P. Berry
Solid Waste

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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Ardaman & Associates, Inc.

Consulting Engineers in Soil Mechanics,
Foundations, and Materials Testing

February 22, 1983
File Number 81-159

Camp Dresser & McKee, Inc.
One Center Plaza
Boston, Massachusetts 02108

Attention: Mr. Robert Hauser, P.E.

Subject: Hydrogeological and Geotechnical Investigation for Proposed Southeast Hillsborough County Sanitary Landfill

Gentlemen:

As requested by Camp Dresser & McKee, Inc. and authorized by Hillsborough County, we have completed the hydrogeological and geotechnical investigation for the above mentioned project. The proposed landfill will be located within the initial waste clay settling area for the old Boyette Mine, within Sections 14, 15, 22 and 23 of Township 31 South, Range 21 East. This report documents our findings.

The proposed landfill area is a satisfactory landfill site. The waste clay, which covers over 90 percent of the proposed landfill area (i.e., that portion south of the partition dike) will provide an effective liner for the leachate collection system. We have analyzed the stability of the liner under the proposed filling plan and have concluded that the liner is stable under the proposed operating conditions. A variety of good cover material is also available within the settling area immediately north of the proposed landfill site.

This report has been prepared for the exclusive use of Hillsborough County and their solid waste management consultant, Camp Dresser & McKee, Inc. for specific application to the above mentioned project in accordance with generally accepted geotechnical engineering practice. No other warranty, expressed or implied, is made. In the event any changes occur in the design criteria for the landfill such as a change in the filling plan or a modification in the location of the landfill area, we should review the applicability of conclusions and recommendations in this report. We also recommend a general review of the final design plans and specifications by our office to ensure that our recommendations have been properly interpreted and implemented.

It has been a pleasure assisting you with this project. Please do not hesitate to contact us if you have questions concerning this report or if we can be of further service.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Herbert G. Stangland

Herbert G. Stangland, Jr., P.E.
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John E. Garlanger

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HGS:ed
Enclosures

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Chapter 1

INTRODUCTION

1.1 Purpose and Scope

The Board of County Commissioners of Hillsborough County in 1981 authorized Camp Dresser & McKee, Inc. (CDM), environmental engineers, and Ardaman & Associates, Inc. to conduct a site selection program involving four potential sites with the purpose of selecting a final site for use as a sanitary landfill. The Lonesome Mine site (CDM Site 8) was selected as the preferred site for the sanitary landfill. In 1982 Ardaman & Associates, Inc. investigated the hydrogeological and hydrological characteristics of the site for purposes of permitting and design of the landfill. The selected site is hereafter referred to as the Southeast County Landfill site.

The scope of work for the hydrogeological and hydrological investigation at this site included:

- Compilation and review of existing reports containing hydrological, hydrogeological, groundwater, and water quality data.
- Performance of a drilling program to determine and document Surficial and underlying aquifer(s) water levels, thickness of Surficial Aquifer, depth to top of Floridan Aquifer, confining bed thicknesses for Floridan Aquifer, depth to top of Secondary Artesian Aquifer, thickness of Secondary Artesian Aquifer, and type and composition of potential cover soils.
- Determination of groundwater flow directions.
- Performance of laboratory analyses to include grain size distributions, permeability, compressibility, compaction, Atterberg limits, chemical, mineralogical and strength characteristics of selected soils to be used for cover and liner material. Grain size tests and permeability tests were also performed on selected samples for aquifer/aquiclude systems.
- Performance of geotechnical analyses required for the design of the liner and leachate collection system and for the landfill development.
- Determination of the potential for the development of sinkholes.
- Performance of well inventory within 1 mile of the site.
- Determination of site suitability for landfill.
- Documentation of investigation findings in this report.

1.2 Previous Studies

Soil, geology and hydrology studies have been made in southern Hillsborough County as part of county, regional or statewide investigations by the U.S. Geological Survey, U.S. Department of Agriculture, private consultants, and the Bureau of Geology, Florida Department of Natural Resources (formerly the Florida Geological Survey). The U.S. Geological Survey work is under cooperative programs with the county and/or with the Southwest Florida Water Management District (SWFWMD).

The first report on the water resources of Hillsborough County was made by Matson and Sanford (1913). The U.S. Department of Agriculture, Soil Conservation Service published their detailed soil survey in 1958. Peek (1959) described the geology and groundwater of the Ruskin area in southwestern Hillsborough County. Menke, Meredith and Wetterhall (1961) published a thorough evaluation of the water resources of the county. Puri and Vernon (1964) summarized the geology and White (1970) delineated the physiographic features of Florida. Stuart and Duerr (1973) enumerated factors to be considered in landfill site selection and noted the necessity for hydrogeological investigations as part of landfill projects. Mills and Laughlin (1976) mapped the potentiometric surface of the Floridan Aquifer in Hillsborough County. Ardaman & Associates, Inc. (1977) conducted a feasibility study for the Bullfrog Creek Reservior/Recharge Project. Also, Geraghty and Miller and others (1977) studied the hydrology of the Four River Basins area for the U.S. Army Corps of Engineers. Yobbi and others (1980) document the May 1980 groundwater levels for part of the study area. The SWFWMD has published the potentiometric surface of the Floridan Aquifer for May and September 1982 for the study area. In addition, the Water Management District has hydrogeological data from the ROMP program. This regional observation and monitor well program consists of inland monitor wells and coastal traces of two to four wells each measuring the extent of saltwater intrusion and changes in the salt water/fresh water interface. This valuable information was also used as part of this investigation.

1.3 Acknowledgements

The assistance of Mr. Bob Saunders of American Cyanamid Company and Mr. Cody Sutherland of Agrico Chemical Company is greatfully acknowledged. Hillsborough County's assistance in obtaining access and securing the site is also acknowledged. The County Staff also assisted in monitoring at the weather station.

Chapter 2

SITE CONDITIONS

2.1 Location

The proposed Southeast County landfill site is located in an area west of State Road 39 between Picnic and Pinecrest, Florida as shown in Figure 2.1. The project area is located in Sections 14, 15, 22, and 23 of Township 31 South, Range 21 East, Hillsborough County, Florida. The landfill will be constructed within the boundaries of Settling Area No. 1, an initial waste clay settling area at the Lonesome Phosphate Mine or "Boyette Mine". Settling Area No. 1 is also referred to as the West Settling Area.

2.2 Site History

Mined and unmined areas at the site are shown in Figure 2.2. This figure is based on Agrico Chemical Company data and an aerial photograph taken January 15, 1948. A reproduction of this photograph is presented in Figure 2.3.

Waste phosphatic clays were deposited in Settling Area No. 1 for a number of years prior to the pumping of sand tailings into the northeast portion of the area. These waste clays were pumped into the settling area primarily at the northeast corner. The settling area was built on natural ground by constructing embankments out of sand borrowed from just inside or outside of the area. Phosphate mining in the vicinity of the settling area apparently began in June 1945.

The subject site is within the Polk upland subdivision of the Central Highlands (White, 1970). The Polk upland is for the most part a flat plain with elevations ranging from 100 to 130 feet (NGVD). This area is noted for showing less intense effects of solution than are generally found throughout peninsular Florida (White, 1970). The site is composed mostly of mined and unmined land covered with phosphate mining clay and sand tailings disposal areas.

The near surface deposits in decending order include phosphate mining clay and sand tailings, surficial sands, Bone Valley Formation, Hawthorn Formation, and Tampa Formation. Above the Hawthorn Formation are a mixture of mined and unmined lands. In the mined-out areas the native soils were removed and placed in spoil piles and, within retention dikes, as clay and sand tailings. In the unmined areas the surficial soils consist primarily of Leon, Ona and Pomello fine sands.

Beneath the surficial soils is the Bone Valley Formation which consists of phosphatic clays and sands and is referred to as the matrix or ore zone. In some areas surrounding the proposed landfill site the matrix was mined to depths of approximately 16 to 37 feet.

Underlying the Bone Valley Formation is the Hawthorn Formation. These deposits are of marine origin and consist predominantly of light gray to gray, calcareous, sandy clays interbedded with lenses of dense gray and white limestone with a total thickness greater than 100 feet. Because of the thickness and low permeability of the clay beds, the Hawthorn and where intact, the Bone Valley Formation serve as a confining layer for water in the underlying limestone.

The Tampa Formation lies below the Hawthorn and consists of white and gray, sandy, fossiliferous limestone. At the subject site, the top of the Tampa is found at a depth of approximately 140 feet.

2.3 Hydrogeological Setting

Beneath the site are three Aquifer systems; the Surficial, Secondary Artesian and the Floridan. The Surficial Aquifer in the unmined areas consists of the natural occurring sands above the Bone Valley Formation. In the mined areas it consists of the heterogeneous deposits of cast overburden and the sand tailings deposit. Unmined areas will have perched water tables where sand tailings are separated from the natural surficial sands by waste clay. The thickness and continuity of the Surficial Aquifer is quite variable depending on the depth mined and the amount and areal extent of the waste phosphatic clays. Within the proposed landfill, refuse will only be deposited in unmined areas.

Permeable sand and limestone zones within the Hawthorn Formation make up the Secondary Artesian Aquifer system in the vicinity. These zones can in isolated cases produce significant quantities of water, but of relatively poor quality (Menke, 1961).

The Floridan Aquifer is found below the Hawthorn Formation in the Tampa Limestone and underlying formations and is the most productive of the three aquifers. Generally, the Floridan Aquifer water flows westward across the site.

Head differences between the Floridan and the other aquifers indicate the potential for downward leakance from the overlying aquifers to the Floridan; however, the leakance values are on the order of only one inch per year (Stewart, 1980).

2.4 Hydrology

The site is located in the Alafia River Basin. The natural drainage pattern has been modified considerably by phosphate mining activity. Runoff leaves the vicinity of the site through Long Flat Creek on the west northwest or through an unnamed tributary to Hurrah Creek to the southeast.

Monthly rainfall data from stations at Plant City and Tampa are presented in Tables 2.1 and 2.2. Average annual rainfall at the site is expected to approximate 54 inches. Approximately 58 percent of this rainfall occurs between June and September (wet season) with the remainder occurring from October to May (dry season). The "dry" value on the tables refers to the highest rainfall within the lowest 10 percentile of monthly rainfalls of the period of record while the "wet" value refers to the lowest rainfall within the highest 10 percentile of monthly rainfalls.

During the rainy season runoff from the area and recharge to the surficial aquifer is greatest. Average runoff at the U.S.G.S. gage on Alafia River at Lithia for the 48-year period of record (through 1980) was 14.84 inches per year from the basin (335 square miles). Average runoff at the U.S.G.S. gage on the South Prong Alafia River near Lithia for the 17-year period of record (through 1980) was 14.22 inches per year from the basin (107 square miles).

Regional lake evaporation values have been reported as approximately 50 inches per year (Kohler, 1959) for the period 1946-55 and Class A pan evaporation is reported as 68.99 inches per year (Hutchinson, 1978) for the period 1966-75. The average monthly lake evaporation rates are summarized in Table 2.3.

Water leaves the surficial aquifer as base flow to streams and as evapotranspiration. Average evapotranspiration for the Middle Gulf area of Florida, which includes the subject site, is estimated to be 39 inches per year (Cherry, et. al., 1970).

Table 2.1

MONTHLY RAINFALL DATA - PLANT CITY
(Inches for 1915-1981)

	Dry Range (less than or equal to)	Wet Range (greater than or equal to)	Mean
January	0.42	5.54	2.37
February	0.45	5.39	3.03
March	0.83	6.67	3.56
April	0.32	6.44	2.73
May	1.10	7.46	4.12
June	2.51	11.87	7.57
July	4.49	13.50	8.50
August	5.55	12.88	8.48
September	2.46	10.87	6.61
October	0.49	6.96	2.98
November	0.19	4.48	1.86
December	0.35	5.16	2.23
			54.04

Source: Southwest Florida Water Management District

Table 2.2

MONTHLY RAINFALL DATA - TAMPA
(Inches for 1915-1981)

	Dry Range (less than or equal to)	Wet Range (greater than or equal to)	Mean
January	0.38	4.61	2.08
February	0.59	5.35	2.81
March	0.58	6.98	3.11
April	0.38	5.28	2.18
May	0.59	6.67	3.28
June	2.50	11.12	6.41
July	3.66	12.21	7.64
August	4.20	12.00	7.83
September	2.34	10.32	6.25
October	0.38	5.38	2.62
November	0.14	3.88	1.55
December	0.35	4.20	2.03
			47.79

Source: Southwest Florida Water Management District

Table 2.3

NORMAL MONTHLY PRECIPITATION AND LAKE EVAPORATION RATES FOR SITE

Month	Rainfall[1] (inches)	Lake Evaporation[2] (inches)
January	2.37	2.2
February	3.03	3.0
March	3.56	4.0
April	2.23	4.9
May	4.12	6.0
June	7.57	5.9
July	8.50	5.4
August	8.48	4.8
September	6.61	4.3
October	2.98	4.1
November	1.86	2.9
December	2.23	2.5
	54.04	50.0

[1]1915-1981 Values for Plant City NOAA Gage.
[2]Geraghty and Miller and Reynolds, Smith & Hills, 1977.

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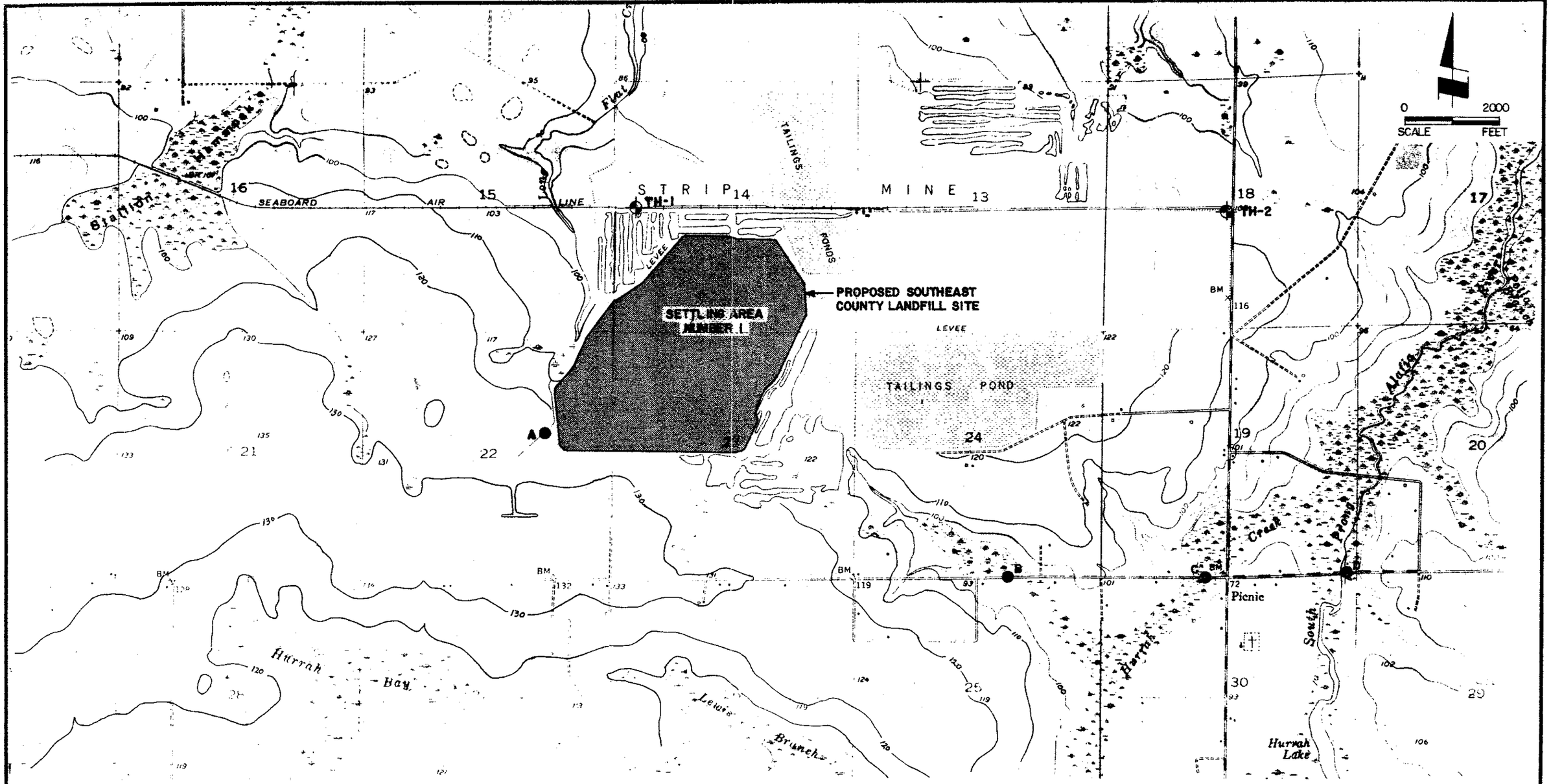

NATURAL GROUND TOPOGRAPHY SURROUNDING PROPOSED SOUTHEAST COUNTY LANDFILL SITE

LEGEND

TH STANDARD PENETRATION TEST HOLE

A SURFACE WATER QUALITY SAMPLING SITES

SOURCE: USGS QUAD MAP (LITHIA, FL 1955)

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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FIGURE 2.1

