REPORT OF GEOTECHNICAL SERVICES
SUBSURFACE CONTAMINATION STUDY
UNOCAL SERVICE STATION 6151
RICHLAND, WASHINGTON
FOR UNOCAL

Geo Engineers

March 11, 1988

Consulting Geotechnical
Engineers and Geologists

Unocal
P.O. Box 76
Seattle, Washington 98121

Attention: Mr. Rod Puppe

Gentlemen:

We are submitting five copies of our subsurface contamination study at the site of Unocal Service Station 6151 in Richland, Washington. Our services were authorized verbally by Mr. Puppe on January 8, 1988. Contractual terms for our services are described in the blanket contract recently negotiated between GeoEngineers, Inc. and Unocal.

We appreciate the opportunity to be of continued service to Unocal. Please call if you have any questions regarding this report.

Yours very truly,

GeoEngineers, Inc.

James A. Miller

James A. Miller
Principal

SEW:JAM:cs

File No. 0161-88-4

RECEIVED
APR 27 1990
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

GeoEngineers, Inc.
2405 140th Ave. NE, Suite 105
Bellevue, WA 98005
Telephone (206) 746-5200
Fax. (206) 746-5068

Geo Engineers

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Geo Engineers

REPORT OF GEOTECHNICAL SERVICES
SUBSURFACE CONTAMINATION STUDY
UNOCAL SERVICE STATION 6151
RICHLAND, WASHINGTON

INTRODUCTION

The results of our subsurface contamination study at the site of Service Station 6151 are presented in this report. This service station is located in Richland, Washington, northeast of the intersection between Columbia Center Boulevard and Fowler Avenue. The site location is shown relative to surrounding physical features in Figure 1. A generalized site plan of the facility is shown in Figure 2.

The purpose of our services is to explore and evaluate potential subsurface fuel-related contamination at the site. The scope of services completed for this study is listed below.

1. Drilling four borings on site with casing-drive air rotary methods.
2. Obtaining soil samples from each boring at 5-foot intervals.
3. Installing ground water monitor wells with flush-grade surface monuments in each boring.
4. Developing the well screens by hand bailing with a stainless steel bailer.
5. Determining the monitor well casing elevations to an accuracy of 0.01 feet using our engineer's level and an assumed site datum.
6. Measuring the air space in each well casing for hydrocarbon vapors using a Bacharach TLV Sniffer.
7. Measuring water table elevations for all of the wells and sampling each well for the potential presence of free (floating) hydrocarbons.
8. Obtaining ground water samples from the monitor wells for laboratory analysis.

9. Testing a soil and ground water sample from each well for the presence of petroleum hydrocarbons and related compounds.
10. Evaluating the field and laboratory data with regard to existing regulatory concerns.

SITE CONDITIONS

GENERAL

Service Station 6151 is located approximately 2000 feet southwest of the Columbia River and west of the center of downtown Richland. The topography of the site is generally level. The altitude of the site is approximately 360 feet above mean sea level.

The property includes an inactive service station building, two underground gasoline storage tanks, underground waste oil and heating oil tanks, and two fuel service islands. The remainder of the site is covered with asphalt paving. At the time of our visit, we measured approximately 290 gallons and 165 gallons of product in the waste oil tank and the heating oil tank, respectively. The underground gasoline tanks were locked and could not be measured at the time of our field studies.

SUBSURFACE SOIL CONDITIONS

Subsurface soil conditions beneath the service station site were explored by drilling four test borings at the locations indicated in Figure 2. Details of the field exploration program and the boring logs are presented in Appendix A.

The monitor well borings encountered native gravel with cobbles and boulders. The base of the native gravel deposit was not reached in the borings. The presence of boulders made drilling very difficult and time consuming.

GROUND WATER CONDITIONS

Ground water conditions at the site were explored by installing a monitor well in each boring. Construction details for the monitor wells are included in Appendix A. We determined the water table depth and elevation in each monitor well on February 16 and March 2, 1988.

The water table at the site was approximately 37 to 38 feet below ground surface at the time of our site measurements. Water table elevations for the monitor wells are included in Figure 2 for measurements made on February 16. A relatively flat water table with a gentle slope toward the east is present at the site. The general direction of ground water flow and water table contours for February 16, 1988 are shown in Figure 2. A similar ground water slope and flow direction resulted from the March 2 site measurements.

SUBSURFACE CONTAMINATION

Potential subsurface contamination at the site from fuel products was evaluated by:

1. Physical examination of soil samples and noting the presence of petroleum odor in the samples.
2. Measuring the air space in the monitor well casings for hydrocarbon vapors.
3. Sampling the water table interface in each monitor well for the potential presence of free (floating) hydrocarbons.
4. Testing soil and ground water samples for petroleum hydrocarbons and related compounds.

The subsurface contamination data are summarized in Table 1 and Table 2. Laboratory reports for soil and water samples are included in Appendix B. Free (floating) hydrocarbons were not found in the monitor wells. A slight odor of fuel was found in soil samples collected from Monitor Well MW-3 during drilling. Petroleum and fuel hydrocarbons were not detected on any of the soil samples with the exception of 2 ppm gasoline in the soil sample taken from a depth of 34 feet in Boring MW-2. Ground water samples were free of chlorinated solvents. However, volatile organic compounds typical of gasoline were detected in MW-3. The concentration of benzene in the ground water sample taken from MW-3 (21 ppb) exceeds the EPA's Maximum Contaminant Level for benzene (5 ppb) for drinking water. The concentrations of other volatile organic compounds detected in ground water from MW-3 are below drinking water standards.

Insignificant hydrocarbon vapors were detected in the well casings for MW-1, MW-2 and MW-4. However, hydrocarbon vapors were measured in MW-3 at 29 percent of the lower explosive limit (hexane).

CONCLUSIONS

Our explorations detected the presence of a trace of gasoline in soil collected from MW-2 and gasoline contamination of ground water in MW-3. In addition, moderately high concentrations of hydrocarbon vapors (probably gasoline) were detected in the well casing for MW-3. Serious contamination, such as that caused by persistent tank or line leaks, is not indicated by our site studies. However, the data indicate that a release of a modest amount of gasoline has probably occurred in the past in the vicinity of the fuel service islands.

