SUPPLEMENTAL REPORT OF
GEOTECHNICAL SERVICES
SUBSURFACE CONTAMINATION STUDY
UNOCAL BULK PLANT 0082
CHELAN, WASHINGTON

FOR

UNOCAL

GeoEngineers

Geotechnical,
Geoenvironmental and
Geologic Services

September 3, 1991

Unocal
P.O. Box 76
Seattle, Washington 98111

Attention: Mr. Gary Gunderson

We are submitting five copies of our "Supplemental Report of Geotechnical Services" of Unocal Bulk Plant 0082 in Chelan, Washington. Contractual terms for our services are described in blanket contract number B1982D.

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

Yours very truly,

GeoEngineers, Inc.

James A. Miller, P.E.
Principal

NLP:JAM:wd

cc: Mr. Mike Wilson
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SUPPLEMENTAL REPORT OF GEOTECHNICAL SERVICES
SUBSURFACE CONTAMINATION STUDY
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CHELAN, WASHINGTON
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INTRODUCTION

The results of GeoEngineers' supplemental subsurface contamination study at the site of Unocal Bulk Plant 0082 are presented in this report. The site is located southeast of the intersection between Highway 97 and East Street in Chelan, Washington. The site location is shown relative to surrounding physical features in Figure 1. The general layout of the site is shown in Figure 2.

PREVIOUS STUDY

GeoEngineers explored the possible presence of petroleum-related contamination beneath Bulk Plant 0082 in November and December 1989 by drilling three borings, installing ground water monitor wells in each boring and excavating three test pits. The results of our initial subsurface contamination study are presented in our "Report of Geotechnical Services," dated March 14, 1990.

TPH (total petroleum hydrocarbon) concentrations of 4,600 mg/kg (milligrams per kilogram) and 1,300 mg/kg were detected in soil samples obtained from MW-1. TPH concentrations of 14,000 mg/kg and 1,900 mg/kg were detected in soil samples obtained from TP-1. TPH concentrations of 6,000 mg/kg and 590 mg/kg were detected in soil samples obtained from TP-2. A TPH concentration of 69,000 mg/kg was detected in a soil sample obtained from TP-3. A xylenes concentration of 59 mg/kg was detected in a soil sample obtained from TP-1. These hydrocarbon concentrations exceed the MTCA Method A soil cleanup levels. The hydrocarbon concentrations in soil samples obtained from MW-2 and MW-3 either were less than laboratory detection limits or less than the MTCA Method A soil cleanup levels. The locations of wells MW-1, MW-2, MW-3 and test pits TP-1, TP-2 and TP-3 are shown in Figure 2.

Concentrations of 270 μg/l (micrograms per liter) benzene, 95 μg/l ethylbenzene, 150 μg/l toluene and 700 μg/l xylenes were detected in the ground water sample obtained from MW-1. TPH concentrations of 3.8 mg/l (milligrams per liter) and 9.3 mg/l were detected in the ground water samples obtained from MW-1 and MW-3, respectively. These hydrocarbon concentrations exceed the MTCA Method A ground water cleanup levels. The hydrocarbon concentrations in the ground water sample obtained from MW-2 either were less than laboratory detection limits or less than the MTCA ground water cleanup levels.

Water level measurements obtained during our November and December 1989 study indicated a general direction of ground water flow toward the west, with a relatively flat gradient of approximately 0.0005.

SCOPE OF SERVICES

The purpose of our latest services is to explore and evaluate subsurface petroleum-related contamination at the downgradient boundaries of the site and in the area northwest of the aboveground tanks. Our scope of services includes the following.

1. Monitor the drilling of three exploratory borings at the site using top-drive, air-rotary drilling equipment.
2. Obtain soil samples from each boring at 5-foot intervals. Conduct field screening on soil samples for evidence of contamination using visual and water sheen screening methods. These methods are described in Appendix A.
3. Select at least one soil sample from each boring for laboratory analysis.
4. Monitor the installation of 2-inch-diameter monitor well casings with flush-grade surface monuments in each boring.
5. Determine the monitor well casing elevations in existing and newly installed monitor wells to an accuracy of 0.01 foot using an engineer's level and an assumed site datum.
6. Develop the well screens by hand-bailing.
7. Measure water table depths in existing and newly installed wells to determine water table elevations and ground water flow direction.
8. Obtain ground water samples from each monitor well for laboratory analysis.

9. Measure the airspace in the monitor well casings for hydrocarbon vapors using a Bacharach TLV Sniffer calibrated to hexane.
10. Evaluate the field and laboratory data with regard to current regulatory criteria.

SITE CONDITIONS

GENERAL

Unocal Bulk Plant 0082 is located approximately 200 feet south of Lake Chelan outside the Chelan city limits. The site slopes gently downward toward the north with a ground surface elevation of approximately 1,120 feet above sea level. The bulk plant is inactive.

SUBSURFACE SOIL CONDITIONS

Subsurface soil conditions beneath the bulk plant site were explored by drilling three additional borings (MW-4 through MW-6) at the locations shown in Figure 2. The boring logs are presented in Appendix A.

Boring MW-4 encountered coarse gravel with sand from the base of the crushed rock surface covering to a depth of 11 feet. From a depth of 11 feet to 21 feet, fine to medium sand was encountered. Silt with sand extended from 21 to 26 feet. A second unit of fine to medium sand was encountered from 26 feet to the base of the boring at 30.5 feet. Fine to medium sand and coarse gravel units were encountered in borings MW-5 and MW-6.

GROUND WATER CONDITIONS

Ground water conditions at the site were explored by constructing a monitor well in each new boring. Construction details for the three monitor wells are included in Appendix A.

