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REPORT OF GEOTECHNICAL SERVICES
SUBSURFACE CONTAMINATION STUDY
CHEVRON BULK FUEL TERMINAL
BREMERTON, WASHINGTON
FOR CHEVRON, U.S.A.
FILE NO. 0372-34-4

11/88



November 16, 1988

Consulting Geotechnical
Engineers and Geologists

Chevron U.S.A., Inc.
P.O. Box 220
Seattle, Washington 98111

Attention: Mr. Mel C. Knutson

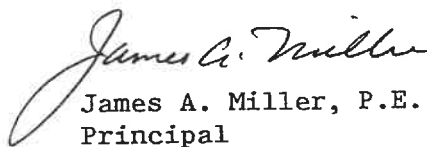
Gentlemen:

This letter transmits three copies of our subsurface contamination investigation of the former Chevron Bulk Fuel Terminal located in Bremerton, Washington. Our services were authorized verbally by Chevron on September 7, 1988, and have been performed under the terms of Contract Number M66CNW00696X, Release No. 9.

We appreciate the opportunity to be of service to Chevron U.S.A. Please call if you have any questions regarding this report.

Yours very truly,

GeoEngineers, Inc.

A handwritten signature in cursive script, reading "James A. Miller".
James A. Miller, P.E.
Principal

DWA:JAM:cs

File No. 0372-34-4

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

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REPORT OF GEOTECHNICAL SERVICES
SUBSURFACE CONTAMINATION STUDY
CHEVRON BULK FUEL TERMINAL
BREMERTON, WASHINGTON
FOR CHEVRON, U.S.A.

INTRODUCTION

The results of our subsurface contamination investigation at the Chevron Bulk Fuel Terminal in Bremerton, Washington are presented in this report. The site is located at 1310 Highland Avenue (Figure 1). We understand that Chevron is planning to sell this property.

A previous site study was conducted by our firm (GeoEngineers, Inc. report dated August 22, 1986). Our previous study was limited in scope and included the installation of two monitoring wells. While no free (floating) hydrocarbons were observed in either monitoring well, petroleum product odors were detected in soil samples and drill cuttings from each boring. Flammable gases were also detected within the air space in both wells. The 1986 monitor wells were destroyed by recent demolition activities at the site.

The purpose of our current investigation is to explore subsurface conditions for potential petroleum-related contamination across the entire terminal site. The scope of work for this investigation included:

1. Subcontracting and monitoring the drilling of twelve exploratory borings with truck-mounted, hollow-stem auger drilling equipment.
2. Subcontracting and monitoring the excavation of seven backhoe pits.
3. Collecting soil samples from the borings at intervals of 5 feet, and a minimum of one soil sample from each backhoe pit. Testing one or more soil samples from each deep boring and backhoe pit for benzene, ethylbenzene, toluene and xylenes (BETX) (EPA Method 8020) and for gasoline and diesel (EPA Method 8015, Modified).
4. Installing a 2-inch-diameter PVC monitor well casing in nine of the twelve borings.

5. Establishing monitor well casing elevations to an accuracy of 0.01 feet using an engineer's level and an assumed site datum.
6. Developing the monitor wells by hand bailing with a stainless steel bailer.
7. Collecting ground water samples from the monitor wells and analyzing these samples for BETX (EPA Method 8020) and for total petroleum hydrocarbons (EPA Method 418.1).
8. Measuring water table elevations for all of the wells and sampling each monitor well for the presence of free petroleum product.
9. Measuring the concentration of hydrocarbon vapors in each monitor well casing.

SITE CONDITIONS

GENERAL

The Bremerton Bulk Fuel Terminal is located approximately 1/4 mile north of the Manette Bridge on Port Washington Narrows (Figure 1). All buildings and major facilities, exclusive of the dock, have been demolished and removed from the site; concrete slabs and limited asphalt paving remain. The former fuel storage tank area is located on a bench cut into the hillside and is generally 8 to 10 feet higher than the northern terminal area (Figure 2).

SUBSURFACE SOIL CONDITIONS

Subsurface soil conditions were explored by drilling 12 hollow-stem auger borings and excavating 7 backhoe pits at the locations indicated on Figure 2. Details of the field exploration program and the boring logs are included in Appendix A.

The borings and backhoe pits revealed relatively uniform soil conditions consisting of sand and silty sand (glacial till) to the total depth explored. Borings B-1, B-2 and B-3 were located near the shoreline and encountered large concrete blocks (rip rap) in the fill. These borings could not be extended deeper than 6 feet. Boring MW-7 encountered sandy gravel at a depth of approximately 16 feet. Ground water was encountered in the nine deep borings.

GROUND WATER CONDITIONS

Ground water conditions at the site were investigated by constructing a monitoring well in the nine borings which encountered ground water Wells MW-4 through MW-12). Construction details for the wells are included in Appendix A. Water level measurements indicate ground water flow in a general northerly direction (Figure 2). The ground water may be influenced by tidal activity in close proximity to Port Washington Narrows.

SUBSURFACE CONTAMINATION

Subsurface contamination by petroleum products was investigated by:

1. Physical examination of soil from the borings and backhoe pits for odors or stains indicative of hydrocarbon contamination.
2. Testing soil and water samples for various indexes of hydrocarbon contamination.
3. Measuring the concentration of hydrocarbon vapors in each monitoring well casing.
4. Sampling the water table interface in each monitor well for the presence of free (floating) hydrocarbons.

Soil analytical chemistry data for the borings and test pits are summarized on Table 1; the laboratory data sheets are presented in Appendix B. The presence of hydrocarbons was detected in all areas of the site, with higher contaminant concentrations in the northern one-third of the site.

Ground water analytical chemistry data are summarized on Table 2; the laboratory data sheets are presented in Appendix B. Both dissolved and free (floating) hydrocarbons were detected in the ground water underlying the site. Free product in Well MW-4 was measured to be 1.09, 1.35 and 1.04 feet thick on 9/26/88, 10/12/88, and 10/27/88, respectively. Free product in Well MW-8 was measured to be 0.02 and 0.03 feet thick on 10/12/88 and 10/27/88, respectively.

Petroleum fuel odors were encountered in soil samples and drill cuttings, where indicated on the boring logs. Flammable gases were measured within the air space of all monitoring wells using a TLV Sniffer

calibrated to hexane. Well MW-7 resulted in 7800 ppm (70% LEL); the other eight monitoring wells had flammable gas concentrations in excess of 10,000 ppm (92% LEL), the maximum range of the instrument.

Samples of free (floating) petroleum product were examined and reported to be 82 percent gasoline and 18 percent diesel. API gravity was determined to be 47.4.

LIMITATIONS

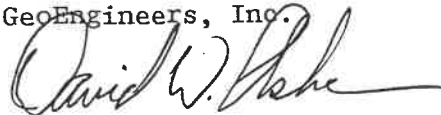
This report has been prepared for use by Chevron U.S.A. in their evaluation of subsurface contamination at the Bulk Fuel Terminal located in Bremerton, Washington. This report may be made available to potential buyers of the property or to regulatory agencies. The report is not intended for use by others and the information contained herein may not be applicable to other sites.

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, expressed or implied, should be understood.

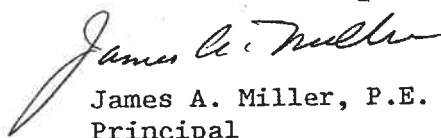
If you have questions concerning this report, please call.

Respectfully submitted,

GeoEngineers, Inc.



David W. Ashcom, P.E.
Project Manager



James A. Miller, P.E.
Principal

DWA:JAM:cs

TABLE 1
SUMMARY OF SOIL ANALYTICAL CHEMISTRY DATA

Location	Gasoline (ppm)	Diesel		Benzene (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Total Xylenes (ppb)
		#1 (ppm)	#2 (ppm)				
B-3	66	<10	<10				
MW-4	630	<10	100	<10	15,000	3,100	12,400
MW-5	4,300	17,000	<10	3,400	9,400	2,600	6,800
MW-6	230	71	<10	<10	8,700	2,300	10,500
MW-7	<1	<10	<10	<10	27	66	<10
MW-8	900	<10	200	<10	39,000	110,000	37,000
MW-9	<1	<10	<10	<10	<10	<10	29
MW-10	<1	<10	<10	<10	<10	<10	<10
MW-11	3	<10	480	<10	<10	<10	<10
MW-12	220	<10	210	<10	<10	<10	520
TP-1	250	<10	1,400	<10	<10	169	15
TP-2	31	<10	74	<10	<10	201	15
TP-3	81	<10	250	<10	<10	88	680
TP-4	<1	<10	<10	<1	<1	<1	<1
TP-5	<1	<10	<10	<1	<1	<1	<1
TP-6	4	<10	82	<10	<10	<10	41
TP-7	280	<10	47	<10	6,100	2,400	2,300

TABLE 2
SUMMARY OF GROUND WATER ANALYTICAL CHEMISTRY DATA

Location	Total Petroleum Hydrocarbons (ppm)	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Total Xylenes (ppb)
MW-4	a.	<100	<100	3,600	23,000
MW-5	46.4	1,900	360	290	1,900
MW-6	36.7	2,000	1,500	150	4,300
MW-7	76.7	<1	<1	62	21
MW-8	1,742	3,900	19,000	2,900	18,000
MW-9	38.9	6,100	11,000	1,400	9,800
MW-10	150	<1	<1	350	110
MW-11	<10	<1	<1	<1	<1
MW-12	<10	<1	<1	11	<1