The benzene concentration in ground water from MW-3 exceeds drinking water standards. Well MW-3 is located upgradient from MW-1, where no detectable benzene was found. Therefore, the presence of benzene in MW-3 does not appear to present a risk to ground water in off-site areas.

RECOMMENDATIONS

Remediation of gasoline-contaminated soil is relatively routine if the soil can be exposed to the atmosphere for aeration. We understand that the existing underground tanks at Service Station 6151 may be removed prior to selling the site. We recommend that any gasoline-contaminated soil found in the tank excavations be stockpiled temporarily on site and spread into a single 12-inch-thick layer for aeration. We further recommend that the fuel lines between the underground tanks and the fuel service islands be removed and the soil surrounding those lines be examined for evidence of gasoline contamination. Any gasoline-contaminated soil that is found should be excavated and aerated on site until no detectable gasoline remains in the soil that is undergoing aeration. The aerated soil can then be used to backfill open excavations at the site.

We recommend that the monitor wells be sealed and abandoned in accordance with state law within one year of the date of this report. Alternatively, if the site remains in use as a fuel retail facility, the monitor wells can be incorporated into a permanent leak detection system at the site.

LIMITATIONS

We have prepared this report for use by Unocal. This report can be made available to prospective buyers of the property and to regulatory agencies. The report is not intended for use by others and the information contained herein may not be applicable to other sites.

Our interpretations of subsurface conditions are based on data from widely spaced boreholes at the site. It is possible that areas with undetected contamination exist in areas of the site that were not explored by drilling.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No other conditions, express or implied, should be understood.

- o 0 o -

Please call if you have questions concerning our report.

Respectfully submitted,

GeoEngineers, Inc.

Scott E. Widness/by JAM

Scott E. Widness
Geological Engineer/Hydrogeologist

James A. Miller

James A. Miller
Principal

SEW:JAM:cs

Table 1

Summary of Hydrocarbon Contamination Data for Soil Samples and Subsurface Vapors

Sample Location	Soil Odor During Drilling	Vapor Levels(1)		Water Table Conditions	Depth of Soil Sample Tested(ft)	No.1 Gasoline in soil (ppm)	No.2 Diesel in soil (ppm)	Diesel in soil (ppm)	Total Petroleum Hydrocarbons in Soil (ppm)
		ppm	%L.E.L.						
MW-1	No	20	<1	No sheen	34.0	<1	<10	<10	<5
MW-2	No	22	<1	No sheen	34.0	2	<10	<10	<5
MW-3	Slight	3200	29	No sheen	34.5	<1	<10	<10	<5
MW-4	No	15	<1	No sheen	34.0	<1	<10	<10	<5

Notes: 1. Measurements obtained in Wells MW-1 through MW-4 were measured on March 2, 1988 using a Bacharach TLV Sniffer calibrated to hexane (110 ppm = 1% LEL hexane).

