GEOSCIENCE CORP.

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EVALUATION OF THE GEOLOGIC AND HYDROLOGIC CONDITIONS AT THE SLUDGE LAGOON

TEXACO, INC.
Beacon Research Laboratories
Beacon, New York

Prepared for:

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Contract No. TRCB-NW-1553

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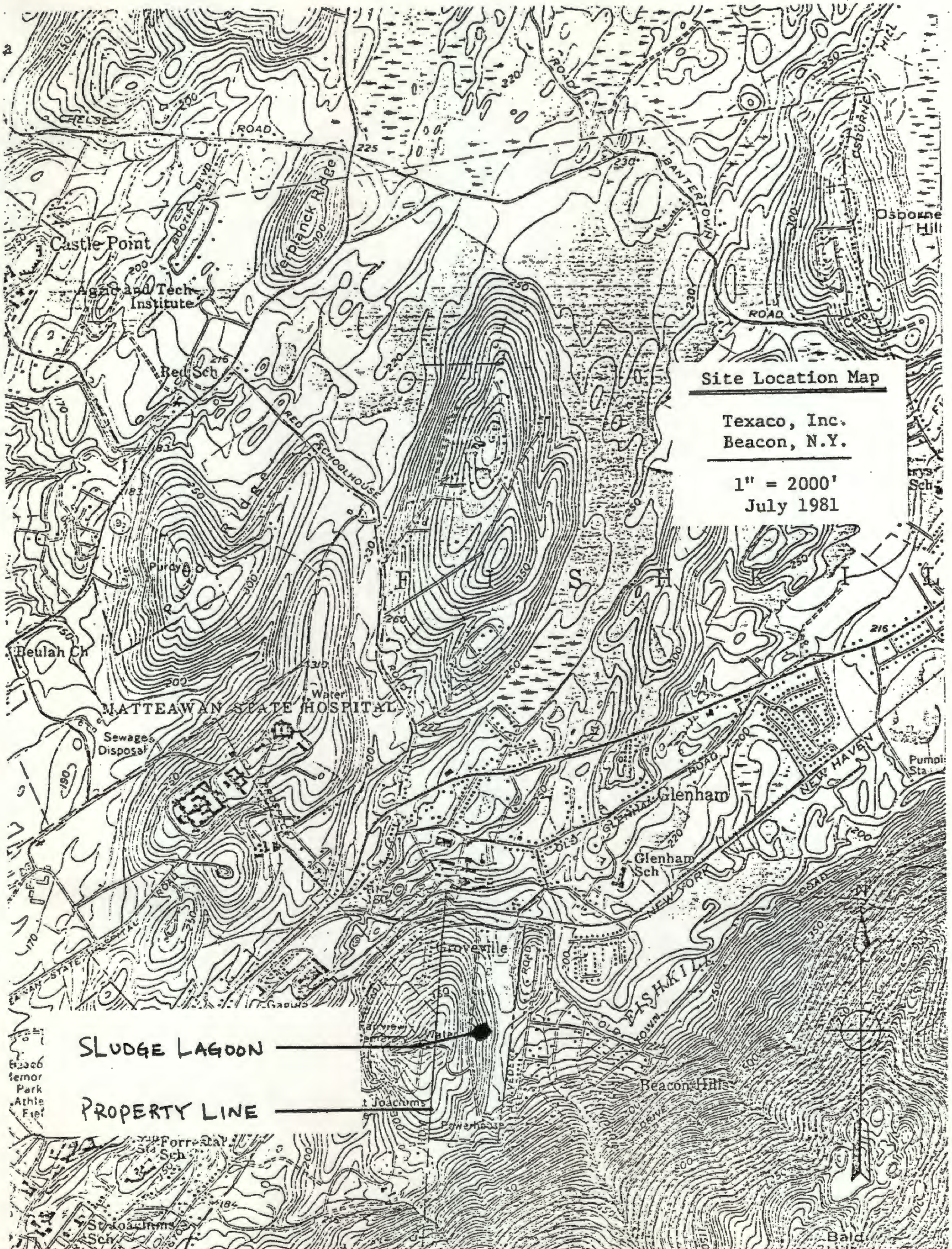

Site Location Map
Texaco, Inc.
Beacon, N.Y.
1" = 2000'
July 1981
SLUDGE LAGOON
PROPERTY LINE
Castle Point
Agric and Tech Institute
Red Sch
Verplanck Ridge
Osborne Hill
Beulah Ch
MATTEAWAN STATE HOSPITAL
Sewage Disposal
Glenham
Glenham Sch
Groveville
Beacon Hills
NEW HAVEN
Bald Hill

TABLE OF CONTENTS

1.0 INTRODUCTION

Dunn Geoscience Corporation was retained by Texaco, Inc. in May, 1981, to provide geologic and hydrologic consulting services at the Texaco Beacon Research Laboratories in Beacon, New York.

2.0 PURPOSE OF STUDY

The purpose of this study is to determine the geologic and hydrologic conditions, at a sludge treatment lagoon located at Texaco's Beacon Research Laboratories.

3.0 SCOPE OF STUDY

The scope of study included the following:

1. A subsurface investigation program was prepared and initiated by Dunn Geoscience Corporation (DGC). This program included exploratory drilling of four test borings, DGC observation of drilling, sampling, and installation of four observation wells. In-place permeability testing, development of wells, and measurement of observation well water levels were done by DGC.

2. Laboratory analyses of subsurface soil samples were completed to determine cation exchange capacity (CEC), particle size distribution, permeability, pH, and moisture content.

3. The results of the subsurface exploration and laboratory testing were analyzed and evaluated to reach the conclusions presented in this report.

4. A sampling and analysis plan was developed for the wells in the sludge lagoon area as required by RCRA (40 CFR 265.92).

4.0 PERSONNEL

The project manager of this study is James P. Behan, Jr., Senior Engineer. The observation of the test boring program, soil sampling, and well development were done by Gary D. Casper, Staff Geologist. Project Geologist is William J. Hall. Project Hydrologist is James Narkunas, and Project Advisor is William E. Cutcliffe.

5.0 METHODOLOGY

5.1 Test Borings

A test boring program was conducted from June 4 to June 12, 1981. Drilling was performed by Soil & Material Testing, Inc., of Castleton, New York, under subcontract to DGC. A total of four test borings were drilled in the vicinity of the sludge lagoon, at the locations determined by DGC. All of the test borings were converted to permanent monitoring wells.

Location of monitoring wells was based on a preliminary site visit and on assessment of existing information including topography from U.S.G.S. 7-1/2 minute quad map (Wappingers Falls) and two U.S.G.S. publications entitled Groundwater Resources of Dutchess County, New York, (1961) and Ground-water Resources of the Fishkill Beacon Area, Dutchess County, New York (1980). The wells were located to provide a clean up-gradient ground-water sample and to monitor the lagoon as closely as possible on its downgradient side to ensure early detection of any leakage.

One upgradient hole (UL-1) was drilled to 81.5 feet to determine the geologic conditions and to define any aquifers at depth. A permanent monitoring well was installed with the well screen in the interval between 25.0 and 30.0 feet below grade, as the dense gray till at greater depth would not be expected to yield a significant amount of water. Three downgradient holes (DL-2, DL-3, and DL-4) were drilled to 27.0 feet with all monitoring wells screened in the interval between 20.0 and 25.0 feet below grade. See Appendix B for monitoring well details.

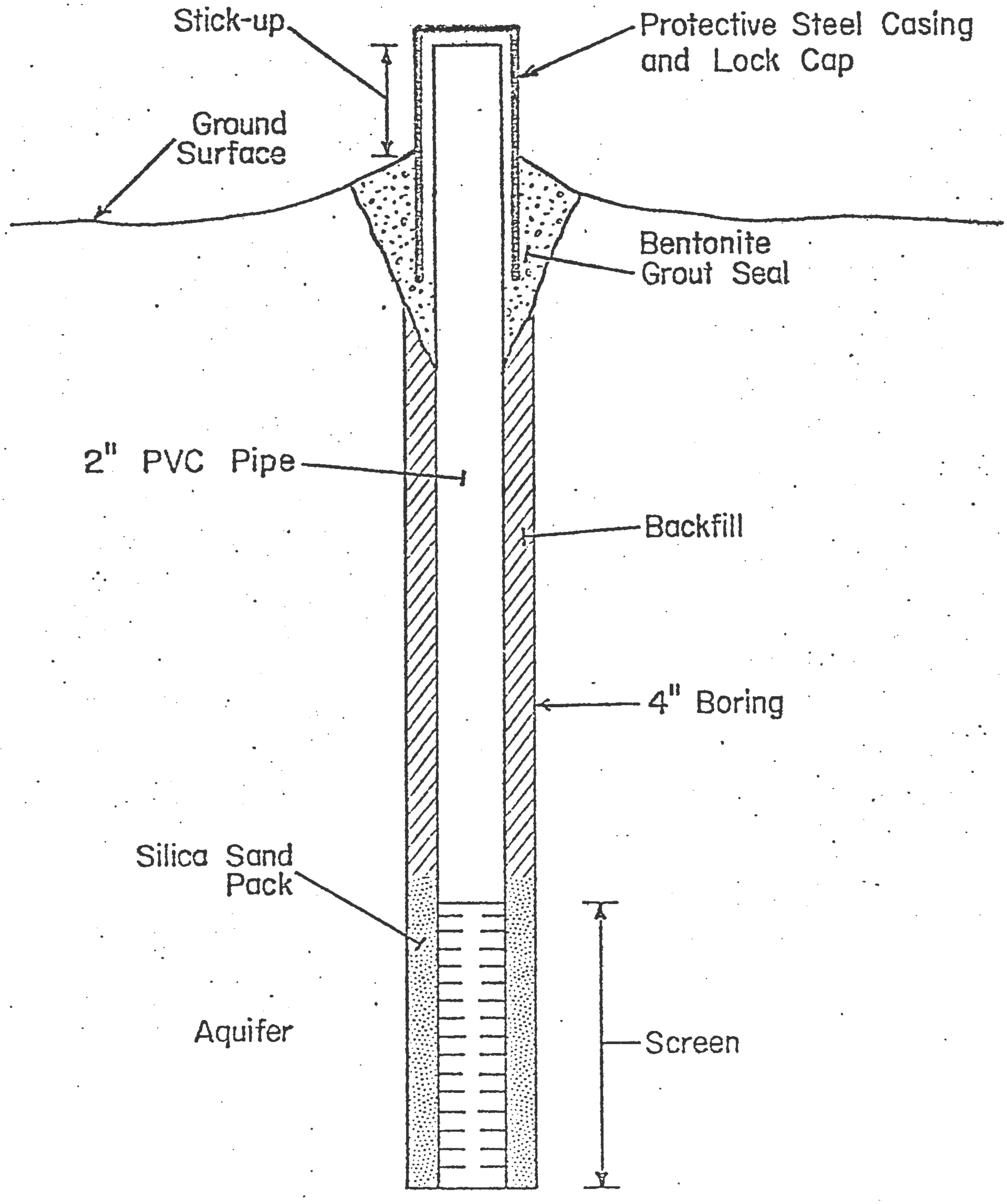
All monitoring wells were backfilled from the bottom of the screen to approximately five feet below grade wtih silica sand to collect any ground water occurring in this interval.

