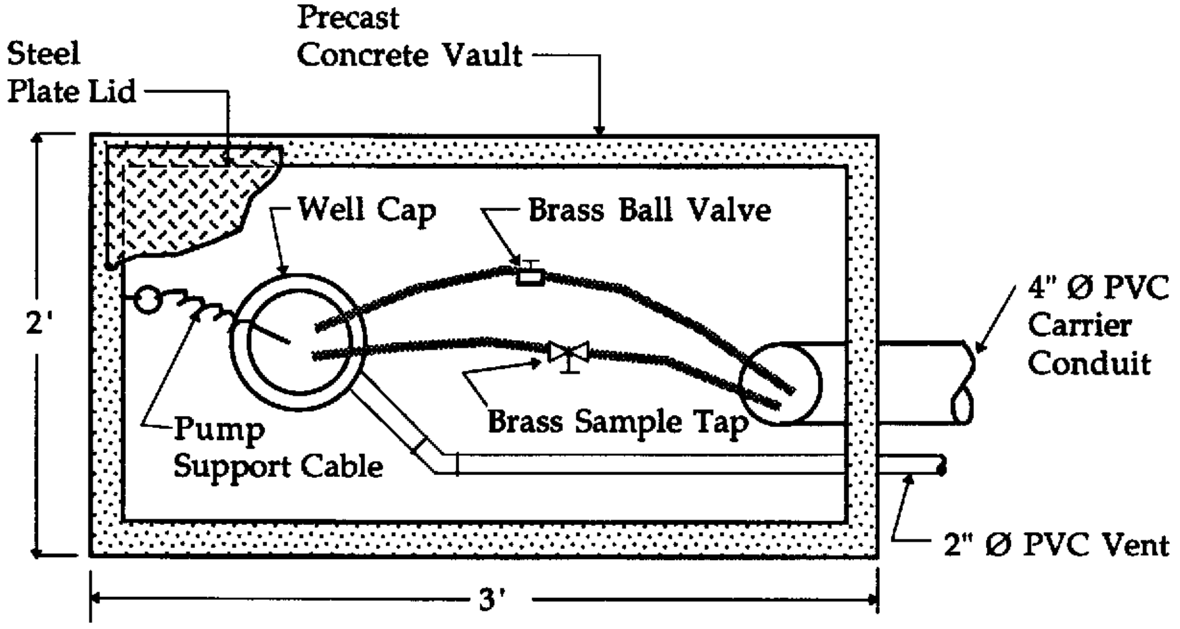
TREATMENT SYSTEM LAYOUT

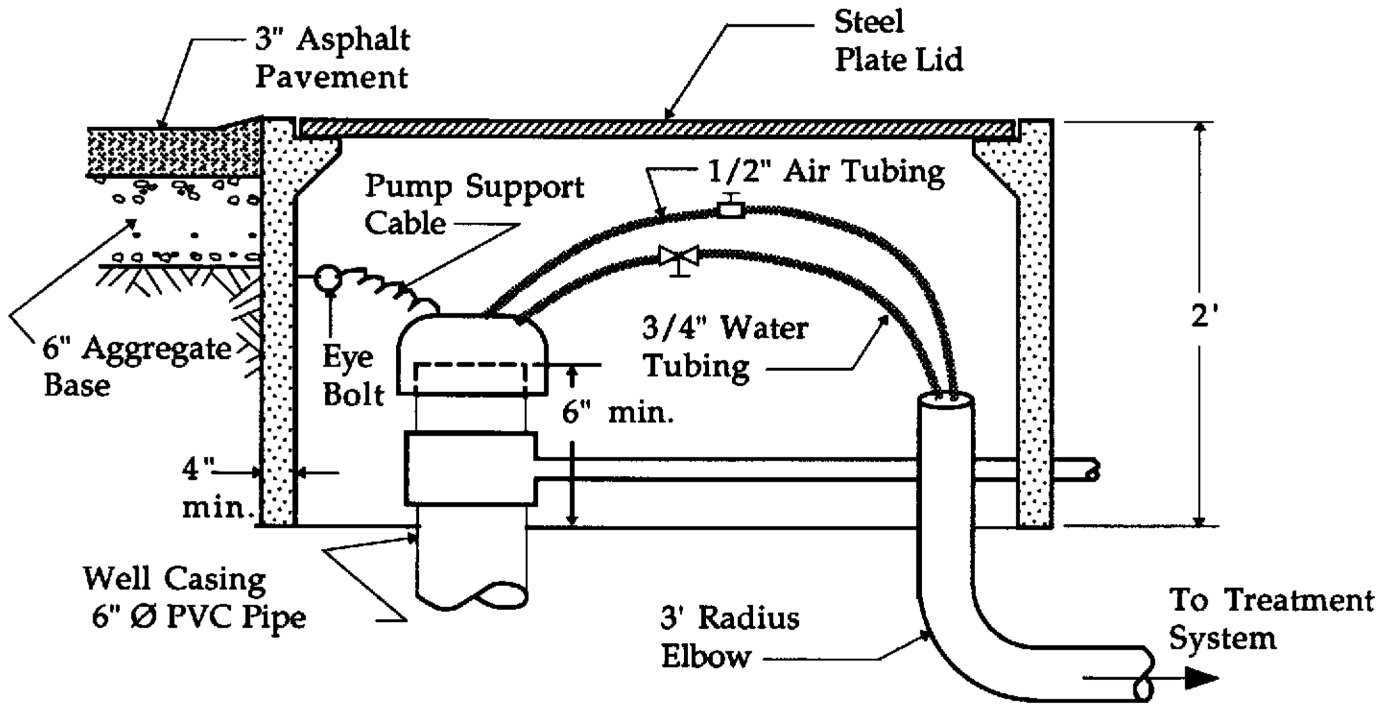
BP SERVICE STATION No. 11266
1541 Park Street, Alameda, California