The ground water depths and elevations in the existing and newly installed wells were determined on April 28, 1991, approximately three weeks after the newly installed wells were drilled. The ground water at the site was between 22.1 feet and 22.7 feet below ground surface at the time of our measurements. Based upon the measurements obtained on April 28, 1991, the ground water gradient was almost flat and we were unable to define the ground water flow direction. Because of the close proximity of the site to Lake Chelan and the coarse-grained nature of the soil, the ground water flow direction may change with fluctuations of the lake level. Water table elevations for the monitor wells are included in the boring logs and Figure 2 for the measurements obtained on April 28.

SUBSURFACE CONTAMINATION

The presence of petroleum-related subsurface contamination at the site was evaluated by the following methods.

1. Conduct field screening on soil samples using visual and water sheen screening methods.
2. Measure the airspace in the well casings for hydrocarbon vapors.
3. Test the water table interface in each ground water monitor well for free (floating) product.
4. Test selected soil samples obtained from the borings for BETX (benzene, ethylbenzene, toluene and xylenes) by EPA Method 8020, fuel hydrocarbons (gasoline and diesel) by modified EPA Method 8015 and TPH (total petroleum hydrocarbons) by EPA Method 418.1. If gasoline was detected by the fuel hydrocarbon analysis, the sample was analyzed for WTPH-G by Washington Department of Ecology draft analytical methods.
5. Test ground water samples obtained from the monitor wells for BETX, fuel hydrocarbons, TPH, WTPH-G, and dissolved lead by EPA Method 7421.

Field screening procedures and results are included in Appendix A. The subsurface soil analytical data are summarized in Table 1. Ground water analytical data and hydrocarbon vapor concentrations are summarized in Table 2. Laboratory reports for the soil and ground water samples are included in Appendix B.

The soil sample obtained from 15 feet in MW-5 had a moderate sheen during field screening. The soil sample obtained from 20 feet in MW-5 had a heavy sheen. Either slight sheens or no sheens were detected in the remainder of the samples obtained from the new borings. No visual indications of contamination were observed in the soil samples. Field screening results are given in the boring logs.

Four soil samples were selected from the three borings and analyzed for BETX, fuel hydrocarbons and TPH. One of the four soil samples was analyzed for WTPH-G. Benzene, ethylbenzene, toluene and xylenes were detected at concentrations ranging from 0.033 mg/kg (milligrams per kilogram) to

0.072 mg/kg in the soil sample obtained from 20 feet in boring MW-4. Benzene (1.4 mg/kg), ethylbenzene (4.3 mg/kg), toluene (2.0 mg/kg) and xylenes (14 mg/kg) were detected in the soil sample obtained from 20 feet in boring MW-5. BETX was not detected in the remaining soil samples.

The fuel hydrocarbons analyses detected gasoline (1,200 mg/kg) and diesel (7,000 mg/kg) in the soil sample obtained from 20 feet in boring MW-5. Fuel hydrocarbons were not detected in the remaining soil samples.

The WTPH-G analysis detected a concentration of 4,000 mg/kg gasoline in the soil sample obtained from 20 feet in boring MW-5. The WTPH-G analysis was not conducted on the remaining soil samples because no gasoline was detected by the fuel hydrocarbons analysis.

TPH was detected at a concentration of 6,600 mg/kg in the soil sample obtained from a depth of 20 feet in boring MW-5. TPH concentrations ranged from 11 mg/kg to 54 mg/kg in the remaining soil samples that were tested.

Ground water samples were obtained from MW-1 through MW-6 on April 9 and April 11, 1991. Benzene (280 μg/l), ethylbenzene (41 μg/l), toluene (50 μg/l) and xylenes (270 μg/l) were detected in the ground water sample obtained from MW-1. Benzene (3.9 μg/l) and xylenes (1.6 μg/l) were detected in the ground water sample obtained from MW-3. Benzene (300 μg/l), ethylbenzene (78 μg/l), toluene (20 μg/l) and xylenes (410 μg/l) were detected in the ground water sample obtained from MW-5. Toluene (0.6 μg/l) was detected in the ground water sample obtained from MW-6. BETX was not detected in the ground water samples obtained from MW-2 and MW-4. Fuel hydrocarbons were not detected in the ground water samples.

WTPH-G was detected in the ground water samples obtained from MW-1 (2.8 mg/l) and MW-5 (3.2 mg/l). WTPH-G was not detected in the ground water samples obtained from the remaining wells. Dissolved lead was detected in the ground water samples obtained from MW-1 (0.010 mg/l), MW-2 (0.009 mg/l), MW-3 (0.012 mg/l) and MW-4 (0.045 mg/l). The MTCA Method A cleanup level for lead is 0.005 mg/l. The MCL (maximum contaminant level) established for lead by the Environmental Protection Agency is 0.050 mg/l. Dissolved lead was not detected in the ground water samples obtained from the remaining monitor wells.

Hydrocarbon vapor concentrations in the monitor well casings were measured on April 8, 1991 with a Bacharach TLV Sniffer calibrated to hexane. Hydrocarbon vapor was measured in MW-5 at a concentration greater than

10,000 ppm (parts per million). Hydrocarbon vapor concentrations ranging between 100 ppm and 900 ppm were measured in the remaining monitor wells (Table 2).

CONCLUSIONS

The results of our previous study indicated the presence of surface and subsurface petroleum-related contamination at Bulk Plant 0082 in the vicinity of the truck unloaders, the current and former truck loading areas and in the barrel storage area.

In addition to the areas of contamination detected by our previous study, the results of our most recent study at the site indicate the presence of subsurface petroleum-related contamination in the soil and ground water beneath the central portion of the site of Unocal Bulk Plant 0082, and dissolved lead in the ground water beneath most of the site. We notified the Central Regional Office of Ecology (Washington State Department of Ecology) of petroleum-related contamination at this site on January 16, 1990 and on April 17, 1991.