5.2 Monitoring Well Installation

All monitoring wells were installed immediately following the completion of the exploratory boring. All wells are constructed of two-inch inside diameter schedule 40 PVC pipe, with a five-foot slotted PVC well screen. A typical detail of well construction is shown in Figure 5.1. All wells are secured by a four-inch

Figure 5.1

TYPICAL MONITORING WELL CONSTRUCTION



diameter steel casing with a locking cap. The Monitoring Well Details in Appendix B show well depth, screen location, ground and measuring point elevations for each well, in addition to water level measurements for each well.

All monitoring wells were developed by removing several well volumes with a stainless steel bailer as soon after well installation as possible. Well development was completed by June 12, 1981.

6.0 LABORATORY ANALYSIS OF SOIL SAMPLES

Soil samples were analyzed by C.T. Male Associates, P.C. in Schenectady, New York, for cation exchange capacity. Soil samples were analyzed by Dunn Geoscience Laboratory for permeability, pH, moisture content and grain size distribution. Results are discussed in Section 7.4 and laboratory data sheets are presented in Appendix C.

7.0 SUBSURFACE CONDITIONS

7.1 General Geologic Setting

7.1.1 Bedrock

The general site area lies within the Hudson Highlands physiographic province.

In this area, the bedrock geology is relatively complex. The steep northeast trending hills to the east and south of the site (Bald Hill), are composed of Pre-Cambrian metamorphic gneiss bedrock. These rocks were originally deposited as sediments, then consolidated, metamorphosed and uplifted to form an ancient mountain range. During the late Cambrian and Ordovician periods, about 435 to 520 million years ago, sediments were deposited on the flanks of these mountains. Later these sediments were consolidated to become shales, limestones and dolomites. These rocks were faulted and folded in response to tectonic stresses and the regional horizonal beds of these formations were contorted. The main structural trend of the Cambrian and Ordovician rocks is northeast - southwest. Some of the shale was metamorphosed to slate and the carbonate (limestone and dolomite) rocks to marble. The contact between the younger carbonate rocks and the older metamorphic rocks occurs to the south of the site.

7.1.2 Unconsolidated Deposits

Most of the unconsolidated (soil) deposits on the site are of glacial origin and were deposited about 15,000 - 30,000 years ago during the last stage of Wisconsin glaciation. As the glacier advanced from the north it removed soil and weathered rock in many areas and deposited this material in several modes of deposition "down ice" to the south. Where the glacial material was deposited directly by the ice hetereogenous material occurs, called till, consisting of the complete range of soil gradations. A thick (greater than 80') blanket of till is found over most of the site. Till is generally thickest where the forward moving ice mass confronts an obstruction such as a bedrock mound or fills an existing depression.

7.2 Site Geology

Four test borings were drilled in the area of the sludge lagoon: one upgradient bore hole, UL-1,and three downgradient bore holes, DL-2, DL-3, and DL-4 as shown in Figure 7.1. The stratigraphy of the area

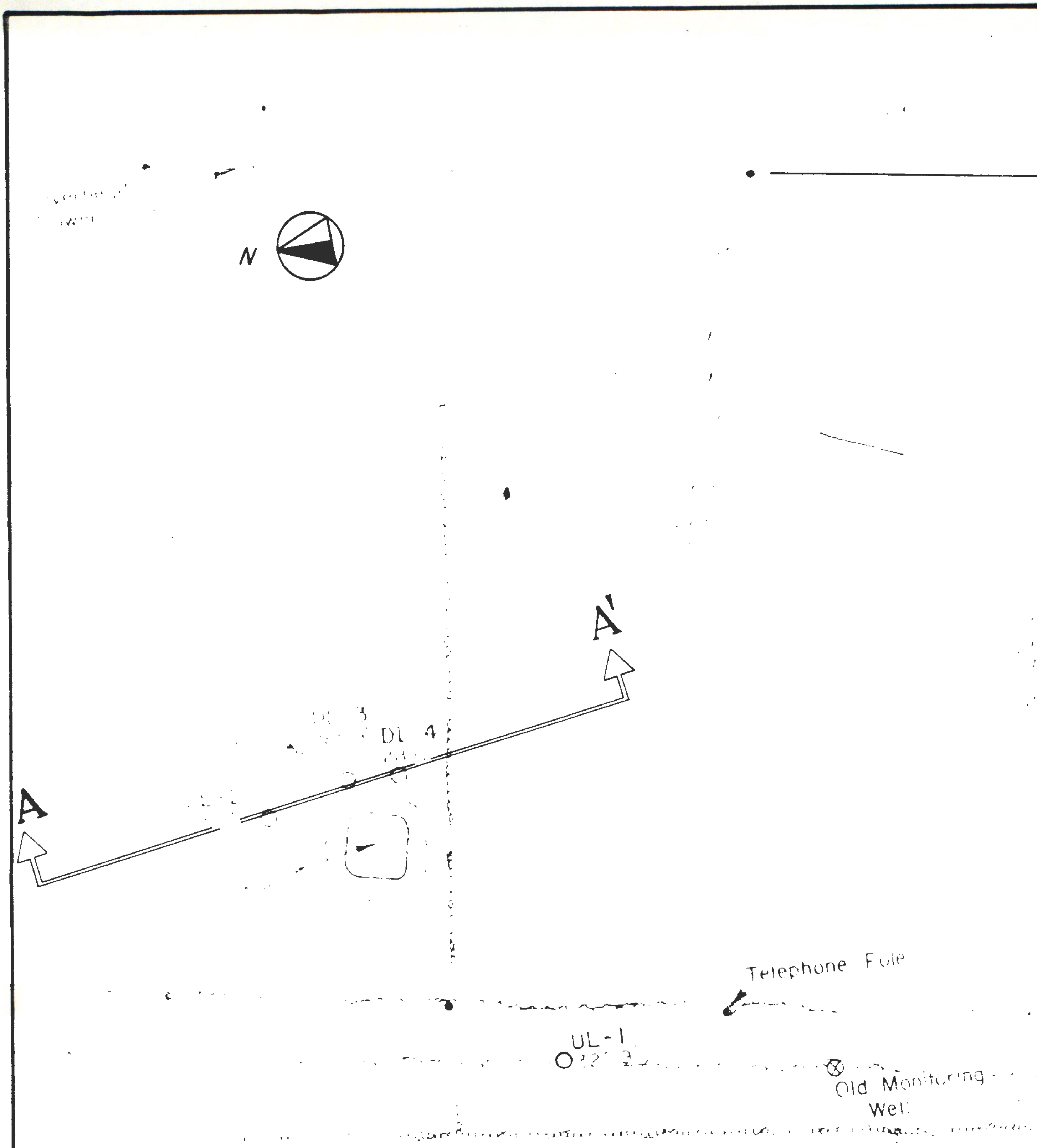


Figure 7.1

MONITORING WELL LOCATIONS

TEXACO, INC.

Scale 1" = 100'   March 1982

is shown on geologic section A-A' in Figure 7.2. With the exception of 4 feet of road fill encountered at the surface in UL-1, the surficial soil consists of glacial till. The upper 14 to 16 feet consists of a brown glacial till resulting from oxidation, underlain by a gray glacial till. The glacial till consists of a heterogeneous mixture of silt, clay, sand and gravel.