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LONESOME MINE

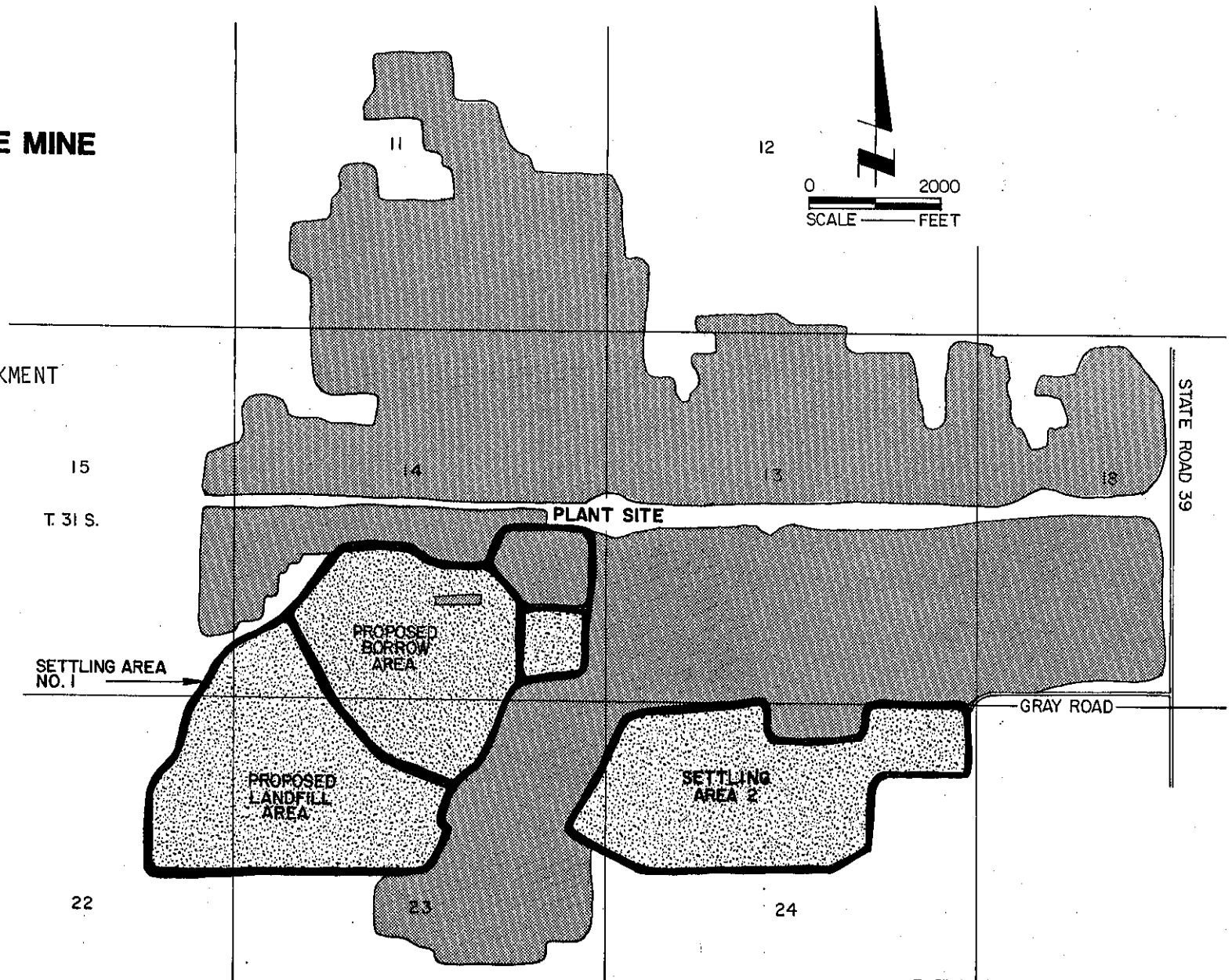

FIGURE 2.2

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGIC INVESTIGATION OF HILLSBOROUGH COUNTY LANDFILL SITES

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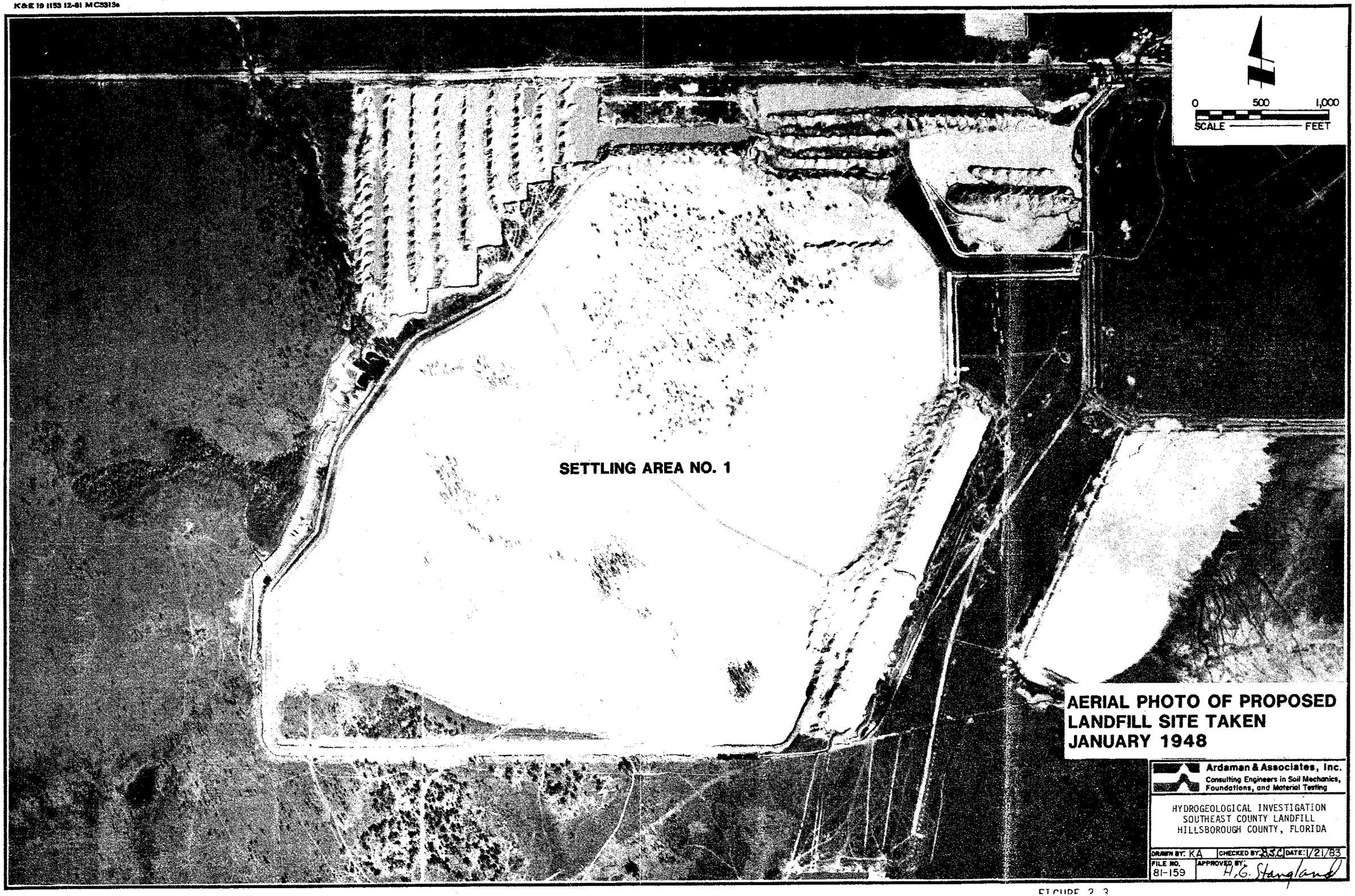

AERIAL PHOTO OF PROPOSED LANDFILL SITE TAKEN JANUARY 1948

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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FIGURE 2.3

Chapter 3

FIELD INVESTIGATION

3.1 Boring Program

The purpose of the boring program included determining the extent and condition of the waste phosphatic clays within Settling Area No. 1, locating and defining the aquifer systems underlying the subject site, and investigating the nature and consistency of the perimeter embankments. These objectives were accomplished with Standard Penetration Test (SPT) borings, auger borings, probings (with PVC pipe), wash borings, and SPT/core borings performed around, along, and within the perimeter of Settling Area No. 1, the proposed landfill site. Sampling and testing procedures used in this program are described in Appendices A.1 and A.2. Upon completion, all borings and probings were grouted with a cement-bentonite slurry.

The boring program was implemented in three phases. The first phase included three wash borings and five probings conducted within the boundaries of Settling Area No. 1 and two deep SPT/core borings located north and northeast of the subject site. This work was conducted between December 7 and 21 of 1981. The second phase included seven auger borings, nine SPT borings and one deep SPT/core boring performed east of and adjacent to the site in the other settling area. These borings were drilled between May 28 and June 14 of 1982. The third and final phase of the program included: 20 SPT borings performed along the perimeter of the settling area; two deep SPT/core borings, one performed at the southwest corner and one performed at the northwest corner of the subject site; one deep wash boring performed at the southwest corner of the site; and 15 SPT borings and 22 auger borings performed within the perimeter of Settling Area No. 1. The third phase began on September 28 and was completed on December 3 of 1982.

The locations of all the borings and probings are shown on the Boring Location Plan presented in Figure 3.1. The borings and probings were located in the field by our field engineer by measuring from reference points on the ground, easily identifiable on the 1 inch equal 200 feet scale map of the site. The locations should be considered accurate only to the degree implied by the method used.

3.2 Soil Sampling Program

Four types of samples were recovered during the boring program for purposes of classification and laboratory analyses. These included SPT split-spoon samples, Shelby tube samples, auger boring bag and jar samples, and NQ wire-line core samples.

A total of 22 Shelby tube samples were obtained, all but two samples of which were of the waste phosphatic clay. These "undisturbed" samples of the waste clay enabled us to perform detailed tests for classification purposes and for determining strength and consolidation characteristics.

Continuous split-spoon or jar sampling was utilized in all SPT borings performed in areas containing waste phosphatic clays. Standard split-spoon sampling was performed in the remaining SPT and SPT/core borings. Standard split-spoon sampling consists of continuous sampling for the first 10 feet and one sample taken every 5 feet thereafter.

A total of 14 bag samples were obtained from auger borings AB-41 through AB-45 performed in the sand tailings located in the northeast corner of the subject site. These samples, 40 to 50 pounds each, were returned to our laboratory where the fines, i.e., the portion passing the No. 200 sieve, were removed and sent to Dr. Emmett Bolch at the University of Florida in Gainesville for radiation analyses.

Sampling for the auger borings performed in the areas containing waste phosphatic clays consisted of taking a jar sample every 2.5 feet or every soil change, whichever was less. For the other auger borings, excluding AB-41 through AB-45, jar samples were obtained every 5 feet or every soil change, whichever was less. These jar samples were utilized primarily for laboratory classification purposes.

For mineralogic analysis of the waste phosphatic clays, three SPT jar samples from TH-49 at different depths were sent to Dr. R. T. Martin at M.I.T. in Cambridge, Massachusetts.

The cation exchange capacity of the waste phosphatic clays was determined by A & L Southern Agricultural Laboratories in Fort Lauderdale, Florida from two composite samples of the waste clays, one from AB-30 and one from AB-38. Each composite sample was a mixture of four jar samples.

In order to stratify the deeper rock-like formations, NQ wire-line core was utilized to obtain continuous samples of these soils.

3.3 Geophysical Investigation

To aid in stratifying the deeper formations and characterizing the various aquifer systems, gamma-ray and electric resistivity logging were performed by CH2M Hill in the deep SPT/core borings at TH-40 and TH-42. Since no construction data are available on the abandoned well adjacent to TH-19, a caliper log (as well as an electric resistivity log) was made. The geophysical logs for the abandoned production well and Test Holes 40 and 42 are presented in Figures 3.2, 3.3 and 3.4, respectively. The abandoned production well has a 24-inch casing extending to a depth of 98 feet with an additional 48 feet of open hole for a total depth of 145.7 feet.

3.4 Piezometer Installation

Twenty-two piezometers were installed both within and around the proposed landfill site. Eighteen of these were positioned within the surficial aquifer: 13 along the perimeter dikes (TH-20, TH-22, TH-24, TH-26, TH-28, TH-30, TH-32, TH-33, TH-34A, TH-35, TH-36, TH-37A, and TH-38); three within Settling Area No. 1 itself (AB-37, TH-48, and TH-56); and one just outside both the southwest and northwest corners of the site (AB-21 and AB-22). All but one of the above

piezometers were constructed of 2-inch PVC pipe, solid for the riser and slotted for the collection zone. The shallow piezometer or well located at the southwest corner (AB-21) was constructed of 6-inch slotted PVC. A battery-powered strip-chart recorder was installed here to obtain continuous water-level readings in the Surficial Aquifer. In addition to the shallow aquifer piezometers, four piezometers were placed in the Floridan Aquifer. These aquifer piezometers are located as follows: one at the southwest corner (TH-40); one at the northwest corner (TH-42); and one due east of the subject site (TH-19). A deeper Floridan Aquifer piezometer is located at the southwest corner (TH-41).

The piezometers were installed by advancing a 4-inch diameter open hole to the final depth of the well, inserting the collection zone of 10 slot PVC screen connected to the bottom of the solid riser, backfilling the annular space between the well screen and the walls of the borehole with silica sand, installing a bentonite ball seal, and backfilling the remainder of the borehole with a bentonite-cement grout. The piezometer and collection zone locations are shown on the boring profiles presented in Appendix A.3.

3.5 **Water Levels**

A Stevens Type-F water-level recorder with a weekly chart was installed on piezometer AB-21 on September 17, 1982 to measure fluctuations of the water table. The recorder was leveled-in in order to reference the data to NGVD. The recorder was checked weekly for proper operation by a field technician.

Water levels in 17 other piezometers were measured on a weekly basis between December 2, 1982 and January 7, 1983. The ground surface elevations at each of these piezometers was obtained by a field survey.

3.6 **Sensitivity Testing**

In situ permeability or "sensitivity" tests were performed at six selected surficial aquifer piezometers. These included AB-22, TH-20, TH-26, TH-28, TH-30, and TH-32. The testing methods utilized included one or both of the following: falling head method and recovery method. For the falling head method, each piezometer is flushed and then filled with water, after which the declining water level is measured over time. For the recovery method, the piezometer is flushed and drawn down below the static water level using a vacuum pump. The rising water level is then measured over time as it recovers to the equilibrium position. A total of six falling head tests and three recovery tests were performed on the six piezometers.

3.7 **Water Quality**

In situ groundwater quality data (conductivity, temperature and pH) were measured at 14 piezometers during collection of groundwater samples for laboratory analysis. The laboratory samples were obtained December 1-2, 1982 and January 7, 1983 at PZ-20, -24, -28, -32, -35, and -37A in order to document the background water quality. Conductivity values of four surface waters were also measured. The groundwater sampling sites are located in Figure 3.1 and the surface water sites are located in Figure 2.1.

On December 1, 1982, each piezometer was pumped, using a nitrogen-lift sampler, until conductivity was stable. This required approximately 2-4 gallons to be pumped. On the following day the piezometers having water with the highest and lowest recorded conductivity values plus 4 other piezometers were sampled for laboratory analysis.

Prior to the second sampling of January 7, 1983, all piezometers were pumped an additional 3-12 gallons in an attempt to further clear up the well waters. The second sampling was made on the same six piezometers originally tested.

Water collected on both sampling dates was placed in laboratory provided bottles, stored on ice and transported to the lab within 24 hours of collection. Chemical analyses were performed by Orlando Laboratories, Inc.

3.8 **Weather Station**

The weather station includes a continuous recording raingage, continuous recording wind direction and wind speed station, and a Class A evaporation pan station. A Science Associates Incorporated (SAI) Model No. 551 instrument with an 8-day, hand-wound clock mechanism is the raingage. The SAI Model 451-2 electronic wind station using d-c power and one month unattended operation is the wind station. The wind speed sensor and wind direction vane are mounted on a 10-meter mast supported with guy wires. The weather station layout is shown in Figure 3.5. The raingage and the Class A evaporation pan were operational July 15, 1982. The wind speed station was operational August 4, 1982.

PRODUCTION WELL

WATER

WEATHER STATION

POWER LINE

N
SCALE 1" = 400'

E 444,000

E 442,000

E 440,000

E 438,000

LEGEND

- STANDARD PENETRATION TEST BORING
- WASH BORING
- AUGER BORING
- PROBE
- SURFICIAL AQUIFER PIEZOMETER
- SECONDARY AQUIFER PIEZOMETER
- FLORIDAN AQUIFER PIEZOMETER
- SURFICIAL AQUIFER WELL

REV NO	DATE	DRWN	CHKD	REMARKS

DESIGNED BY
DRAWN BY
CHECKED BY
APPROVED BY
DATE

CAMP DRESSER & McKEE INC.

environmental engineers, scientists, planners, & management consultants

CDM

BORING LOCATION PLAN INCLUDING GROUNDWATER MONITORING SITES

PROJECT NO

SHEET NO

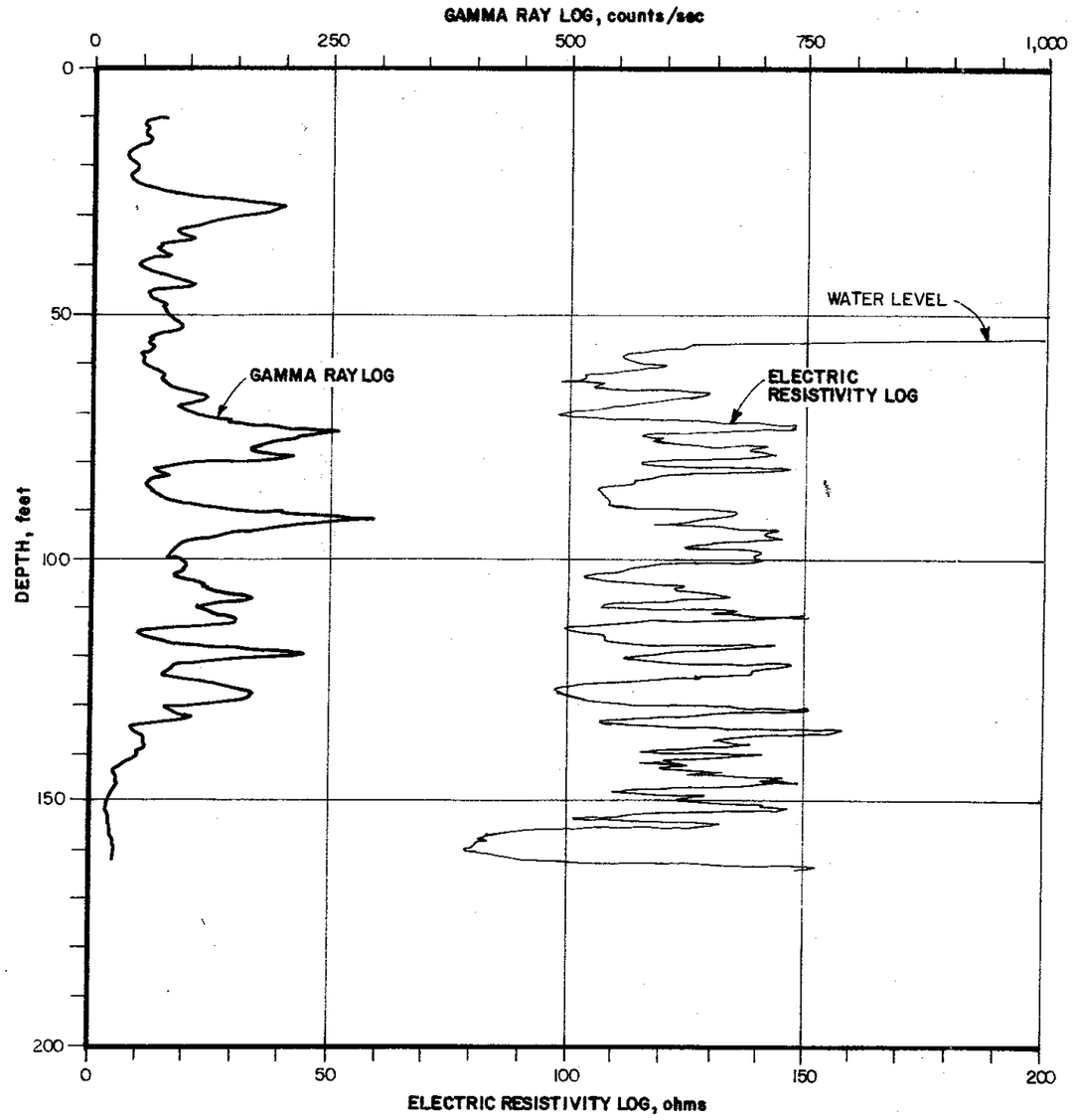
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: T.S.	CHECKED BY: S.J.C.	DATE: 1/21/93
FILE NO. 91-159	APPROVED BY: H.C. Stanford	

FIGURE 3.1

K&E 19 1153 12-81 MC3313a



LOGGING DATA

TEST HOLE NUMBER: TH-42
DATE DRILLED AND LOGGED: NOVEMBER 1982
LOGGING PERFORMED BY: CH2M HILL
LOG SCALES: ELECTRIC RESISTIVITY LOG
20 ohms/inch
GAMMA RAY LOG WITH 3/4"x1" DETECTOR
100 counts/second/inch
TIME CONSTANT - 4 seconds
LOGGING SPEED - 25 FPM