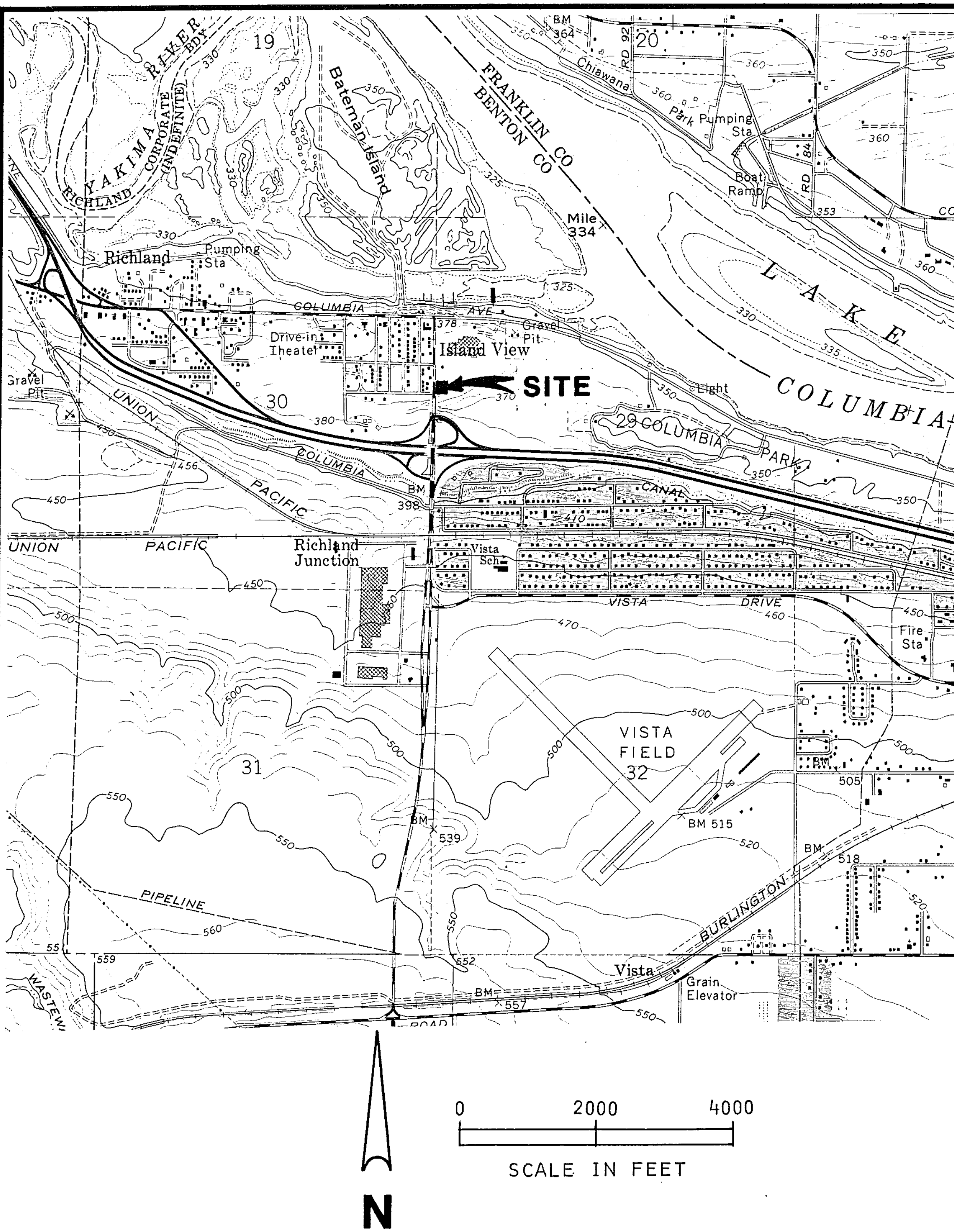
Table 2

Summary of Ground Water Analyses for Volatile Organic Compounds (ppb)

	MW-1	MW-2	MW-3	MW-4
Benzene	ND	ND	21	ND
Ethylbenzene	ND	ND	21	ND
Toluene	ND	ND	15	ND
o xylene	ND	ND	ND	ND
m, p xylenes	ND	ND	14	ND
1,1-Dichloroethylene	ND	ND	--	--
Methylene Chloride	ND	ND	--	--
Carbon Tetrachloride	ND	ND	--	--
1,1,1-Trichloroethane	ND	ND	--	--
Trichloroethylene	ND	ND	--	--
Tetrachloroethylene	ND	ND	--	--
Chloroform	ND	ND	--	--

Notes:

1. -- indicates not analyzed. ND indicates "not detected."
2. Detection limits are presented on the laboratory data sheets in Appendix B.
3. Ground water samples were obtained on February 16, 1988.



REFERENCE: USGS 7.5' TOPOGRAPHIC QUADRANGLE MAP "KENNIWICK, WASH."

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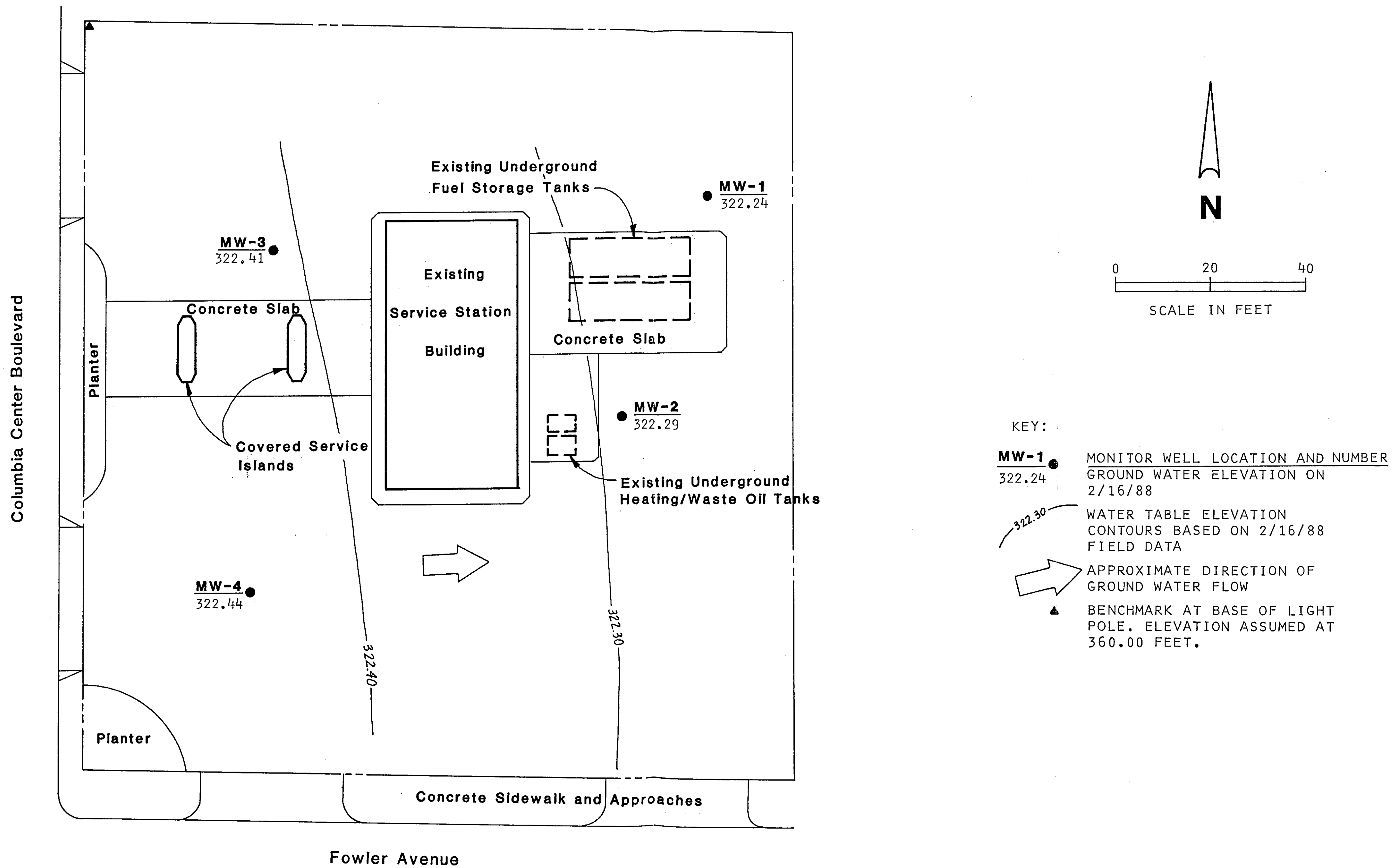
VICINITY MAP

FIGURE 1

0161-007-T SLW:KKT 1-21-86



REFERENCE: DRAWING ENTITLED "GENERAL ARRANGEMENT, SERVICE STATION 6151, COLORADO ST. & FOWLER AVE., RICHLAND, WASHINGTON" DATED 9/13/68 BY UNOCAL.