The composition of the till is variable due to the mode of deposition and wide variations are expected locally. In general, the composition of the till averages about 70% sand and gravel and about 30% silt and clay. However, zones containing higher percentages of sand with less clay and gravel fractions were encountered in DL-4 (10-12.5 feet). Local zones containing silt and clay as the dominant fraction (greater than 50%) were encountered in DL-4 (0-10 feet), and DL-3 (0-10 feet). Several zones at various depths containing cobbles and boulders were encountered in UL-1. Local pockets containing higher percentages of the

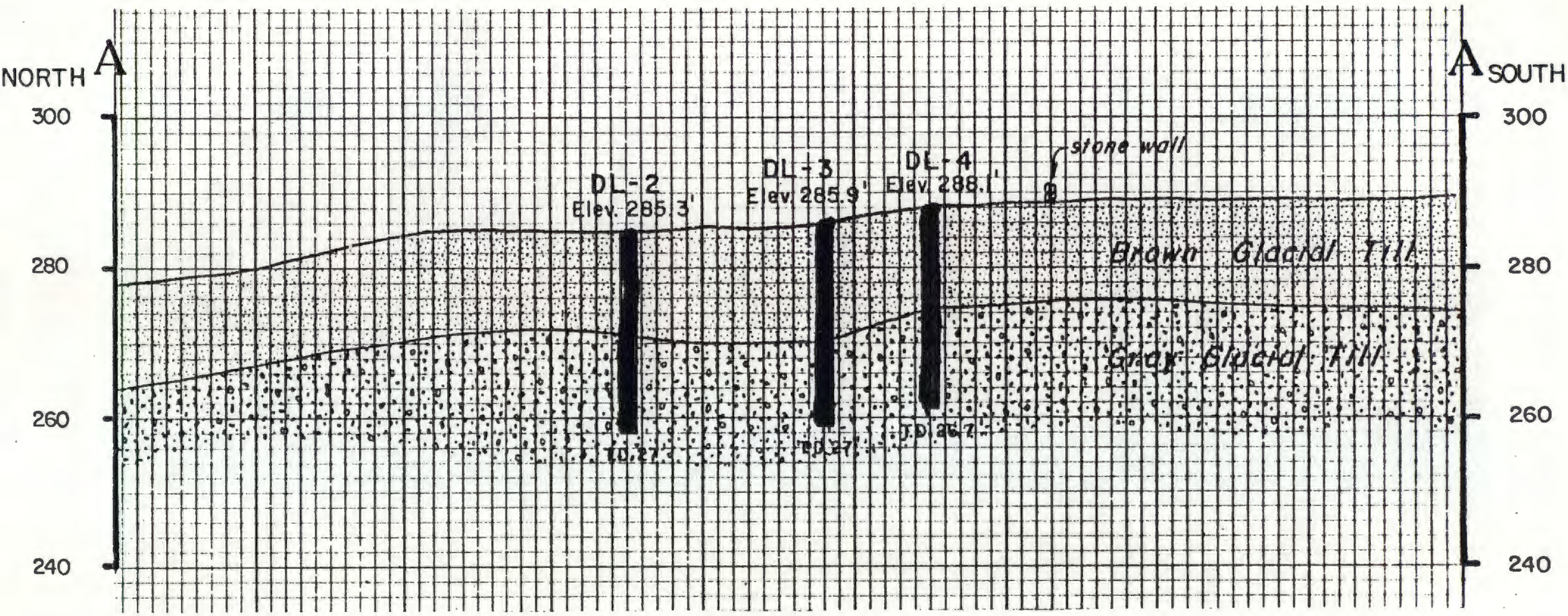


FIGURE 7.2

GEOLOGIC SECTION A-A'

TEXACO, INC.

DUNN GEOSCIENCE CORP

Scale:
Hor: 1"=50'
Vert: 1"=10'

March 1982

various fractions are expected; however, it is likely that these pockets will be irregular and not continuous over large areas.

Bedrock was not encountered in this area, and test boring UL-1 was terminated after sampling glacial till to a depth of 81.5 feet.

7.3 Ground-Water Hydrology

The surficial soils in this area consist of glacial till overlying dolomite bedrock. The elevation of ground-water levels in the glacial till as measured in the four monitoring wells has been contoured and is shown on Figure 7.3. The direction of ground-water movement is perpendicular to the ground-water level contours, i.e., generally to the east. In this area, the direction of movement approximately parallels the inclined ground surface. From the water level data it is clear that UL-1 is upgradient of the lagoon and DL-2, DL-3, and DL-4 are directly downgradient.

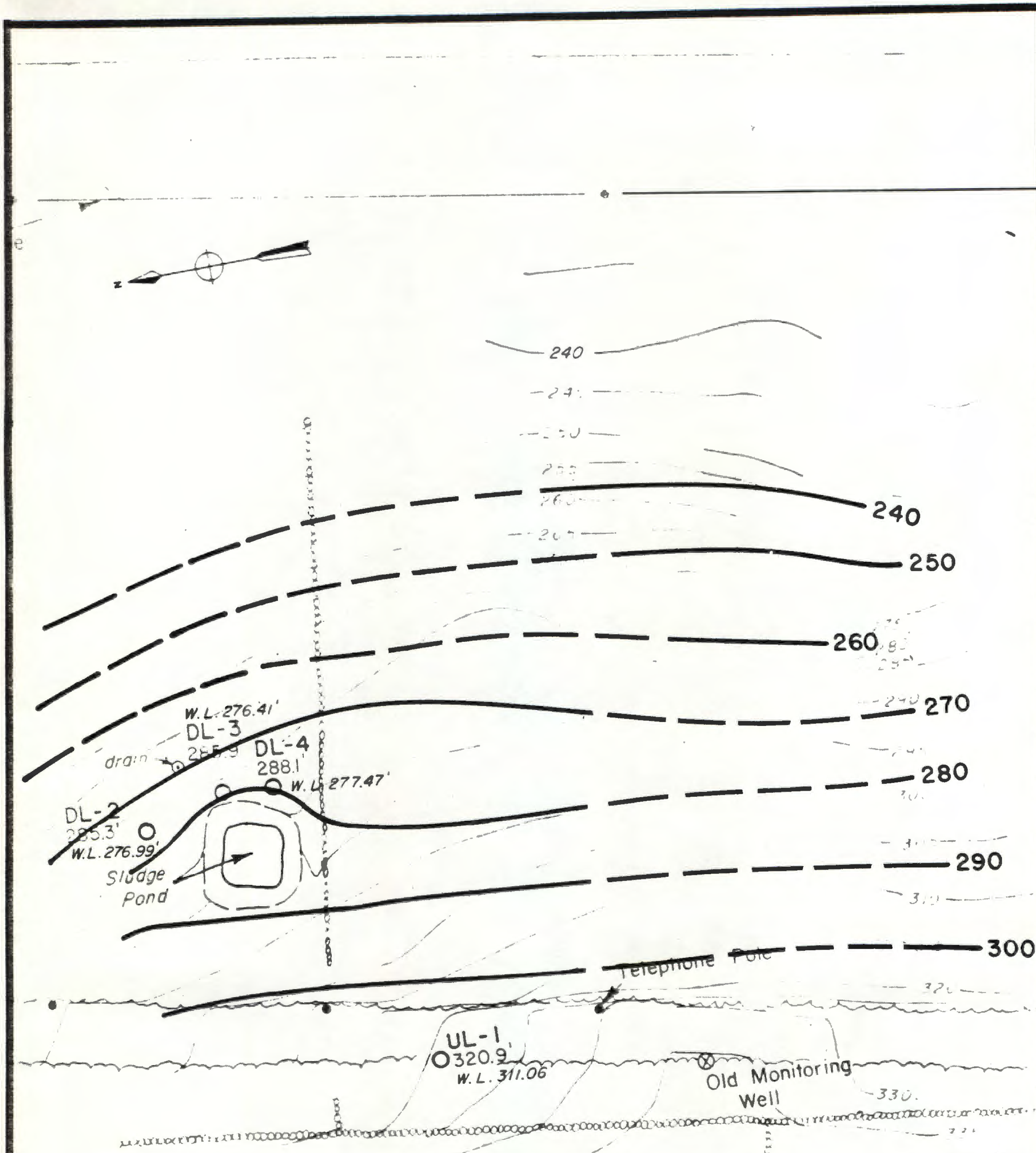


Figure 7.3

WATER TABLE CONTOUR MAP
TEXACO, INC.

From water measurements recorded
6/17/81

Scale: 1"= 100'

March 1982

The composition of the glacial till is variable, as discussed in the previous section, which influences the direction and rate of movement in local areas. Where the dominant soil fraction is silt and clay, the glacial till can be considered relatively impermeable. In areas where the dominant soil fraction is sand and gravel and the percentages of silt and clay is less than about 15%, the glacial till will be more permeable. The results of permeability tests performed in the bore holes on glacial till samples indicate permeabilities on the order on 10^{-4} to 10^{-5} cm/sec for the clayey till and about 1 x 10^{-2} cm/sec for the sandy till. The results of laboratory testing of clayey till indicate a permeability on the order of 10^{-7} cm/sec. While the sandy tills have the capacity to transmit greater quantities of ground water due to their higher permeability, it is unlikely that zones of sandy till are continuous or that they provide a discharge for ground water.

Technically, an aquifer is defined as a soil or rock formation that contains sufficient saturated permeable material to conduct ground water and to yield economically significant quantities of ground water to wells and springs. The glacial till should be considered to be a poor aquifer as it will yield relatively low quantities of water. The velocity of ground-water flow in the area of the sludge lagoon has been calculated to be about 10 feet per year using a permeability of 1 x 10^{-5} cm/sec and an assumed porosity of 15 percent.

As explained in Section 5.1 and shown in Appendix B UL-1 is screened from 25.0 to 30.0 feet below grade and the downgradient wells are screened from 20.0 to 25.0 feet below grade. All wells are backfilled with silica sand from screen bottom to about five feet below grade. This interval of 5.0 to 30.0 feet below grade upgradient and 5.0 to 25.0 feet below grade downgradient overlaps the contact between the lower dense gray till and the overlying oxidized brown till. It was felt that any ground water moving in this system would occur at or above this contact. The additional depth of the wells was provided to allow for monitoring and collection of ground water occurring in the upper part of the gray till as water levels drop in dry months and to provide an adequate reservoir for ground-water sample collection during all seasons.

7.4 Soils Analysis

The results of laboratory analyses of soils are presented in Appendix C.

7.4.1 Cation Exchange Capacity (CEC)

Cation exchange capacity (CEC) is a measurable indicator of the soil's potential absorption capacity for various cations, such as calcium, magnesium, potassium, sodium and heavy metals. Therefore, CEC is an indicator of the soil's potential ability to absorb, and thus attenuate, some of the pollutants that could be present in leachate moving through the soil. CEC is expressed in milliequivalents(meq) per 100 grams of dry soil, where an meq is defined as one milligram of hydrogen or the amount of any other element that will combine with or displace one milligram of hydrogen.