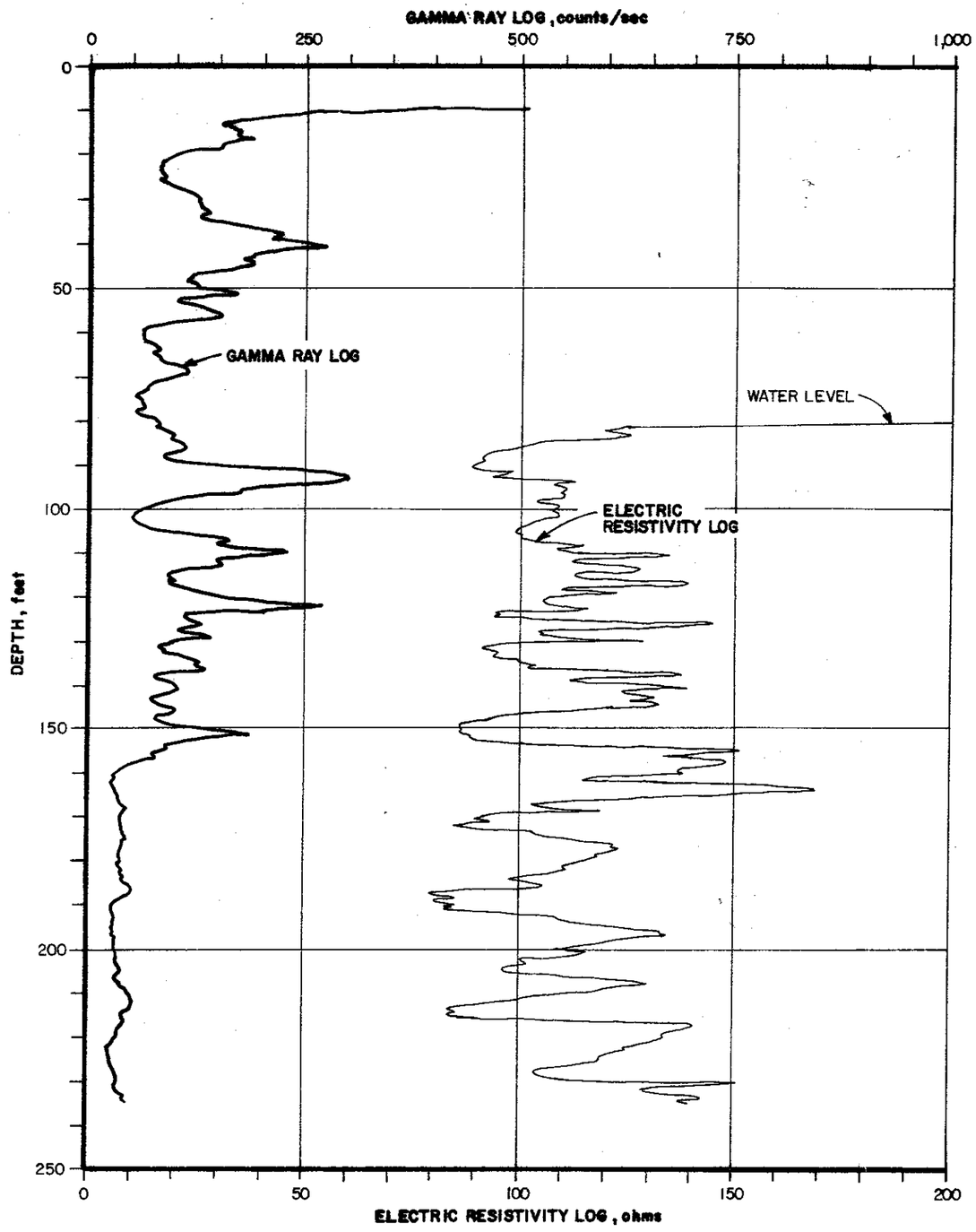
GAMMA RAY LOG AND ELECTRIC RESISTIVITY LOG FOR TEST HOLE NUMBER 42

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA	CHECKED BY: J.C.	DATE: 1/17/83
FILE NO. 81-159	APPROVED BY: H.G. Stanford	

FIGURE 3.3



LOGGING DATA

TEST HOLE NUMBER: TH-40
DATE DRILLED AND LOGGED: NOVEMBER 1982
LOGGING PERFORMED BY: CH2M HILL
LOG SCALES: ELECTRIC RESISTIVITY LOG
20 ohms/inch
GAMMA RAY LOG WITH $^3/_4$"x1" DETECTOR
100 counts/second/inch
TIME CONSTANT - 4 seconds
LOGGING SPEED - 25 FPM

GAMMA RAY LOG AND ELECTRIC RESISTIVITY LOG FOR TEST HOLE NUMBER 40

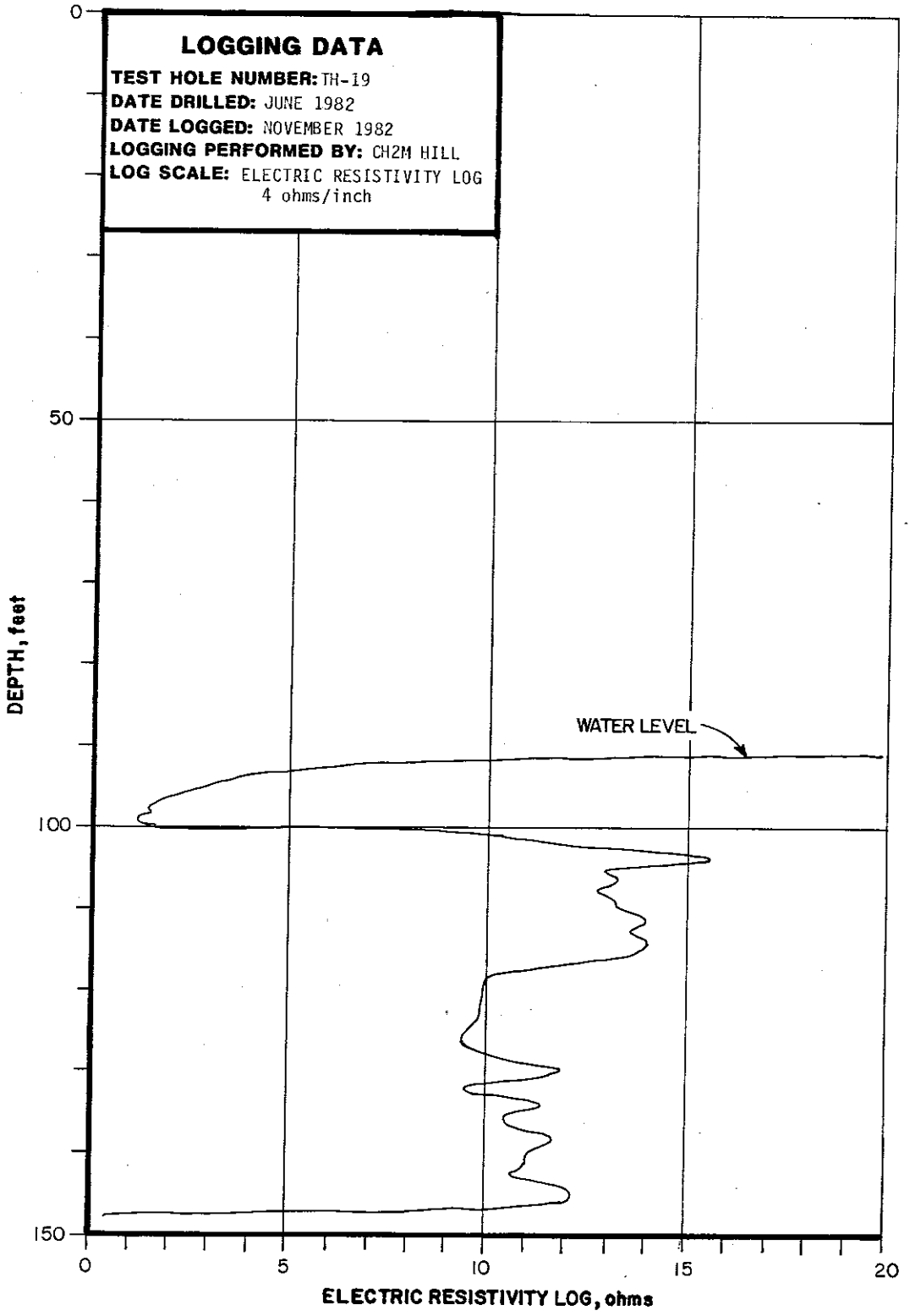
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA	CHECKED BY: S.F.C.	DATE: 1/14/83
FILE NO. 81-159	APPROVED BY: H.E. Stangland	

FIGURE 3.2

K&E 19 1153 12-80 MC1983e



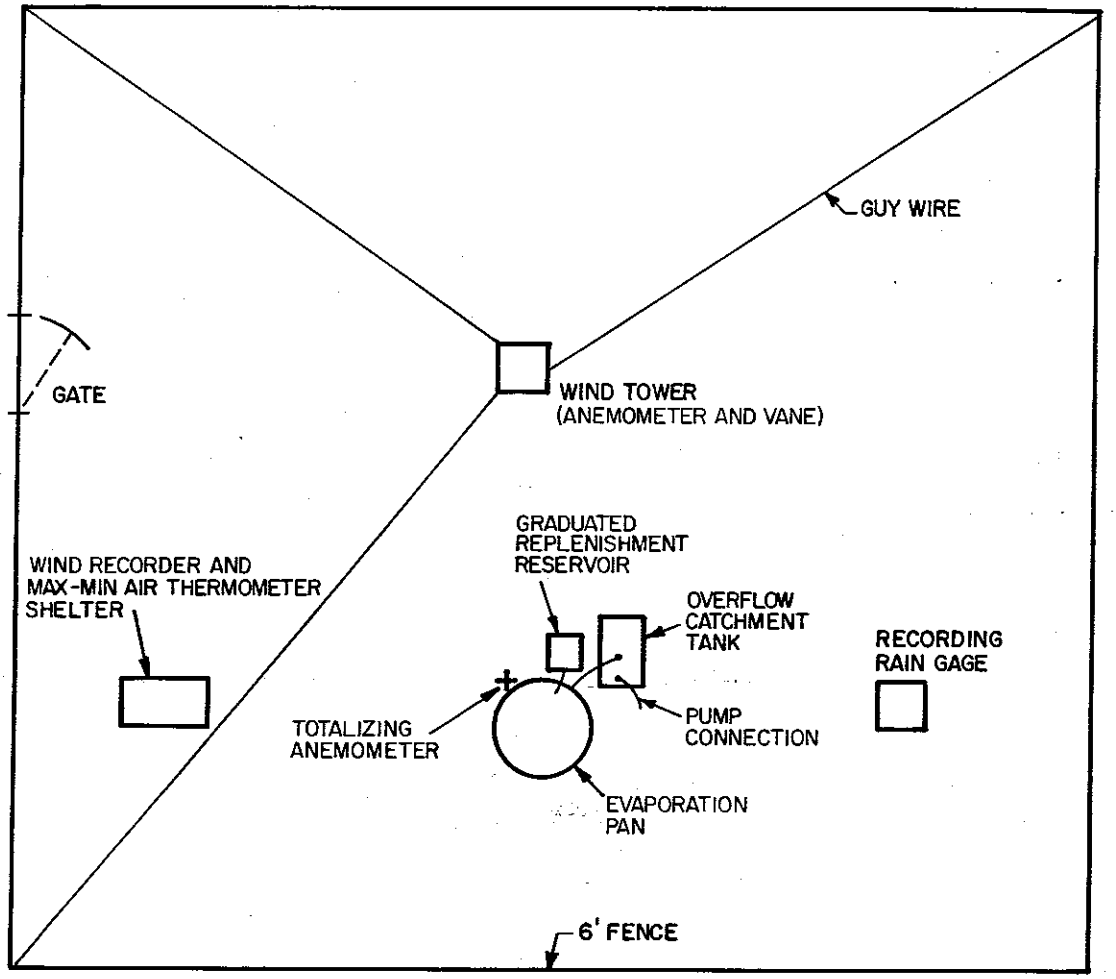
ELECTRIC RESISTIVITY LOG FOR TEST HOLE NUMBER 19

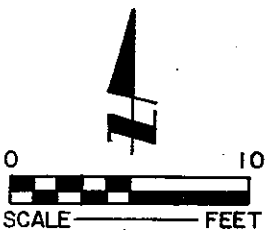
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA	CHECKED BY: S.C	DATE: 1/17/83
FILE NO. 81-159	APPROVED BY: H.G. Stanglund	

FIGURE 3.4





WEATHER STATION LAYOUT

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KC	CHECKED BY: HCS	DATE: 7/29/82
FILE NO. 81-159	APPROVED BY:	

FIGURE 3.5

Chapter 4

FIELD INVESTIGATION RESULTS

4.1 Results of Boring Program

The stratigraphic profiles for all the borings and probings, as stated earlier, are presented in Appendix A.3 as Figures A.3-1 through A.3-14. Included on each of the SPT boring profiles are the Standard Penetration Test "N" values. These values greatly aid in the stratification of the soils encountered and in distinguishing trends in strength characteristics for the various strata. The soil stratigraphy presented on the boring profiles is based on an examination of recovered soil samples and interpretation of field boring logs by a geotechnical engineer. The stratification lines represent the approximate boundaries between soil types of significantly different engineering properties, although the transition may be gradual. A generalized soil profile for the unmined, areas of the subject site without tailings or waste clay on top is summarized below:

Depth (feet) From	To	Soil Description
0	4	Light to dark gray slightly silty to silty fine sands with occasional traces of roots and other organic matter
4	12	Light to dark brown slightly silty to silty fine sands with occasional seams of cemented sands (Hard pan)
12	22	Light gray to light brown clayey sands to sandy clays with traces of cementation
22	42	Greenish gray to yellowish brown clayey fine sands to sandy clays with phosphates (Bone Valley Formation)
42	142	Gray to yellowish brown consolidated calcareous silts and clays with phosphates (Hawthorn Formation)
142	Termination	Light gray to tan limestone with layers of greenish gray clay (Tampa Limestone)

The borings revealed that the northeastern portion of Settling Area No. 1 was covered by a high, sparcely vegetated sand tailings pile overlying a very thin or nonexistent waste clay layer. The southern and western portions, on the other hand, were found to be relatively low and highly vegetated with little or no sand tailings overlying a relatively thick waste clay layer. Except for a few small sections in the northeastern portion of the settling area, the entire subject site was found to be unmined with the waste phosphatic clays resting directly on the natural ground surface sands. Within the boundaries of the site, the waste phosphatic clays varied in thickness from 0 to 18 feet. An aerial of the site showing the thickness of the waste clay encountered at each boring location is presented in Figure 4.1. This figure also shows the elevations in NGVD of the upper surface of the waste clay.

4.2 Geology

Beneath the site for the near surface sediments are found six distinct lithologic units: surficial sands, Bone Valley Formation, Hawthorn Formation, Tampa Limestone, Suwannee Limestone and the Eocene Age limestones (Ocala, Avon Park and Lake City Limestones). The stratigraphy for the upper four units are depicted on Figure 4.2, a fence diagram.

Overlying the Bone Valley Formation are the undifferentiated sands and clays of Pliocene to Holocene Age. These deposits consist of brown fine to silty fine sand and sandy clay. In the unmined areas, these soils are approximately 22 feet thick.

The Bone Valley Formation consists of a fine grained matrix of clay and sand containing pebbles of phosphate and/or chert. This Formation, referred to as the matrix or ore zone, was mined in the vicinity of the proposed landfill site between June 1945 and February 1966. The original thickness of the Bone Valley on-site ranged from approximately 10 to 40 feet. The average thickness at the site is 20 feet.

Underlying the Bone Valley is the Hawthorn Formation which contains a variety of lithologies. The top of the Formation was recognized by the first occurrence of a light brown sandy, silty, phosphatic, calcareous consolidated clay or a light brown, very calcareous, phosphatic, consolidated silt. The Hawthorn Formation at the site is a 96- to 113-foot thick sequence of sandy, phosphatic, consolidated clay and limestone or dolomite.

Below the Hawthorn Formation lies the Tampa Limestone. Some difference of opinion exists among experts as to where the contact between these two units may lie. Wilson (1977) used a marked decrease in gamma radiation to indicate the contact between the Hawthorn Formation/limestone unit of the Tampa and the sand and clay unit of the Tampa Limestone. Scott (1981) defined the Tampa as the first non-phosphatic limestone below the Hawthorn. For purposes of this report, the point on the gamma logs when a minimum value (i.e., a lack of phosphate) was reached and maintained was judged to be the contact between the Hawthorn and Tampa units. This contact was reached at depths between 140 and 160 feet.

The Tampa Limestone consists of a non-phosphatic, white to light yellow, soft, moderately sandy and clayey, finely granular and locally fossiliferous limestone. Wilson (1977) documents the presence of a sand and clay unit in Desoto and Hardee counties which comprises the lower portion of the Tampa Limestone. Hutchinson (1978) extends this unit into eastern Hillsborough County. Clay layers were found in the core samples from the Tampa Limestone but a correlation with the sand and clay unit of Wilson and Hutchinson was not possible.

Data from the Florida Bureau of Geology indicates the total thickness of the Tampa to be between 50 and 100 feet in the vicinity of the site. Whether or not our drilling encountered the bottom of the Tampa Limestone would require a more intensive study of recovered samples.

The Suwannee Limestone lies beneath the Tampa and is comprised of clean, non-phosphatic, cream to white limestone ranging in thickness from 100 to 250 feet. Below the Suwannee are the Eocene Age limestones with a minimum thickness of at least 400 feet.

4.3 Geohydrology

Beneath the site are three aquifer systems previously referred to as the surficial, the Secondary Artesian and the Floridan. Recently Wilson (1977) has grouped the aquifers into the surficial, upper unit of the Floridan Aquifer and the lower unit of the Floridan. The upper unit of the Floridan (secondary artesian) is defined as the permeable beds of the Hawthorn Formation and Tampa Limestone while the lower unit is defined as those permeable beds beneath the sand and clay unit of the Tampa. This report utilizes Wilson's terminology.

In the unmined areas the surficial aquifer lies within the naturally occurring sands above the Bone Valley Formation. Based on analysis of 190 geologic and driller's logs in Polk, Hardee and Hillsborough counties, Hutchinson (1978) determined that the clayey deposits of the Bone Valley form a semiconfining bed that restricts vertical movement of water between the surficial aquifer and the upper unit of the Floridan Aquifer.

Because the surficial aquifer is not a homogeneous hydrogeologic unit, it is not everywhere a reliable source of water. Well yields are reported (Hutchinson, 1978) to be less than 100 gallons per minute to domestic and irrigation wells.

Pump test data (Hutchinson, 1978) from a surficial aquifer well located approximately 4 miles southeast of the site indicate aquifer transmissivity to be 1600 feet^2 per day, hydraulic conductivity to be 32 feet per day and the storage coefficient (from effective porosity data) to be 0.29. The aquifer thickness was 50 feet with the upper 38 feet cased off.

In situ permeability test results from the Surficial Aquifer at the site indicates a range in permeability from about 0.7 to 24 feet per day. Assuming a permeability of 24 feet per day and a saturated thickness on-site of 20 feet, an upper level estimate of local transmissivity can be estimated at 480 feet^2 per day.

Our drilling did not encounter any significant permeable zones within the Hawthorn Formation. Nevertheless, in the vicinity locally occurring zones of sand or limestone may occur which produce water from this Formation in sufficient quantities for domestic or small irrigation uses.

The top of the first significant producing zone occurred at the contact between the Hawthorn Formation and the Tampa Limestone. In two of our three deep borings complete loss of drilling circulation was observed at this contact. Because the top of the Tampa Limestone is an erosional surface this zone is expected to be more permeable than lower zones of the Tampa. Several piezometers were installed in these water-loss zones to observe water-level fluctuations.

Water level data (see Section 4.8) suggest the absence of a sand and clay unit within the Tampa Limestone indicating that the Tampa and the lower units of the Floridan Aquifer are in direct hydraulic connection. Therefore, at the site, the upper unit of the Floridan Aquifer (secondary artesian aquifer) is judged to be in direct hydraulic connection with the lower unit of the Floridan. The secondary artesian aquifer system (i.e., Hawthorn Formation) probably is not in direct connection to the Floridan at this site.

4.4 Hydrology Including Weather Station Records

The hydrology data collected on-site other than groundwater data include rainfall, pan evaporation, and wind data. The daily rainfall for 1982 are presented in Table 4.1.

Lake evaporation was calculated as a function of Class A pan evaporation and heat transfer through the pan as per a Standard Weather Bureau Technique (Linsley and others, 1958). Preliminary data analyses indicate that lake evaporation is approximately 0.75 of pan evaporation. For the period August through November 1982 sufficient records are available to compare monthly pan evaporation, lake evaporation and rainfall. These data are summarized in Table 4.2. For this period the rainfall exceeded lake evaporation by less than one inch (0.76 inches). Rainfall for the period was 15.16 inches.

The maximum and minimum daily wind speed and direction data have been evaluated for two summer months (August and September). The maximum daily wind speeds were greater than 20 mph on 19 percent of the days. They were less than 10 mph approximately 2 percent of the days. The predominant wind direction was from the east. Minimum daily wind speeds during night time hours typically was less than 1.0 mph.

4.5 Well Inventory

A door-to-door survey of wells was conducted within a one-mile radius of the proposed landfill site. The locations of wells which were inventoried are shown on Figure 4.3 and descriptions of each well are provided in Table 4.3. At locations having more than one well a letter designation was assigned to each well. The data in Table 4.3 were gathered from memories of homeowners, therefore, the data may be subject to some inaccuracies. The total depth of the wells and casing lengths could not be field checked. The casing diameters and most well uses were field verified. Under the "Remarks" column, the type of pump installed may be a guide to the well depth, i.e., submersible pumps infer "deep" wells and jet pumps infer "shallow" wells.