Figure
6

9-031 | 2/2/92

9-031/FM/Fig.4/2-2-92





Not To Scale

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TECHNOLOGIES, INC.

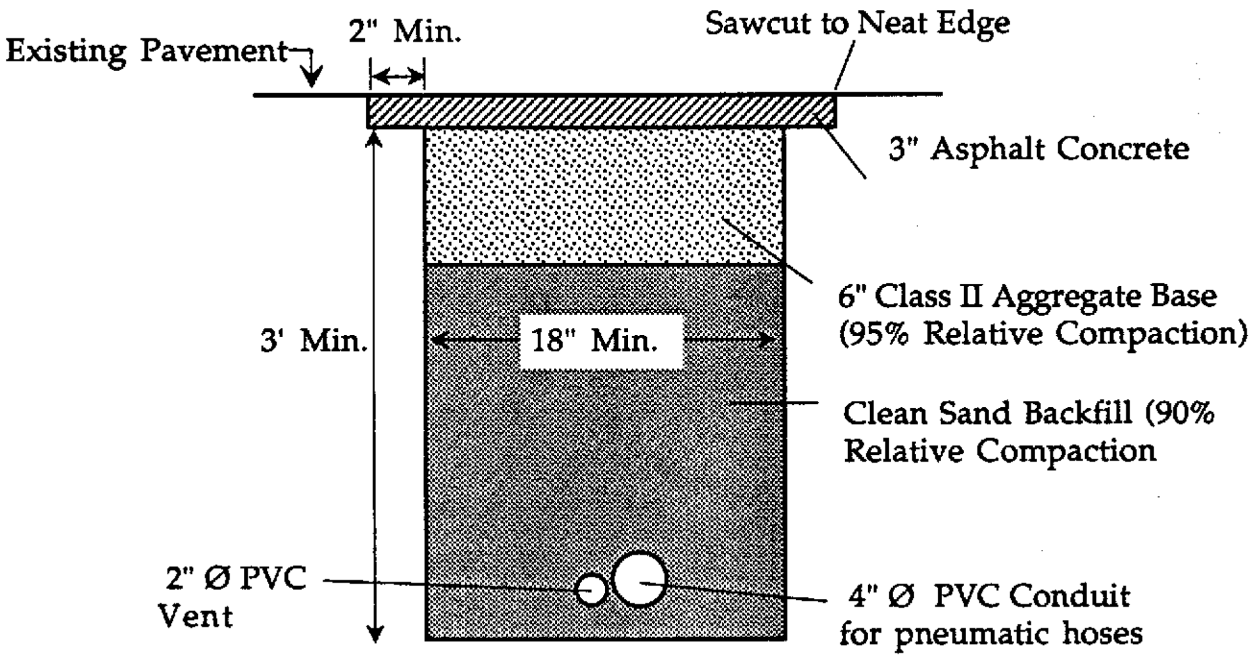
RECOVERY WELL VAULT DETAIL

BP SERVICE STATION NO. 11266
1541 Park Street, Alameda, California

Figure

7

9-031	2/2/92



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HYDRO-ENVIRONMENTAL TECHNOLOGIES, INC.