The CEC of a wide variety of soils from various parts of the United States has been reported in such references as The Nature and Property of Soils by Nyle C. Brady. The CEC varies from a low of almost zero for a Sassafras sand from New Jersey to a high approaching 60 meq per 100 grams for a Sweeney Clay from California. The wide range in CEC is to be expected, because soils vary so markedly in humus content and in the amount and types of clay present. Different clays have widely different capacities to absorb cations. Moreover, humic residues developed under different climates or from diverse plant tissues do not always possess the same absorptive power. In general, finer textured soils, such as clays and silts, tend to have higher cation exchange capacities due to their colloidal nature and net surface charge than do sandy soils. Moreover, within a textural group, the organic matter content and the amount and type of clay influence CEC. Certain clays, such as kaolinite common in Southern soils, have a CEC as low as some sands. The CEC of most soils is pH dependent to some degree.

As a broad interpretation of cation exchange capacity, the following categorization would be reasonable.

CEC, meq/100g	Interpretation
1-10	Sand Soils (limited absorption)
12-20	Silt loam (moderate absorption)
more than 20	Clay & organic soils (high absorption)

The cation exchange capacity of the samples tested was as follows:

Sample	CEC
DL-3, S-2A	5.6 meq/100 g
DL-4, S-2	6.3 " "

A comparison of these results with the preceding interpretation table shows that the soils encountered at the Texaco, Inc. site generally have a low CEC. This preliminary analysis indicates that these soils have only limited capacity for absorption of trace elements and other cations.

7.4.2 Other Physical and Chemical Analyses

The results of additional laboratory analyses of soil samples as described in Section 6.0 are presented in Appendix C. pH values are generally neutral to slightly alkaline.

Two samples did yield anamalous pH reslts between pH 4 and 5. These were both near surface samples in forested areas. In both cases, the acidic pH could be caused by the products of decomposition of organic materials.

8.0 CONCLUSIONS

8.1 The geology in the area of the lagoon consists of a thick sequence of glacial till.

8.2 The direction of ground water movement in the glacial till is to the east in the area of the sludge lagoon.

8.3 The permeability of the glacial till ranges from approximately 10^{-7} cm/sec for the clayey till to about 10^{-2} cm/sec for the sandy till.

8.4 The velocity of ground water flow in the area of the sludge lagoon is approximately 10 feet per year, based on a permeability of 1×10^{-5} cm/sec, an assumed porosity of 15%, and the measured ground water gradient.

8.5 The glacial till typical of the site is considered to be a poor aquifer because it will yield relatively low quantities of water.

8.6 The cation exchange capacity (CEC) of the soils tested was fairly low, and these soils have only limited capacity for absorption of trace elements and other cations.

APPENDIX A

TEST BORING LOGS

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK 518-783-8102	TEST BORING LOG	BORING NO. UL-1
PROJECT Hydrologic Investigation		
CLIENT Texaco, Inc.		SHEET 1 OF 4
DRILLING CONTRACTOR Soil & Material Testing, Inc.		JOB NO. 287-1-2247
PURPOSE Ground Water Evaluation		ELEVATION 320.9'

GROUNDWATER					CASING	SAMPLE	CORE	
								DATUM M.S.L.
DATE	TIME	DEPTH	CASING	TYPE	Flush	SS		DATE STARTED 6/10/81
				DIAMETER	4"ID	13/8"ID		DATE FINISHED 6/11/81
				WEIGHT	300#	140#		DRILLER D. Rappold
				FALL	24"	30"		INSPECTOR G.D. Casper

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
		S-1	6 9 4 10			Br cmf S, t $, lmfG; Fill Brown coarse to fine SAND, trace Silt, little medium to fine Gravel (Fill)	Rec= 0.1' Moist
		S-2	19 100/.3			Br cmfS, t$, S mfG; Fill	Rec=0.7' Moist
						4.0	Rec=0.3' pp=2.0 tsf Moist
5		S-3	10 20 16 20			Br cmf S, l Cy$, lmfG	
		S-4	20 24 27 54			Br Cy $a, cmfS, smfG	Rec=1.9' pp=4.5 tsf Moist
		S-5	60 72 100			Br cmfS, t⁻$; W Brown coarse to fine SAND, some Clayey Silt, little medium fine Gravel (SM) (GLACIAL TILL)	Rec=0.2' Wet Wash?
10		S-6	47 85				No Rec Cobbly drilling
		S-7	50 100			Br cmfS, sCy$, lmfG; occ cbls	Rec=1.0' pp=> 4.5tsf Moist
		S-8	110/.4			Same 15.4	Rec=0.4' pp=> 4.5tsf Moist,Dense change from wash
15		S-9	54 100/.3			Gr cmfS, s(+)Cy$, lmf(+)G;occ cbls Gray coarse to fine SAND, some Silt & Clay, some medium fine Gravel; occasional cobbles (SM) (GLACIAL TILL)	Rec=0.5' pp=> 4.5tsf Moist,Dense
		S-10	100				Rec=0.5' pp=> 4.5tsf Moist, Dense
20							

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK	TEST BORING LOG	BORING NO. UL-1

PROJECT Hydrologic Investigation — SHEET 2 OF 4

CLIENT. Texaco, Inc. — JOB NO. 287-1-2247

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
20'		S-11	25 100/.2			GrcmfS, s(+)$ & C,lmf(+)G;occ cbls	Rec=0.6' pp= > 4.5tsf Moist,Dense cobbles 21.0'-23.0'
25'		S-12	30 40 100			Same	Rec=1.5' pp= > 4.5tsf Moist Dense cobbles 27.0'
30'		S-13	14 26 54			Gr $ & Ca, cmfS, tfG Gray coarse to fine SAND, some Silt & Clay; some medium fine Gravel; occasional cobbles (SM) (GLACIAL TILL)	-cobbles 29.0-30.0' Change to 300# hammer/24" Rec=1.0' pp= > 4.5tsf Moist
35'		S-14	13 24 40			Same	Rec=1.1' pp= 4.5tsf Moist
40'		S-15	19 60			GrcmfS, s$&C, smf(+)G	Rec=0.3' pp= > 4.5tsf Moist
45'							

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK	TEST BORING LOG	BORING NO. UL-1
PROJECT Hydrologic Investigation		SHEET 3 OF 4
CLIENT Texaco, Inc.		JOB NO. 287-1-2247

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
45		S-16	16 33 41			Same	Rec=1.5' pp= > 4.5tsf Moist
50		S-17	65			Same Gray, coarse to fine SAND, some Silt & Clay, some medium fine Gravel; occasional cobbles (SM) (GLACIAL TILL)	Rec=0.3' pp= 4.5tsf Moist
55		S-18	11 21 25			Same	Rec=1.0' pp= 4.5tsf Moist
60		S-19	15 25 29			Same	Rec=1.0' pp= >4.5tsf Moist
65		S-20	17 25 34			Same	Rec=0.9' pp= 4.5tsf Moist
70							

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK	TEST BORING LOG	BORING NO. UL-1

PROJECT Hydrologic Investigation — SHEET 4 OF 4

CLIENT Texaco, Inc. — JOB NO. 287-1-2247

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
70		S-21	50/.3			Same	Rec=0.2' pp= 3.75tsf Moist
						Gray coarse to fine SAND, some Silt & Clay, some medium fine Gravel; occasional cobbles (SM) (GLACIAL TILL)	
75		S-22	17 26 37			Same	Rec=0.8' pp=4.0tsf
80		S-23	12 20 39			Same	Rec=1.2' pp=2.5tsf Moist
						Bottom of Hole @ 81.5'	Well pt @ 30.0' Screen @ 24.0'-29.0' Backfill w/#2 Jersey & # 2 Silica Sand 81.5'-4.0' Cement grout w/ steel casing & lock 4.0'-0.0' Hole was washed clean above 30.0' during backfilling considerable natural sand & gravel may be included. Backflushed until clear, however this well may require more extensive development.
85							

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK 518-783-8102	TEST BORING LOG	BORING NO. DL-2
PROJECT Hydrologic Investigation		
CLIENT Texaco, Inc.		SHEET 1 OF 2
DRILLING CONTRACTOR Soil & Material Testing, Inc.		JOB NO. 287-1-2247
PURPOSE Ground Water Evaluation		ELEVATION 285.3'

GROUNDWATER					CASING	SAMPLE	CORE	
DATE	TIME	DEPTH	CASING	TYPE	Flush	SS		DATUM M.S.L.
								DATE STARTED 6/4/81
				DIAMETER	4"ID	1 3/8"ID		DATE FINISHED 6/4/81
				WEIGHT	300#	140#		DRILLER D. Rappold
				FALL	24"	30"		INSPECTOR G.D. Casper

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
0		S-1	6 6 50 35			Br cmf S, SCy$, s(-)mfG;O,rts,TS	Rec=0.1' Moist pushed cobble near surface
						Brown coarse to fine SAND, some silt & clay, little (+) medium to fine Gravel (SM-SC) (GLACIAL TILL)	
5		S-2	35 25 25 27				No Recovery
		S-3	5 15 21 22			Br cmfS, s$&C, 1(+)mfG	Rec=0.7' pp=.75-3.75tsf Moist
10		S-4	100/.5				Rec=0.5' pp=3.25tsf Moist(slightly drier thanS-3)
						14.0'	Change from wash
15		S-5	35 45 50 100/.3			Gr cmfS, s(+)$&C, 1mfG	Rec=0.9' pp > 4.5tsf Moist, dense
20							

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK	TEST BORING LOG	BORING NO. DL-2
PROJECT Hydrologic Investigation		SHEET 2 OF 2
CLIENT Texaco, Inc.		JOB NO. 287-1-2247

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
20		S-6	22 100/.45			Same Gray coarse to fine SAND some (+) Silt & Clay, little medium fine Gravel (SM-SC) (GLACIAL TILL)	Rec=0.5' pp=> 4.5tsf Moist,dense cobble 21.0'-21.5'
25		S-7	30 45 80 65			Same	Rec=0.6' pp=> 4.5tsf Moist,dense
						Bottom of Hole @ 27.0'	Well pt. @ 25.0' Screen @ 24.0'-19.0' Backfill w/#2 Jersey Sand to 4.0'