Descriptions of additional wells in the area are provided in the Appendix. These data, provided by the Southwest Florida Water Management District, are wells cataloged by that agency. Wells in existence prior to 1970 would not be listed. Figure 4.4 shows the number of wells within the site vicinity as per these Water Management District files.

4.6 Groundwater Levels

Daily water levels for the month of December for several aquifers are presented in Figure 4.5. Head differences between the surficial aquifer and the lower unit of the Floridan (TH-40, 41) ranged between 83 and 88 feet. Head differences at TH-42 ranged between 65 and 67 feet. These values would be expected to increase approximately 10 feet during the dry season based on the existing water use characteristics in the area.

Figure 4.6 is a map of the water table on-site at the time of our drilling. A groundwater mound exists beneath the sand tailings from which water moves radially away. Groundwater discharges predominantly to the southwest part of the site toward the Long Flat Creek basin. In addition, groundwater discharges north into the mined out pits along the north edge of the site.

Periodic water level data from the 17 piezometers located around the site (Figure 3.1) are presented in Table 4.4. In general, the shallow aquifer water levels fluctuated within a narrow range of values for the period observed. These water levels approximate the wet season water table while the dry season levels would be approximately 3 to 4.5 feet lower. The maximum water table elevation probably is on the order of 1 to 2 feet higher.

Potentiometric levels in piezometers TH-40, TH-41 and ROMP wells 48 and 49 are presented in Figure 4.5 for the month of December. These levels agree closely with the September 1981 area-wide potentiometric map levels as shown in Figure 4.7. By comparing these values with the May 1982 potentiometric map (Figure 4.8) a decline of approximately 15 feet can be expected on-site between the wet and dry seasons based on the present water uses in the area.

Water levels and core samples recovered at piezometers TH-41 (total depth 214 feet) and TH-40 (total depth 163 feet) indicate that the sand and clay unit at the bottom of the Tampa as referred to by Hutchinson (1978) and other authors (Wilson, 1977) is at least partially absent at the site. Water levels in these piezometers equate to those reported for the lower unit of the Floridan Aquifer; therefore, it appears that the Tampa Limestone and lower units of the Floridan are in direct hydraulic connection.

Potentiometric levels in piezometer TH-42 are somewhat higher than TH-40 and TH-41. This condition is most likely the result of the presence of a 10-foot thick clay layer which occurs 6 feet below the screened zone. This clay layer, which may equate to the sand and clay unit of the Tampa, serves to partially restrict flow downwards to the lower limestone units. Since the water level in TH-42 is not high enough to equate to levels reported for the upper unit of the Floridan (approximately 90 feet NGVD according to Hutchinson, 1978), the well must have its collection zone between the upper and lower units of the Floridan.

4.7 *In Situ* Permeabilities

The results of the *in situ* falling-head permeability tests performed in the piezometers are noted at the appropriate depth adjacent to the piezometer

profiles in Figures A.3-6 and A.3-7. The test results for the surficial aquifer are expressed as coefficients of permeability and varied from 2.0×10^{-4} cm/sec to 7.1×10^{-3} cm/sec.

4.8 **Water Quality**

Field values of conductivity and pH are presented in Table 4.5 for the latest water quality sampling period. Relatively high conductivity values in some piezometers may be the result of the influence of residual biodegradable driller's mud used during installation of the piezometers and/or high background aquifer characteristics. Actual background values in the adjacent surface waters were 125-165 μmhos/cm^2. Additional pumping may lower the background conductivity values at TH-28, 32 and 35.

Results of the January 1983 chemical analyses are presented in Table 4.6.

Table 4.1

1982 RAINFALL FOR SOUTHEAST LANDFILL SITE

Day	Rainfall in Inches					
	July	August	September	October	November	December
1	-	0.09	0.00	0.08	0.00	0.00
2	-	0.00	0.00	0.00	0.18	0.00
3	-	0.00	0.06	0.00	0.00	0.00
4	-	0.00	0.00	0.88[e]	0.57	0.00
5	-	0.00	0.37	0.28[e]	0.02	0.00
6	-	0.00	0.04	0.15[e]	0.00	0.00
7	-	0.00	1.25	0.00[e]	0.00	0.00
8	-	0.6[e]	0.40	0.00	0.00	0.00
9	-	0.00	0.01	0.00	0.00	0.00
10	-	0.00	0.02	0.00	0.00	0.00
11	-	0.00	0.00	0.00	0.00	0.00
12	-	0.00	0.00	0.06	0.08	0.47
13	-	0.89	0.55	0.00	0.00	0.00
14	-	0.00	0.00	0.05	0.00	0.00
15	-	0.03	0.00	0.00	0.00	0.00
16	0.15	0.00	0.00	0.00	0.00	0.07
17	0.00	0.00	0.03	0.00	0.00	0.00
18	0.48	0.47	0.00	0.00	0.00	0.00
19	0.00	0.40	0.14	0.00	0.00	0.00
20	1.74	0.04	0.84	0.00	0.00	0.00
21	0.00	0.00	1.74	0.00	0.00	0.00
22	0.00	0.00	0.74	0.00	0.00	0.00
23	1.53	0.00	0.00	0.70[e]	0.00	0.00
24	0.68	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.05	0.00	0.00	0.00
26	0.00	0.00	2.46	0.00	0.00	0.00
27	0.24	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00
30	0.19	0.00	0.00	0.00	0.00	0.00
(31)	0.00	0.08	-	0.00	-	0.00
	-	3.23	8.70	2.20	1.03	0.54

[e]Estimated

Table 4.2

1982 MONTHLY LAKE EVAPORATION - RAINFALL DATA COMPARISON AT SOUTHEAST LANDFILL SITE

Month	Rainfall (inches)	Lake Evaporation (inches)	Pan Evaporation (inches)
August	3.23	4.0	5.34
September	8.70	3.9	5.21
October	2.20	2.9	3.92
November	1.03	3.6	4.76
	15.16	14.4	19.23

Table 4.3

WELL INVENTORY DATA

Well Number*	Casing Diameter (in)	Total Depth (ft)	Casing Length (ft)	Use	Remarks
1	3	u	u		capped
2A	4	147	90	D/I	
2B	2	147	u	Unused	
2C	6	385	375	I/D	
3A	4	224	120	D	
3B	4	190	120	D/I	
3C	4	u	u	I	
3D	4	u	u	I	
4	4	235	90	D	
5A	4	u	u	D	
5B	4	u	u	I	
5C	2	"shallow"	u	I	
6	u	u	u	u	
7A	3	u	u	unused	
7B	3	u	u	unused	
7C	6	u	u	D	Submersible Pump
8A	4	160	146	D	
8B	4	u	u	D	
9	2	u	u	D	Jet Pump
10A	4	u	u	unused	
10B	3	"deep"	u	D/I	
11	1.5	35	u	D	
12A	4	165	95	D	
12B	1.5	37	22	I	
13A	4	364	190	unused	
13B	3	300	u	I/D	
13C	2	90	u	D	
13D	2	24	u	D	
14	4	130	u	D	
15A	4	172	96	D	
15B	2	170	120	D	
16	2	20	20	D	
17	4	u	u	D	Submersible Pump
18	12	800	u	I	
19	6	600	u	D	
20A	4	35	u	D	
20B	10	749	200	I	
21	4	u	u	D	Jet Pump
Deep Well No. 10	24	881	202	unused	
24" Well	24	145	98	unused	

*See Figure 3.1 for well locations and Table 6.4 for inventory data for onsite wells.
D = domestic, I = irrigation, u = data unknown.

Table 4.4

PIEZOMETER WATER LEVEL DATA

Test Hole	Land Surface Elevation (feet NGVD)	Riser Height (feet)	Water Level Elevations in feet NGVD 12/02/82	12/10/82	12/17/82	12/30/82	1/07/83
20	130.5	3.0	122.4	123.8	123.9	122.5	122.3
22	126.4	3.7	123.4	123.7	123.3	123.1	123.3
24	128.0	3.0	121.25	122.6	121.2	121.0	121.25
26	125.1	3.0	115.85	116.7	115.2	114.1	114.6
28	128.8	3.0	103.3	105.7	104.3	103.8	103.95
30	125.9	3.0	104.0	105.4	103.9	103.9	103.9
32	129.5	3.0	114.6	115.9	114.5	114.5	114.33
33	142.3	3.0	111.5	112.5	111.6	111.3	111.47
34A	150.0	3.0	110.2	111.0	109.5	109.0	109.42
35	135.9	3.0	110.1	111.4	110.0	109.9	109.9
36	145.6	2.25	114.7	115.95	114.65	114.35	114.6
37A	131.0	2.7	118.25	119.5	117.9	117.7	117.8
38	134.0	3.0	121.7	123.1	121.8	122.0	121.58
40	122.1	3.1	—	30.9	33.0	31.0	—
41	122.1	3.0	—	29.6	35.3	31.9	—
42	112.7	3.0	—	53.7	51.9	51.1	—
AB-22	113.0	2.7	108.8	110.3	108.6	109.3	108.7
AB-37	121.8	2.8	-	-	-	-	119.5
56	128.0	2.8	-	-	-	-	126.4

Water level readings at AB-37, TH-48, and TH-56 were 115.8, 117.7, and 121.4 feet NGVD for February 9, 1983. Land surface elevation and riser height for TH-48 are 123.0 feet NGVD and 2.7 feet, respectively.

Table 4.5

***IN SITU* WATER QUALITY DATA**

Test Hole	1/7/83 Conductivity (µmhos/cm^2)	1/7/83 pH (units)	1/7/83 Temperature (,C)
20	100	5.2	21
24	80	4.4	21
28	500	6.3	22
32	360	5.5	25
35	600	6.5	23
37A	100	6.7	24
Long Flat Creek (A)	165		
Tributary to Hurrah Creek (B)	125		
Hurrah Creek (C)	125		
So. Prong Alafia River (D)	260		

Locations of test holes and surface water sites are shown on Figures 3.1 and 2.1, respectively.

Table 4.6

PIEZOMETER WATER QUALITY ANALYSES
(in mg/l unless otherwise stated)

Sampling Date:	TH-20 1-6-83	TH-24 1-6-83	TH-28 1-7-83	TH-32 1-7-83	TH-35 1-7-83	TH-37A 1-7-83
Results of Analyses:						
Total Dissolved Solids	36	50	448	480	788	220
Total Kjeldahl Nitrogen	3.0	1.8	3.7	4.8	8.6	3.5
Total Phosphate as Phosphorus	11	6.5	32	245	71	42
Nitrate Nitrogen, as Nitrogen	0.02	0.02	0.02	0.02	0.02	0.02
Iron	0.43	0.86	4	1.7	20	2.3
Chemical Oxygen Demand	34	105	107	220	805	295
Total Organic Carbon	19.3	43.8	45.5	77.5	216	100
Sulfate	6.5	8	220	107	107	21
Chloride	15	18	8.7	43	64	0.97
pH, units	5.5	5.3	6.3	5.4	6.3	6.4

ISOPACH OF WASTE PHOSPHATIC CLAY THICKNESS

LEGEND

- DENOTES BORING LOCATION
- (2) DENOTES 2-FOOT THICKNESS CONTOUR
- 2.0 / 123.8 — THICKNESS OF WASTE PHOSPHATIC CLAY ENCOUNTERED IN FEET / ELEVATION OF UPPER SURFACE OF WASTE PHOSPHATIC CLAY IN FEET (NGVD)
- 123.8 — APPROXIMATE ELEVATION OF UPPER SURFACE OF WASTE PHOSPHATIC CLAY IN FEET (NGVD)
- 0 — INDICATES THAT NO WASTE PHOSPHATIC CLAY WAS ENCOUNTERED

SCALE 1" = 400'

CAMP DRESSER & McKEE INC.

REMARKS | REV NO. | DATE | DRWN | CHKD

DESIGNED BY
DRAWN BY
CHECKED BY
APPROVED BY
DATE

CDM

PROJECT NO

SHEET NO

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

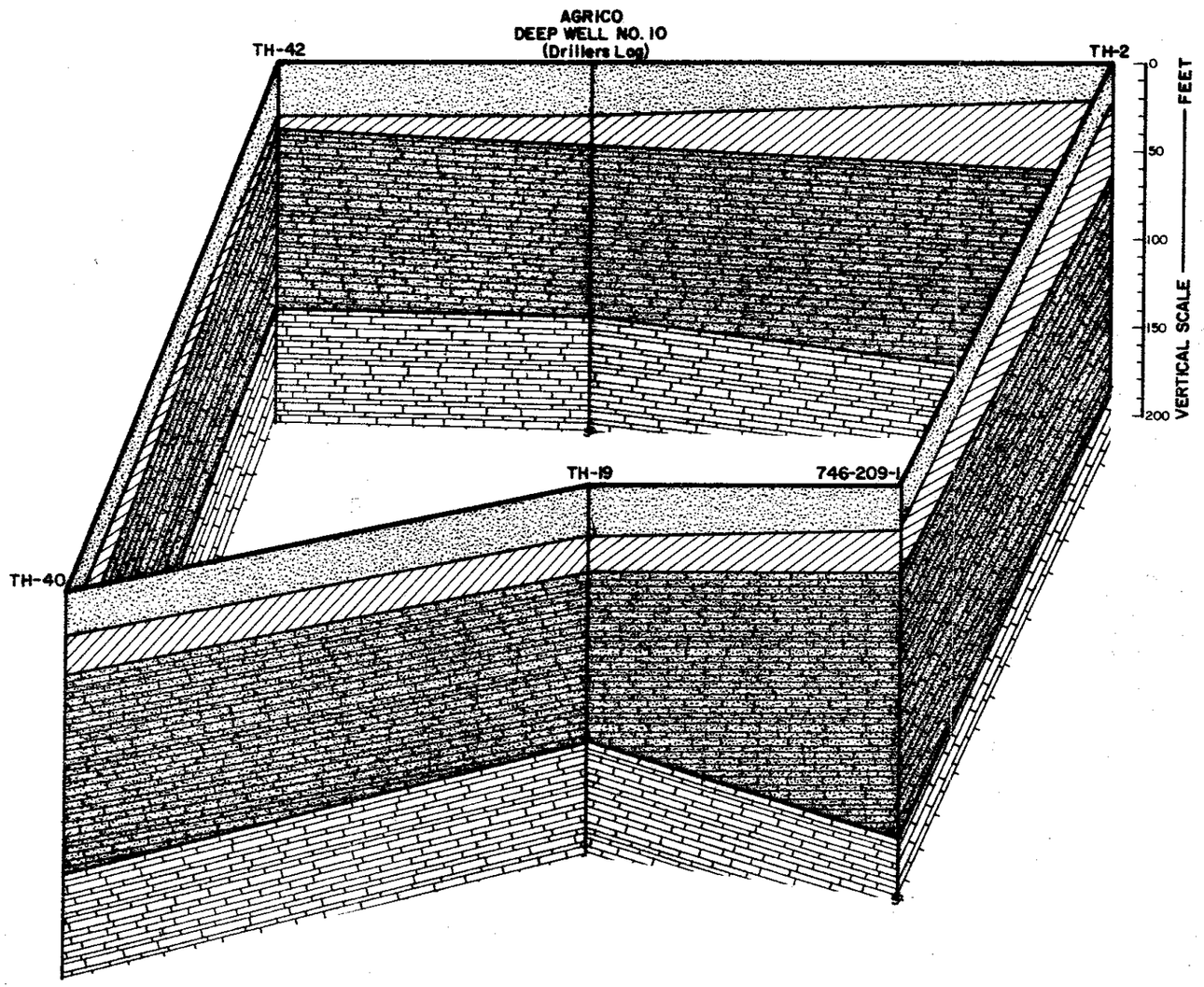
HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

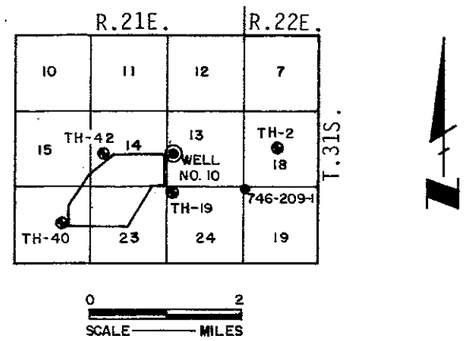
DRAWN BY: KA | CHECKED BY: JC | DATE: 1/19/83
FILE NO. 81-159 | APPROVED BY: W.S. Strayhorn

FIGURE 4-1

K&E 19 1153 12-81 MC3313e

FENCE DIAGRAM OF THE GENERAL GEOLOGY





LEGEND

- UNDIFFERENTIATED SANDS AND CLAYS
- BONE VALLEY FORMATION
- HAWTHORN FORMATION
- TAMPA LIMESTONE
- 746-209-1 U.S. GEOLOGICAL SURVEY WELL LOG
- AGRICO DEEP WELL NO. 10
- TEST HOLE LOCATION

NOTE: TH-2 WAS DRILLED AS PART OF ARDAMAN REPORT DATED DECEMBER 28, 1981.