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SITE PLAN

FIGURE 2

01..-88-4 SEW:KKT 1-29-88

APPENDIX A

APPENDIX A

FIELD EXPLORATIONS

DRILLING AND SOIL SAMPLING PROGRAM

Subsurface conditions at Service Station 6151 were explored by drilling four borings using casing drive air rotary methods at the locations indicated in Figure 2. The borings were drilled between February 9 and 15, 1988 to depths of 42 to 44 feet using drilling equipment owned and operated by Soil Sampling Service, Inc. The soil sampling equipment was cleaned with a trisodium phosphate wash and distilled water rinse between each attempt. The drilling equipment was cleaned with a hot-water pressure washer between each boring.

A hydrogeologist from our staff determined the boring locations, examined and classified the soils encountered, and prepared a detailed log of each boring. Soils encountered were classified visually in general accordance with ASTM D-2488-83, which is described in Figure A-1. An explanation of the boring log symbols is presented in Figure A-2. The boring logs are given in Figures A-3 through A-10.

Relatively undisturbed soil samples were obtained from each drilled boring using a Dames & Moore split barrel sampler (2.4-inch-ID). The sampler was driven 18 inches by a 300-pound weight falling a vertical distance of approximately 30 inches. The number of blows needed to advance the sampler the final 12 inches is indicated to the left of the corresponding sample notations on the boring logs.

One representative soil sample from each boring was selected for chemical analysis of fuel hydrocarbons and petroleum hydrocarbons. Samples that were tested are denoted in our boring logs with a "CA."

MONITOR WELL CONSTRUCTION

Two-inch-diameter, Schedule 40 PVC pipe was installed in each boring at the completion of drilling. The lower portion of the PVC pipe is machine slotted (0.02-inch slot width) to allow entry of water, floating hydrocarbons and hydrocarbon vapors into the well casings. Coarse sand was placed in the borehole annulus surrounding the slotted portion of the wells. Monitor well construction is indicated in Figures A-3 through A-10.

The monitor wells were developed shortly after drilling by removing water from the wells with a stainless steel bailer. We determined the elevations of the well casings to the nearest 0.01 foot with an engineers level on February 15, 1988. An elevation datum of 360 feet was assumed at a benchmark on the northwest corner of the property (see Figure 2). Elevations referenced to this datum are included on the monitor well logs.

GROUND WATER SAMPLING PROGRAM

Ground water samples were collected from the monitor wells by GeoEngineers on February 16, 1988. The water samples were collected with a teflon bailer after a minimum of three well volumes of water was removed from each well casing. The water samples were transferred to septum vials in the field and kept cool during transport to the testing laboratory.

The bailer was cleaned prior to each sampling attempt with a fresh water rinse, a trisodium phosphate wash, and a second fresh water rinse which was followed by a distilled water rinse.

GROUND WATER ELEVATIONS

The depth to the ground water table relative to the monitor well casing rims was measured on February 16 and March 2, 1988. The site measurements were made using a weighted fiberglass tape and water-finding paste. Ground water elevations were calculated by subtracting the water table depth from the casing rim elevations. Water table positions measured on February 16, 1988 are shown on the monitor well logs. Similar water levels were measured on March 2.

HYDROCARBON VAPOR CONCENTRATIONS

Hydrocarbon vapor concentrations were measured in each monitor well on March 2, 1988. Vapor concentrations in parts per million (ppm) were measured with our Bacharach TLV Sniffer, which is calibrated to hexane. The field data are presented in Table 1 of this report.

CHEMICAL ANALYTICAL PROGRAM

Four soil samples and four ground water samples were analyzed by Farr, Friedman & Bruya, Inc. The soil samples were analyzed for petroleum hydrocarbons using freon extraction/infrared spectroscopy in accordance with EPA Method 418.1. The soil samples were also analyzed for fuel hydrocarbons using gas chromatography/flame ionization detection.

The water samples were analyzed for benzene, ethylbenzene, toluene, and xylenes and chlorinated solvents using gas chromatography/photoionization detection in accordance with EPA Methods 601 and 602. Sample results have been corrected for constituents found in the reagent blank.

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50% OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS MORE THAN 50% PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-83.
2. Soil classification using laboratory tests is based on ASTM D2487-83.
3. Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry - Absence of moisture, dusty, dry to the touch

Moist - Damp, but no visible water

Wet - Visible free water or saturated, usually soil is obtained from below water table

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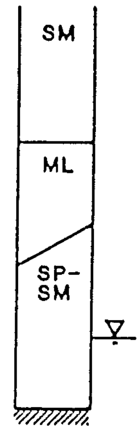
SOIL CLASSIFICATION SYSTEM

FIGURE A-1

LABORATORY TESTS:

AL	Atterberg limits
CP	Compaction
CS	Consolidation
DS	Direct shear
GS	Grain-size analysis
HA	Hydrometer analysis
K	Permeability
M	Moisture content
MD	Moisture and density
SP	Swelling pressure
TX	Triaxial compression
UC	Unconfined compression
CA	Chemical Analysis

SOIL GRAPH:



Soil Group Symbol (See Note 1)

Distinct contact between Soil Strata

Gradual Change between Soil Strata

Water Level

Bottom of Boring

BLOW-COUNT/SAMPLE DATA:

Blows required to drive Dames & Moore sampler 12 inches or other indicated distances using pound hammer falling inches.

'P' indicates sampler pushed with weight of hammer or hydraulics of drill rig.

22 ■ Location of relatively undisturbed sample

12 ⊠ Location of disturbed sample

P □ Location of sampling attempt with no recovery

10 ◪ Location of sample attempt using Standard Penetration Test procedures

40 ▄ Location of relatively undisturbed sample using 140 pound hammer falling 30 inches.

NOTES:

1. Soil classification system is summarized in Figure A-1.

2. The reader must refer to the discussion in the report text as well as the exploration logs for a proper understanding of subsurface conditions.