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK 518-783-8102	TEST BORING LOG	BORING NO. DL-3

PROJECT	Hydrologic Investigation
CLIENT	Texaco, Inc.
DRILLING CONTRACTOR	Soil & Material Testing, Inc.
PURPOSE	Ground Water Evaluation
SHEET	1 OF 2
JOB NO.	287-1-2247
ELEVATION	285.9'
DATUM	M.S.L.
DATE STARTED	6/9/81
DATE FINISHED	6/10/81
DRILLER	D. Rappold
INSPECTOR	G.D. Casper

GROUNDWATER					CASING	SAMPLE	CORE
DATE	TIME	DEPTH	CASING	TYPE	Flush	SS	
				DIAMETER	4"ID	1 3/8ID	
				WEIGHT	300#	140#	
				FALL	24"	30"	

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
		S-1	6 5 12 14			Br Cy$s, mfS, 1(-) mfG; O, rts Brown SILT & CLAY some, coarse to fine Sand, little (-) medium fine Gravel (ML-CL) (GLACIAL TILL)	Rec=1.2' Moist Topsoil
5		S-2 S-2A	14 18 15 15			Br cmfS, 1 S & C, 1(-) mG Br $ & C a, cmfS, tfG	Rec=0.6' Moist-Wet
10						10.0	
		S-3	17 10 4 4			Br mf(+) S, t$, smfG Brown coarse to fine (+) SAND, trace Clayey Silt, some(-) medium fine Gravel (SP) (GLACIAL TILL)	Rec=0.05' Moist-Wet
		S-4	19 26			Br mf(+)S, tCy$, S(-)mf(+)G	
		S-4A	45 90			BrcmfS,tCy$,s(-)mf(+)G	Rec=0.1' Moist
15		S-5	30 79 48 50			Br fS, tS, t(+) fG 16.1	
		S-6	50 120 100			Grcmf(+)S, 1Cy$, 1(+)fG Gray coarse to fine SAND, some Silt & Clay, some medium to fine(+) Gravel (SM) GLACIAL TILL)	Rec=0.2' Moist pp=3.75tsf
20							

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK	TEST BORING LOG	BORING NO. DL-3
PROJECT Hydrologic Investigation		SHEET 2 OF 2
CLIENT Texaco, Inc.		JOB NO. 287-1-2247

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
20		S-7	20 24 35 40			Grcmf(+)S, $S^{(+)}$ $&C $S^{(+)}$mfG Gray coarse to fine SAND, some Silt & Clay, some medium fine(+) Gravel (SM) (GLACIAL TILL)	Rec=1.0' pp> 4.5tsf Moist
25		S-8	16 22 22 28			Same	Rec=1.0' pp> 4.5tsf Moist
						Bottom of Hole @ 27.0'	Well pt @ 25.0' Screen @ 24.0'-19.0' Backfilled w/ #2 Jersey Sand to 4.0' Cement Grout to 0.0' w/ steel casing & lock

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK 518-783-8102	TEST BORING LOG	BORING NO. DL-4

PROJECT	Hydrologic Investigation
CLIENT	Texaco, Inc.
DRILLING CONTRACTOR	Soil & Material Testing
PURPOSE	Groundwater Evaluation

SHEET 1 OF 2	
JOB NO.	287-1-2247
ELEVATION	288.1
DATUM	MSL
DATE STARTED	6-8-81
DATE FINISHED	6-8-81
DRILLER	D. Rappold
INSPECTOR	G. Casper

GROUNDWATER					CASING	SAMPLE	CORE
DATE	TIME	DEPTH	CASING	TYPE	FLUSH	SS	
				DIAMETER	4" ID	$1^{3}/8$"ID	
				WEIGHT	300#	140#	
				FALL	24"	30"	

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
		S-1	6 6 11 12			Br Cy$a, mfS, l(+)mfG Brown Clayey SILT and, medium fine Sand, little (+) medium fine Gravel (ML) (GLACIAL TILL)	Rec = 0.5' Moist Gravel includes granite, quartz limestone rounded-subangular
5		S-2	14 16 18 16			Same w/ occ pkt $	few small cobbles from 2.0'-5.0' Rec = 0.9' Moist
						10.0	Rec = 0.1' Wet pp= 0.75 tsf chemical odor, oily
10		S-3	11 8 7 13			Br cmfS, l(-) $ Brown coarse to fine SAND, little(-) Silt (SP-SM)	
						13.5'	wash turned Gray casing to 15.0' -caving in-
15		S-4	25 35 20 73			Gr cmfS, sC&$, tmfG Gray coarse to fine SAND some (-) clay & Silt, some medium to fine Gravel (SM-SC) (GLACIAL TILL)	Boulder @ 15.0' piece Gravel in tip Rec = 0.1' Moist pp=3.75 tsf
20							

DUNN GEOSCIENCE CORPORATION LATHAM, NEW YORK	TEST BORING LOG	BORING NO. DL-4
PROJECT Hydraulic Investigation		SHEET 2 OF 2
CLIENT Texaco, Inc.		JOB NO. 287-1-2247

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	UNIFIED CLASSIFICATION	GRAPHIC LOG	IDENTIFICATION	REMARKS
		S-5	35 100/.3			Gr m(+)fGa, cmfS, lC&$ Gray coarse to fine Sand, some (-) Clay & Silt, some (-) medium to fine Gravel (GLACIAL TILL)	Rec = 0.1' pp = 4.5 tsf Moist, Dense
25		S-6	31 41 50 100/.2			Gr cmfS, S(-)$C, s-mfG	Rec = 0.4' pp= 4.5 tsf Moist, Dense
						Bottom of Hole @ 26.7'	Well pt at 25.0' screen 24.0' - 19.0' #2 Jersey Sand to 4.0' Cement Grout w/ protective casing & lock 4.0'-0.0'

APPENDIX B

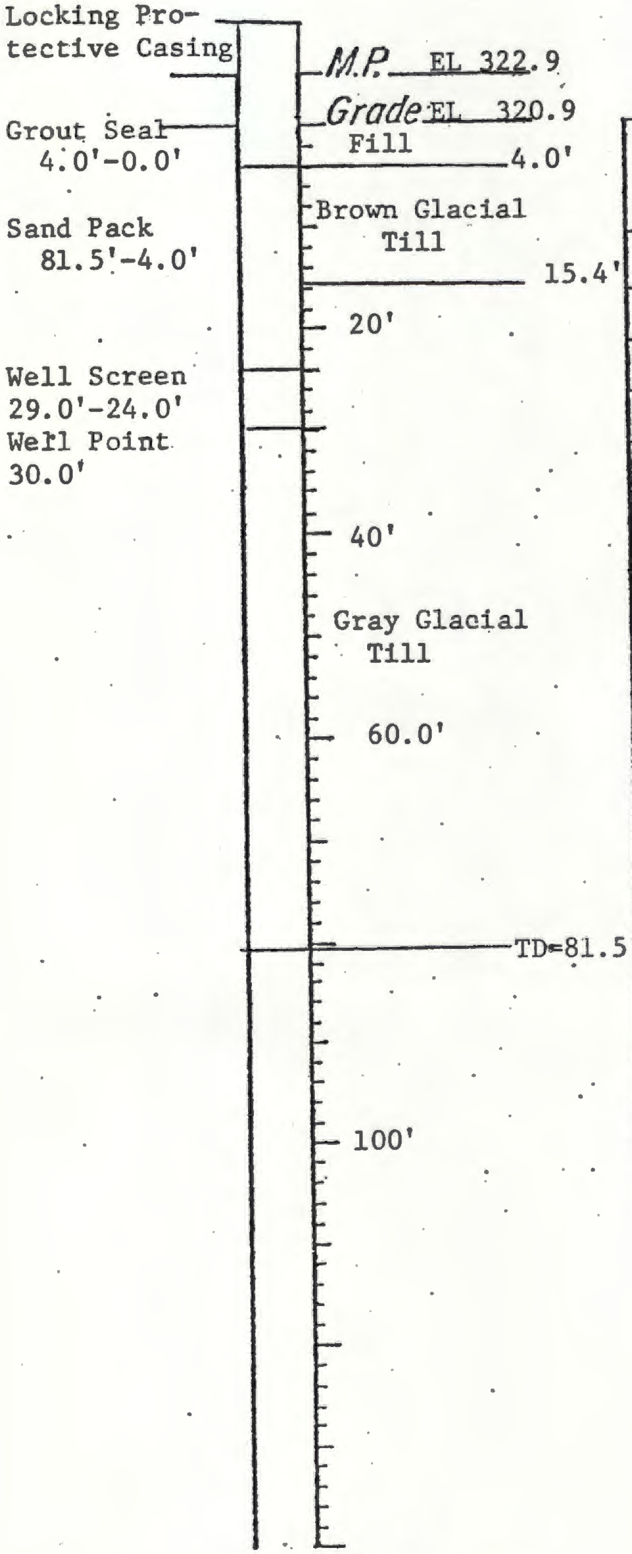
MONITORING WELL DETAILS

DUNN GEOSCIENCE CORP.
5 Northway Lane North
Latham, New York 12110
GEOSCIENCE CORP

TEXACO, INC.

DETAILS OF WELL NO. III-1 DATE DRILLED 6-11-81

TOTAL DEPTH 81.5'



DATE	ELEVATION OF WATER TABLE	DATE	ELEVATION OF WATER TABLE
6/12/81	311.0		
6/17/81	311.1		

NOTE: Screen, slotted pipe and perforated pipe indicated in the same manner.

Grade to measuring point (M.P.) is not to scale.

Datum is mean sea level.