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FIGURE 4.2

K&E 19 1153 12-81 MC3913a

WELL INVENTORY MAP

18 ● DENOTES WELL LOCATION

(FOR WELL INVENTORY SEE TABLE 4.3)

0 1000 2000
SCALE —— FEET

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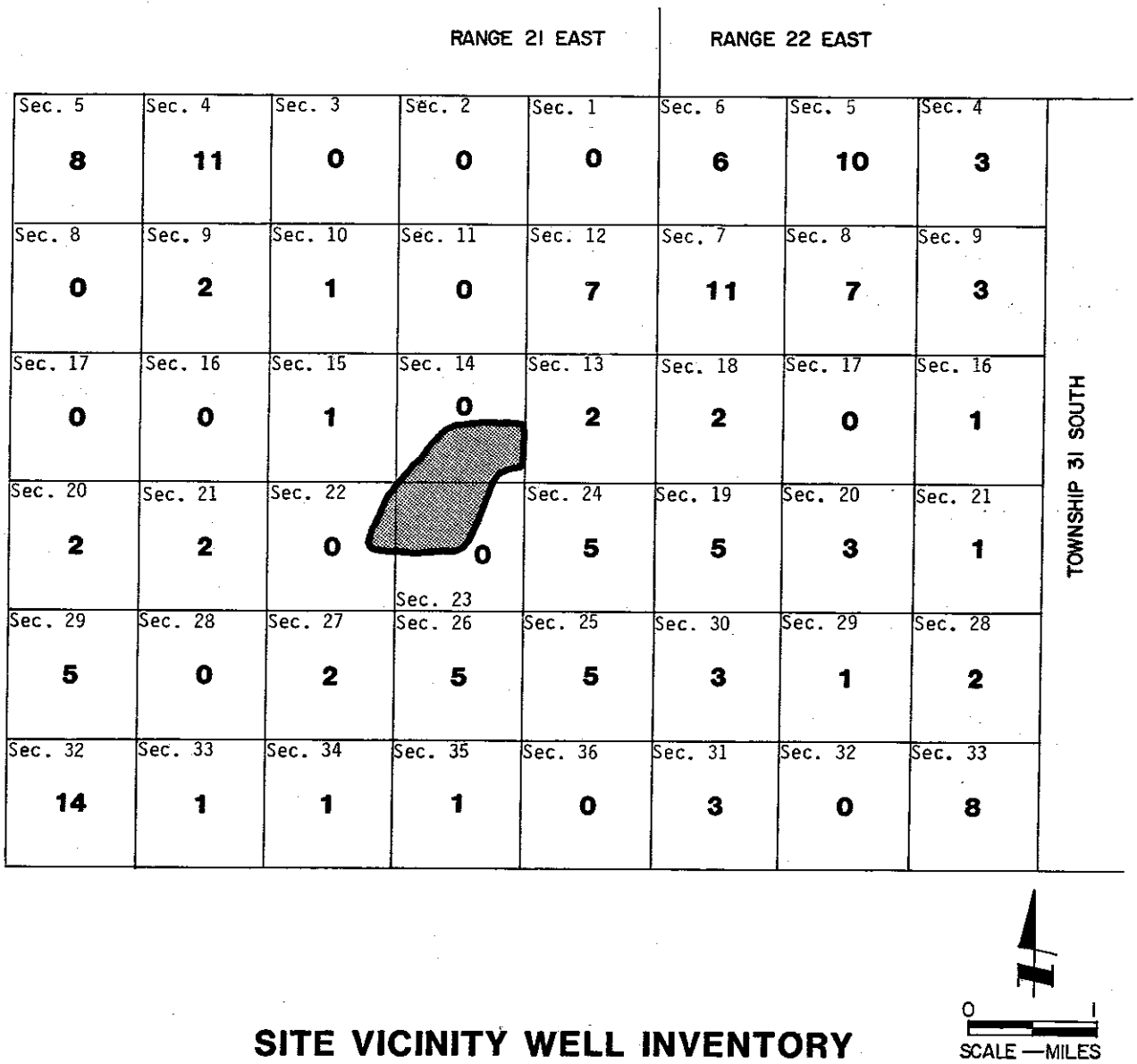
FIGURE 4.3

K&E 19 1153• MC825



SITE VICINITY WELL INVENTORY

SITE LOCATION

5 NUMBER OF WELLS RECORDED IN THAT SECTION

Sec. 12 SECTION NUMBER

DATA FROM : SOUTH WEST FLORIDA WATER MANAGEMENT DISTRICT

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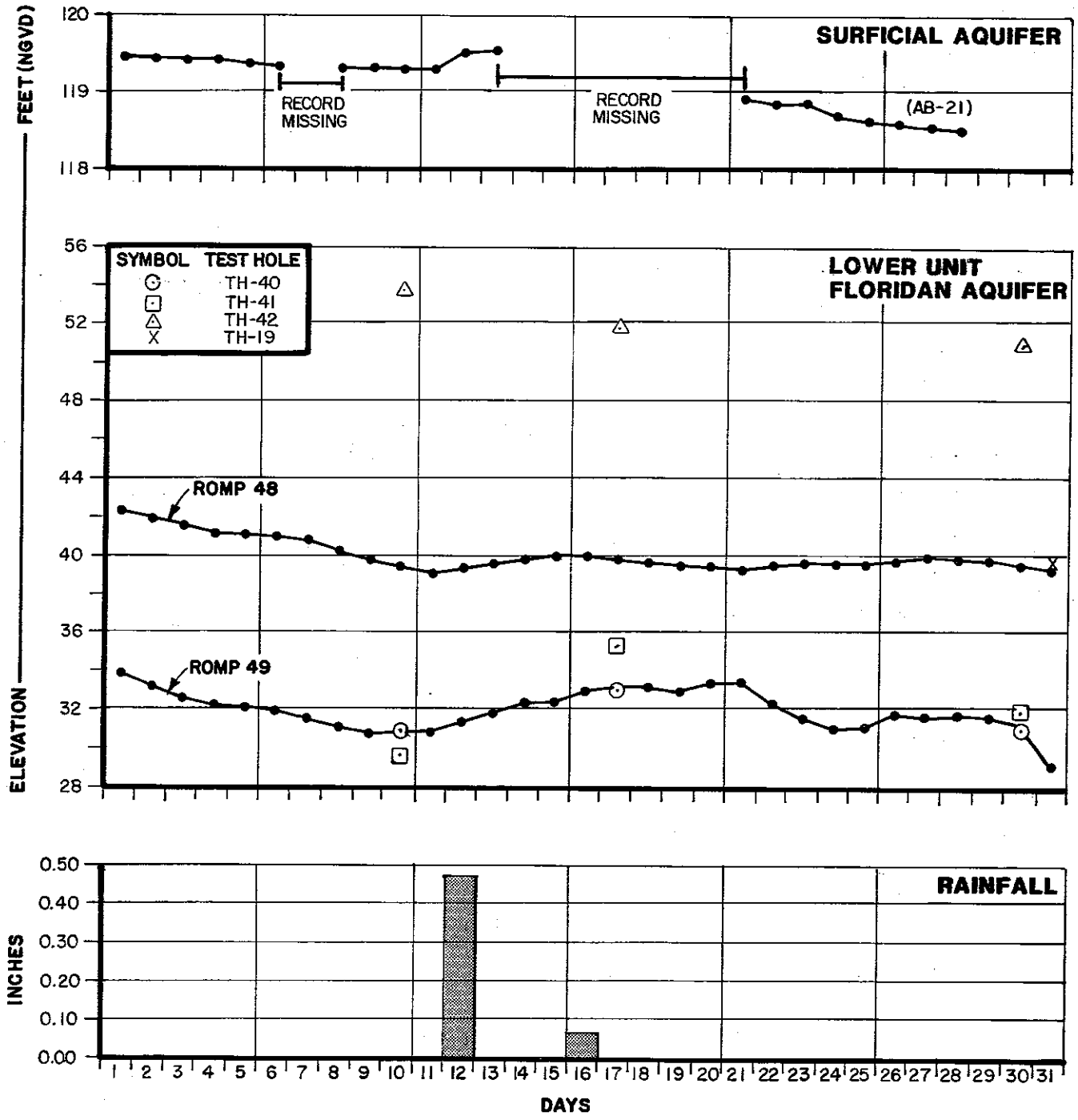
FIGURE 4.4



WATER LEVELS FROM DECEMBER 1982

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FIGURE 4.5

WATER TABLE ELEVATIONS: OCTOBER–NOVEMBER 1982

SCALE 1" = 400'

E 444,000

E 442,000

E 440,000

E 438,000

WATER

POWER LINE

LEGEND

- WATER LEVEL CONTOUR IN FEET (NGVD)
- WATER LEVEL CONTOUR ESTIMATED
- 132.70 WATER LEVEL DURING OCTOBER–NOVEMBER
- (132.70) WATER LEVEL DURING DECEMBER

REV NO	DATE	DRWN	CHKD	REMARKS

DESIGNED BY
DRAWN BY
CHECKED BY
APPROVED BY
DATE

CAMP DRESSER & McKEE INC.

CDM

PROJECT NO

SHEET NO

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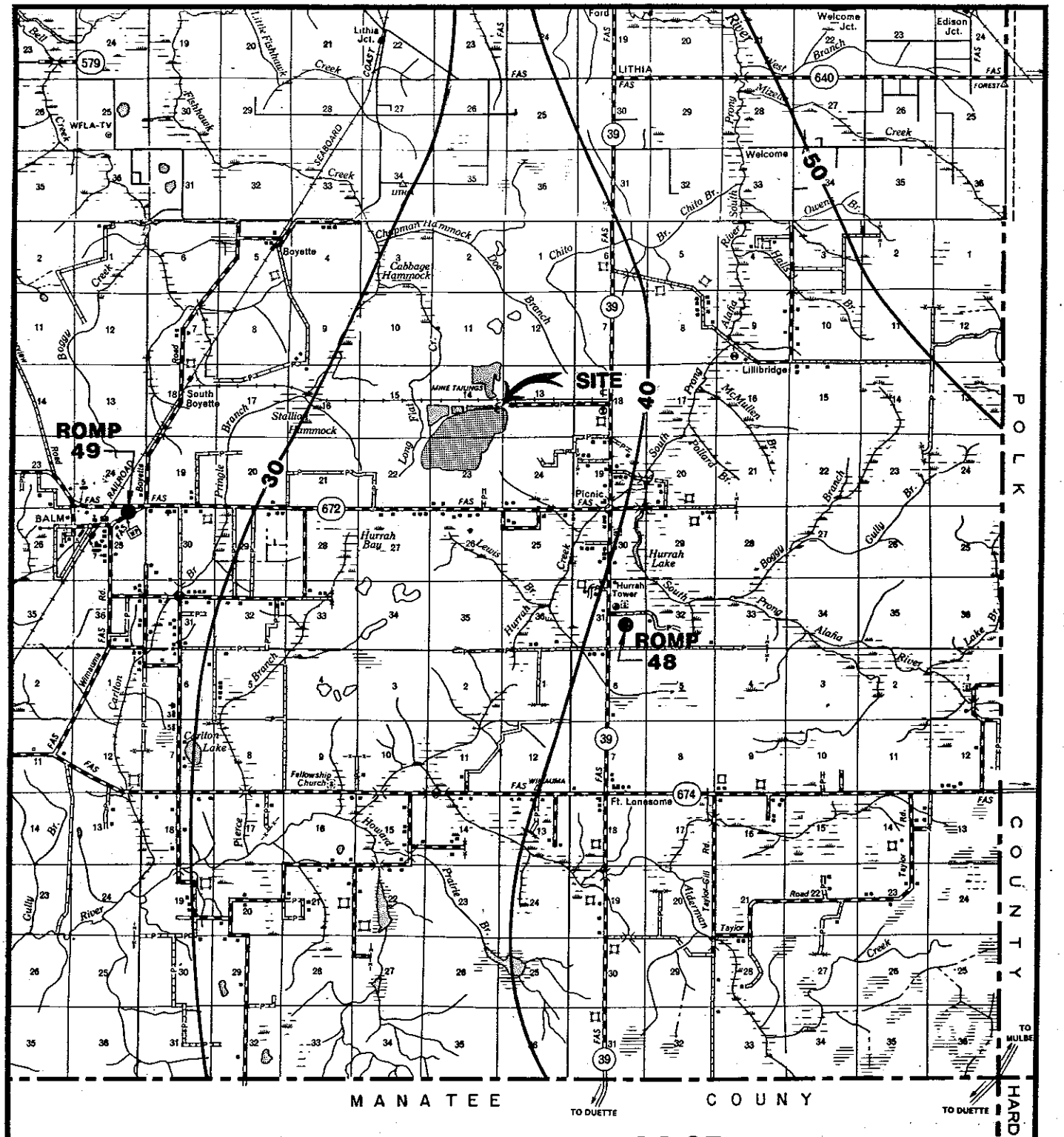
FIGURE 4.6

K&E 19 1153 12-80 MC1983e



POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER (SEPTEMBER 1981)

—40— POTENTIOMETRIC CONTOUR IN FEET (NGVD)

N

0 2
SCALE——MILES

SOURCE: SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

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Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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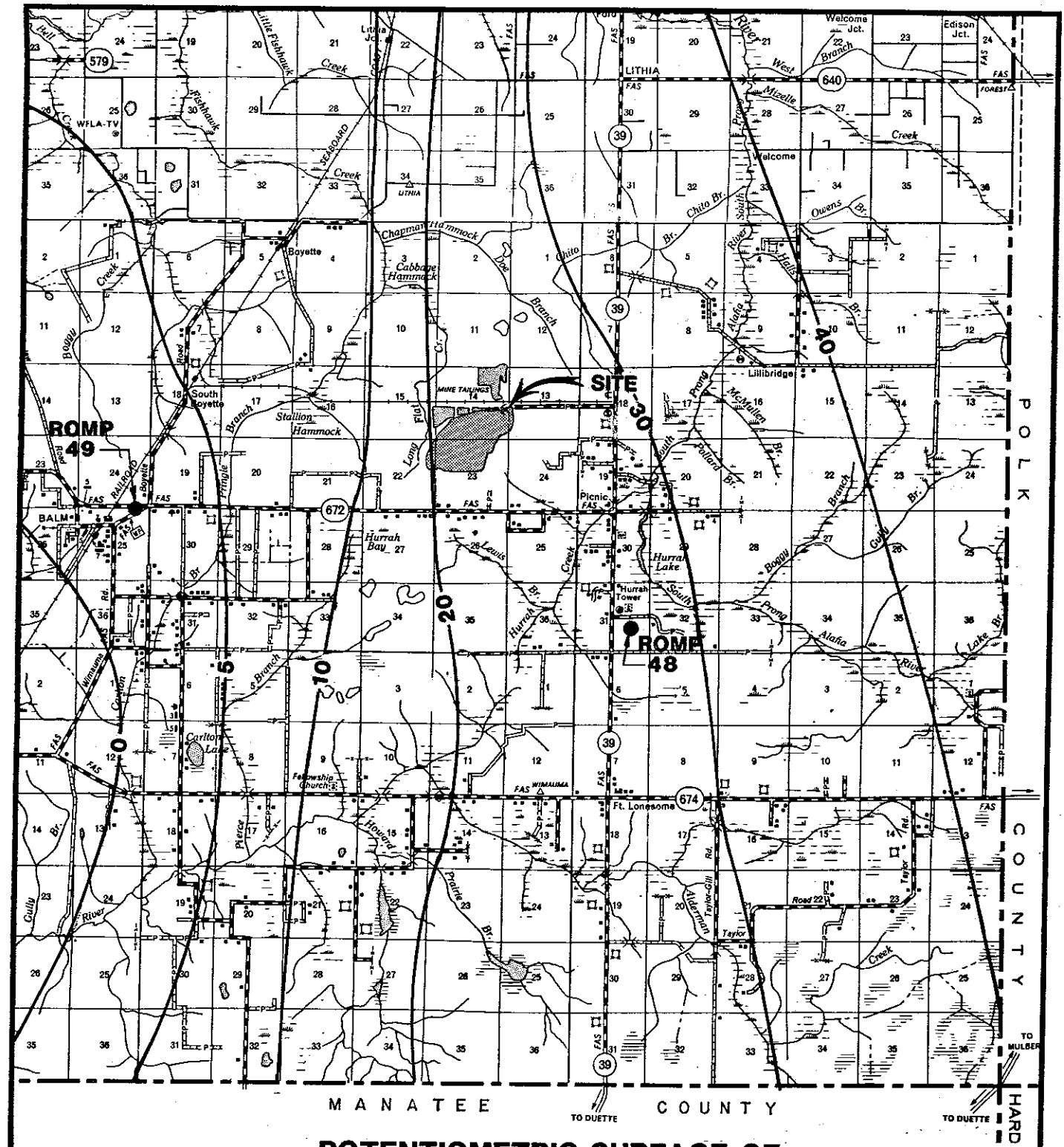
FIGURE 4.7

K&E 19 1153 12-80 MC1983e



POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER (MAY 1982)

—20— POTENTIOMETRIC CONTOUR IN FEET (NGVD)

N

0 2
SCALE MILES

SOURCE: SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

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FIGURE 4.8

Chapter 5

LABORATORY INVESTIGATION AND RESULTS

All recovered split-spoon, auger and Shelby tube samples obtained during the field investigation were returned to our laboratory for visual examination and for determination of engineering properties.

5.1 Laboratory Classification

The split-spoon and auger jar samples taken during the field investigation program were reclassified in the laboratory using the procedures outlined by the Unified Soil Classification System. Several tests were performed on these samples including determination of natural moisture content, Atterberg limits, unconfined compressive strength, and percent fines passing the No. 200 sieve. The unconfined compressive strengths were obtained with a pocket penetrometer, a torvane and a laboratory vane along with unconfined compression tests performed in a triaxial load frame. The results of these tests were used to aid in classifying and stratifying the soils encountered. All tests were performed in accordance with current ASTM standards.

A total of 169 natural moisture contents were obtained for samples of the waste phosphatic clays, the sand tailings and mixtures of these two materials. This information not only aided in classifying the soils but also in estimating total unit weights and strength characteristics for use in the stability analyses. The moisture content results are shown alongside the location of each tested sample on the boring profiles presented in Figures A.3-1 through A.3-12.

Twenty-nine Atterberg limits were performed on representative jar and Shelby tube samples of the waste phosphatic clays (ASTM Testing Methods D-423 and D-424). The results are listed in Table 5.1 as well as being presented on the boring profiles. The typical range in plasticity for these clays is illustrated in Figure 5.1, a plot of Liquid Limit versus Plasticity Index.

The unconfined compressive strength of the waste clays was determined by the performance of 6 pocket penetrometer tests, 13 laboratory vane tests, 12 torvane tests and 18 unconfined compression tests. The results from these tests are included on the boring profiles. Excluding the pocket penetrometer tests, the results are also presented in Figure 5.2 in a plot of undrained shear strength versus moisture content. The tabulated results of the unconfined compression tests and the torvane tests are given in Tables 5.2 and 5.3, respectively.

The percent fines passing the standard U.S. No. 200 sieve was determined by washing the test specimen of known dry weight over the sieve and then weighing what was retained after drying it in the oven. A total of 19 minus 200 determinations were obtained on representative samples of the waste clays, the sand tailings and mixtures thereof. The results of these tests are presented on the boring profiles alongside the respective location of each tested sample.

5.2 Density of the Waste Phosphatic Clay

The *in situ* density of the waste phosphatic clay was determined by analyzing 25 of the 30 Shelby tube samples recovered during the field investigation. The specific gravity (G_s = 2.80) was obtained by performing two specific gravity tests, the results of which are shown on Figures A.3-11 and A.3-12 of the boring profiles. The dry density ranged from a low of 22 pounds per cubic foot (PCF) to a high of 61 PCF with a mean density of 35 PCF. These results are also presented on the boring profiles included in Appendix A.

5.3 Shear Strength of Waste Phosphatic Clay

Besides the unconfined compressive strength tests discussed in Section 5.1, a total of 7 consolidated-undrained triaxial compression tests with pore pressure measurements ($\overline{CU}$ tests) were performed on representative samples of the waste phosphatic clay to determine its undrained and effective stress shear strength parameters. The test specimens were obtained from Shelby tube samples.

These triaxial tests were strain-controlled and the rate of strain was slow enough to allow for pore pressure equilization. The samples were consolidated under back pressures ranging from 11.5 to 12.75 kg/cm^2. Back pressuring was utilized to obtain complete saturation of the sample prior to shear. Pore pressures were monitored with a rigid, flush-diaphragm pressure transducer. The signal from the transducer was measured with a digital voltmeter. The readouts from the voltmeter were, in turn, continuously recorded by a computerized data aquisition system.

The undrained effective stress paths and Mohr-Coulomb parameters for these 7 tests are presented in Figure 5.3. It shows a range of K_f envelopes for the normally consolidated waste clay (i.e., OCR = 1.0) for which $\bar{c}$ = 0 and $\bar{\phi}$ varies from 25 to 31 degrees. The individual test results are presented in Appendix A.6, Figures A.6-1 through A.6-7. These figures include the effective stress path diagram, the stress-strain curve, the excess pore pressure versus strain curve and the obliquity versus strain curve. Relevant specimen data are also included on these figures.

5.4 Permeability of Waste Phosphatic Clay

The permeability of the waste phosphatic clay was determined from five consolidation tests and nine constant head permeability tests. These tests were all performed on selected Shelby tube samples. For the five consolidation tests, the variation of the permeability coefficient was calculated from c_v and m_v using the square root of time method. The coefficient of permeability was also obtained directly from the nine constant head tests. Prior to permeation in the constant head tests, the test specimens were back-pressured to achieve saturation.

The results of the constant head permeability tests are presented in Table 5.4. All the permeability test data are included on Figure 5.4, a plot of coefficient of permeability versus void ratio. The coefficient is shown to vary from a high of 6.0×10^{-7} cm/sec to a low of 3.0×10^{-10} cm/sec.

5.5 Consolidation Tests on Waste Phosphatic Clay

Seven incremental one-dimensional consolidation tests were performed on representative undisturbed samples of the waste phosphatic clay. The results of these tests are summarized in Appendix A.5, Figures A.5-1 through A.5-7.

Primary compression curves indicate that the waste clays are normally consolidated and highly compressible. The virgin compression ratio in terms of strain, CR, which governs the magnitude of primary virgin compression settlements, was found to range between 0.24 and 0.37. The recompression ratio, RR, was estimated to vary between 0.04 and 0.07.

The coefficient of consolidation, c_v, which governs the rate of consolidation, is on the order of 1.5×10^{-4} cm^2/sec for the normally consolidated range of stresses. Presented in Figure 5.5 is a plot of stress level versus coefficient of consolidation. The variation of effective vertical consolidation stress with void ratio is illustrated in Figure 5.6.