The concentrations of BETX, WTPH-G, fuel hydrocarbons and TPH in the soil sample obtained from 20 feet in boring MW-5 exceed the MTCA Method A soil cleanup levels of 0.5 mg/kg benzene, 20 mg/kg ethylbenzene, 40 mg/kg toluene, 20 mg/kg xylenes, 100 mg/kg gasoline and 200 mg/kg diesel or heavier petroleum compounds. Laboratory results indicate that the product present in the soil sample obtained from 20 feet in MW-5 is mainly diesel fuel. MW-5 is located in the vicinity of the aboveground tanks, product pumps, and product lines. Petroleum-related soil contamination was not encountered in MW-4 or MW-6, located near the east and north property boundaries.

The concentrations of BETX and WTPH-G detected in the ground water samples obtained from MW-1 and MW-5 exceed the MTCA Method A ground water cleanup levels of 5 μg/l benzene, 30 μg/l ethylbenzene, 40 μg/l toluene, 20 μg/l xylenes and 1 mg/l gasoline. The concentration of benzene detected in the ground water sample obtained from MW-3 approaches but does not exceed the MTCA ground water cleanup level. The concentrations of dissolved lead detected in the ground water samples obtained from MW-1, MW-2, MW-3 and MW-4 are less than the MCL of 0.050 mg/l but exceed the MTCA ground water cleanup level of 0.005 mg/l. The concentrations of dissolved hydrocarbons and dissolved lead in the ground water samples obtained from the remaining wells either were less than the MTCA ground water cleanup levels or were less than laboratory detection limits. A high concentration of hydrocarbon vapors was detected in the airspace of MW-5.

It is our opinion that the lead-contaminated ground water does not represent a threat to human health or the environment because (1) the shallow ground water aquifer in the vicinity of the bulk plant is not used for drinking water, and (2) the lead concentrations are less than the MCL.

Based upon our ground water measurements obtained on April 28, 1991, the ground water gradient is almost flat. The movement of contaminants in the ground water in the vicinity of the site may be governed by diffusion and not by ground water movement. However, the ground water gradient could change seasonally in response to precipitation cycles and to changes in the level of Lake Chelan.

RECOMMENDATIONS

GeoEngineers recommends that ground water levels be measured in the six existing on-site monitor wells on a quarterly basis to determine the seasonal fluctuations of the ground water table and to further define the ground water gradient. It may be possible to establish a correlation between the absolute ground water elevations and the lake water level by connecting our survey with existing water level gauges in Lake Chelan. We also recommend monitoring ground water quality on a quarterly basis.

It is our opinion that the most certain method of soil remediation at this site is soil excavation and land farming/aeration. Implementation of this option would require that all facilities be demolished and removed from the property. The excavated contaminated soils could be treated on-site or on other Unocal property. The treatment process should consist of tilling the soil regularly to enhance aeration and adding nutrients and water as necessary to promote biodegradation of the residual hydrocarbons.

Relatively deep excavation would be necessary to remove all of the contaminated soil at this site. An alternative option to deep excavation is more limited excavation/treatment of contaminated soils to depths of 12 feet to 15 feet, and treatment of the deeper sand unit by operating a VES (vapor extraction system). Because most of the deep hydrocarbon contamination appears to be related to releases of diesel, the VES would attempt to achieve remediation by stripping volatile hydrocarbons from the deeper soil and by improving subsurface air flow to accelerate biodegradation of the hydrocarbons. The VES system would have to be operated for several years, based on our experience, and there is no certainty that the VES would achieve complete soil cleanup to the criteria set forth in the MTCA. Additionally, a VES would not be effective in remediating lead-contaminated ground water. If the results of future ground water quality monitoring indicate that lead represents a potential threat to human health or the environment, possible remedial actions would include installation of a ground water pump-and-treat system.

If vapor extraction treatment methods are used for the deeper soils, we recommend sampling ground water periodically for laboratory analyses of BETX, fuel hydrocarbons, TPH and dissolved lead. Several wells may be destroyed during soil excavation operations. If wells are destroyed, they should be replaced so that ground water can be sampled.

LIMITATIONS

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

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

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 this report was prepared. No other conditions, express or implied, should be understood.

Please call if you have any questions concerning this report.

Respectfully submitted,
GeoEngineers, Inc.

Norman L. Puri
Environmental Engineer

James A. Miller, P.E.
Principal

NLP:JAM:wd

TABLE 1
SUMMARY OF SOIL CHEMISTRY ANALYTICAL RESULTS

Boring Number	Sampling Date	Depth of Sample (feet)	TPH[1] (mg/kg)	Fuel Hydrocarbons[2] (mg/kg)		WTPH-G[4] (mg/kg)	BETX[3] (mg/kg)			
				Gasoline	Diesel		B	E	T	X
MW-4	04/03/91	20.0	35	<5	<5	--	0.033	0.052	0.033	0.072
MW-5	04/04/91	20.0	6,600	1,200	7,000	4,000	1.4	4.3	2.0	14
MW-5	04/04/91	29.5	54	<5	<5	--	<0.025	<0.025	<0.025	<0.025
MW-6	04/04/91	21.0	11	<5	<5	--	<0.025	<0.025	<0.025	<0.025

Notes:

[1] TPH by EPA Method 418.1. TPH = total petroleum hydrocarbons

[2] Fuel hydrocarbons by modified EPA Method 8015.

[3] BETX by EPA Method 8020. B = benzene, E = ethylbenzene, T = toluene, X = total xylenes.