Notes:

a. Sample contained 75% naptha



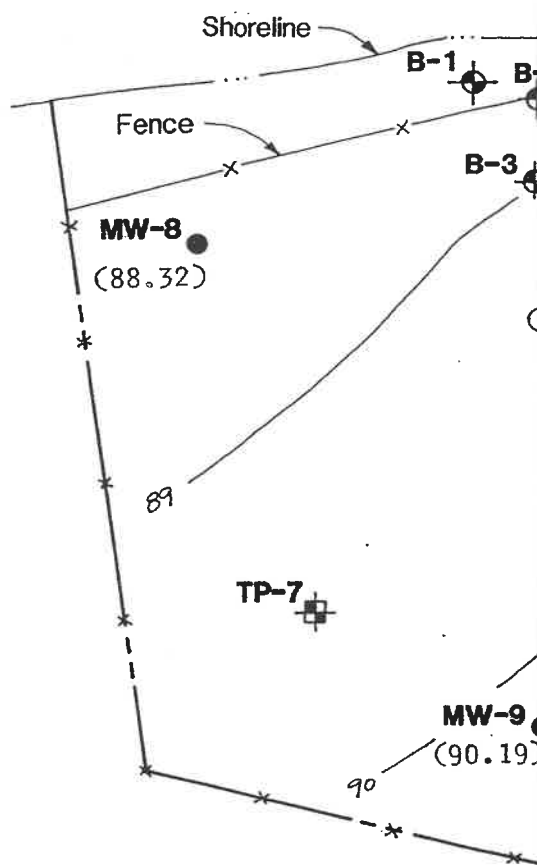
REFERENCE: USGS 7.5' TOPOGRAPHIC
QUADRANGLE SHEETS "BREMERTON
EAST, WASH." AND "BREMERTON
WEST, WASH."

0 2000 4000
SCALE IN FEET

Geo  Engineers

VICINITY MAP

FIGURE 1



EXPLANATION:

B-1 BORING LOCATION
AND NUMBER

MW-4 MONITOR WELL LOCATION
AND NUMBER

TP-1 BACKHOE PIT LOCATION
AND NUMBER

(89.92) RELATIVE GROUND WATER
ELEVATION ON 10/12/88

GROUND WATER FLOW DIRECTION

MW-1 MONITOR WELL INSTALLED
JULY, 1976 BY GEOENGINEERS

91 WATER TABLE ELEVATION CONTOURS
BASED ON 10/12/88 MEASUREMENTS

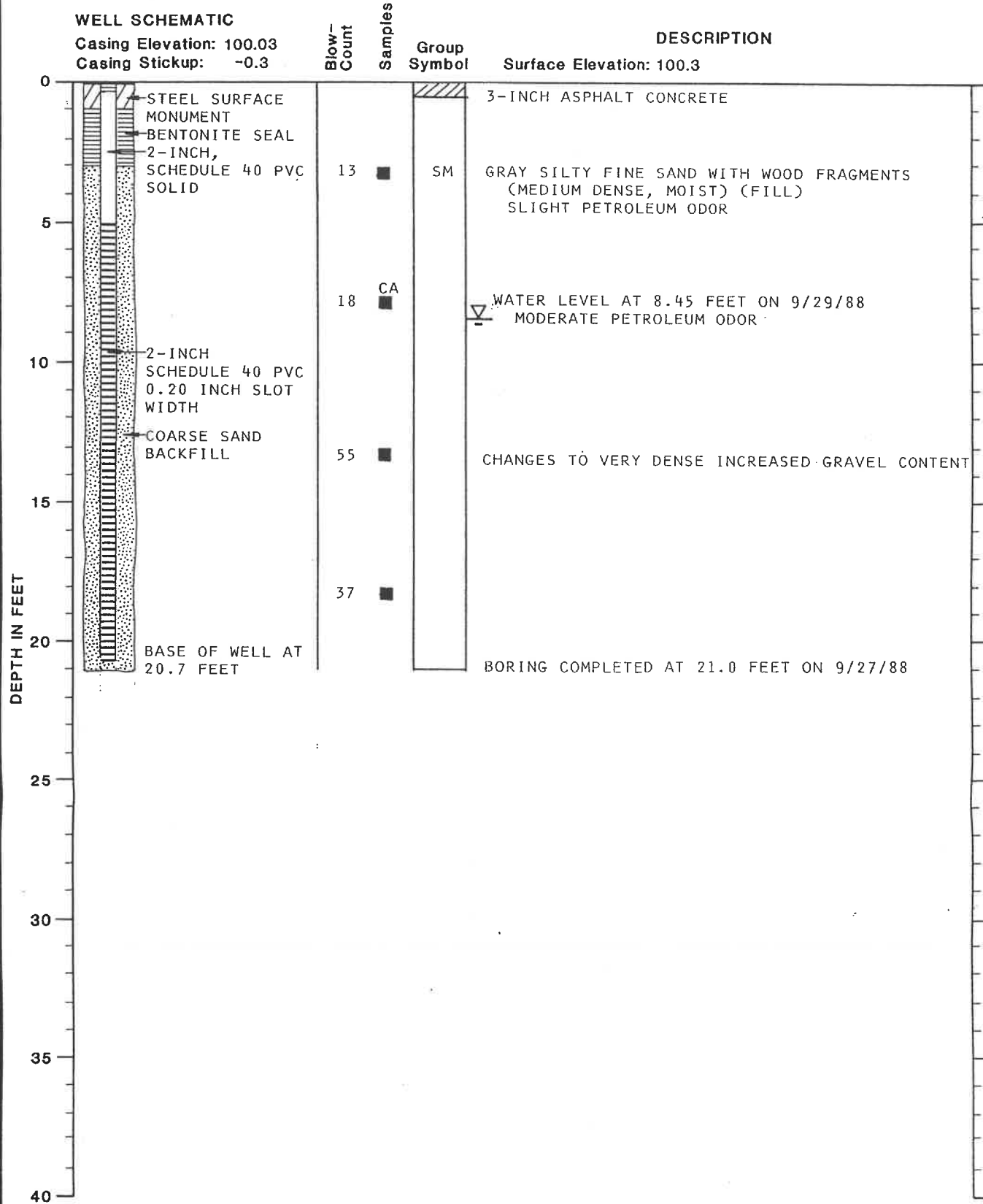
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STANDARD OIL