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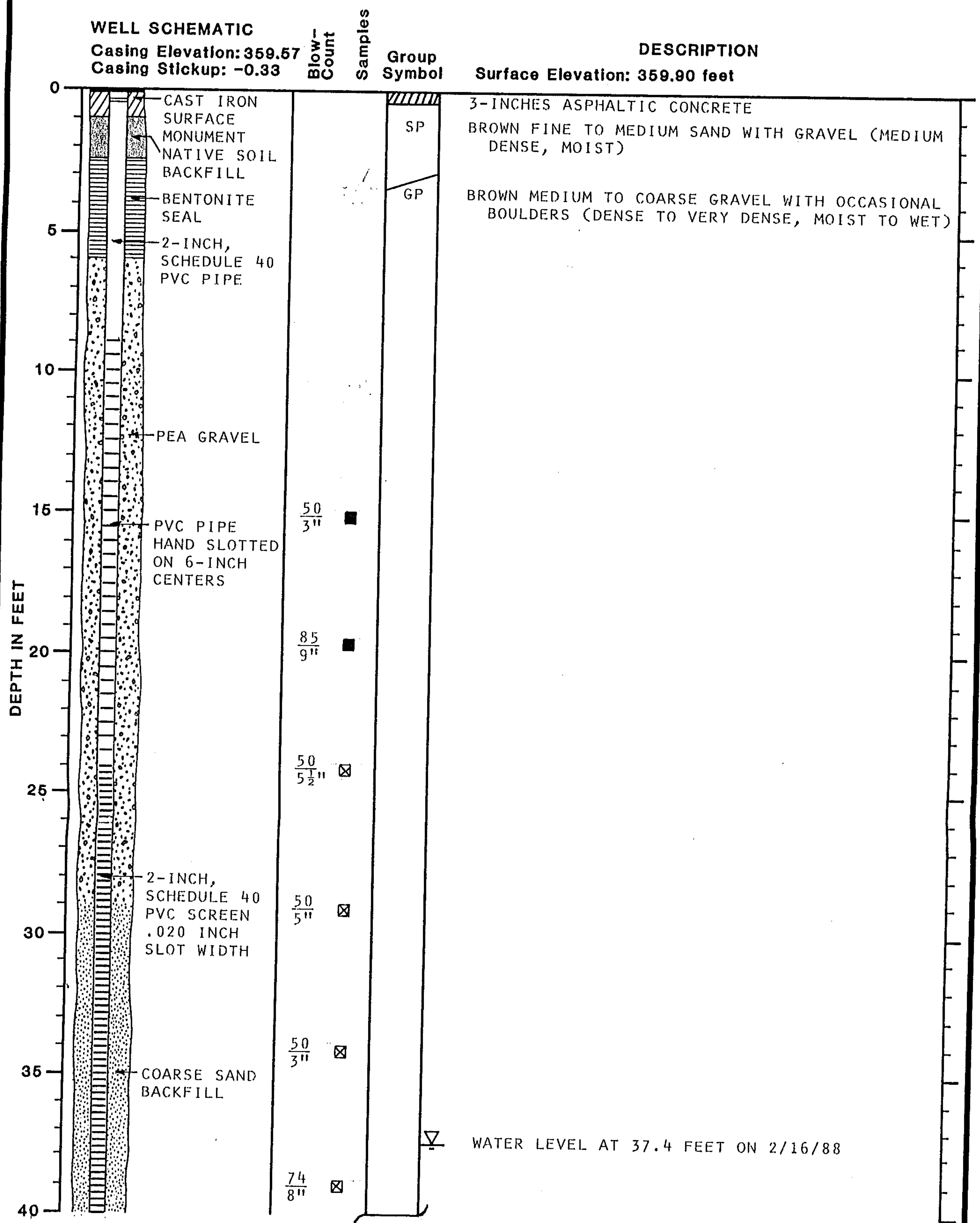
KEY TO BORING LOG SYMBOLS

FIGURE A-2

MONITOR WELL NO. 1



Note: See Figure A-2 for Explanation of Symbols

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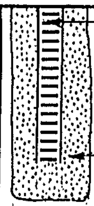
LOG OF MONITOR WELL

FIGURE A-3

MONITOR WELL NO. 1
(CONTINUED)

WELL SCHEMATIC
Casing Elevation:
Casing Stickup:

Depth (feet)	Well Schematic	Blow-Count	Samples	Group Symbol	DESCRIPTION
40–45	2-INCH, SCHEDULE 40 PVC SCREEN .020 INCH SLOT WIDTH; COARSE SAND BACKFILL; BASE OF WELL AT 44.0 FEET	78/9"	■	GP	
45					BORING COMPLETED AT 45 FEET ON 2/11/88
					NO HYDROCARBON ODOR ENCOUNTERED