5.6 Clay Mineralogy

Three moist clay samples (No. 2, No. 4, and No. 7) from test hole 49 were supplied to R. T. Martin at MIT for mineralogical examination. After thorough mixing, a subsample was air dried and crushed to pass a sieve with 44 μm openings. The air dried powder was used to prepare random mounts for x-ray diffraction (XRD). The remainder of the moist sample was made into a 4% slurry based upon the air-dry water content. Small roots were removed from the slurries by pouring the slurry over a sieve with 44 μm openings. No mineral matter was retained on the sieve. The fairly uniform clay concentration facilitated comparison of clay relative peak amplitudes in the XRD data from the different samples.

The major crystalline phases were clay and apatite. Minor amounts of quartz, crandallite, wavellite, and dolomite were detected in the XRD data. The clay species were smectite, illite, and kaolin. Palygorskite was not detected. The results are summarized in Table 5.5 using relative peak amplitude, R, calculated from reference data generated specifically for phosphatic clay (Martin, 1982). The wavellite XRD peaks were too weak to allow a reliable estimate of R and no reference data were available for crandallite. While relative peak amplitude is not equivalent to weight percent, one normally expects the sum of R values from clay species to be approximately equal to total clay weight percent. The very low clay mineral sums are ascribed to inter-stratified clay material and/or nearly amorphous clay that gave no basal peaks but did contribute to the total clay XRD peak.

Partial X-ray diffractograms indicate the interstratified nature of the clay minerals. The smectite peak is a very broad doublet. Heat treatment increased significantly the low angle background which suggests interstratification. Both position and skewness of the kaolin peak suggest that kaolin probably is interstratified with the expandable layers. The poorly crystalline clay material in all three samples was dominantly an expandable phase that appeared to be interstratified with illite and probably also with kaolin.

5.7 Cation Exchange Capacity

Two waste clay samples were supplied to A & L Southern Agricultural Laboratories in Fort Lauderdale, Florida for determination of cation exchange capacity. The results of these analyses are presented in Table 5.6.

Table 5.1

PLASTICITY OF WASTE PHOSPHATIC CLAYS

Boring No.	Sample	Depth (feet)	LL (%)	PL (%)	PI (%)
P-1	US-1	1.0-3.0	71	25	46
P-2	US-1	3.0-5.0	182	41	141
P-3	US-1	1.0-3.0	142	35	107
P-4	US-1	1.0-3.0	174	35	139
P-5	US-1	1.0-3.0	151	29	122
P-7	US-1	1.0-2.5	164	37	127
W-1	US-1	19.0-21.0	178	43	135
W-2	US-1	13.5-15.5	60	21	39
W-2	US-1	13.5-15.5	51	17	34
W-4	US-1	12.0-14.0	91	28	63
TH-6	S-2	4.0-4.3	162	46	116
TH-9	US-1	4.0-6.0	188	38	150
TH-14	US-3	10.0-12.0	158	32	126
TH-14	S-3	9.0-9.3	238	40	198
TH-15	S-2	4.0-4.3	170	40	130
TH-16	US-1	1.5-3.5	160	40	120
TH-16	US-2	3.5-5.5	179	33	146
TH-16	US-3	5.5-7.5	161	29	132
TH-49	S-2	1.5-3.0	136	52	84
TH-49	S-4	4.5-6.0	164	50	114
TH-49	S-7	9.0-10.5	211	66	145
AB-16	S-4	7.0-7.3	176	25	151
AB-20	S-2	1.5-1.8	151	41	110
AB-27	US-2	8.0-10.0	177	41	136
AB-29	US-2	9.0-11.0	178	35	143
AB-30	US-1	4.0-6.0	184	43	141
AB-37	US-1	3.0-5.0	224	43	181
AB-37	US-2	10.0-12.0	157	36	121
AB-39	US-1	8.0-10.0	194	37	157

Table 5.2

UNCONFINED COMPRESSION TEST RESULTS ON WASTE PHOSPHATIC CLAYS

Boring No.	Sample	Depth (feet)	w_i (%)	γ_d (pcf)	S_u (psf)	ε_f (%)	PI (%)	LI $\left(\frac{w_i - PL}{PI}\right)$
P-1	US-1	1.0-3.0	80.4	53.8	180	5.0	46	1.20
P-3	US-1	1.0-3.0	96.1	46.9	300	10.3	107	0.57
P-4	US-1	1.0-3.0	198.1	26.1	40	16.7	139	1.17
P-5	US-1	1.0-3.0	114.9	41.4	130	15.5	122	0.70
P-7	US-1	1.0-2.5	69.6	56.5	1150	2.5	127	0.26
W-1	US-1	19.0-21.0	109.9	42.2	240	2.9	135	0.50
W-3	US-1	12.0-14.0	123.5	39.0	130	10.1	63	1.49
TH-9	US-1	4.0-6.0	100.9	44.9	510	4.0	150	0.42
TH-14	US-2	5.0-7.0	262.3	21.0	50	2.8	-	-
TH-16	US-1	1.5-3.5	162.9	30.6	250	4.3	120	1.02
TH-16	US-2	3.5-5.5	160.6	31.6	80	2.9	146	0.87
TH-16	US-3	5.5-7.5	163.1	31.1	70	2.7	132	1.02
AB-26	US-1	0.0-2.0	105.2	43.3	380	3.5	-	-
AB-27	US-1	4.0-6.0	206.8	25.7	45	5.9	-	-
AB-27	US-2	8.0-10.0	173.8	28.9	30	6.0	136	0.98
AB-29	US-1	4.0-6.0	161.0	30.5	120	9.4	-	-
AB-29	US-2	9.0-11.0	149.4	33.9	25	15.0	143	0.80
AB-32	US-1	4.0-6.0	157.1	32.1	120	5.3	-	-

Table 5.3

TORVANE UNDRAINED SHEAR STRENGTH INDEX TEST RESULTS ON WASTE PHOSPHATIC CLAYS

Boring No.	Sample	Depth (feet)	w_n (%)	S_u (psf)	LI
P-1	US-1	1.0-3.0	70	250	0.98
P-2	US-1	3.0-5.0	174	200	0.94
P-3	US-1	1.0-3.0	95	300	0.56
P-7	US-1	1.0-2.5	66	1200	0.23
P-7	US-1	1.0-2.5	70	1300	0.26
P-7	US-1	1.0-2.5	77	1500	0.32
P-7	US-1	1.0-2.5	83	1350	0.36
W-2	US-1	13.5-15.5	55	150	0.87
W-3	US-1	12.0-14.0	100	200	1.13
TH-14	US-3	10.0-12.0	144	112	0.53
TH-16	US-1	1.5-3.5	153	250	0.94
TH-16	US-2	3.5-5.5	163	125	0.89

Table 5.4

PERMEABILITY TEST RESULTS ON WASTE PHOSPHATIC CLAYS

Boring No.	Sample	Depth (feet)	Initial w_i (%)	Initial γ_d (pcf)	Final w_f (%)	Final γ_d (pcf)	$\bar{\sigma}_c$ (kg/cm^2)	k (cm/sec)	-200 (%)	PI (%)
P-1	US-1	1.0-3.0	78.6	51.3	63.4	61.5	0.50	6.4×10^{-8}	99	46
P-2	US-1	3.0-5.0	107.7	41.1	81.6	50.8	0.50	1.2×10^{-8}	97	141
P-3	US-1	1.0-3.0	88.0	47.9	73.3	54.2	0.50	1.6×10^{-8}	100	107
P-4	US-1	1.0-3.0	132.1	36.3	94.7	45.9	0.50	1.4×10^{-8}	100	139
P-5	US-1	1.0-3.0	101.8	44.3	76.6	53.3	0.50	1.5×10^{-8}	100	122
W-1	US-1	19.0-21.0	115.9	40.6	88.7	49.7	0.50	1.1×10^{-8}	-	135
W-2	US-1	13.5-15.5	56.4	63.0	36.8	81.6	0.50	5.7×10^{-7}	-	39
W-3	US-1	12.0-14.0	103.4	41.3	67.8	52.8	0.50	2.7×10^{-8}	-	63
TH-9	US-1	4.0-6.0	102.4	44.1	100.4	46.8	1.00	9.8×10^{-9}	97	150

Table 5.5

RELATIVE MINERALOGIC COMPOSITION FOR TEST HOLE 49

Phase	Relative Peak Amplitude (100R) #2	#4	#7
Non clay:			
Quartz	1	2	3
Apatite	58	51	39
Crandallite	xx	xx	x
Wavellite	xx	x	x
Dolomite	o	o	2
Clay:			
Total Clay	53	61	80
Smectite	7	9	15
Illite	8	8	8
Kaolin	2	3	1

Table 5.6

CATION EXCHANGE CAPACITY TEST REPORT

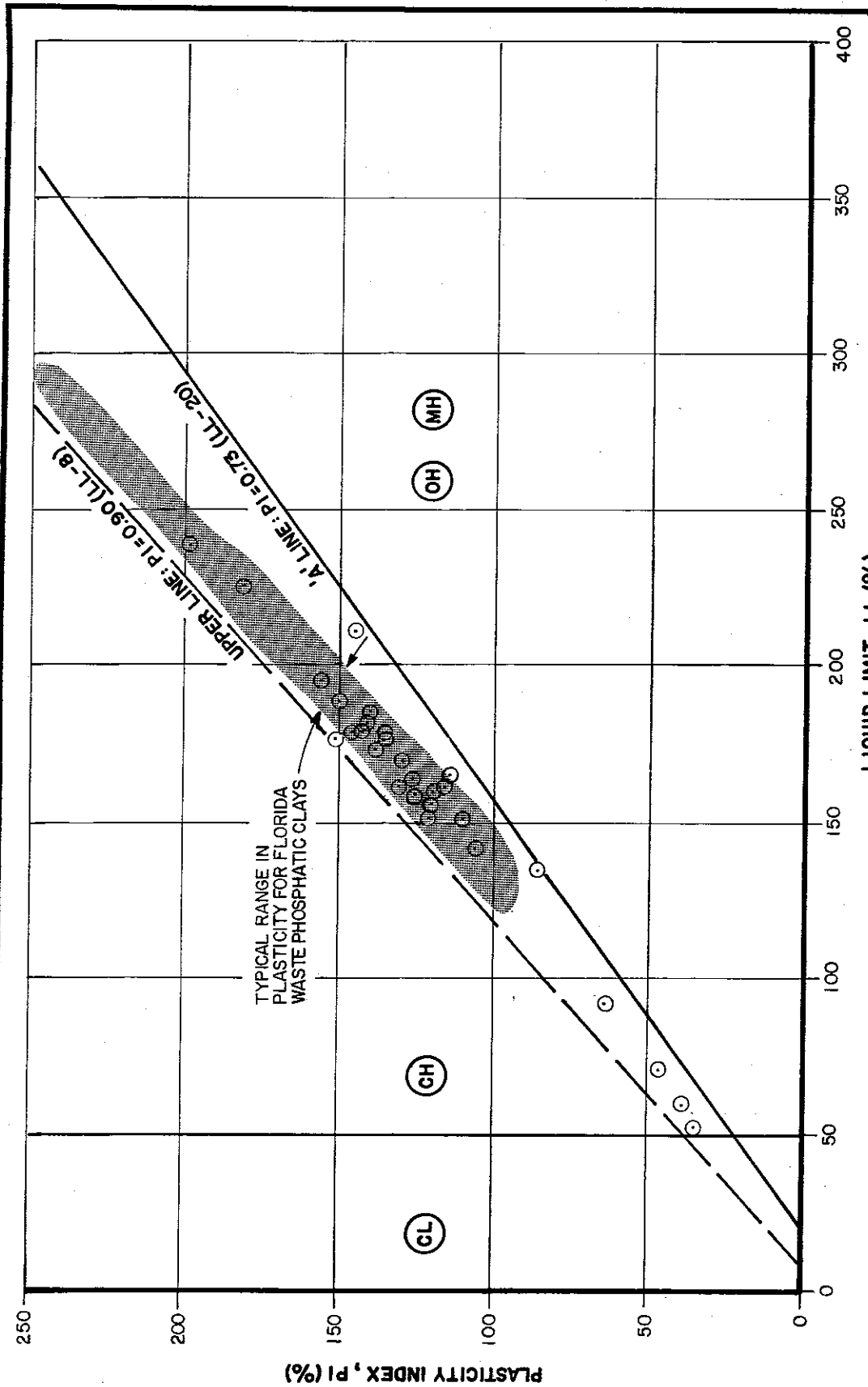
Parameters	AB-30[1] Values	AB-38[2] Values
Organic Matter	1.1 percent	1.7 percent
Weak Bray (P_1)	189 ppm P	236 ppm P
N_aHCO_3 - P (P_2)	234 ppm P	254 ppm P
Soil pH	7.0 units	6.0 units
Cation Exchange Capacity	22.6 meq/100 g	19.3 meq/100 g
Percent Base Saturation		
Potassium	2.5 percent	1.8 percent
Magnesium	34.8 percent	37.4 percent
Calcium	62.3 percent	57.7 percent
Hydrogen	0.4 percent	3.1 percent

Notes: Weak Bray method (P_1) determines the amount of readily available phosphorus in the soil. Sodium Bicarbonate method (P_2) determines the amount of readily available phosphorus in calcareous soils.

[1]Sample taken from 2.5-15.0 feet below land surface, a waste clay.
[2]Sample taken from 2.0-10.0 feet below land surface, a waste clay.

Source: A & L Southern Agricultural Laboratories

K&E 19 1153 12-80 MC1985



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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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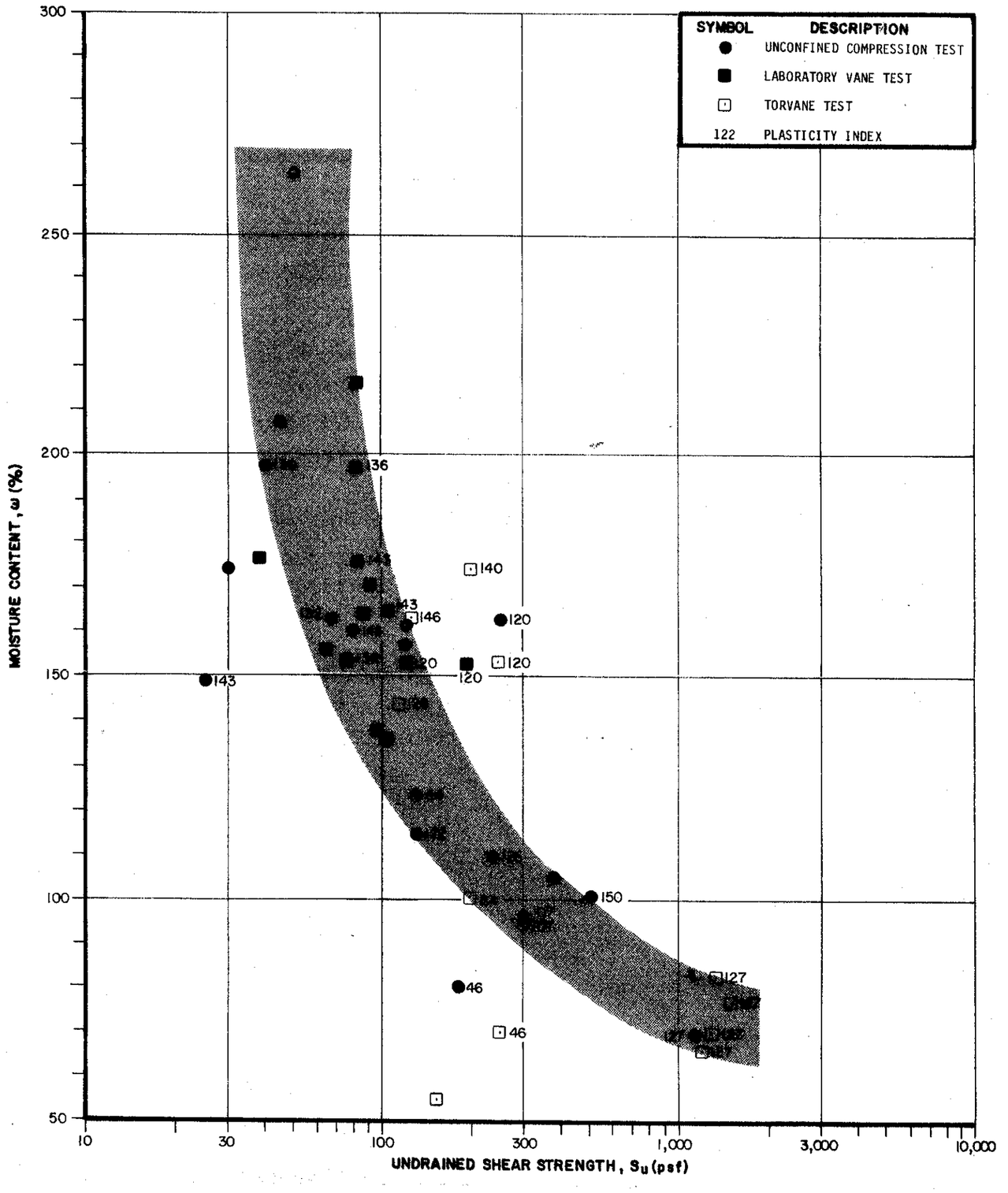
FILE NO. 81-159	APPROVED BY:	