SITE PLAN

FIGURE 2

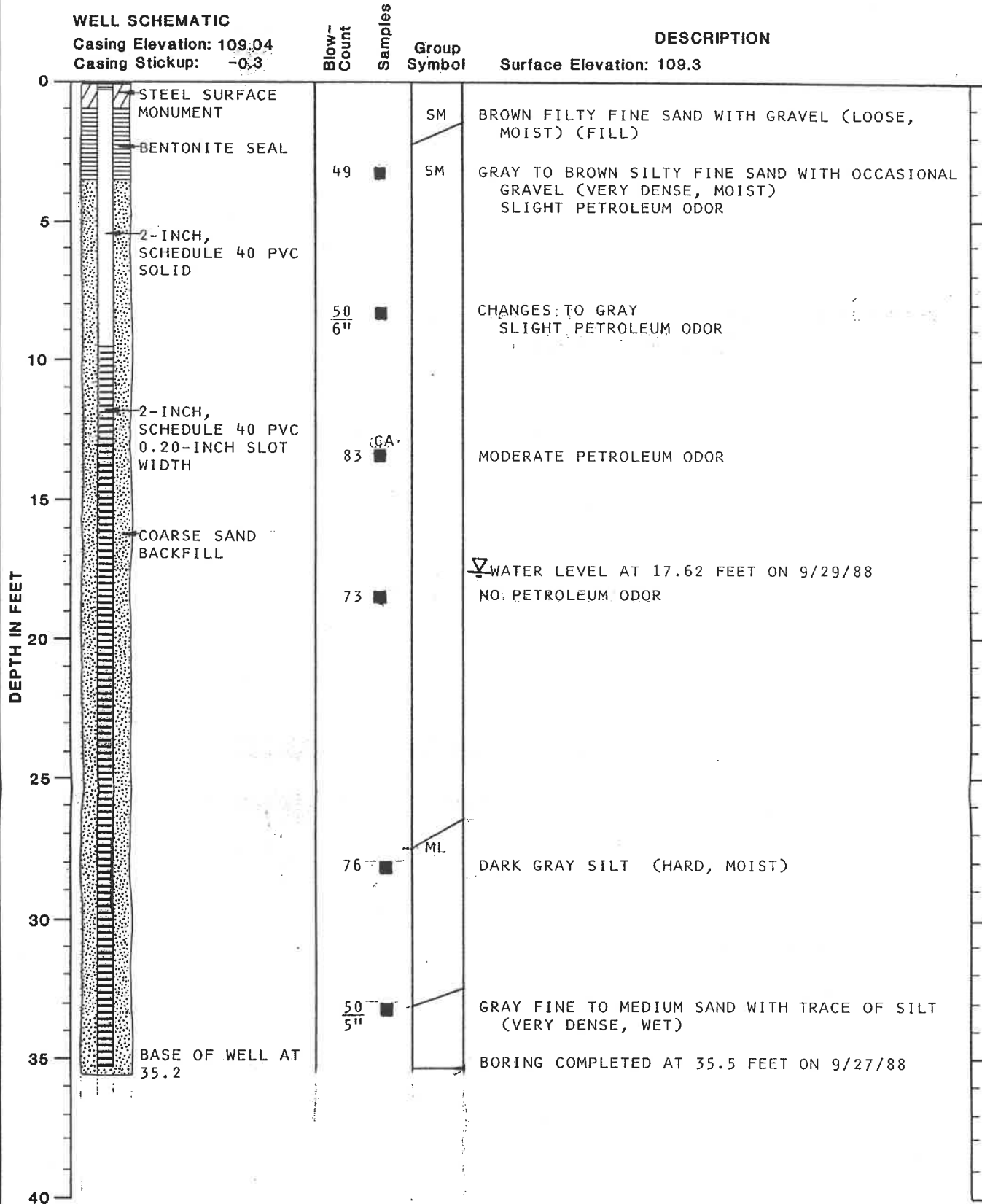
0572-54-44 BATH: KLV 10-7-88

MONITOR WELL NO. MW-11



Note: See Figure A-2 for Explanation of Symbols

MONITOR WELL NO. MW-12



Note: See Figure A-2 for Explanation of Symbols

LOG OF TEST PIT

DEPTH BELOW GROUND SURFACE (FEET)	GROUP SOIL CLASSIFICATION SYMBOL	DESCRIPTION
<u>TEST PIT 1</u>		
0 - 2.5	SM	BROWN SILTY FINE SAND WITH OCCASIONAL FINE TO MEDIUM GRAVEL, WOOD FRAGMENTS, METAL, AND BLOCKS OF CONCRETE (LOOSE, MOIST) (FILL)
2.5 - 5.5	SM	BROWN TO GRAY SILTY FINE SAND WITH FINE GRAVEL (DENSE TO VERY DENSE, MOIST) SLIGHT PETROLEUM ODOR DETECTED AT 3.0 FEET
5.5 - 9.5	SM	GRAY SILTY FINE SAND WITH FINE GRAVEL (VERY DENSE, MOIST) (TILL) SLIGHT PETROLEUM ODOR DETECTED; BECOMES MODERATE PETROLEUM ODOR AT 7.0 FEET OCCASIONAL COBBLES AT 8.0 FEET SLIGHT PETROLEUM ODOR DETECTED AT 9.0 FEET SAMPLE OBTAINED AT 7.0 FEET TEST PIT COMPLETED AT 9.5 FEET ON 9/28/88
<u>TEST PIT 2</u>		
0 - 1.5	SM	BROWN SILTY FINE SAND WITH OCCASIONAL FINE TO MEDIUM GRAVEL, CONCRETE, WIRE AND WOOD FRAGMENTS (MEDIUM DENSE, MOIST) (FILL)
1.5 - 3.0	SM	BROWN TO GRAY SILTY FINE SAND WITH FINE GRAVEL (DENSE, MOIST) (WEATHERED TILL) MODERATE ORGANIC ODOR AT 2.0 FEET
3.0 - 9.0	SM	BLUE-GRAY SILTY FINE SAND WITH FINE GRAVEL AND OCCASIONAL COBBLES (VERY DENSE, MOIST) (FILL) MODERATE PETROLEUM ODOR DETECTED AT 4.0 FEET SAMPLES OBTAINED AT 2.5 AND 9.0 FEET TEST PIT COMPLETED AT 9.0 FEET ON 9/28/88
<u>TEST PIT 3</u>		
0 - 1.2	SM	BROWN SILTY FINE SAND WITH OCCASIONAL FINE TO MEDIUM GRAVEL, WOOD AND METAL FRAGMENTS (MEDIUM DENSE, MOIST) (FILL) SLIGHT PETROLEUM ODOR DETECTED
1.2 - 2.0	SM	BROWN TO GRAY SILTY FINE SAND WITH FINE GRAVEL (DENSE, MOIST) (WEATHERED TILL) SLIGHT TO MODERATE PETROLEUM ODOR DETECTED AT 1.5 FEET
2.0 - 8.5	SM	BLUE-GRAY SILTY FINE SAND WITH FINE GRAVEL AND OCCASIONAL COBBLES (VERY DENSE, MOIST) (TILL) MODERATE TO STRONG PETROLEUM ODOR DETECTED AT 4.0 FEET SAMPLE OBTAINED AT 4.0 FEET TEST PIT COMPLETED AT 8.5 FEET ON 9/28/88

THE DEPTHS ON THE TEST PIT LOGS, ALTHOUGH SHOWN TO 0.1 FEET, ARE BASED ON AN AVERAGE OF MEASUREMENTS ACROSS THE TEST PIT AND SHOULD BE CONSIDERED ACCURATE TO 0.5 FEET.

LOG OF TEST PIT

DEPTH BELOW GROUND SURFACE (FEET)	GROUP SOIL CLASSIFICATION SYMBOL	DESCRIPTION
<u>TEST PIT 4</u>		
0 - 1.2	SP	GRAY TO BROWN FINE TO MEDIUM SAND WITH FINE GRAVEL AND A TRACE OF SILT (LOOSE, MOIST) (FILL)
1.2 - 7.0	SM	GRAY SILTY FINE SAND WITH FINE GRAVEL AND OCCASIONAL COBBLES (VERY DENSE, MOIST) (FILL) NO PETROLEUM ODOR DETECTED SAMPLE OBTAINED AT 6.0 FEET TEST PIT COMPLETED AT 7.0 FEET ON 9/28/88
<u>TEST PIT 5</u>		
0 - 1.5	SM	BROWNISH-GRAY SILTY FINE SAND WITH OCCASIONAL FINE TO MEDIUM GRAVEL AND WOOD FRAGMENTS (MEDIUM DENSE, MOIST) (FILL)
1.5 - 8.0	SM	GRAY SILTY FINE SAND WITH FINE GRAVEL AND OCCASIONAL COBBLES (VERY DENSE, MOIST) (TILL) NO PETROLEUM ODOR DETECTED SAMPLE OBTAINED AT 8.0 FEET TEST PIT COMPLETED AT 8.0 FEET ON 9/28/88
<u>TEST PIT 6</u>		
0 - 0.5	SM	BROWN TO GRAY SILTY FINE SAND WITH OCCASIONAL FINE GRAVEL, ROOTS AND CONCRETE (MEDIUM DENSE, MOIST) (FILL) SLIGHT PETROLEUM ODOR DETECTED AT 0.5 FEET
0.5 - 8.0	SM	GRAY TO BLUE-GRAY SILTY FINE SAND WITH FINE GRAVEL AND OCCASIONAL COBBLES (VERY DENSE, MOIST) MODERATE PETROLEUM ODOR DETECTED AT 7.0 FEET SAMPLE OBTAINED AT 7.5 FEET TEST PIT COMPLETED AT 8.0 FEET ON 9/28/88
<u>TEST PIT 7</u>		
0 - 0.2		ASPHALT CONCRETE
0.2 - 2.5	SM	BROWN SILTY FINE TO MEDIUM SAND WITH FINE GRAVEL (LOOSE, MOIST) (FILL)
2.5 - 9.0	SP-SM	GRAY FINE TO MEDIUM SAND WITH SILT AND OCCASIONAL FINE TO MEDIUM GRAVEL (MEDIUM DENSE, MOIST) (FILL) MODERATE PETROLEUM ODOR DETECTED AT 3.0 FEET; STRONG PETROLEUM ODOR DETECTED AT 8.5 FEET SAMPLE OBTAINED AT 8.0 FEET SOIL BECOMES WET AT 9.0 FEET TEST PIT COMPLETED AT 9.0 FEET ON 9/28/88

APPENDIX B

ENVIRONMENTAL CHEMISTS

Date of Report: October 12, 1988
Date Submitted: September 30, 1988
Project: 372-34-4

RESULTS OF ANALYSES OF SAMPLES FOR
GASOLINE, DIESEL #1 AND
DIESEL #2 BY GC/FID

<u>Sample #</u>	<u>Gasoline</u> (ppm)	<u>Diesel</u>	
		<u>#1</u> (ppm)	<u>#2</u> (ppm)
TP-1 soil	250 ^a	<10	1400 ^a
TP-2 soil	31	<10	74
TP-3 soil	81	<10	250 ^a
TP-4 soil	<1	<10	<10
TP-5 soil	<1	<10	<10
TP-6 soil	4	<10	82
TP-7 soil	280 ^a	<10	47
MW-4 soil	630 ^a	<10	100
MW-5 soil	4300 ^a	17000 ^a	<10
MW-6 soil	230 ^a	71	<10
MW-7 soil	<1	<10	<10
MW-8 soil	900 ^a	<10	200 ^a

^a - Value reported exceeded the calibration range established for the sample.