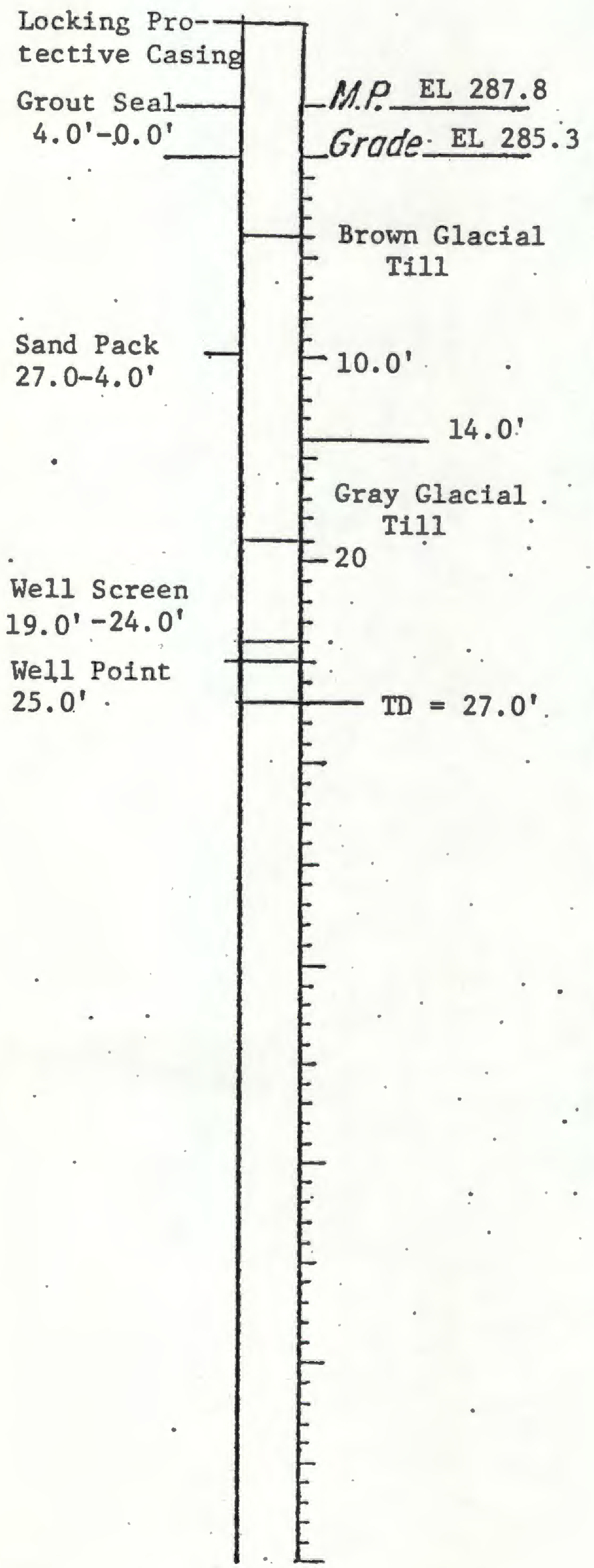
Vertical Scale: 1" = 20'

DUNN GEOSCIENCE CORP.
5 Northway Lane North
Latham, New York 12110

TEXACO, INC.

DETAILS OF WELL NO. DL-2 DATE DRILLED 6-4-81

TOTAL DEPTH 27.0'



DATE	ELEVATION OF WATER TABLE	DATE	ELEVATION OF WATER TABLE
6/10/81	277.7		
6/11/81	277.3		
6/12/81	277.2		
6/17/81	277.0		

NOTE: Screen, slotted pipe and perforated pipe indicated in the same manner.

Grade to measuring point (M.P.) is not to scale.

Datum is mean sea level.

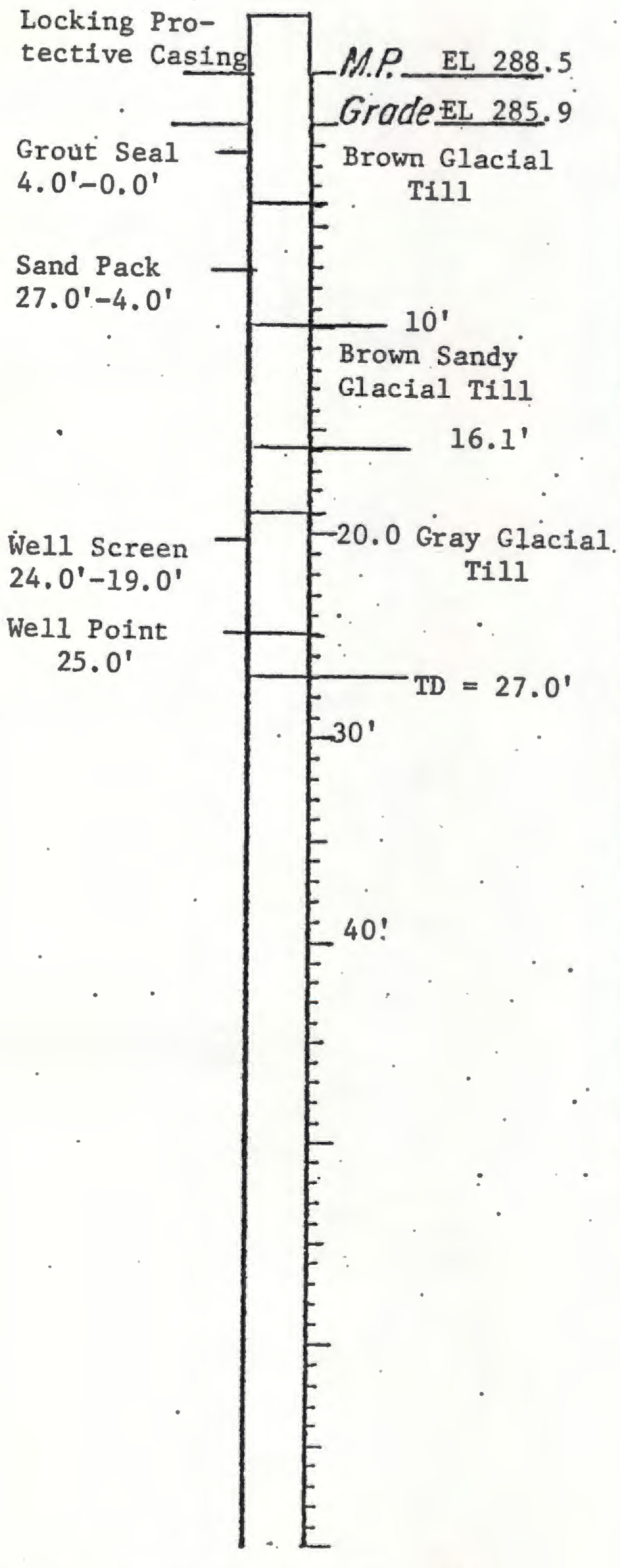
Vertical Scale: 1" = 10'

DUNN GEOSCIENCE CORP.
5 Northway Lane North
Latham, New York 12110
GEOSCIENCE CORP

TEXACO, INC.

DETAILS OF WELL NO. DL-3   DATE DRILLED 6-10-81

TOTAL DEPTH 27.0'



DATE	ELEVATION OF WATER TABLE	DATE	ELEVATION OF WATER TABLE
6/10/81	277.2		
6/11/81	276.7		
6/12/81	276.6		
6/17/81	276.4		

NOTE: Screen, slotted pipe and perforated pipe indicated in the same manner.

Grade to measuring point (M.P.) is not to scale.

Datum is mean sea level.

Vertical Scale: 1" = 10'

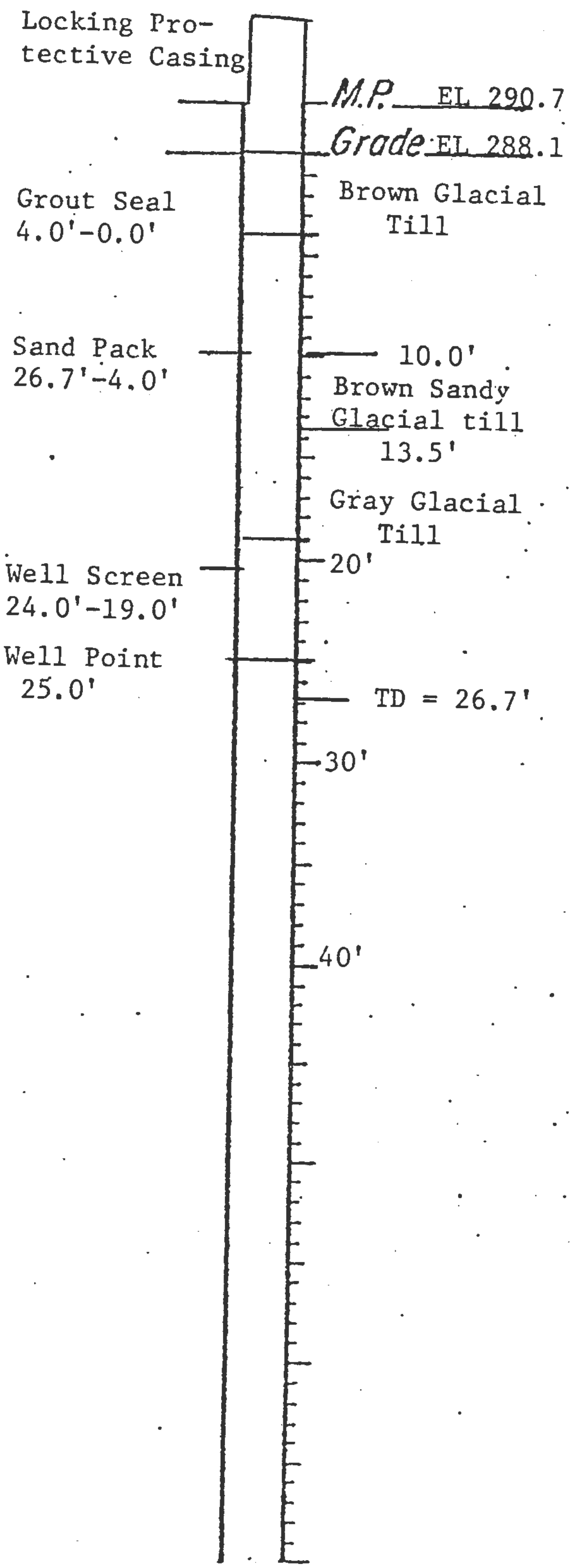
DUNN GEOSCIENCE CORP.
5 Northway Lane North
Latham, New York 12110
DUNN GEOSCIENCE CORP

TEXACO, INC.