FIGURE 5.1



MOISTURE CONTENT VS. UNDRAINED SHEAR STRENGTH FOR WASTE PHOSPHATIC CLAYS

FIGURE 5.2

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K&E 19 1153 12-81 MC3313a

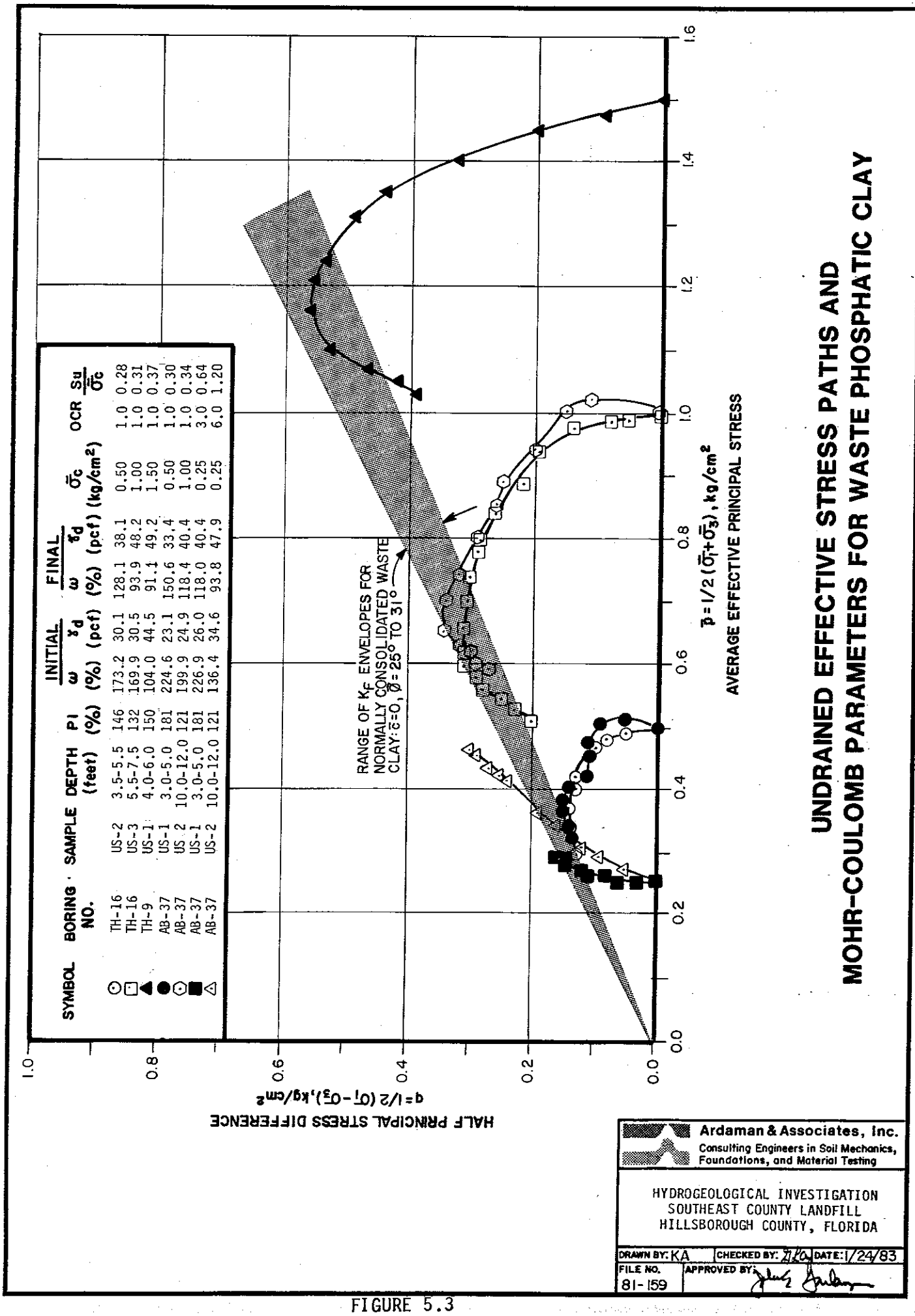

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FIGURE 5.3

K&E 19 1153 12-80 MC1983e

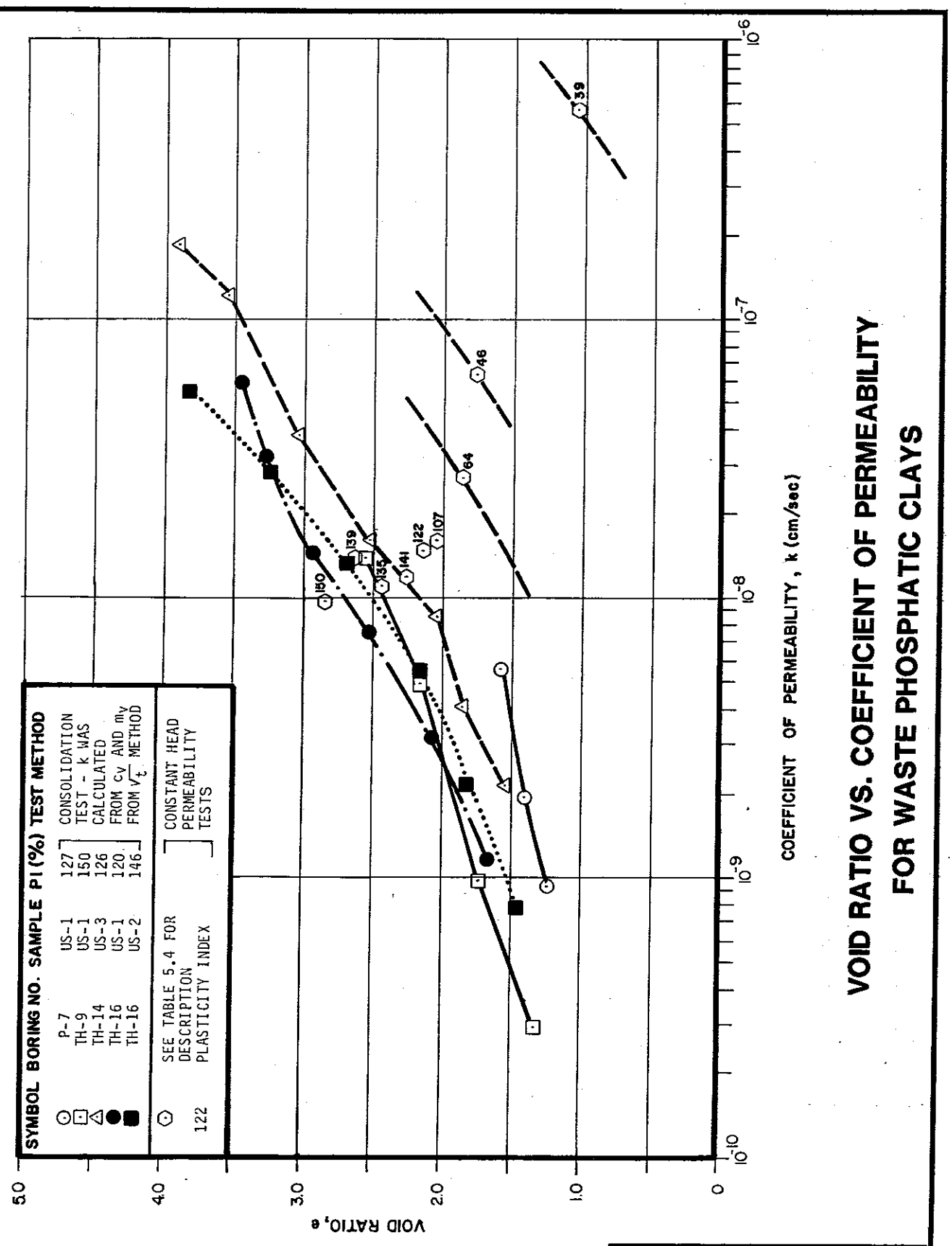
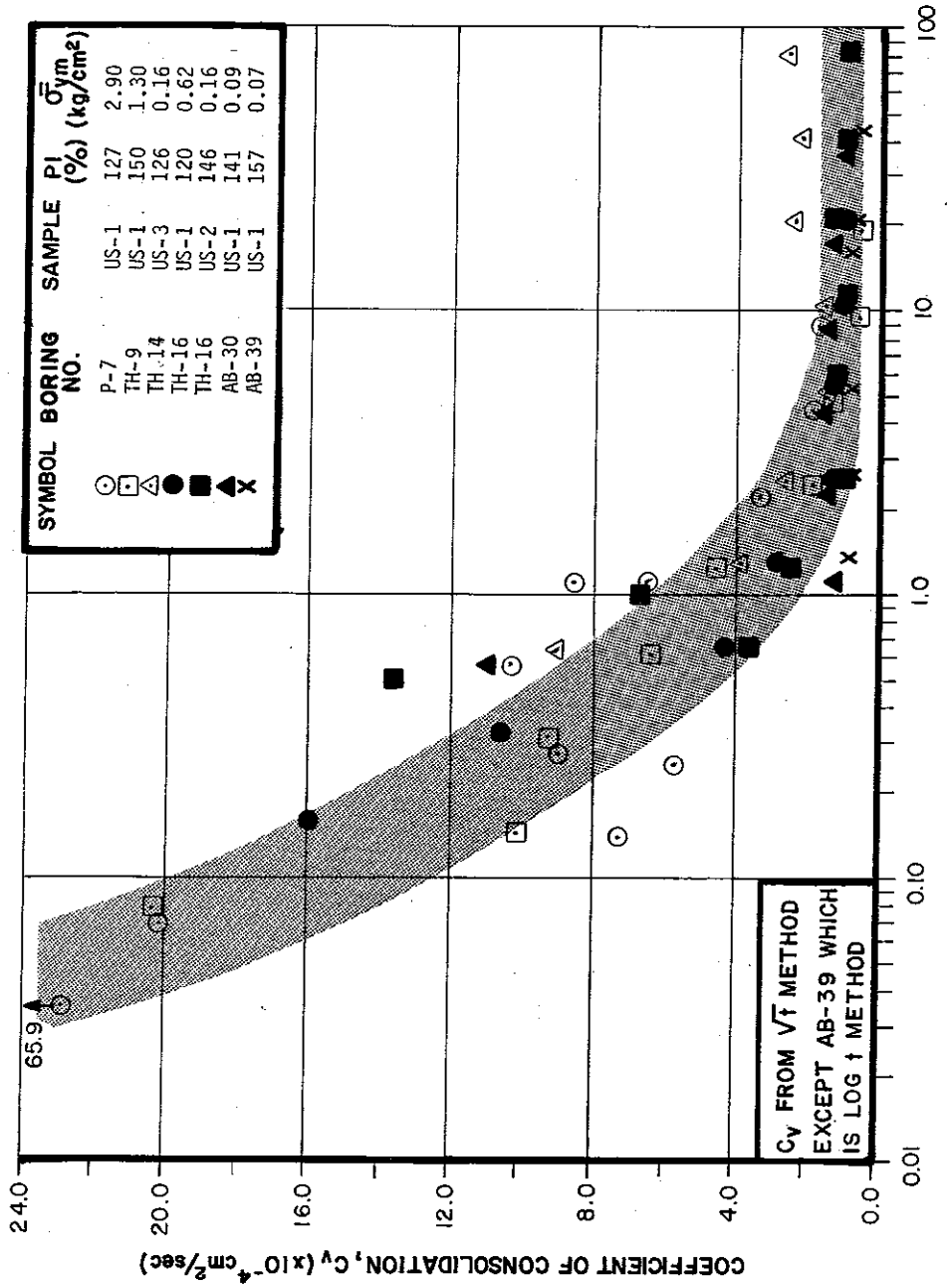


FIGURE 5.4



STRESS LEVEL VS. COEFFICIENT OF CONSOLIDATION FOR WASTE PHOSPHATIC CLAYS

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FIGURE 5.5

K&E 19 1153 12-80 MC1983e

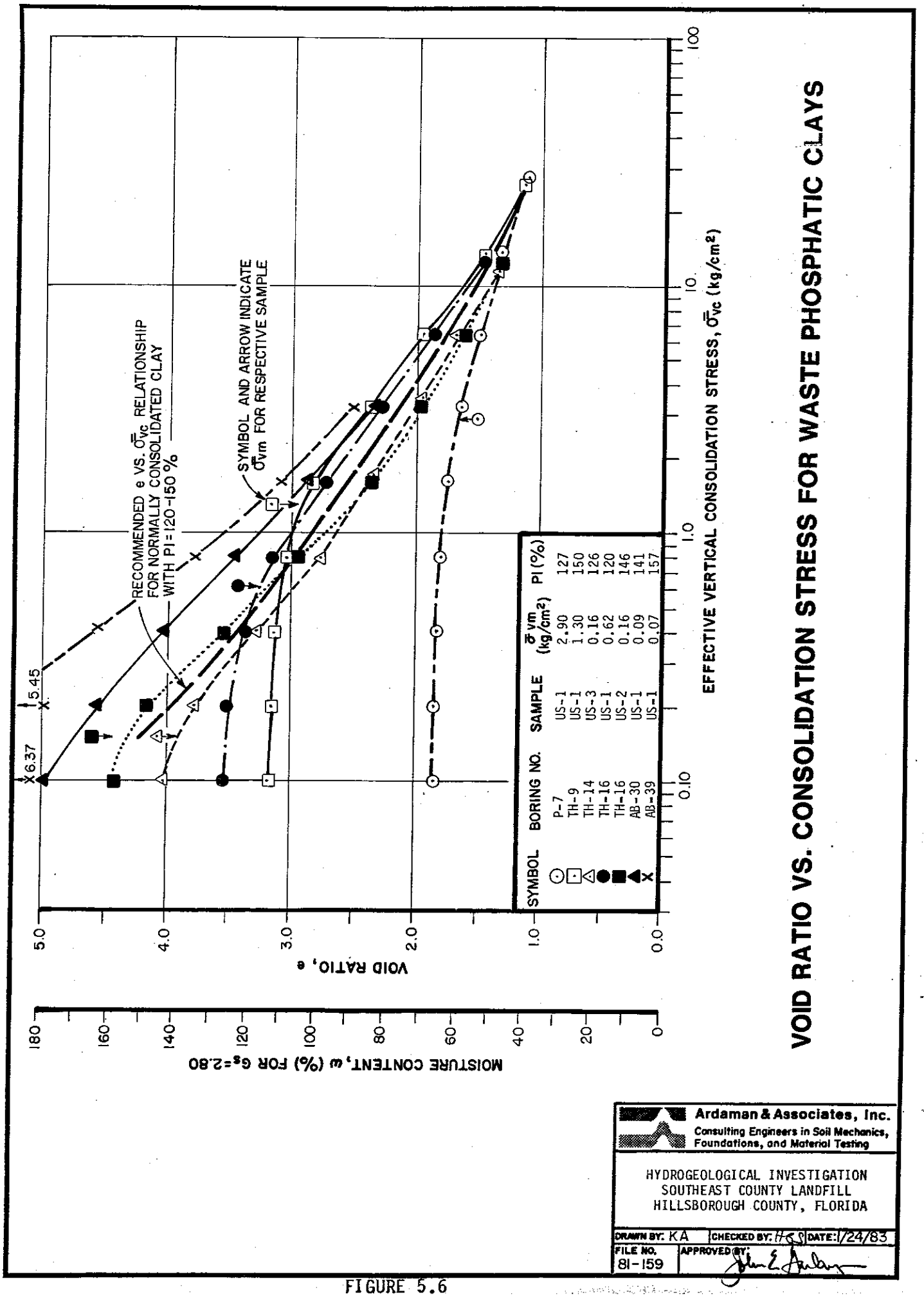

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FIGURE 5.6

Chapter 6

ANALYSES AND CONCLUSIONS

6.1 Potential for Sinkhole Development

There are three distinct types of sinkholes which have developed in Florida. The first type is the classical collapse sink, which is generally steep-sided and rocky. It occurs when a cavity can no longer support the weight of the overlying soil and rock. This type of sink generally occurs when the limestone is at or near the surface and solution weathering is still very active. It is unlikely that cavities in ancient rocks at great depth below the surface, which have undergone much more intensive solution weathering in the past, are large enough to cause a deep-seated roof collapse. Any cavity which is large enough to have caused a roof collapse would have done so when it was closer to the surface and the beam action or arching effects of the overlying formation was not as great as it is today.

The second type of sink, which is more common though not as dramatic as the collapse sink, is called a doline or solution sink. There is no physical disturbance of the soluble rock beneath a doline. Subsidence of the overlying soil occurs due to gradual lowering of the rock surface and/or the gradual dissolution or leaching of calcium carbonate from the calcareous soil and rock which exists between the ground surface and the underlying aquifers. (The Florida Geological Survey estimates that this type of subsidence occurs at the rate of one foot every five to six thousand years.) Because the water flows radially to the intersection of vertical joints where the water enters the rock mass, the surface expression of the rock lowering or the leaching of the soluble soil constituents is a shallow depression located over the intersection of the joints. In some cases, the surface depression has the same shape as the original calcareous deposit, as in the case of a shell bed which has dissolved or partially dissolved since deposition.

The third type of sinkhole and probably the most common type of sink occurring in Florida is the erosion sink. Erosion sinks most frequently occur in an environment with the following characteristics:

- Limestones overlain by relatively pervious unconsolidated sediments; e.g., sandy soils.
- Cavity systems present in the limestone.
- A water table higher than the potentiometric surface in the underlying limestone.
- A breach of the limestone into the cavernous zone creating a point of high recharge to the artesian aquifer.

Under these circumstances water moving down into the limestone may take large amounts of sediment into the cavernous system creating a void in the overlying sediment. When the void in the overlying sediment reaches the size where the

roof is no longer stable, the overburden suddenly collapses. In many cases the overburden is visible after the collapse, but some sinks of this type have occurred in which even the collapsed overburden disappeared into the cavity system. In other cases the sudden subsidence of the ground surface is only six inches to one foot deep.

Figure 6.1 shows the location of erosion-type sinkholes which have occurred in Hillsborough County. Both recent and prehistoric sinkholes have been plotted. The subject site is located in an area of low to very low sinkhole activity. Only one occurrence has been documented within a 6-mile radius of the site during the past 9 years.

Because solutioning is most active along fractures in the limestone, it is desirable when studying the sinkhole potential of a site to ascertain the location of these features, especially those which may be exposed at the surface of the limestone. The location of the intersection of two fractures on the surface of the limerock is of particular interest. When the limestone surface is buried under overlying sediment, it is not possible to map these features. However, they can sometimes be inferred from linear surface features, e.g. stream segments, alignment of sinkholes, etc. These linear surface features are called lineaments.

Figure 6.2 presents a lineament map of the study area discerned from aerial photographs. Also located on this map is the one sinkhole occurrence documented in the study area.

The presence of linear surface features is only one of the factors which must be considered in determining the potential for sinkhole activity. Some other factors include thickness of clay beds above the limestone layers, relationship between elevations of water table and potentiometric surface in artesian aquifers, groundwater pumping, etc. Figure 6.3 considers all of these parameters and divides the state into various zones of sinkhole potential. The site is located at the border between two zones. Based on the thickness of overburden, as documented by our test borings, the site should be included in the least probable area for sinkhole development.

This hydrogeological investigation has documented that the nearest limerock layer to the land surface is 115 to 120 feet below land surface. The clastic overburden consists of clay, sandy clay and clayey sand. The difference in elevation between the water table and the potentiometric surface is approximately 87 feet downward in December 1982. The low sinkhole activity in the area surrounding the site, the relatively few lineaments apparent on Figure 6.2, the lack of an obvious primary and/or secondary direction of lineaments, and the relatively large difference in water levels between the water table and artesian aquifer are factors supportive of the conclusion that a thick, relatively impermeable layer overlies the bedrock in this area. These same factors support our conclusion that the subject site is located in an area with a low probability of sinkhole occurrence.

6.2 Cover Material Evaluation

6.2.1 Overview

Cover material for a sanitary landfill according to various authors (U.S. Army, 1972; U.S. EPA, 1979; U.S. EPA, 1980) is intended to perform many functions:

- Discourage rodents from burrowing or tunneling
- Impede vector emergence
- Control water movement
- Control potentially harmful gas movement
- Provide erosion control and dust control
- Preserve slope stability
- Support vegetation
- Support future land use
- Resist cracking
- Provide adequate trafficability
- Minimize the fire hazard potential

The soils available at the subject site should be capable of performing all of these functions. Practically the only soils that can be ruled out for use as cover material are peat and highly organic soils. These soils were not encountered within the proposed borrow area at the site.

The following excerpts from Florida Department of Environmental Regulation (FDER) Chapter 17-7 Florida Administrative Code (17-7, F.A.C.) detail some design criteria for cover materials:

- Class I landfills (i.e., monthly average of 20 tons or more of solid waste per day) shall receive a compacted 6-inch cover at the end of each working day.

- An intermediate cover of one foot of compacted earth in addition to the 6-inch daily cover shall be applied within 7 days of cell completion if final cover is not to be applied within one year of cell completion.

- Two feet of final cover material is required before final closing of the site. The cover material shall be compacted in 6-inch layers with the final 6 inches loosely compacted to promote plant growth.

Many different soils are capable of fulfilling the functions for cover material. Minor differences in soil grain size or clay mineralogy can make significant differences in the behavior of soils that fall within a given soil group or division. In addition, different methods of placing and compacting the same soil can result in a significantly different behavior. Moisture content during placement, for example, is a critical factor; it influences the soil's density, strength and permeability.

Soils for this project have been classified using the Unified Soil Classification System. The soil groups and typical properties of compacted materials from this system are presented in Table 6.1. The site soils will be discussed and cataloged according to this system.

The following factors will be analyzed in this section as pertains to cover materials:

- Classification of on-site soils
- Availability of cover materials
- Permeability of cover materials
- Cover recommendations

6.2.2 Soil Classification

The results of our laboratory and field investigation are summarized in Chapters 3 and 4 and on the boring profiles shown in Appendix A.3. Table 6.2 is a summary of the major soil groups onsite that can be used for cover materials. For purposes of this report soils within and below the Bone Valley Formation have not been considered as potential cover materials.

6.2.3 Available Cover Materials

Cover material is readily available onsite. Over 5 million cubic yards of cover material is available north of the partition dike within the tailings area. This estimate considers excavation to 130 feet NGVD approximately. In addition, about 30,000 cubic yards of waste clay are available in this area. Figure 6.4 shows a cross section through the site showing the location of the cover material. The material above 140 feet NGVD is suitable for both daily and intermediate cover material. The clayey sand portions of the material between 130 and 150 feet NGVD is suitable primarily for final cover but could also be used for temporary intermediate cover. The waste clay can also be used for final cover material; however, it will need to be dried out and mixed with sand to achieve optimum characteristics with respect to workability, resistance to cracking, and trafficability. A mixture of 1 part clay by weight to 4 to 6 parts sand should provide an excellent final cover material.

Drying and mixing can be accomplished after the material is spread by working the material with disks, harrows, scarifier or other suitable equipment. After the water content has been reduced to approximately the standard Proctor optimum moisture content the sand-clay mixture should be compacted with a sheepsfoot roller, loaded scraper pans or other similar equipment until the desired density is achieved.