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: October 12, 1988
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RESULTS OF ANALYSES OF SAMPLES FOR
GASOLINE, DIESEL #1 AND
DIESEL #2 BY GC/FID

<u>Sample #</u>	<u>Gasoline</u> (ppm)	<u>Diesel</u>	
		<u>#1</u> (ppm)	<u>#2</u> (ppm)
MW-9 soil	<1	<10	<10
MW-10 soil	<1	<10	<10
MW-11 soil	3	<10	480 ^a
MW-12 soil	220 ^a	<10	210 ^a
B-3 soil	66	<10	<10
<u>Quality Assurance</u>			
Method Blank	<1	<10	<10
MW-4 (Duplicate)	840 ^a	<10	140 ^a
MW-4 (Matrix Spike)			
Spiked @ 100 ppm			
Percent Recovery	c	b	140%

a - Value reported exceeded the calibration range established for the sample.

b - The analyte indicated was not added to the matrix spike sample.

c - The amount spiked was insufficient to give meaningful recovery data.

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: October 12, 1988
 Date Submitted: September 30, 1988
 Project: 372-34-4

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR BTX AND ETHYLBENZENE USING THE HEADSPACE METHOD Results Reported as ng/g (ppb)

Sample #		Benzene	Toluene	Et-Benzene	Xylene	
					<i>m,p</i>	<i>o</i>
TP-1	soil	<10 ^a	<10 ^a	169 ^a	15 ^a	<10 ^a
TP-2	soil	<10 ^a	<10 ^a	201 ^a	15 ^a	<10 ^a
TP-3	soil	<10 ^a	<10 ^a	88 ^a	680 ^a	<10 ^a
TP-4	soil	<1	<1	<1	<1	<1
TP-5	soil	<1	<1	<1	<1	<1
TP-6	soil	<10 ^a	<10 ^a	<10 ^a	41 ^a	<10 ^a
TP-7	soil	<10 ^a	6100 ^a	2400 ^a	2300 ^a	<10 ^a
MW-4	soil	<10 ^a	15000 ^a	3100 ^a	404 ^a	12000 ^a
MW-5	soil	3400 ^a	9400 ^a	2600 ^a	460 ^a	6300 ^a
MW_6	soil	<10 ^a	8700 ^a	2300 ^a	7900 ^a	2600 ^a
MW-7	soil	<10 ^a	27 ^a	66 ^a	<10nn ^a	<10 ^a
MW_8	soil	<10 ^a	39000 ^a	110000 ^a	1300 ^a	36000 ^a
MW-9	soil	<10 ^a	<10 ^a	<10 ^a	<10 ^a	29 ^a
MW-10	soil	<10 ^a	<10 ^a	<10 ^a	<10 ^a	<10 ^a

a - Interferences were present which interfered with the identification and quantitation of the analyte indicated.

b - Value reported exceeded the calibration range established for the sample.

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: October 12, 1988
Date Submitted: September 30, 1988
Project: 372-34-4

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES
FOR BTX AND ETHYLBENZENE
USING THE HEADSPACE METHOD
Results Reported as ng/g (ppb)

<u>Sample #</u>		<u>Benzene</u>	<u>Toluene</u>	<u>Et-Benzene</u>	<u>Xylene</u>	
					<u>m.p</u>	<u>o</u>
MW-11	soil	<10a	<10a	<10a	<10a	<10a
MW-12	soil	<10a	<10a	110a	520a	<10a
B-3	soil	<1	<1	<1	<1	<1
MW-7	water	<1	<1	62	21	<1
MW-8	water	3900b	19000b	2900b	13000b	5200b
MW-9	water	6100b	11000b	1400b	7100b	2700b
MW-10	water	<10a	<10a	350	110	<10a
MW-11	water	<1	<1	<1	11	<1
MW-4	water	<100a	<100a	3600b	23000b	<100a
MW-5	water	1900b	360	290	1300b	580b
MW-6	water	2000b	1500	150	3200b	1100b
MW-12	water	<1	<1	<1	<1	<1

a - Interferences were present which interfered with the identification and quantitation of the analyte indicated.

b - Value reported exceeded the calibration range established for the sample.

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: October 12, 1988
Date Submitted: September 30, 1988
Project: 372-34-4

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES
FOR TOTAL PETROLEUM HYDROCARBONS
BY IR (EPA METHOD 418.1)

<u>Sample #</u>	<u>Total Petroleum Hydrocarbons</u> (ppm)
MW-6 water	36.7
MW-7 water	76.7
MW-8 water	1742
MW-9 water	38.9
Mw-10 water	150
MW-11 water	<10
MW-4 water	a
MW-5 water	46.4
MW-12 water	<10
<u>Quality Assurance</u>	
Method Blank	<10

a - Sample contained 75% naphtha.

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: October 12, 1988
 Date Submitted: September 30, 1988
 Project: 372-34-4

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR BTX AND ETHYLBENZENE USING THE HEADSPACE METHOD Results Reported as ng/g (ppb)

Quality Assurance

<u>Sample #</u>	<u>Benzene</u>	<u>Toluene</u>	<u>Et-Benzene</u>	<u>Xylene</u>	
				<u>m,p</u>	<u>o</u>
Method Blank	<1	<1	<1	<1	<1
MW-4 soil (Duplicate)	<1 ^a	12000 ^a	31000 ^a	360 ^a	12000 ^a
MW-4 soil (Matrix Spike) Spiked @ 5 ppm Percent Recovery	c	c	c	c	c
MW-5 water (Duplicate 1500 ^b		120	21	680 ^b	340
MW-5 soil (Matrix Spike) Spiked @ 5 ppm Percent Recovery	c	66%	56%	c	43%

- a - Interferences were present which interfered with the identification and quantitation of the analyte indicated.
- b - Value reported exceeded the calibration range established for the sample.
- c - The amount spiked was insufficient to give meaningful recovery data.

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: October 21, 1988
Date Submitted: October 12, 1988
Project: 372-34-4

**RESULTS OF ANALYSES OF ENVIRONMENTAL
SAMPLES FOR PERCENT GAS AND DIESEL**

Sample #

MW-2 The sample contained 82% gasoline and 18% diesel.