[4] WTPH-G by Washington Department of Ecology draft analytical methods = total petroleum hydrocarbons-gasoline

mg/kg = milligrams per kilogram

"--" = not tested

TABLE 2
SUMMARY OF HYDROCARBON VAPOR CONCENTRATIONS AND GROUND WATER CHEMICAL ANALYTICAL RESULTS

Monitor Well Number	Hydrocarbon Vapor Concentrations[1] (ppm)	Fuel Hydrocarbons[2] (mg/l)		WTPH-G[4] (mg/l)	BETX[3] (µg/l)				Dissolved Lead[5] (mg/l)
		Gasoline	Diesel		B	E	T	X	
MW-1	900	<1	<1	2.8	280	41	50	270	0.010
MW-2	200	<1	<1	<1.0	<0.5	<0.5	<0.5	<0.5	0.009
MW-3	200	<1	<1	<1.0	3.9	<0.5	<0.5	1.6	0.012
MW-4	200	<1	<1	<1.0	<0.5	<0.5	<0.5	<0.5	0.045
MW-5	>10,000	<1	<1	3.2	300	78	20	410	<0.005
MW-6	100	<1	<1	<1.0	<0.5	<0.5	0.6	<0.5	<0.005

Notes:

[1]Hydrocarbon vapor concentrations were measured with a Bacharach TLV Sniffer and Tigon hose lowered within 1 foot of the ground water level.

[2]Fuel hydrocarbons by modified EPA Method 8015.

[3]BETX by EPA Method 8020. B = benzene, E = ethylbenzene, T = toluene, X = total xylenes.

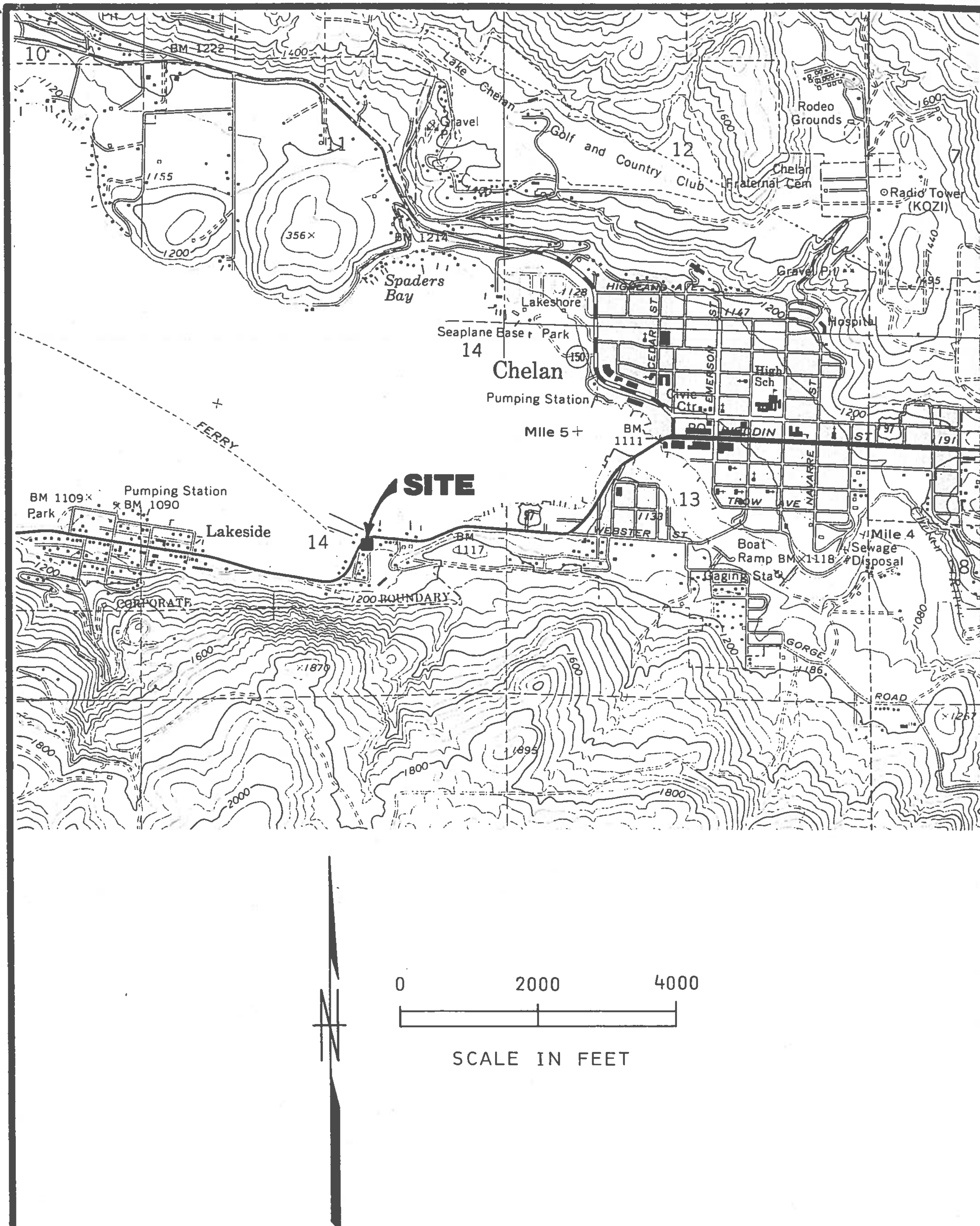
[4]WTPH-G by Washington Department of Ecology draft analytical methods = total petroleum hydrocarbons-gasoline

[5]Dissolved lead by EPA Method 7421.