TRENCH DETAIL

BP SERVICE STATION NO. 11266
1541 Park Street, Alameda, California

Figure 8

9-031 2/2/92

TABLE 1
Cumulative Analytical Results of Soil Samples
BP Oil Facility No. 11266
Alameda, California

TANK EXCAVATION

Date	Sample	Depth	TPH	B	T	X
10/87	A1	11.5	<1.0	<0.1	<0.1	<0.1
	A2	11.5	<1.0	<0.1	<0.1	<0.1
	B1	11.5	<1.0	<0.1	<0.1	<0.1
	B2	11.5	340	<0.1	<0.1	8.6
	C1	11.5	3200	81	42	450
	C2	11.5	490	2.6	13	180
	D1	11.5	<1.0	<0.1	<0.1	<0.1
	D2	11.5	75	0.3	6.1	4.0
	W.0-1	11.5	<10	NA	NA	NA

WELL INSTALLATION

Date	Sample	Depth	TPH	B	T	E	X
3/88	MW-1	10.0	2.1	0.1	0.2	<0.1	0.7
	MW-2	10.0	<0.1	<0.1	<0.1	<0.1	<0.1
	MW-3	10.0	<0.1	<0.1	<0.1	<0.1	<0.1
	MW-4	5.0	ND	ND	ND	ND	ND
	MW-4	10.0	ND	ND	ND	ND	ND
	MW-5	5.0	ND	ND	ND	ND	ND
	MW-5	10.0	ND	ND	ND	ND	ND
	MW-6	5.0	ND	ND	ND	ND	ND
	MW-6	10.0	ND	ND	ND	ND	ND

PIPING REPLACEMENT

Date	Sample	TPH	B	T	E	X
9/90	Composite A	ND	ND	ND	ND	ND
	D1	ND	ND	ND	ND	ND
	D2	ND	ND	ND	ND	ND
	D3	ND	ND	ND	ND	ND
	D4	ND	ND	ND	ND	ND

All results are reported in mg/kg by KEI
TPH=Total Petroleum Hydrocarbons (no distinction given)
B=benzene T=toluene E=ethylbenzene X=xylene
ND=not detected in concentrations exceeding the laboratory detection limit
NA=not analyzed
KEI=Kaprealian Engineering, Inc.

TABLE 2
Cumulative Analytical Results of Water Samples
BP Oil Facility No. 11266
Alameda, California

Well No.	Sample Date	Collector	TPHg	B	T	E	X
*	10/87	KEI	530	6.3	66	NA	200
MW-1	3/4/88	KEI	95,000	2,000	5,900	1,100	10,000
	3/29/89	KEI	25,000	930	2,600	24	3,100
	11/28/89	EMCON	15,000	280	880	340	1,200
	2/13/91	EMCON	25,000	680	2,700	1,100	3,200
	1/8/92	HETI	10,000	260	1,100	570	2,000
MW-2	3/4/88	KEI	ND	ND	ND	ND	ND
	3/29/89	KEI	ND	1.1	0.78	ND	1.7
	11/28/89	EMCON	170	ND	ND	ND	ND
	2/13/91	EMCON	150	1.4	ND	ND	0.9
	1/8/92	HETI	ND	1.4	ND	ND	1.1
MW-3**	3/28/88	KEI	ND	ND	ND	ND	ND
	3/29/89	KEI	ND	ND	ND	ND	ND
	11/28/89	EMCON	ND	ND	ND	ND	ND
	2/13/91	EMCON	ND	ND	ND	ND	ND
	1/8/92	HETI	ND	ND	ND	ND	ND
MW-4	3/29/89	KEI	ND	ND	ND	ND	ND
	11/28/89	EMCON	ND	ND	ND	ND	ND
	2/13/91	EMCON	430	6.2	0.6	12	3.3
	1/8/92	HETI	ND	ND	ND	ND	ND
MW-5	3/29/89	KEI	ND	ND	ND	ND	ND
	11/28/89	EMCON	ND	ND	ND	ND	ND
	2/13/91	EMCON	ND	ND	ND	ND	ND
	1/8/92	HETI	ND	ND	ND	ND	ND
MW-6	4/19/89	KEI	ND	ND	ND	ND	ND
	11/28/89	EMCON	ND	ND	ND	ND	ND
	2/13/91	EMCON	ND	ND	ND	ND	ND
	1/8/92	HETI	ND	ND	ND	ND	ND