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: November 7, 1988

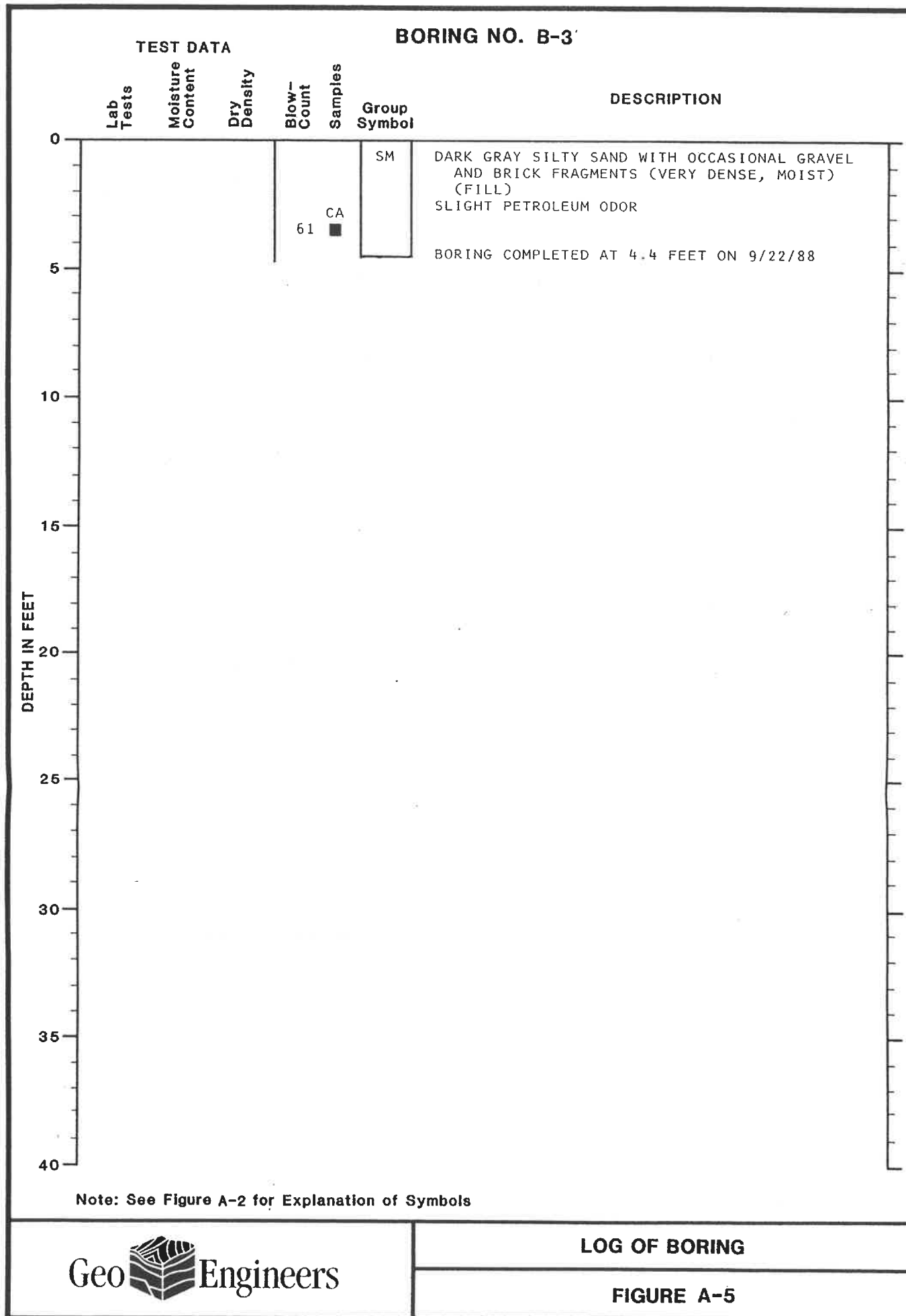
Date Submitted: October 31, 1988

Project: 372-34-4

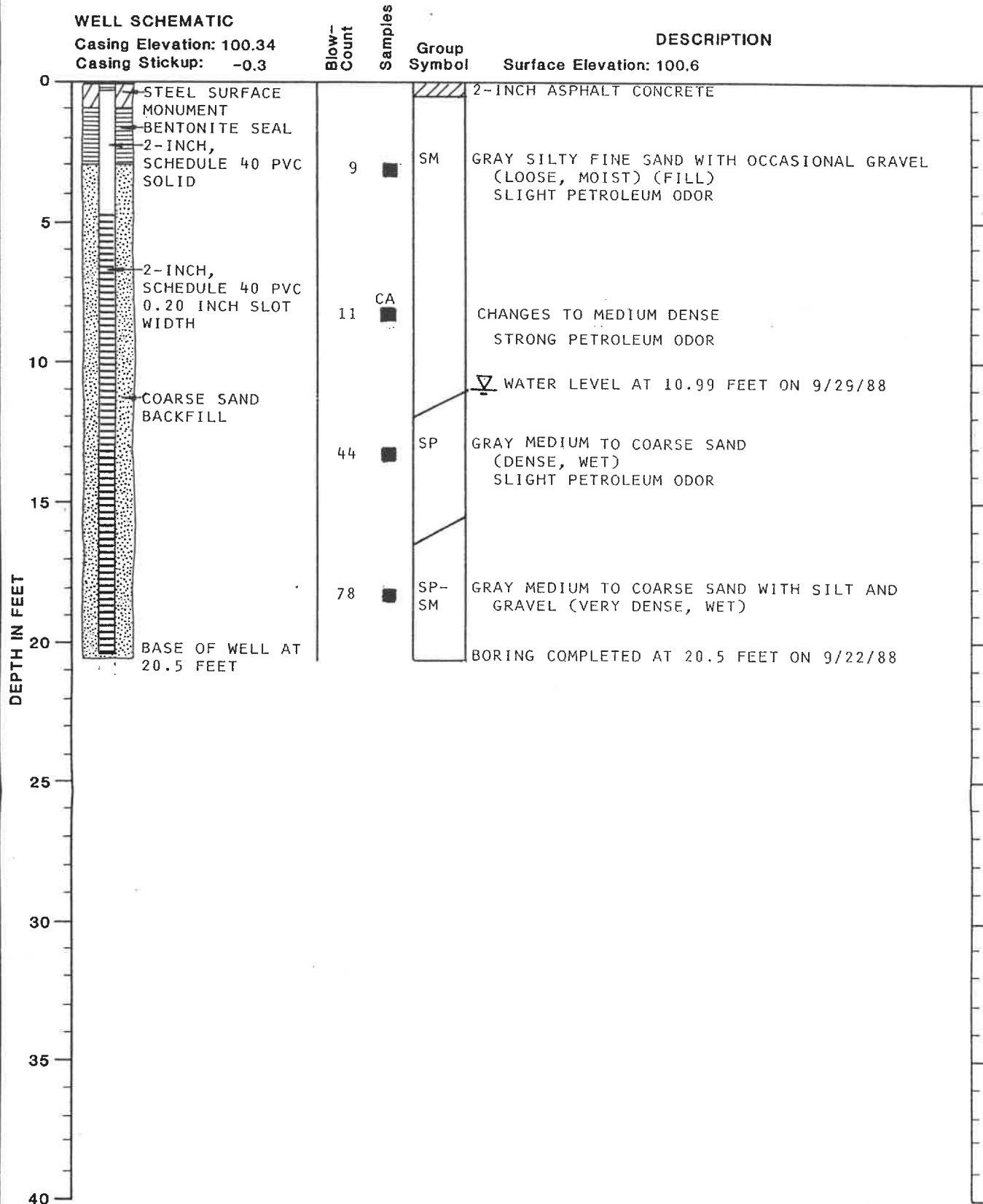
RESULTS OF ANALYSES OF ENVIRONMENTAL
SAMPLES FOR API GRAVITY

<u>Sample #</u>	API Gravity
MW-4 product	47.4

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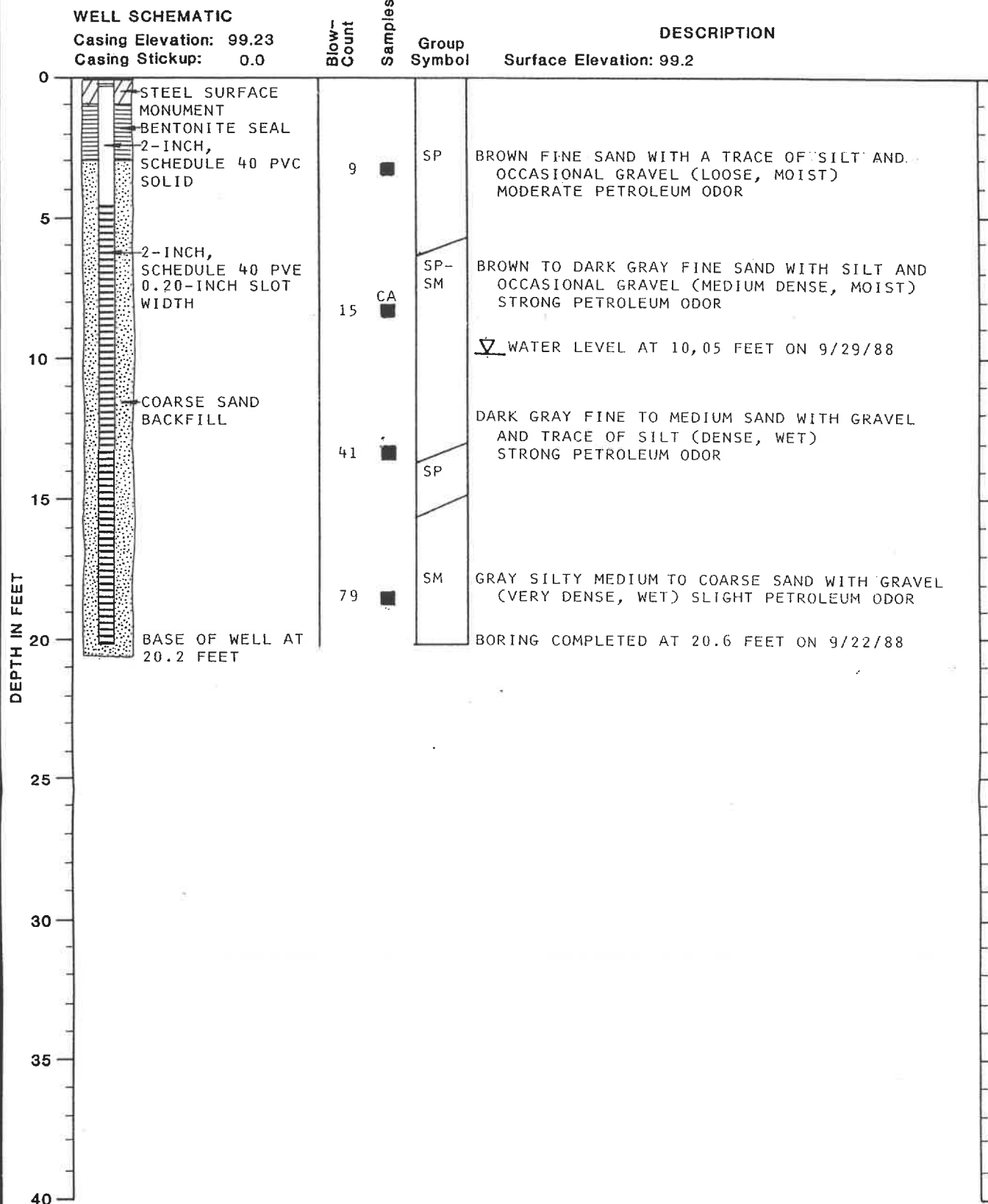