ppm = parts per million

mg/l = milligrams per liter

µg/l = micrograms per liter



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

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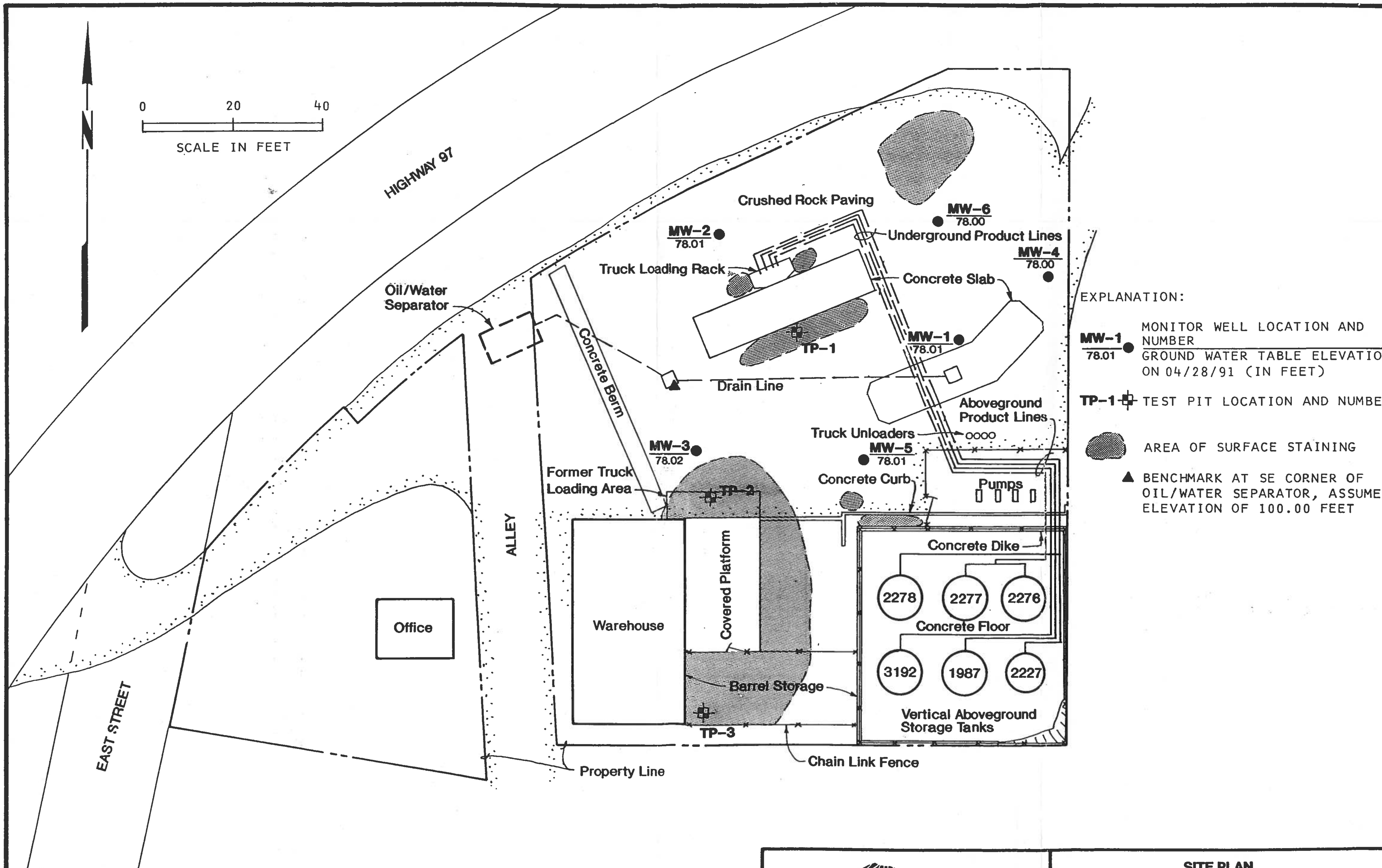
VICINITY MAP

FIGURE 1

0161-228-B04 DJK:KKT 1-12-90

0161·228·B04 WSL:KKT 2·19·90
REV. 4.18.91 BDH



REFERENCE: DRAWING ENTITLED "CHELAN, WASH., MARKETING BRANCH, GENERAL ARRANGEMENT," REVISION DATED 10/8/85, BY UNOCAL.

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SITE PLAN

FIGURE 2

APPENDIX A

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APPENDIX A

FIELD EXPLORATIONS

DRILLING AND SOIL SAMPLING PROGRAM

Subsurface conditions at Unocal Bulk Plant 0082 were explored by drilling three borings at the locations shown in Figure 2 using truck-mounted, air-rotary drilling equipment owned and operated by Soil Sampling Service. Borings MW-4 through MW-6 were drilled from April 3 to 4, 1991, each to a depth of 30.5 feet. The drilling and soil sampling equipment was cleaned with a hot-water pressure washer prior to drilling each boring.

A representative 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-2488-84, which is described in Figure A-1. An explanation of the monitor well log symbols is presented in Figure A-2. The monitor well logs are given in Figures A-3 through A-5.

Soil samples were obtained from each 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 or other specified intervals is indicated to the left of the corresponding sample notations on the boring logs.

At least one soil sample was selected from each boring for chemical analyses of BETX, fuel hydrocarbons, TPH and WTPH-G. Samples that were tested are denoted in our boring logs with a "CA." Chain-of-custody procedures were followed in transporting the soil samples to the laboratory.

FIELD SCREENING OF SOIL SAMPLES

A GeoEngineers representative field screened soil samples obtained from the borings. Field screening results are used as a general guideline to delineate areas of potential petroleum-related contamination. In addition, field screening results are used to aid in the selection of soil samples for chemical analysis. The field screening methods used include (1) visual screening and (2) water sheen screening. The results of water sheen screening are included on the boring logs.

Visual screening consists of inspecting the soil for stains indicative of fuel-related contamination. Visual screening is generally more effective when contamination is related to heavy petroleum hydrocarbons such as motor oil, or when hydrocarbon concentrations are high.

Water sheen screening is a more sensitive method that has been effective in detecting contamination at concentrations less than regulatory cleanup guidelines. Water sheen screening involves placing soil in water and observing the water surface for signs of sheen. Sheens observed are classified as follows:

No Sheen (NS)	No visible sheen on the water surface.
Slight Sheen (SS)	Light, colorless dull sheen; spread is irregular, not rapid; dissipates rapidly.
Moderate Sheen (MS)	Light to heavy sheen, may have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on water surface.
Heavy Sheen (HS)	Heavy colorful sheen with color/ iridescence; spread is rapid; entire water surface may be covered with sheen.