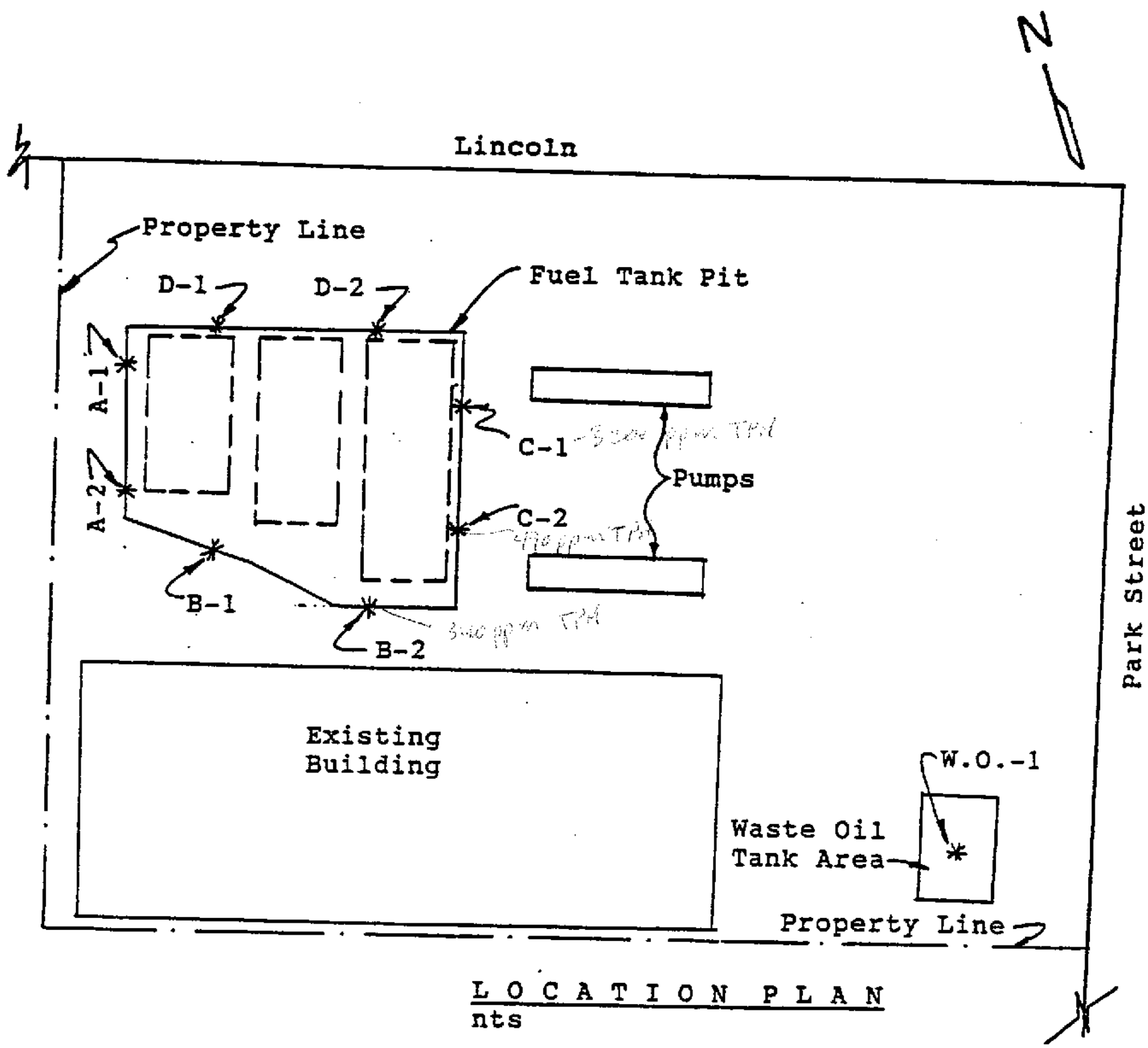
All concentrations in µg/l (ppb)
TPHg = Total petroleum hydrocarbons as gasoline.
B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes

ND = Not detected in concentrations exceeding the laboratory method detection limit
KEI = Kaprealian Engineering, Inc.
EMCON= EMCON Associates

***Sample was obtained from the tank excavation in 1987**
****In March of 1988, KEI reported less than 50 ppb as diesel in MW-3**

APPENDIX A

KAPREALIAN ENGINEERING, INC.
Consulting Engineers
P. O. BOX 913
BENICIA, CA 94510
(415) 676-9100 (707) 746-6915