MONITOR WELL NO. MW-4



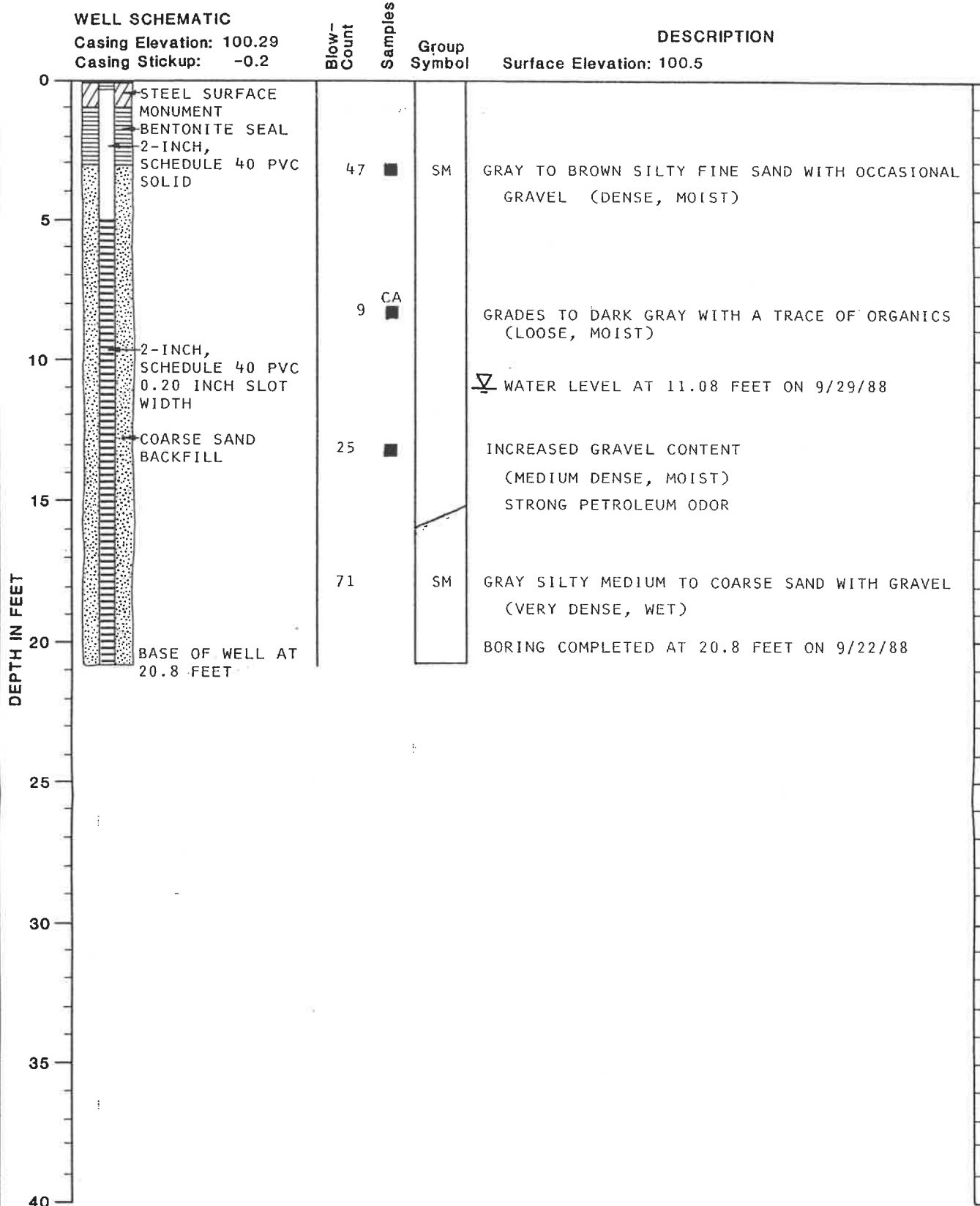
Note: See Figure A-2 for Explanation of Symbols