Field screening results are site- and boring-specific. The results vary with temperature, soil type, soil moisture content and type of contaminant.

MONITOR WELL CONSTRUCTION

Two-inch-diameter, Schedule 40 PVC (polyvinyl chloride) 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. Medium sand was placed in the borehole annulus surrounding the slotted portion of the PVC pipe. The well casings are protected within flush-grade, locking surface monuments. Monitor well construction details are shown in Figures A-3 through A-5.

The monitor well screens were developed 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 using an engineer's level on April 28, 1991. An elevation datum of 100 feet was assumed at the southeast corner of a catch basin as shown in Figure 2. Elevations referenced to this datum are included on the monitor well logs.

GROUND WATER ELEVATIONS

The depth to the ground water table relative to the monitor well casing rims was measured in MW-1 through MW-6 on April 28, 1991. The site measurements were made using a weighted fiberglass tape and water-finding paste. The weighted fiberglass tape was cleaned with a TSP (trisodium phosphate) solution wash and distilled water rinse prior to use at each well.

Ground water elevations were calculated by subtracting the water table depth from the casing rim elevations. Water table positions measured on April 28, 1991 are shown on the monitor well logs.

GROUND WATER SAMPLING PROGRAM

Ground water samples were collected from the monitor wells by GeoEngineers on April 9 and 11, 1991. The water samples were collected with disposable Teflon bailers after at least three well volumes of water were removed from each well casing. The water samples were transferred to septum vials, liter bottles and 500 milliliter bottles in the field and kept cool during transport to the testing laboratory. The water samples obtained for TPH and BETX analyses had hydrochloric acid added as a preservative. The water samples that were obtained for dissolved lead analysis were filtered in the field through a 0.45 micron QED filtering system and preserved with hydrochloric acid. Chain-of-custody procedures were observed during transport of the samples to the laboratory.

HYDROCARBON VAPOR CONCENTRATIONS

Hydrocarbon vapor concentrations were measured in each monitor well casing on April 8, 1991. Vapor concentrations were measured in ppm with a Bacharach TLV Sniffer. The field data are presented in Table 2.

SOIL CUTTINGS AND PURGE WATER DISPOSAL

The soil cuttings generated during drilling were collected in four 55-gallon drums. The purge water generated during ground water sampling was collected in one 55-gallon drum. The soil cuttings and purge water drums remain on-site.

CHEMICAL ANALYTICAL PROGRAM

Four soil samples and six ground water samples were analyzed by Analytical Technologies, Inc. Freon extraction/infrared spectroscopy in accordance with EPA Method 418.1 was used to quantify TPH in the soil samples. Gas chromatography was used to quantify specific aromatic hydrocarbons (BETX) in the soil and ground water samples and gasoline in soil samples using EPA Method 8020. Gas chromatography methods were also used to quantify fuel hydrocarbons (gasoline and diesel) in the ground water and soil samples by modified EPA Method 8015. Acid digestion and graphite furnace atomic absorption methods were used to quantify dissolved lead in the ground water samples by EPA Method 7421.

The analytical data 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
		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

GEI 85-88

LABORATORY TESTS:

CA Chemical Analysis

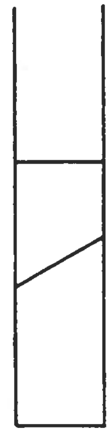
FIELD SCREENING TESTS:

Headspace vapor concentration data given in parts per million

Sheen classification system:

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

SOIL GRAPH:



SM Soil Group Symbol (See Note 2)

Distinct Contact Between Soil Strata

Gradual or Approximate Location of Change Between Soil Strata

∇ Water Level

Bottom of Boring

BLOW-COUNT/SAMPLE DATA:

Blows required to drive a 2.4-inch I.D. split-barrel sampler 12 inches or other indicated distances using a 300-pound hammer falling 30 inches.

- 22 ■ Location of relatively undisturbed sample
- 12 ⊠ Location of disturbed sample
- 17 □ Location of sampling attempt with no recovery

Blows required to drive a 1.5-inch I.D. (SPT) split-barrel sampler 12 inches or other indicated distances using 140-pound hammer falling 30 inches.

- 10 Location of sample obtained in general accordance with Standard Penetration Test (ASTM D-1586) procedures
- 26 Location of SPT sampling attempt with no recovery

Location of grab sample

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

NOTES:

1. The reader must refer to the discussion in the report text, the Key to Boring Log Symbols and the exploration logs for a proper understanding of subsurface conditions.