DETAILS OF WELL NO. DL-4

DATE DRILLED 6-8-81

TOTAL DEPTH 26.7'



DATE	ELEVATION OF WATER TABLE	DATE	ELEVATION OF WATER TABLE
6/10/81	277.8		
6/11/81	277.7		
6/12/81	277.5		
6/17/81	277.5		

NOTE: Screen, slotted pipe and perforated pipe indicated in the same manner.

Grade to measuring point (M.P.) is not to scale.

Datum is mean sea level.

Vertical Scale: 1" = 10'

APPENDIX C

LABORATORY TESTING RESULTS

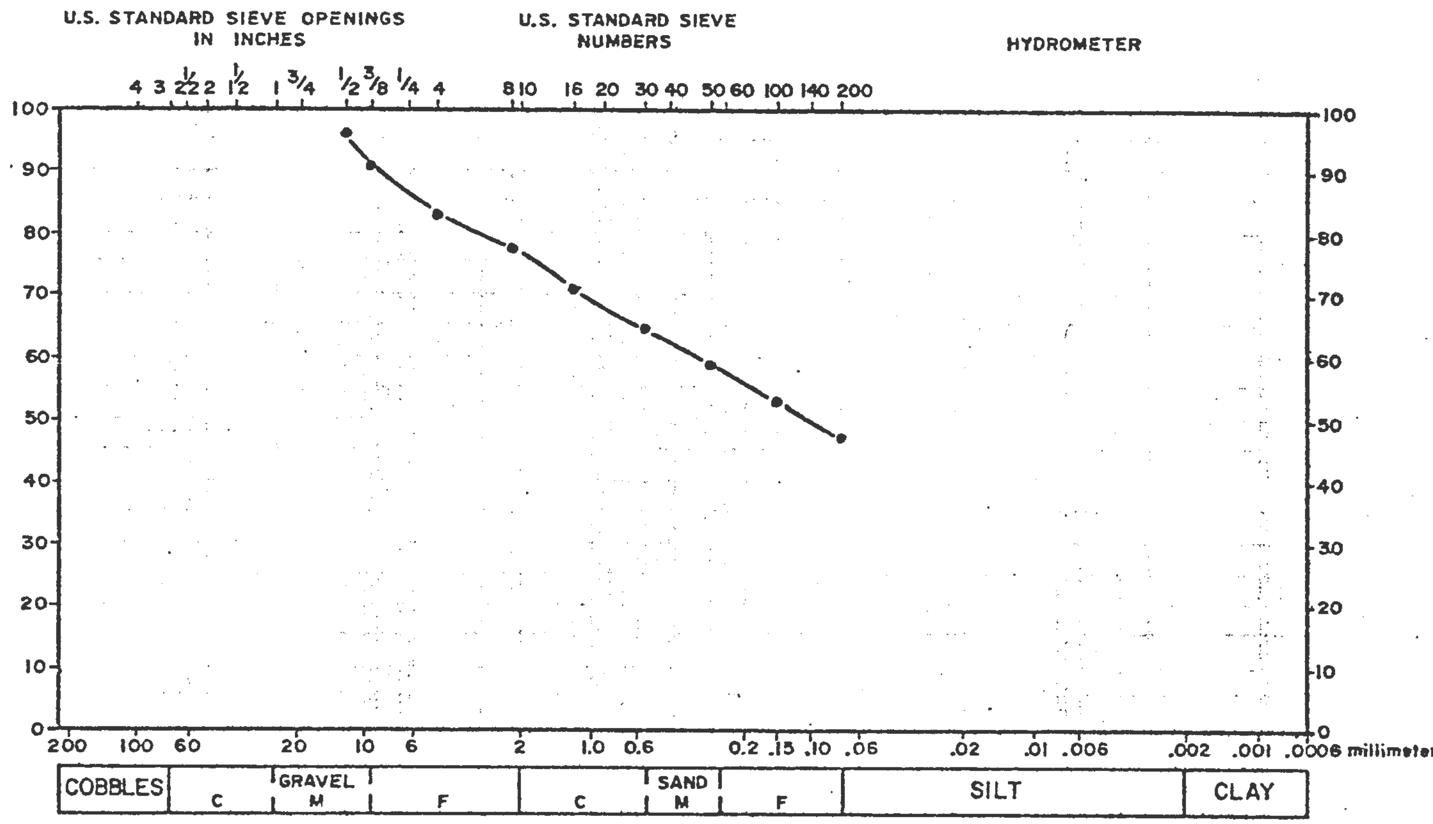
Dunn Geoscience Laboratory

5 Northway Lane North, Latham, NY 12110 (518) 783-8102

CLIENT: TEXACO, INC.
LAB NUMBER: 11546
TEST BY: JWH
REVIEWED BY:
SAMPLE DESCR: DL-2 SAMPLE # 5 15.0' - 16.0'

DATE RECEIVED: 07-30-81
DATE TESTED: 07-30-81
DATE REPORTED: 08-17-81

GRAIN SIZE DISTRIBUTION



COARSE

SIZE (inches)	PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPECS.
1/2	4.2	95.8	–
3/8	5.6	90.1	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–

FINE

SIEVE	PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPECS.
4	7.2	82.9	–
8	5.7	77.1	–
16	6.6	70.5	–
30	6.0	64.5	–
50	6.1	58.4	–
100	6.0	52.4	–
200	6.0	46.4	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–
–	0.0	0.0	–

HYDROMETER

PARTICLE DIAMETER (mm)	PERCENT PASSING	SPECS.

PAN=46.4%
WASH LOSS=46.4%

SPECIFIC GRAVITY=0.0

SAMPLE WT(C)= 179.40

SAMPLE WT(F)= 179.40

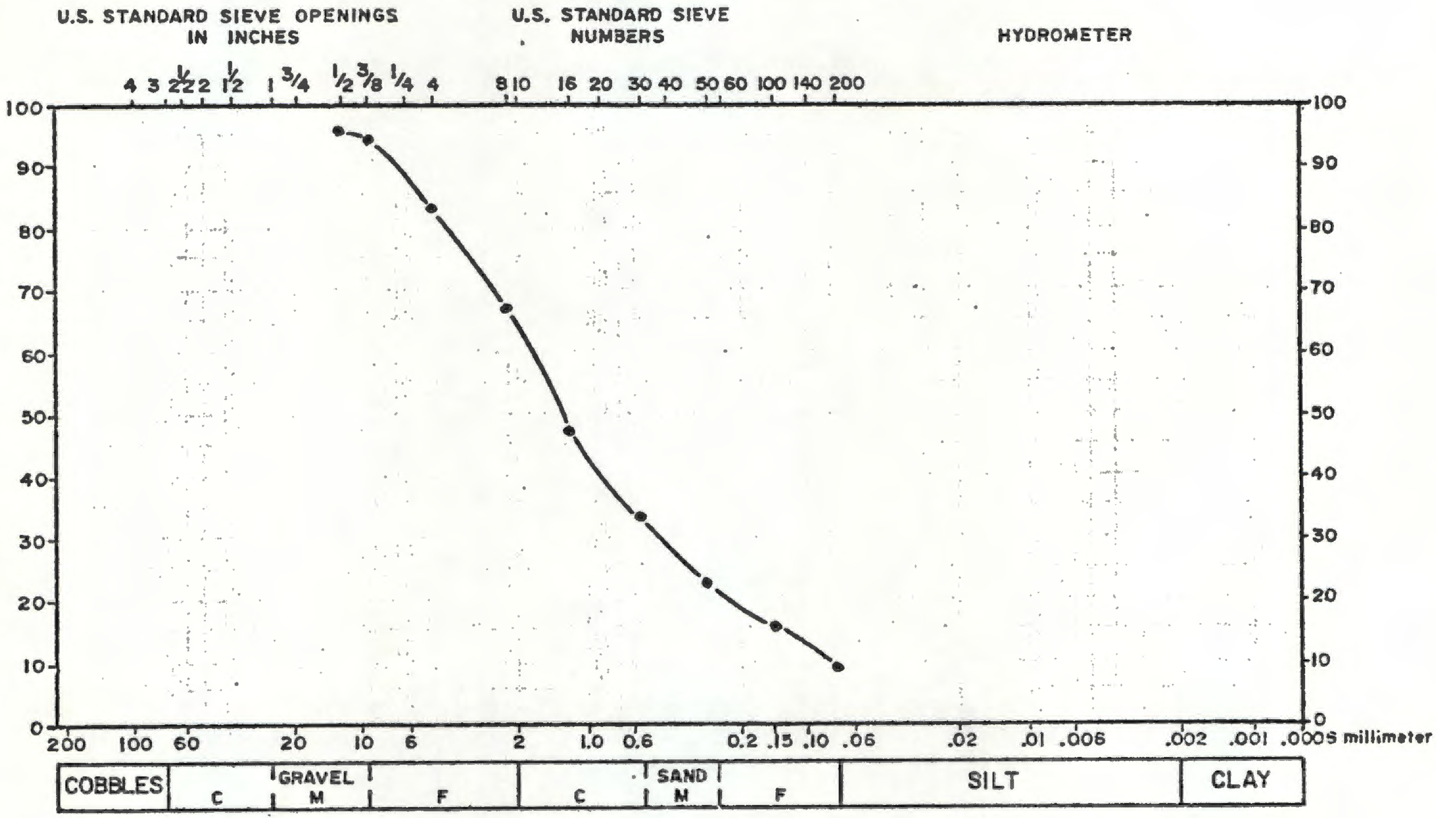
SPECIFICATION: NONE
TEST STANDARD: NONE
NOTES: NONE

Dunn Geoscience Laboratory

5 Northway Lane North, Latham, NY 12110 (518) 783-8102

CLIENT: TEXACO, INC.
LAB NUMBER: 11546 DATE RECEIVED: 07-30-81
TEST BY: JWH DATE TESTED: 07-30-81
REVIEWED BY: DATE REPORTED: 08-17-81
SAMPLE DESCR: UL-1 SAMPLE # 7 12.0' - 13.0'