MONITOR WELL NO. MW-5



Note: See Figure A-2 for Explanation of Symbols

MONITOR WELL NO. MW-6



Note: See Figure A-2 for Explanation of Symbols

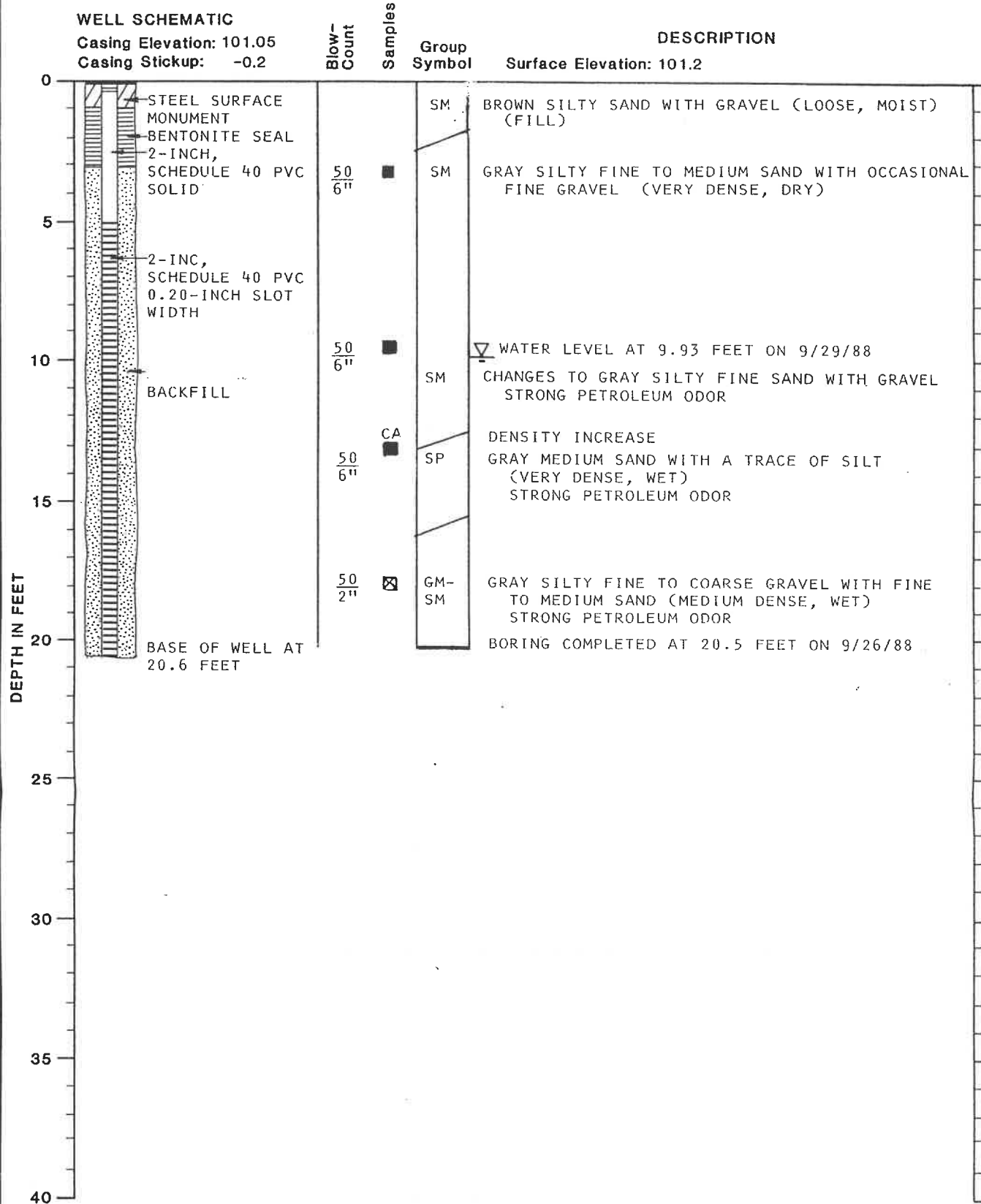
Geo  Engineers

LOG OF MONITOR WELL

FIGURE A-8

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MONITOR WELL NO. MW-7



Note: See Figure A-2 for Explanation of Symbols

MONITOR WELL NO. MW-8

WELL SCHEMATIC

Casing Elevation: 98.17
Casing Stickup: -0.5

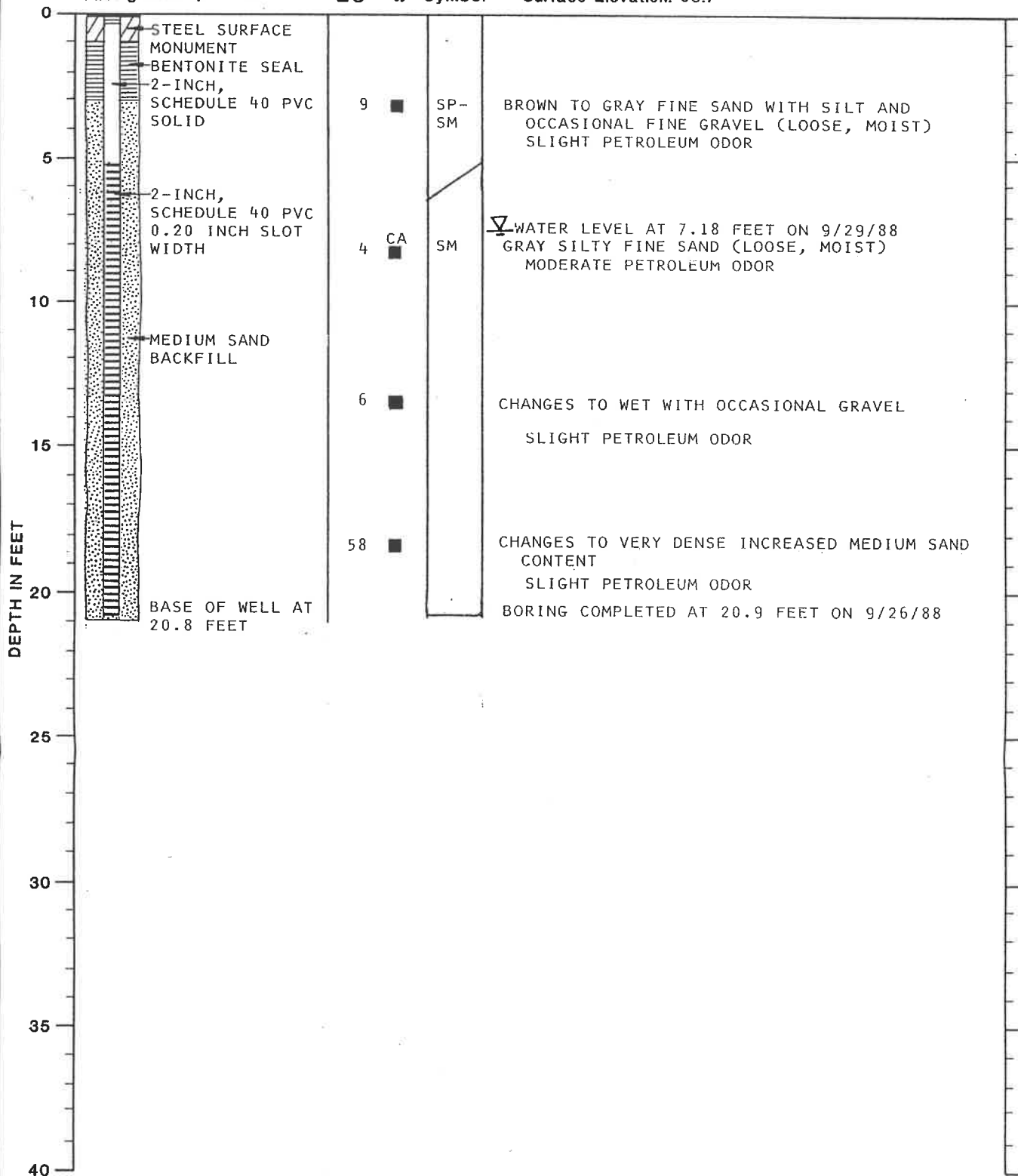
Blow-
Count

Samples

Group
Symbol

DESCRIPTION

Surface Elevation: 98.7



Note: See Figure A-2 for Explanation of Symbols

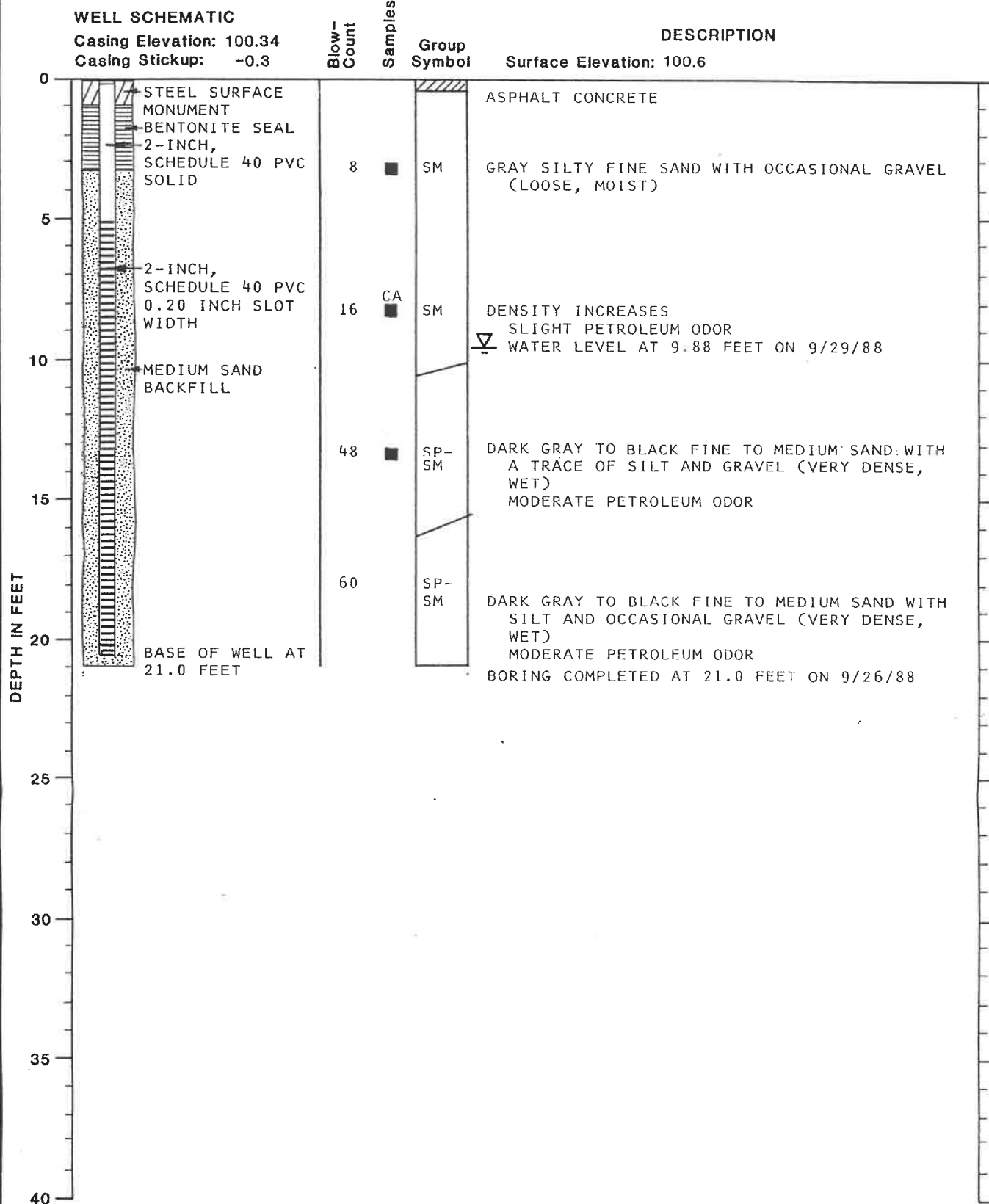
Geo  Engineers

LOG OF MONITOR WELL

FIGURE A-10

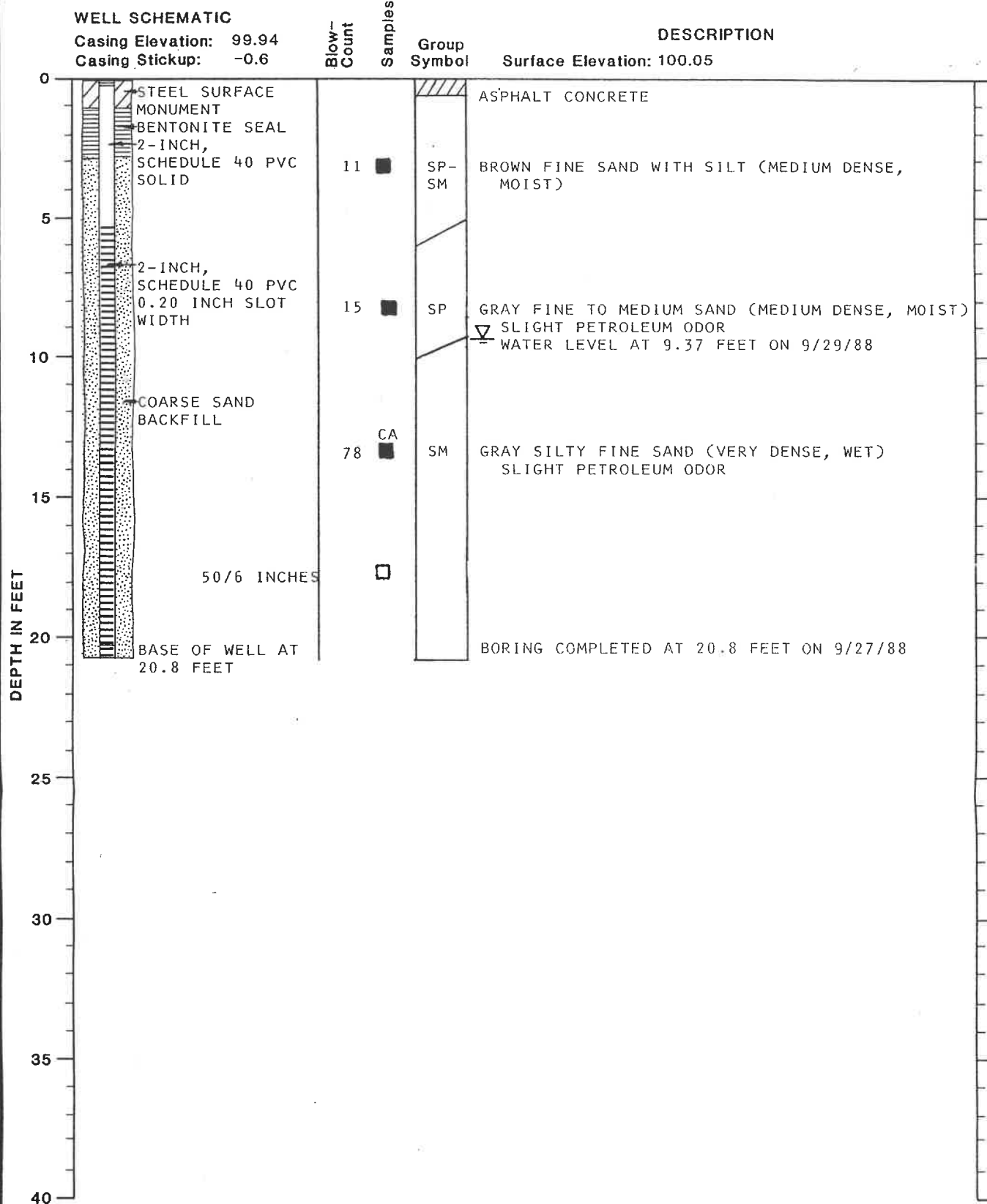
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MONITOR WELL NO. MW-9