DEPTH IN FEET: 40, 45, 50, 55, 60, 65, 70, 75, 80

Note: See Figure A-2 for Explanation of Symbols

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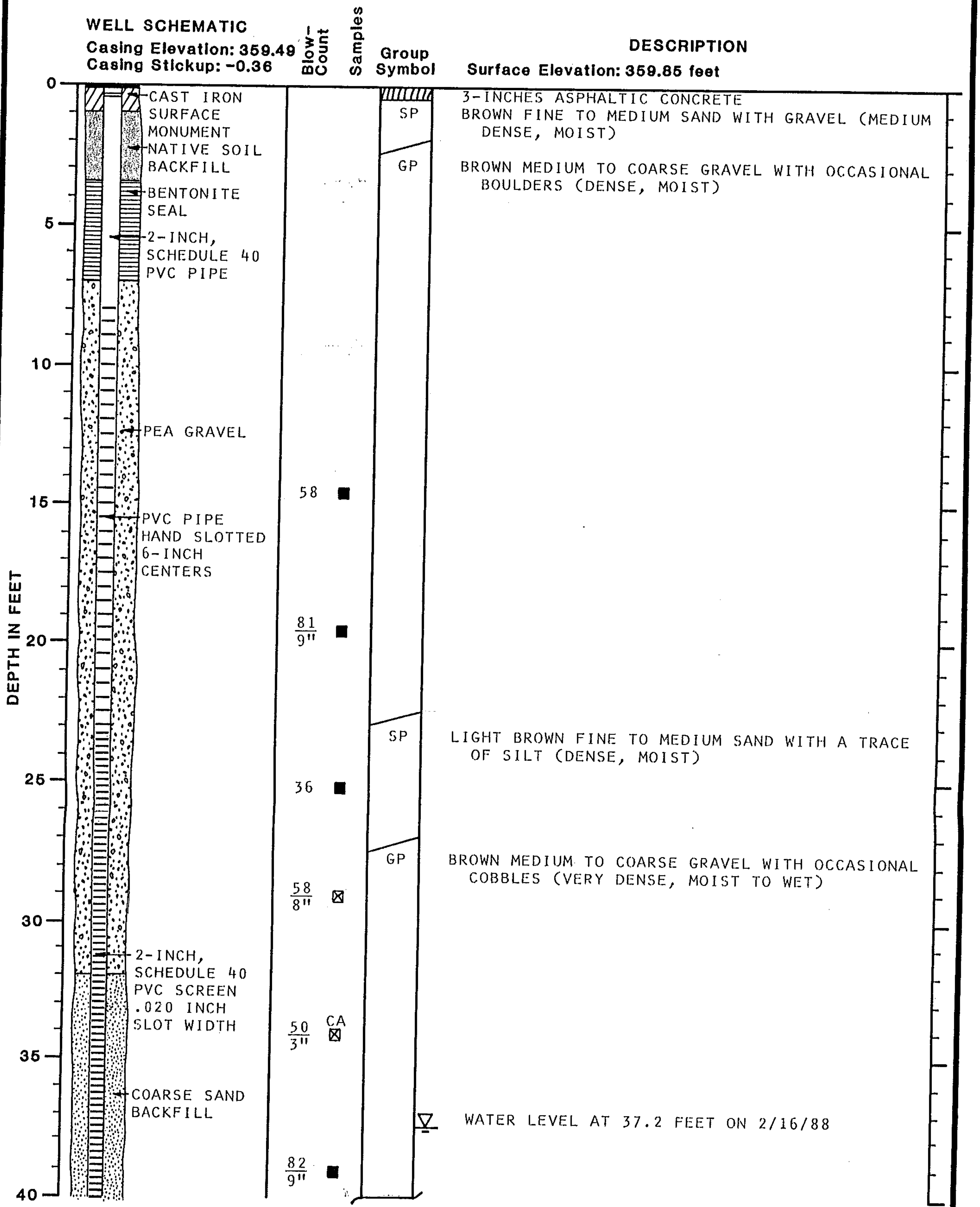
LOG OF MONITOR WELL

FIGURE A-4

MONITOR WELL NO. 2



Note: See Figure A-2 for Explanation of Symbols

GeoEngineers Incorporated

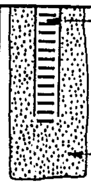
LOG OF MONITOR WELL

FIGURE A-5

MONITOR WELL NO. 2
(CONTINUED)

WELL SCHEMATIC Casing Elevation: Casing Stickup:	Blow-Count	Samples	Group Symbol	DESCRIPTION
			GP	

DEPTH IN FEET: 40, 45, 50, 55, 60, 65, 70, 75, 80



2-INCH, SCHEDULE 40 PVC SCREEN .020 INCH SLOT WIDTH

COARSE SAND BACKFILL

BASE OF WELL AT 43.0 FEET

BORING COMPLETED AT 44.5 FEET ON 2/13/88

NO HYDROCARBON ODOR ENCOUNTERED

Note: See Figure A-2 for Explanation of Symbols

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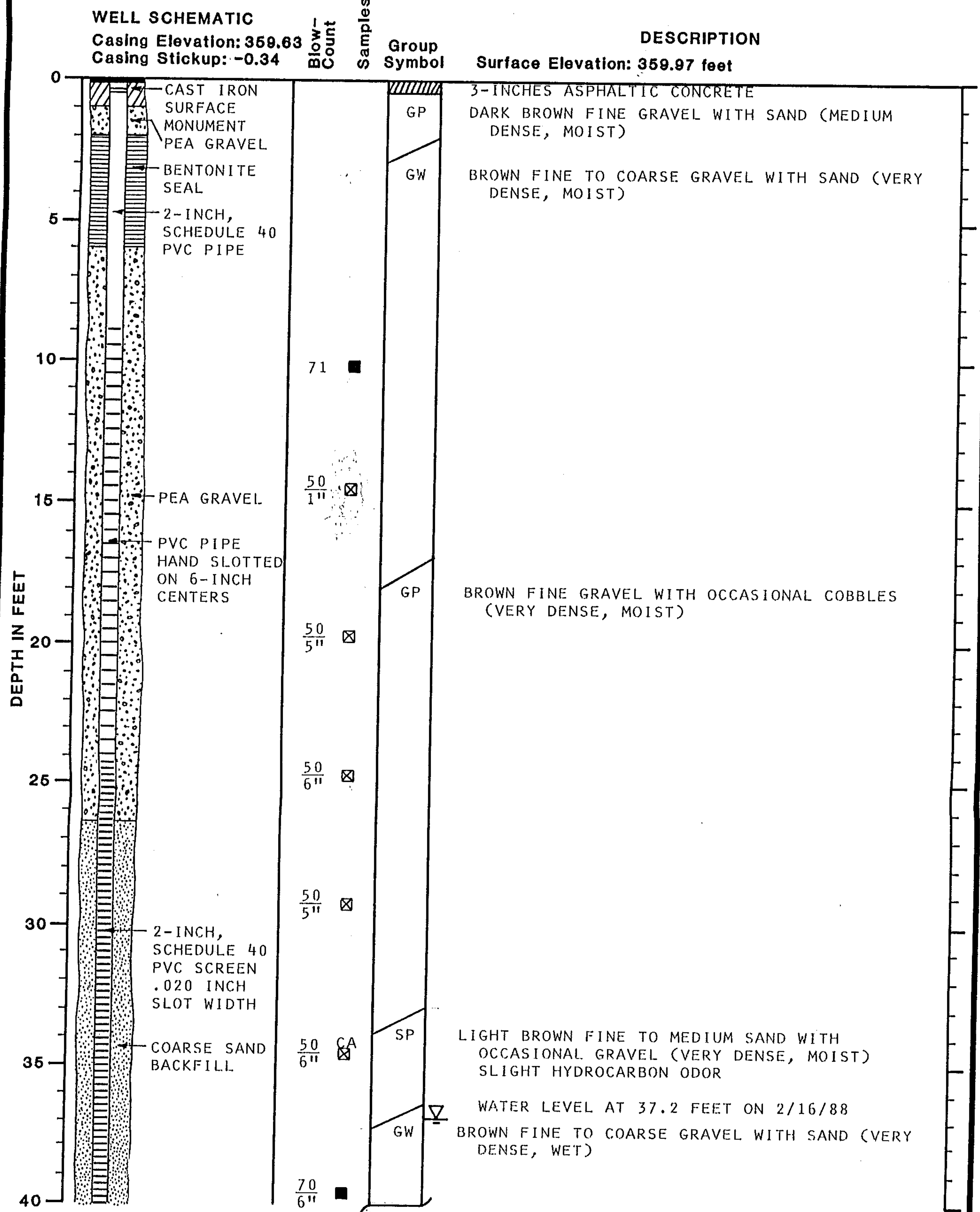
LOG OF MONITOR WELL