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

GEI 121-90

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KEY TO BORING LOG SYMBOLS

FIGURE A-2

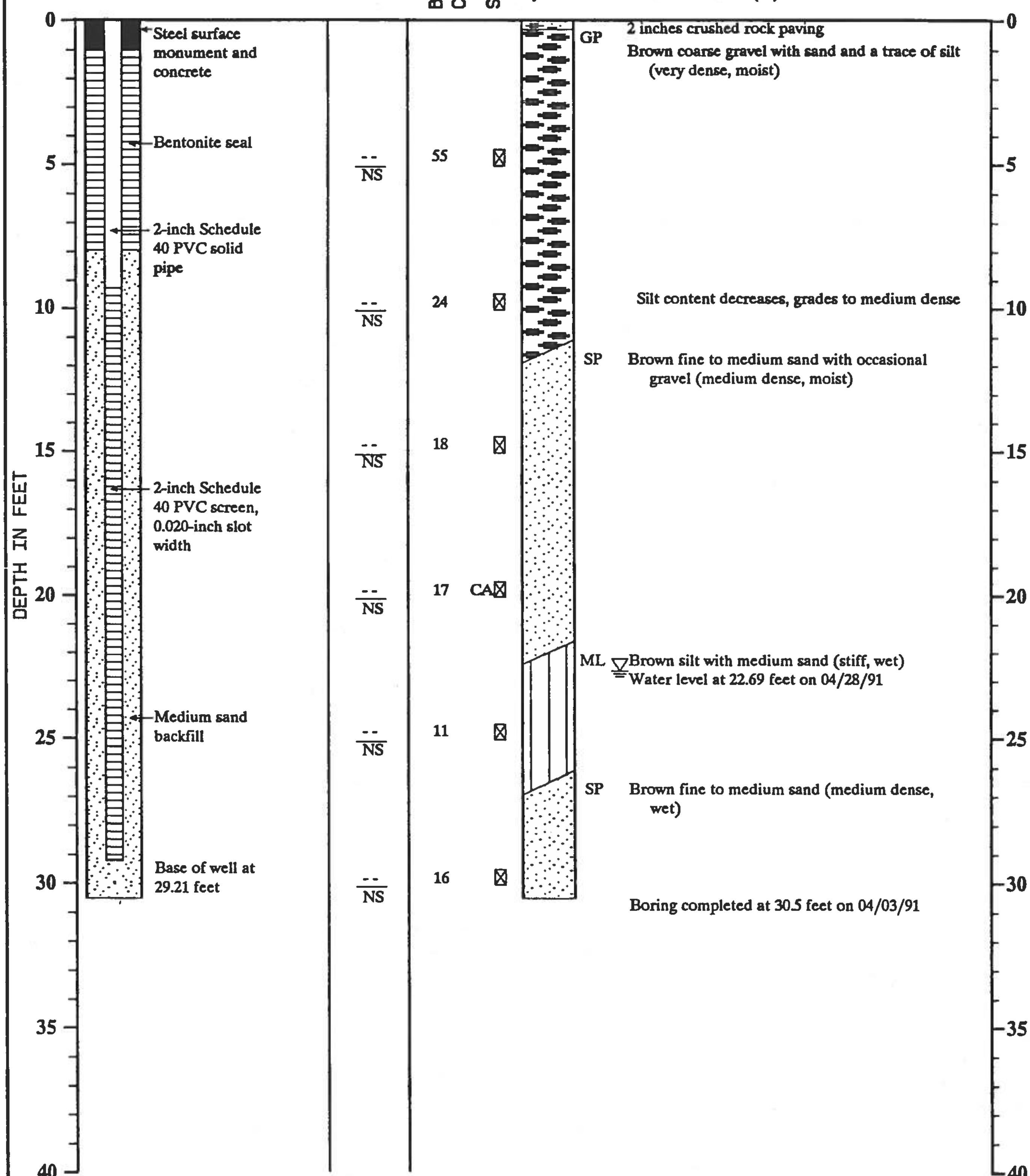
MONITOR WELL NO. MW-4

WELL SCHEMATIC

Casing Elevation (ft.): 100.85
Casing Stickup (ft.): 0.16

Vapor Conc.(ppm) / Sheen | Blow-Count | Samples | Group Symbol | DESCRIPTION

Surface Elevation (ft.): 100.69



Note: See Figure A-2 for explanation of symbols

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Log of Monitor Well

Figure A-3

MONITOR WELL NO. MW-5

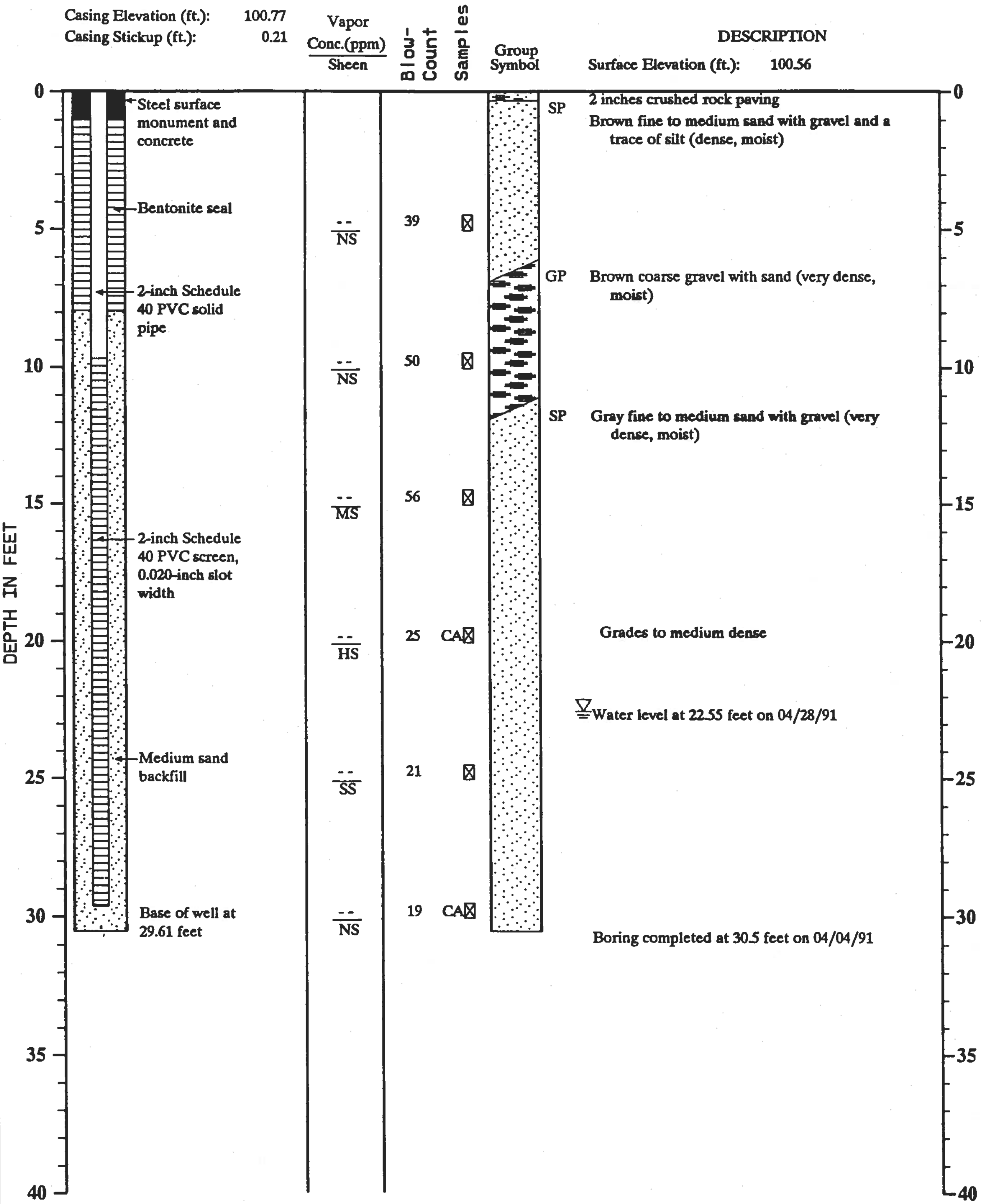