Note: See Figure A-2 for Explanation of Symbols

MONITOR WELL NO. MW-10



Note: See Figure A-2 for Explanation of Symbols

APPENDIX A

A P P E N D I X A

FIELD EXPLORATIONS

DRILLING AND SOIL SAMPLING PROCEDURES

Subsurface soil conditions at the Chevron Bulk Fuel Terminal in Bremerton, Washington were investigated by drilling 12 hollow-stem auger borings to depths of from 3 to 35 feet. Drilling services were sub-contracted to R & R Drilling of Puyallup, Washington. Subsurface conditions were further examined by excavating seven backhoe pits to depths of approximately 8 feet each. This site investigation was performed on September 22-29, 1988.

A geologist from our staff examined the soils encountered, classified them visually in general accordance with ASTM-2488-83 (Figure A-1), and prepared detailed logs of the explorations. An explanation of the boring log symbols (Figure A-2) precedes the boring logs (Figures A-3 through A-14). Backhoe pits are similarly described on Figures A-15 and A-16.

MONITOR WELL CONSTRUCTION

Two-inch-diameter, Schedule 40 PVC pipe was installed in 9 of 12 borings at the completion of drilling. The lower portion of the well casing is machine slotted (0.02-inch slot width) to allow entry of water, floating hydrocarbons, or hydrocarbon vapors into the well. Medium to coarse sand was placed in the borehole annulus surrounding the slotted portion of the wells. Bentonite surface seals were installed in the upper annular space of all monitoring wells. Monitor well construction is indicated in Figures A-3 through A-14.

Monitor well casing elevations were surveyed to the nearest 0.01 foot using an engineer's level. A datum of 100.00 feet was established at the base of the power pole adjacent to Highland Avenue. This relative elevation data is included on the monitor well logs.

GROUND WATER ELEVATIONS AND SAMPLING

The depth to the ground water was measured from the monitor well casing rim using a fiberglass tape and water-finding paste on 9/29/88 and 10/12/88. Ground water elevations were calculated by subtracting the water table depth from the casing rim elevations.

Monitor wells were developed following installation using a stainless steel bailer to remove a minimum of five well volumes of water. Ground water samples were collected from monitoring wells MW-4 through MW-12 by GeoEngineers on 9/29/88 using a teflon bailer following the removal of a minimum of three well volumes of water from each well casing. The water samples were transferred to septum vials in the field and kept cool during transport to the analytical chemistry laboratory. The bailer was cleaned prior to each sampling event with a trisodium phosphate wash followed by a distilled water rinse.

Free (floating) product was similarly obtained from MW-4 and MW-8 using a teflon bailer.

ANALYTICAL CHEMISTRY PROGRAM

Soil and ground water samples were analyzed by Farr, Friedman & Bruya, Inc. of Seattle, Washington. Laboratory results are presented in Appendix B.

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
	SILT AND CLAY LIQUID LIMIT 50 OR MORE	ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
		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:

- Field classification is based on visual examination of soil in general accordance with ASTM D2488-83.
- Soil classification using laboratory tests is based on ASTM D2487-83.
- 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

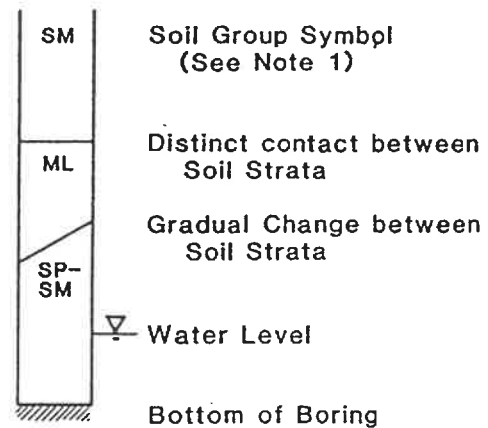
Molst - Damp, but no visible water

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

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:



BLOW-COUNT/SAMPLE DATA:

Blows required to drive Dames & Moore sampler 12 inches or other indicated distances using 300 pound hammer falling 30 inches.

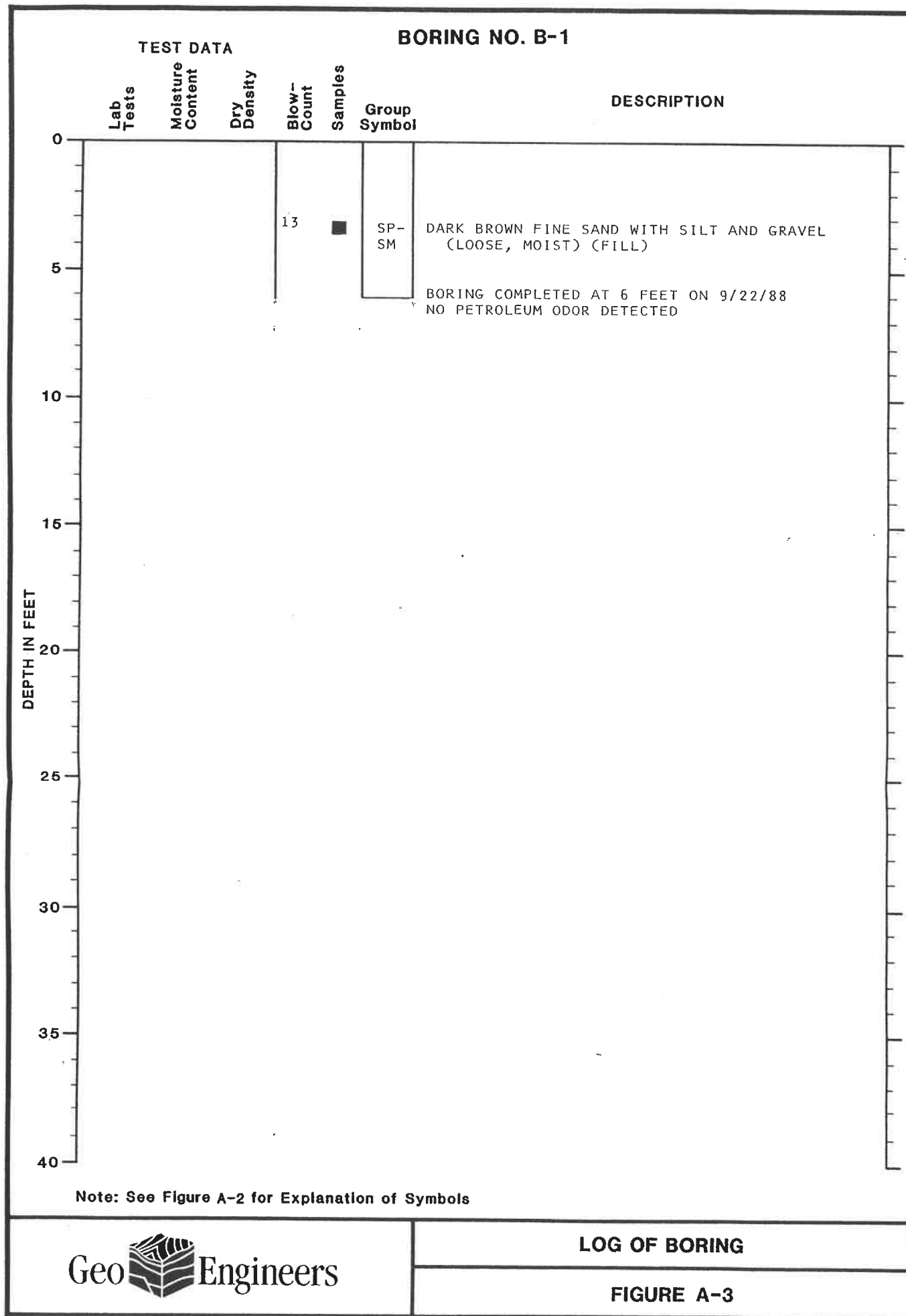
"P" indicates sampler pushed with weight of hammer or hydraulics of drill rig.

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.

0372-34-4 KF:DW:DK 10/11/88



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