FIGURE A-6

MONITOR WELL NO. 3



Note: See Figure A-2 for Explanation of Symbols

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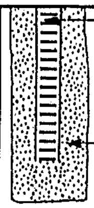
LOG OF MONITOR WELL

FIGURE A-7

MONITOR WELL NO. 3
(CONTINUED)

WELL SCHEMATIC
Casing Elevation:
Casing Stickup:

Depth	Well Schematic	Blow-Count	Samples	Group Symbol	DESCRIPTION
40	2-INCH, SCHEDULE 40 PVC SCREEN .020 INCH SLOT WIDTH, COARSE SAND BACKFILL			GW	
45	BASE OF WELL AT 44.0 FEET	50/5"	⊠		
					BORING COMPLETED AT 45 FEET ON 2/14/88
					SLIGHT HYDROCARBON ODOR AT 35 FEET



DEPTH IN FEET: 40, 45, 50, 55, 60, 65, 70, 75, 80

Note: See Figure A-2 for Explanation of Symbols

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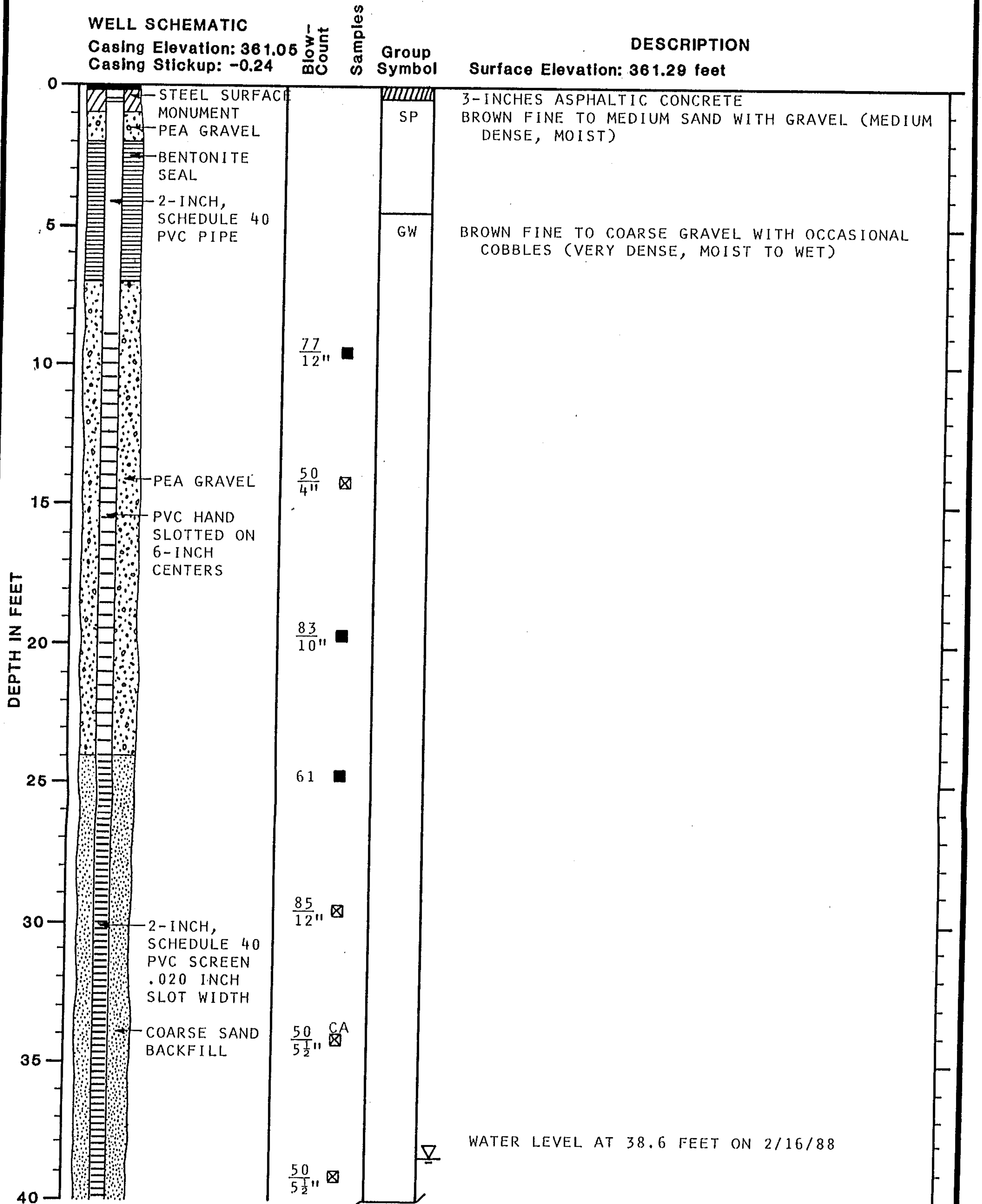
LOG OF MONITOR WELL