WELL SCHEMATIC

Casing Elevation (ft.): 100.77

Casing Stickup (ft.): 0.21

DESCRIPTION

Surface Elevation (ft.): 100.56



Note: See Figure A-2 for explanation of symbols

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Log of Monitor Well

Figure A-4

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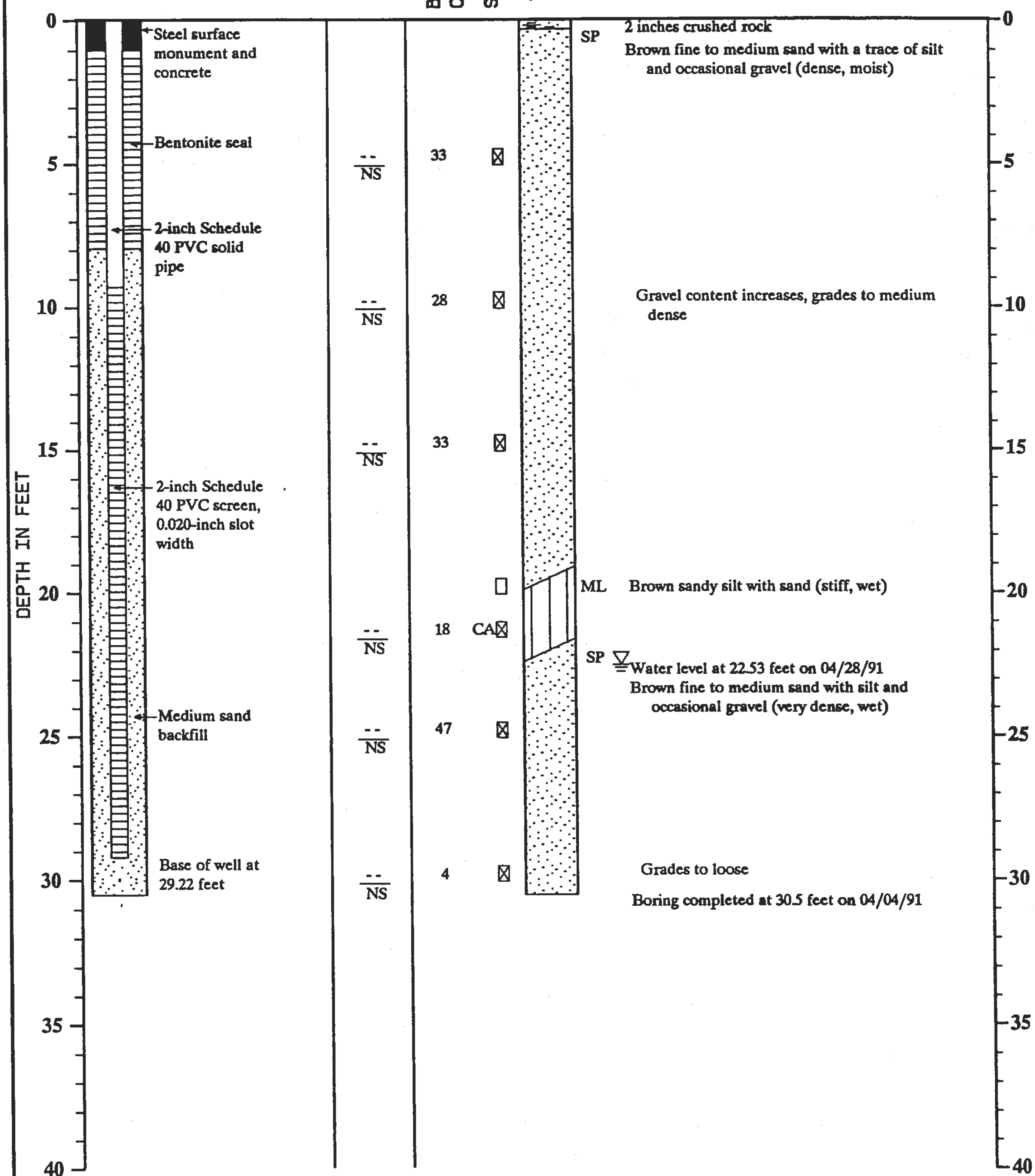
MONITOR WELL NO. MW-6

WELL SCHEMATIC

Casing Elevation (ft.): 100.12
Casing Stickup (ft.): -0.37

Surface Elevation (ft.): 100.49



Note: See Figure A-2 for explanation of symbols

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Log of Monitor Well

Figure A-5