LOCATION PLAN
nts

* Sample Location

MOBIL Service Station
1541 Park Street
Alameda, California

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TABLE 1

SUMMARY OF LABORATORY ANALYSES

(all analyses in parts per million)

Sample #	Type	Depth	Total Hydrocarbon	Benzene	Toluene	Xylene
A1	soil	11.5′	<1.0	<0.1	<0.1	<0.1
A2	Soil	11.5′	<1.0	<0.1	<0.1	<0.1
B1	soil	11.5′	<1.0	<0.1	<0.1	<0.1
B2	soil	11.5′	340	<0.1	<0.1	8.6
C1	soil	11.5′	3200	81	42	450
C2	soil	11.5′	490	2.6	13	180
D1	soil	11.5′	<1.0	<0.1	<0.1	<0.1
D2	soil	11.5′	75	0.3	6.1	40
W.O-1*	soil	7.5′	<10	----	----	----
W-1	water	12′	530	6.3	66	200

* TOG = 150 ppm

Soil was removed [illegible] 400 yd^3

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TABLE - 1

Results of Soil Analyses - Parts Per Million (ppm)

Sample Number	Depth (feet)	TPH	Benzene	Toluene	Xylene	Ethylbenzene
MW-1	10	2.4	0.1	0.2	0.7	<0.1
MW-2	10	<1.0	<0.1	<0.1	<0.1	<0.1
MW-3	10	<1.0	<0.1	<0.1	<0.1	<0.1

no samples @ 5'

Results of Water Analyses - parts per billion (ppb)

Sample Number	Depth (feet)	TPH	Benzene	Toluene	Xylene	Ethylbenzene
MW-1	9.50	95,000	2000	5900	10,000	1100
MW-2	10.208	<50	<0.5	<0.5	<0.5	<0.5
MW-3+	10.667	<50	<0.5	<0.5	<0.5	<0.5

* TPH = Total Petroleum Hydrocarbon

\+ MW-3 (water) had TPH diesel <50 ppb; TOG <50 ppb; EPA 601 and 602 constituents all non-dedectable.

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SEQUOIA ANALYTICAL
1900 Bates Avenue • Suite LM • Concord, California 94520
(415) 686-9600 • FAX (415) 686-9689

Kaprealian Engineering, Inc.
P.O. Box 996
Benicia, CA 94510
Attention: Mardo Kaprealian, P.E.

Client Project ID: BP Station, Park St./Lincoln Ave., Alameda
Matrix Descript: Soil
Analysis Method: EPA 5030/8015/8020
First Sample #: 009-0566

Sampled: Sep 24, 1990
Received: Sep 24, 1990
Analyzed: Sep 24, 1990
Reported: Sep 25, 1990

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/kg (ppm)	Benzene mg/kg (ppm)	Toluene mg/kg (ppm)	Ethyl Benzene mg/kg (ppm)	Xylenes mg/kg (ppm)
009-0566	D1	N.D.	N.D.	N.D.	N.D.	N.D.
009-0567	D2	N.D.	N.D.	N.D.	N.D.	N.D.
009-0568	D3	N.D.	N.D.	N.D.	N.D.	N.D.
009-0569	D4	N.D.	N.D.	N.D.	N.D.	N.D.
Detection Limits:		1.0	0.0050	0.0050	0.0050	0.0050

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Belinda C. Vega
Laboratory Director

SEQUOIA ANALYTICAL

1900 Bates Avenue • Suite LM • Concord, California 94520
(415) 686-9600 • FAX (415) 686-9689

Kaprealian Engineering, Inc.	Client Project ID:	BP Station, Park St./Lincoln Ave., Alameda	Sampled:	Sep 21, 1990
P.O. Box 996	Sample Descript.:	Soil, Comp A	Received:	Sep 24, 1990
Benicia, CA 94510	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Sep 24, 1990
Attention: Mardo Kaprealian, P.E.	Lab Number:	009-0570 A-B	Reported:	Sep 25, 1990

TOTAL PETROLEUM FUEL HYDROCARBONS WITH BTEX DISTINCTION (EPA 8015/8020)

Analyte	Detection Limit mg/kg (ppm)	Sample Results mg/kg (ppm)
Low to Medium Boiling Point Hydrocarbons	1.0	N.D.
Benzene	0.0050	N.D.
Toluene	0.0050	N.D.
Ethyl Benzene	0.0050	N.D.
Xylenes	0.0050	N.D.

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Belinda C. Vega
Laboratory Director