FIGURE A-8

MONITOR WELL NO. 4



Note: See Figure A-2 for Explanation of Symbols

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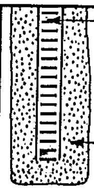
LOG OF MONITOR WELL

FIGURE A-9

MONITOR WELL NO. 4
(CONTINUED)

WELL SCHEMATIC Casing Elevation: Casing Stickup:	Blow-Count	Samples	Group Symbol	DESCRIPTION
40			GW	
45	50/6"	■		BORING COMPLETED AT 44.5 FEET ON 2/15/88 NO HYDROCARBON ODOR ENCOUNTERED



DEPTH IN FEET: 40, 45, 50, 55, 60, 65, 70, 75, 80

Note: See Figure A-2 for Explanation of Symbols

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LOG OF MONITOR WELL

FIGURE A-10

APPENDIX B

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D.
Andrew John Friedman
James E. Bruya, Ph.D.

3008 B - 16th West
Seattle, WA 98119
(206) 285-8282

February 23, 1988

Scott Widness, Geohydrologist
GeoEngineers, Inc.
2405-140th Avenue N.E., Suite 105
Bellevue, WA 98005

Dear Scott:

Enclosed are the results of the analyses of water samples submitted on February 17, 1988 from the Unocal Project, Site #0161-88-4, Richland, WA.

These samples were analysed for BTEX and volatile chlorinated contaminants by GC-FID and GC-FID/ECD.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, please do not hesitate to contact me.

Sincerely,

James K. Farr

James K. Farr, Ph.D.

JKF/cag

Enclosures

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: February 23, 1988
Date Submitted: February 17, 1988
Project: Unocal, Site 0161-88-4, Richland, WA

ANALYSIS OF WATER SAMPLES FOR VOLATILE ORGANICS. RESULTS REPORTED AS ng/g (ppb)

Sample #:	MW-1	MW-2	MW-3	MW-4
Analyte:				
1,1-Dichloroethylene	<10	<10		
Methylene Chloride	<20	<20		
Carbon Tetrachloride	<1	<1		
Chloroform	<1	<1		
1,1,1-Trichloroethane	<1	<1		
Benzene	<5	<5	21	<5
Trichloroethylene	<5	<5		
Toluene	<5	<5	15	<5
Tetrachloroethylene	<5	<5		
o-Xylene	<5	<5	<5	<5
m,p-Xylenes	<5	<5	14	<5
Ethylbenzene	<5	<5	21	<5

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: February 23, 1988
Date Submitted: February 17, 198
Project: Unocal, Site 161-88-4, Richland, WA

ANALYSIS OF WATER SAMPLES FOR VOLATILE ORGANICS. RESULTS REPORTED AS ng/g (ppb)

Sample #:	Method Blank	MW-4 (Duplicate)	MW-4 (Matrix Sp) @ 100 ppb
Analyte:			
1,1-Dichloroethylene			
Methylene Chloride			
Carbon Tetrachloride			
Chloroform			
1,1,1-Trichloroethane			
Benzene	<5	<5	89%
Trichloroethylene			
Toluene	<5	<5	95%
Tetrachloroethylene			
o-Xylene	<5	<5	78%
m,p-Xylenes	<5	<5	93%
Ethylbenzene	<5	<5	93%

Date of Report: February 23, 1988
Date Submitted: February 17, 1988
Project: Unocal, Site 161-88-4, Richland, WA

ANALYSIS OF WATER SAMPLES FOR VOLATILE ORGANICS. RESULTS REPORTED AS ng/g (ppb)

Sample #: Analyte:	Method Blank	MW-2 Matrix Sp) @ 100 ppb
1,1-Dichloroethylene	<10	53%
Methylene Chloride	<20	57%
Carbon Tetrachloride	<1	83%
Chloroform	<1	85%
1,1,1-Trichloroethane	<1	95%
Benzene	<5	98%
Trichloroethylene	<5	100%
Toluene	<5	140%
Tetrachloroethylene	<5	140%
o-Xylene	<5	100%
m,p-Xylenes	<5	99%
Ethylbenzene	<5	98%

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D.
Andrew John Friedman
James E. Bruya, Ph.D.

3008 B - 16th West
Seattle, WA 98119
(206) 285-8282

February 25, 1988

Scott Widness, Geohydrologist
GeoEngineers, Inc.
2405-140th Avenue N.E., Suite 105
Bellevue, WA 98005

Dear Scott:

Enclosed are the results of analyses of soil samples submitted on February 16, 1988 from Unocal Project, Site 161-88-4, Richland, WA.

These samples were analyzed for gasoline, diesel #1 and diesel #2. They were also analyzed for total petroleum hydrocarbons.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, please do not hesitate to contact me.

Sincerely,

James K. Farr

James K. Farr, Ph.D.

JKF/cag

Enclosures

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: February 25, 1988
Date Submitted: February 16, 1988
Project: Unocal, Site #161-88-4, Richland, WA

RESULTS OF ANALYSES OF SOIL SAMPLES FOR GASOLINE, DIESEL #1 AND DIESEL #2

Sample #	Gasoline (ppm)	Diesel #1 (ppm)	Diesel #2 (ppm)
MW-1	<1.0	<10	<10
MW-2	1.8	<10	<10
MW-3	<1.0	<10	<10
MW-4	<1.0	<10	<10
Quality Assurance			
Method Blank	<1.0	<10	<10
MW-1 Duplicate	<1.0	<10	<10
MW-1 Matrix Spike Spiked @ 100 ppm Percent Recovery	71%	-	76%

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: February 25, 1988
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RESULTS OF ANALYSES OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS

Sample #	Total Petroleum Hydrocarbons (ppm)
MW-1	<5
MW-2	<5
MW-3	<5
MW-4	<5