GRAIN SIZE DISTRIBUTION



COARSE				FINE				HYDROMETER		
SIZE (inches)	PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPECS.	SIEVE	PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPECS.	PARTICLE DIAMETER (mm)	PERCENT PASSING	SPECS.
1/2	4.1	95.9	-	4	11.3	83.0	-			
3/8	1.6	94.4	-	8	17.0	66.1	-			
-	0.0	0.0	-	16	19.2	46.8	-			
-	0.0	0.0	-	30	13.6	33.3	-			
-	0.0	0.0	-	50	10.8	22.5	-			
-	0.0	0.0	-	100	7.5	15.0	-			
-	0.0	0.0	-	200	6.0	9.0	-			
-	0.0	0.0	-	-	0.0	0.0	-			
-	0.0	0.0	-	-	0.0	0.0	-			
-	0.0	0.0	-	-	0.0	0.0	-			
-	0.0	0.0	-	-	0.0	0.0	-			
-	0.0	0.0	-	-	0.0	0.0	-			

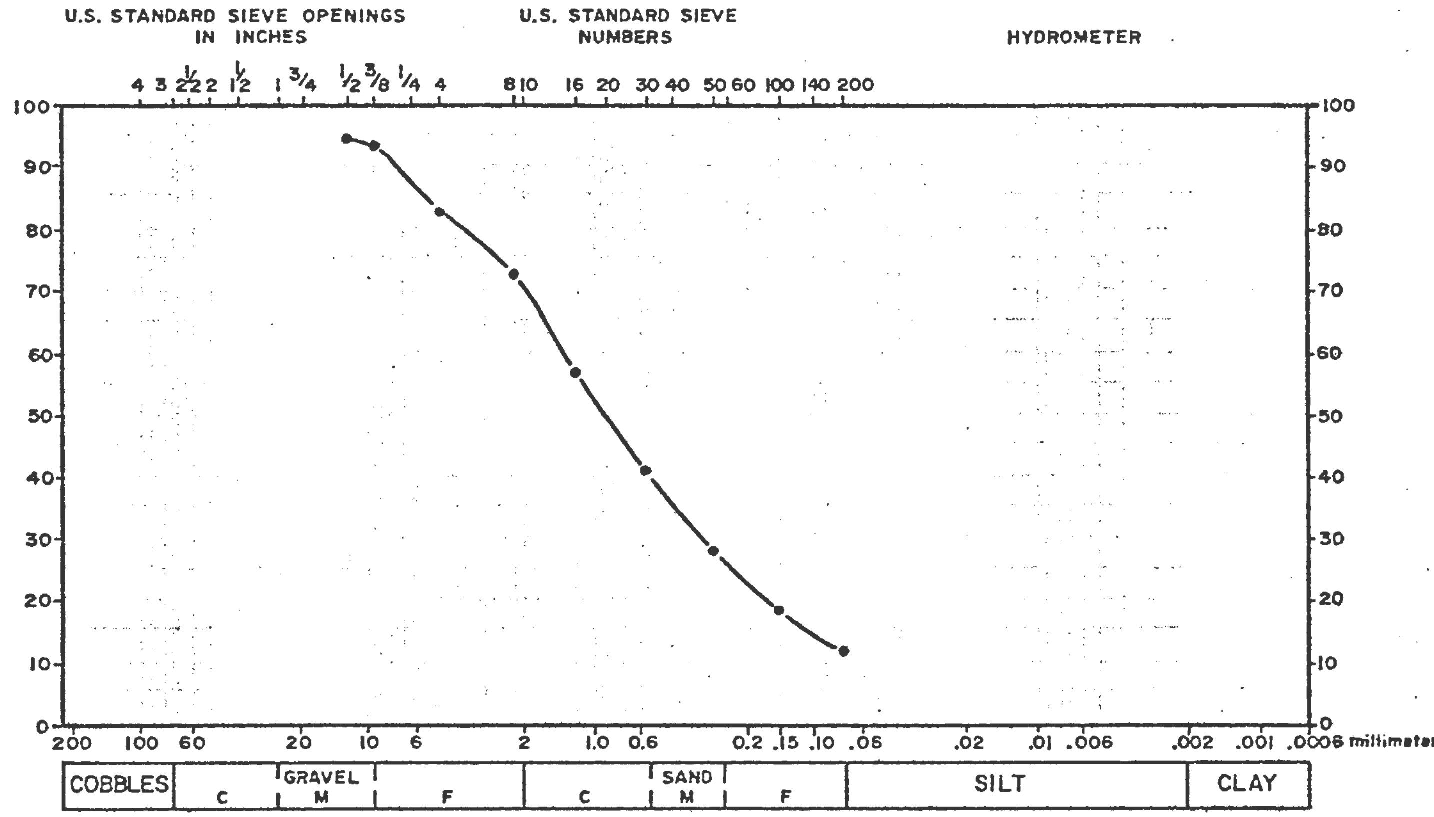
PAN= 9.0% SPECIFIC GRAVITY=0.0
WASH LOSS NOT TESTED
SAMPLE WT(C)= 238.10 SAMPLE WT(F)= 238.10

SPECIFICATION: NONE
TEST STANDARD: NONE
NOTES: NONE

Dunn Geoscience Laboratory
5 Northway Lane North, Latham, NY 12110 (518) 783-8102

CLIENT: TEXACO, INC.
LAB NUMBER: 11546 DATE RECEIVED: 07-30-81
TEST BY: JWH DATE TESTED: 07-30-81
REVIEWED BY: DATE REPORTED: 08-17-81
SAMPLE DESCR: DL-3 SAMPLE # 7 20.0'-22.0'

GRAIN SIZE DISTRIBUTION



COARSE				FINE				HYDROMETER		
SIZE (inches)	PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPECS.	SIEVE	PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPECS.	PARTICLE DIAMETER (mm)	PERCENT PASSING	SPECS.
1/2	5.6	94.4	--	4	11.3	82.2	--			
3/8	0.9	93.5	--	8	10.1	72.1	--			
--	0.0	0.0	--	16	16.0	56.0	--			
--	0.0	0.0	--	30	15.5	40.6	--			
--	0.0	0.0	--	50	12.6	27.9	--			
--	0.0	0.0	--	100	9.1	18.8	--			
--	0.0	0.0	--	200	6.9	11.9	--			
--	0.0	0.0	--	--	0.0	0.0	--			
--	0.0	0.0	--	--	0.0	0.0	--			
--	0.0	0.0	--	--	0.0	0.0	--			
--	0.0	0.0	--	--	0.0	0.0	--			
--	0.0	0.0	--	--	0.0	0.0	--			

PAN=11.9% SPECIFIC GRAVITY=0.0
WASH LOSS NOT TESTED
SAMPLE WT(C)= 199.30 SAMPLE WT(F)= 199.30

SPECIFICATION: NONE
TEST STANDARD: NONE
NOTES: NONE

DUNN GEOSCIENCE LABORATORY
5 NORTHWAY LANE NORTH
LATHAM, NEW YORK 12110
518-783-8102

DUNN GEOSCIENCE CORP.

Falling-Head Permeability Tests

Boring No.	Sample No.	Run No.	Permeability (cm/sec)
DL-3	S-2	1	1.3×10^{-7}
DL-3	S-2	2	1.3×10^{-7}
DL-2	S-4	1	6.9×10^{-8}
DL-2	S-4	2	6.7×10^{-8}

CLIENT	Texaco, Inc.	LAB NUMBER	11546
SAMPLE DESCRIPTION	Bore hole samples, see above	DATE RECEIVED	6/12/81
		DATE TESTED	7/29/81
TEST BY	G. Casper	DATE REPORTED	8/3/81
REVIEWED BY	LABORATORY MANAGER	TEST STANDARD	

DUNN GEOSCIENCE LABORATORY
5 NORTHWAY LANE NORTH
LATHAM, NEW YORK 12110
518-783-8102

DUNN GEOSCIENCE CORP.

Analysis for Moisture Content

Boring No.	Sample No.	Moisture Content (%)
UL-1	S-12	10.59
	S-13	11.04
DL-2	S-3	10.77
	S-6	7.39
DL-3	S-4	11.48
	S-6	7.45
DL-4	S-1	10.10
	S-4	8.10

CLIENT	Texaco, Inc.	LAB NUMBER	11546
SAMPLE DESCRIPTION	Test Boring Samples, see above	DATE RECEIVED	6/12/81
		DATE TESTED	7/29/81
TEST BY	C. Casper	DATE REPORTED	8/3/81
REVIEWED BY	LABORATORY MANAGER	TEST STANDARD	

DUNN GEOSCIENCE LABORATORY
5 NORTHWAY LANE NORTH
LATHAM, NEW YORK 12110
518-783-8102

DUNN GEOSCIENCE CORP

SOIL PH TESTS

Boring No.	Sample No.	pH
UL-1	S-3	6.27
DL-2	S-3	7.71
DL-3	S-4	7.54
DL-4	S-1	4.82

CLIENT	Texaco, Inc.	LAB NUMBER	11546
SAMPLE DESCRIPTION	Bore Hole Samples, see above	DATE RECEIVED	6/12/81
		DATE TESTED	7/29/81
TEST BY	G. Casper	DATE REPORTED	8/3/81
REVIEWED BY	LABORATORY MANAGER	TEST STANDARD	