Quality control for placement of the final cover should be done under the full-time inspection of qualified personnel. Compaction and fines content testing of the placed final cover material should be done at a frequency of not less than one test per 20,000 square feet per 6-inch lift. More tests may be required to accommodate variations in compaction and material or failed compaction tests. The control for field compaction tests shall be the density and fines content

what is gradient?

required to yield a permeability in the range of 10^{-5} to 10^{-7} cm/sec. Because of the low permeability of the final cover, methane gas will need to be vented to the atmosphere.

6.3 Leachate Collection and Control System

In preparation for placement of the leachate collection system, the surface of the waste clay must be cleared of all vegetation and any ponded water. The stripping and grubbing are not required. The ponded water may be drained from the site by ditching.

A 3-foot layer of sand tailings placed above the existing waste clay surface will provide the basis for the leachate collection system. Drainage pipes installed in the sand tailings will provide conduits to carry the leachate to a central collection system. The drain spacing should be computed based on a permeability of the sand tailings of 10^{-2} cm/sec. Not less than 3 inches of filter material is recommended around the drain.

Filter material should have the following specifications:

- Plasticity index must be zero
- D_5 size filter $\geq$ 0.074 mm
- D_{15} size filter $\leq 4 \times D_{85}$ size base
- D_{50} size filter $\leq 25 \times D_{50}$ size base
- D_{85} size filter $\geq$ diameter of perforations in pipe
- D_{100} size filter $\leq$ 3 inches
- Uniformity coefficient < 20
- D_{15} size filter $\geq 5 \times D_{15}$ size base but not smaller than 0.10 mm

Provisions should be made for prevention of siltation by filters or collection and removal of fines by use of silt traps.

6.4 Clay Liner Characteristics

6.4.1 Settlement and Time Rate of Consolidation

6.4.1.1 Ultimate Settlement

The ultimate settlement of the surface of the waste clay under the weight of the landfill is needed in planning and design of the leachate collection system. The ultimate settlement is a result of primary consolidation and secondary compression of the waste clay.

The consolidation settlement, δ_c, was calculated based on the consolidation characteristics of the waste clay as presented in Chapter 5. Settlement analyses were performed for waste clay layers with 6-, 12-, and 18-foot thicknesses. The average *in situ* moisture content of each of the waste clay layers analyzed was taken to be the value at the middle depth of the clay layer based on the corresponding moisture content versus depth plot (Figures 6.5, 6.6, 6.7). The average initial void ratio, e_o, of the waste clay was calculated from this moisture

content. The effective overburden pressure at the middle depth, $\bar{\sigma}_{vo}$, was estimated based on average bulk unit weights obtained from "undisturbed" samples and information on groundwater levels obtained from our field investigation. With the known *in situ* void ratio and effective overburden pressure, e_o and $\bar{\sigma}_{vo}$, a representative consolidation curve for each layer (Figure 6.8, 6.9 and 6.10) was constructed using the void ratio versus effective vertical stress curves presented in Figure 5.6. The change in void ratio, Δe, for a given load intensity was then obtained directly from the curve. Consolidation settlement was calculated using the following equation:

$$\delta_c = (\Delta e/1+e_o)h$$

where h is the layer thickness.

Results of the analyses are presented in Figure 6.11. As shown, the magnitude of the ultimate consolidation settlement increases as the load intensity and layer thickness increase. For a waste clay layer, 12 feet thick, the consolidation settlement under 20 feet of refuse (0.41 tsf) would be 2.4 feet.

The magnitude of secondary compression, δ_t, at a given time was estimated using the following equation:

$$\delta_t = hC_\alpha \log_{10}(t/t_{100}),$$

where H is the thickness of waste clay, C_α is the coefficient of secondary compression obtained from consolidation tests, t_{100} is the time required for 100% primary consolidation. Calculation of the secondary compression for waste clays of various thickness and for load intensities ranging up to 4.5 tsf indicates that secondary compression is no more than an inch after 30 years. Thus, that portion of the ultimate settlement resulting from secondary compression is so small compared to that due to primary consolidation that it can be neglected.

6.4.1.2 Time Rate of Settlement

The percentage of the ultimate settlement which occurs after a given time depends on the rate of consolidation.

Figure 5.5 presented the relationship between the coefficient of consolidation, c_v, and the stress level represented by the ratio of effective vertical stress to maximum past pressure, $\bar{\sigma}_{vc}/\bar{\sigma}_{vm}$, obtained from consolidation tests. In the normally consolidated range, $\bar{\sigma}_{vc}/\bar{\sigma}_{vm} > 1.0$, the coefficient of consolidation has a value of approximately 1.2 to 1.6×10^{-4} cm^2/sec ($\simeq 5$ $ft^2/year$).

The time required to reach 95 percent consolidation for each lift of fill is obtained from the following equation:

$$t = 1.5\ H^2/c_v,$$

where H is the average drainage distance during the consolidation period.

Because the waste clay at the subject site has drainage boundaries at both the top and bottom of the layer, the average drainage distance was computed by subtracting ½ the ultimate settlement from the layer thickness prior to placement of each lift and dividing by 2. The time to reach 95 percent consolidation for a 12-foot thick waste clay layer under a 20-foot lift of refuse is calculated to be 7 years.

6.4.2 Stability of Liner

The stability of the waste phosphatic clay liner as a foundation for the landfill slopes was considered for selected critical cross sections which will exist during various phases of the filling plan. Presented in the following sections are the relevant material parameters, and the results of the stability analyses on selected critical cross sections.

6.4.2.1 Material Parameters

Shear strength and unit weight parameters were selected for the following materials:

- waste phosphatic clay
- sand tailings
- refuse
- residue

In addition, shearing resistance for the interface between the synthetic liner to be placed on the upstream side of the perimeter dikes and the overlying soils were estimated. The selection of parameters for each of the above listed parameters is described below.

6.4.2.1.1 Waste Phosphatic Clay

Considerable data for the waste clay were available from our laboratory investigation which is presented in Chapter 5. Total unit weights for the waste clay were selected as a function of depth using the moisture content versus depth curves presented in Figures 6.5 through 6.7. Values of undrained shear strength for various depths within the liner were also selected from Figures 6.5 through 6.7. The undrained shear strengths shown on these figures were obtained using the laboratory data presented in Figure 5.2.

Where applicable, data obtained in the laboratory investigation on the time rate of consolidation (Figure 5.5) and the effect of consolidation pressure on the undrained shear strength of the clay (Figure 5.3) were used to estimate the increases in shear strength which would occur under the weight of added fill. The values shown on Figure 5.3 were reduced to account for the actual stress path expected *in situ* utilizing the results of direct simple shear tests performed on other waste phosphatic clays.

6.4.2.1.2 Sand Tailings

Although no tests were performed during this investigation to determine values of unit weight or shear strength parameters for the sand tailings, considerable experience with and testing of similar materials placed mechanically at a variety of sites in Central Florida led to the selection of the following parameters:

Total Unit Weight, γ_t = 120 pcf = 3250 #/cy
Shear Strength, $\bar{\phi} = 34^{\circ}$, $\bar{c} = 0$

6.4.2.1.3 Refuse

No tests were performed on samples of refuse, and no values of shear strength parameters were available from local experience. However, documented cases of refuse piles standing at slopes steeper than 2.0 horizontal to 1.0 vertical indicate that an effective angle of internal friction, $\bar{\phi}$, of 26 degrees or greater can be anticipated. The following values were selected for the analyses:

Total Unit Weight, γ_t = 40.7 pcf = 1100 #/cy
Shear Strength, $\bar{\phi} = 26^{\circ}$, $\bar{c} = 0$

6.4.2.1.4 Residue

After the refuse has been processed by incineration, the material is expected to be more uniform and more dense. Although no direct data were available on the residue, data published in the literature for similar ash materials indicate an effective angle of internal friction ranging from 31 to 34 degrees. The following parameters were conservatively selected for the residue:

Total Unit Weight, γ_t = 63 pcf = 1700 #/cy
Shear Strength, $\bar{\phi} = 30^{\circ}$, $\bar{c} = 0$

6.4.2.1.5 Synthetic Liner Interfaces

Although no testing of the synthetic liner was performed in connection with this investigation, values of shearing resistance along the interfaces between the liner and the overlying sand and clay soils were estimated based on experience with similar liner materials. For sliding between the liner and frictional materials such as the sand tailings and residue, a friction angle of 15 degrees was selected. For shearing between the liner and the waste clay, the adhesion between the two materials was taken as the cohesion (undrained shear strength) of the clay.

6.4.2.2 Analyses

Critical cross sections for stability analyses were developed based on the existing topography and the proposed filling plan. The proposed landfill is to be constructed in the area shown in Figure 2.2. The landfill site is bounded by existing dikes along the east and west sides and by the 4-foot contour of the waste clay thickness map (see Figure 4.1) on the remaining sides. Part of the northern boundary will be adjacent to an existing partition dike. The partition dike and

existing perimeter dikes will be raised to tie into proposed perimeter dikes which will follow the 4-foot clay thickness contour to complete the enclosure. Filling of the landfill will be preceded by the placement of a 3-foot thick sand tailings drainage blanket over the entire site.

The proposed filling plan for the landfill is divided into the following three general phases:

- The first phase consists of placing refuse in an "L-shaped" area along the south and east sides of the site and placing an additional 5-foot sand tailings berm over the area within the 16-foot clay thickness contour to preload this area of thickest clay.

- The intermediate filling phase consists of placing residue against the inside face and then on top of the refuse placed in the first phase, leaving the northwest corner of the site (including the area covered with the 5-foot sand berm) open.

- The final phase consists of filling the remainder of the site with residue.

A schematic of this proposed filling plan is shown in Figure 6.12. It is estimated that the first phase of filling will be completed in about 2 years. Each additional lift of all subsequent phases will require at least 7 years to complete. The stability analyses reported herein are based on this requirement.

Due to the very soft nature of the waste phosphatic clay liner and the slow rate at which it consolidates under the load of added fill, the sliding block mode of failure was selected as critical for stability analyses. This mode maximizes the length of the failure surface within the very soft clay soils and, hence, minimizes the computed factor of safety.

The selected critical cross sections for the three general phases of filling are presented in Figures 6.13 through 6.15. The location of the water table and the material parameters utilized in the stability analyses are also noted in these figures. As shown, the maximum perimeter slopes on the refuse and residue are 4.0 horizontal to 1.0 vertical, while the maximum interior slopes are no steeper than 10.0 horizontal to 1.0 vertical. The upper surface of the landfill will be sloped to 20.0 horizontal to 1.0 vertical (or flatter) in the refuse. The upper surface of the residue will be sloped at 20.0 horizontal to 1.0 vertical (or flatter) on the perimeter above the refuse and at 30.0 horizontal to 1.0 vertical (or flatter) elsewhere.

The computed factors of safety for the sliding block stability analyses are noted adjacent to the failure surfaces illustrated in Figures 6.13 through 6.15. As shown, all computed factors of safety are greater than or equal to 1.5, which is prudent for this type of structure.

6.4.3 Permeability of Liner

In its existing condition the average permeability of the liner using the data in Figures 5.4, 6.8 and 6.10 varies from 1.0 to 1.8×10^{-7} cm/sec for a 6-foot thick and for an 18-foot thick layer, respectively. After consolidation under 60 feet of landfill the permeability of the liner will decrease to about 1.3×10^{-8} cm/sec for both the 6 and the 18-foot thicknesses.

During construction of the landfill excess pore water pressures generated within the liner will result in an upward flow of water out of the liner into the leachate collection system. Consequently, the liner will not be subjected to a downward gradient until 5 to 10 years after placement of the final cover.

The major crystalline phases detected in the XRD data presented in Chapter 5 were clay and apatite. Within the non-clay fraction minor amounts of quartz, crandallite, wavellite and dolomite were detected. The clay species were smectite, illite and kaolin. Based on this XRD work and other work by Ardaman, 1982 and Martin, 1982 for the Florida Phosphate Council with regard to documenting mineralogical characteristics of waste phosphatic clays it can be concluded that palygorskite is less than 5 percent by weight and kaolin is less than 5 percent by weight. The smectite-illite ratio by weight probably varies between 1:1 and 2:1, respectively. Table 6.3 summarizes the calculated mineralogy percents by weight utilizing a relationship between relative peak amplitude ratios, sample and mineral mass attenuation coefficients, and percents by weight of (Martin, 1982). The total clay fraction ranged from 58 to 72 percent by weight. The discrepancy between total clay and sum of clay species is attributed to interstratified and amorphous clay material. Partial X-ray diffractograms indicate the interstratified nature of the clay minerals. Both position and skewness of the kaolin peak suggest that kaolin probably is interstratified with expandable layers. The poorly crystalline clay material in all three samples was dominantly an expandable phase (i.e., smectite) that appeared to be interstratified with illite and probably also with kaolin.

6.5 Impacts to Groundwater System

The groundwater system at the site will not be adversely impacted from leachate generated at the landfill. A potential impact may occur as some of the existing "high" background groundwater in the silty and clayey fine sands below the clay seeps out from the center of the landfill. The perimeter stormwater-retention pond system and aquifer dilution capability are viewed as management tools to maintain groundwater within State standards.

6.6 Overall Suitability of the Proposed Landfill Site

Hydrogeologic factors deemed important in landfill investigations (Stewart & Hanan, 1970) include: (1) overburden characteristics; (2) bedrock characteristics; (3) sinkhole potential; (4) confining bed characteristics; (5) groundwater levels; (6) water wells; and (7) groundwater quality characteristics.

Overburden characteristics include such items as total thickness of deposits, texture of deposits, thickness of surficial aquifer, and potential for cover and liner material. For purposes of this investigation overburden is defined as material above the Bone Valley Formation. The top of the Bone Valley Formation is 80 to 100 feet NGVD. The highest elevations are generally along the northeast portion of the site while the lowest elevations are generally along the south and southwest portion of the site. The highest land surface elevations are 190 feet NGVD over the 390+ acre settling area.

A variety of good cover materials are available as summarized in Table 6.2. Excluding the area south of the partition dike and excavation no lower than 130 feet NGVD on the order of 5 million cubic yards of daily and intermediate cover are available. In addition, about 30,000 cubic yards of waste clay are available in this area. The "CH" clay would be good final cover material; however, it will need to be dried out and mixed with some sand to achieve optimum characteristics with respect to permeability, workability, resistance to cracking, and trafficability. The clean tailings sand appears to be most prevalent above 140 feet NGVD while the clayey sands appear to be most prevalent below 140 feet NGVD.

The waste clay extends over 90 percent of the area south of the partition dike. It thins out along the southern edge and near the partition dike in the northwest corner of the proposed area. The waste clay is over 18 feet thick in the southwest part of the area. The top of the waste clay ranges from 121 to 124 feet NGVD. The landfill will be located within the area south of the partition dike where waste clays are at least 4 feet thick.

Bedrock characteristics include rock type and composition, structural features, weathering and water supply potential. The top of the Hawthorn Formation was encountered 70 to 75 feet NGVD. This 96- to 113-foot thick layer was a sequence of sandy, phosphatic, consolidated clay and limestone or dolomite. The top of the Tampa Limestone was reached 140 to 160 feet below land surface. This limestone consisted of nonphosphatic, white to light yellow, soft, moderately sandy and clayey, finely granular and locally fossiliferous limestone. Water losses were experienced at the contact between the Hawthorn Formation and the Tampa Limestone. The Hawthorn Formation has a low potential for water supply development. The bottom of the Hawthorn Formation and the Tampa Limestone were judged to be in hydraulic connection with the Floridan Aquifer. No secondary artesian aquifer was judged to exist at this site.

The site is located within an area with a low probability of sinkhole occurrence. One sinkhole has been documented within a 6-mile radius of the site during the past nine years. The low sinkhole activity in the area, the few lineaments, the lack of an obvious consistent primary or secondary direction of lineaments, and the relatively large difference in water levels between the water table and artesian aquifer are factors supportive of the conclusion that a thick, relatively impermeable layer overlies the bedrock at this site.

Confining bed characteristics include the waste phosphatic clay, the hardpan layer, the clayey fine sands to sandy clays above and within the Bone Valley Formation, and the consolidated calcareous silts and clays within the Hawthorn Formation. These layers average 140 feet thick.

The groundwater level factors will pose no significant problem for operation of a landfill at the site. Water table levels vary from more than 10 feet below land surface in the tailings area to land surface near the drainage systems just south and west of the landfill during wet periods. The water levels within the sands below the waste phosphatic clays were artesian. The water levels were above the bottom of the clay layer. The potentiometric surface of the Floridan Aquifer is more than 80 feet lower than the water table, therefore, there is a potential for downward migration of groundwater. Leakance, however, would be on the order of .0004 feet/day.

The water table will be controlled during landfill operation by drainage to stormwater retention ponds located strategically throughout the site. A network of eight monitor wells are planned to aid in managing this system.

Groundwater quality in the surficial aquifers varied from low to relatively high mineralized water. Total dissolved solids ranged from 36 to 788 mg/l. The concentrations of the selected parameters analyzed (Table 4.6) indicate the presence of higher concentrations than would be expected in the natural state prior to activities of man. The proposed monitoring program will monitor these concentrations with time under different water-level conditions. Most of these pockets of mineralized water are believed to be north and east of the proposed landfill site within the tailings area. Except for low pH values, high concentrations of iron and high nutrient concentrations, the groundwater around the proposed landfill site (e.g. TH-20, TH-24, TH-28, and TH-37A) appears to be within the expected range of typical concentrations for such other parameters as chlorides, sulfate, nitrates, total dissolved solids, total organic carbon, and chemical oxygen demand.

The nearest public supply wells are more than 8 miles away. The well inventory for this project identified 40 wells within 1 mile of the proposed landfill area. Eight of these wells are not used, 24 are used for domestic or a combination of domestic and irrigation and the remainder are used for irrigation. Two wells, both over 1000 feet from the proposed landfill area, have been located east of Settling Area 1 within the old mine area. The next closest well is south and approximately 2000 feet away from the proposed landfill area. Most of the wells are south of County Road 674.

6.7 Groundwater Monitoring

Twenty-three piezometers and/or observation wells have been installed in and around the western settling area as part of this project. These wells are located on Figure 3.1. Table 6.4 summarizes pertinent data about each of these wells for use as groundwater monitoring wells. All except five of these wells are for the surficial aquifer. The five wells are in limestone zones, believed to be the Floridan Aquifer. Three of the surficial aquifer wells (AB-37, TH-48, and TH-56) are in sands beneath the waste clay and eight of the surficial aquifer wells (AB-22, TH-30, TH-32, TH-33, TH-34A, TH-35, TH-36, TH-37A) have tailings as part of its aquifer system. Background water quality data were collected at six surficial aquifer wells (i.e., TH-20, TH-24, TH-28, TH-32, TH-35, and TH-37A).

A group of eight wells are proposed for the operations monitoring program. Six wells (TH-20, TH-24, TH-28, TH-32, TH-35, and TH-37A) are proposed in the surficial aquifer and two wells (TH-19 and TH-40) are proposed in the Floridan Aquifer. Wells at TH-19, TH-32, TH-35 and TH-37A are upgradient or out of the influence of the sanitary landfill system. If any of these wells are destroyed by vandalism replacement wells will be installed as shown in Figure 6.16.

Wells at AB-37, TH-48, and TH-56 will be removed and the holes grouted up prior to start of the landfill operation.

Semiannual (May and October) water-level readings and water quality analyses are recommended for the groundwater monitoring program. The two months coincide with high and low water-level conditions, approximately.

The following procedures must be followed in the groundwater sampling program:

- Obtain sampling kits from analytical laboratory. The type of sample container (e.g. glass, plastic, one gallon, quart, etc.) and types of preservative (where applicable) should be specified for each of the different analyses according to FDER criteria.

- Obtain *in situ* measurements of water level, pH, conductivity and water temperature at each site. Details of each sampling should be recorded on a "Water Sample Log Sheet". The log sheet should contain information on the sampling personnel, date and time of sampling, site location and description, field measurement results, and comments by the sampler. A blank log sheet is illustrated in Table 6.5. In general, all of the recorded information on each sample log sheet should also be recorded on the corresponding sample kit tag.

- Take unfiltered water sample from well using a portable nitrogen airlift or vacuum lift sampler or alternative equivalent sampler. The sampler should be rinsed with distilled water prior to each sampling. The sampler and well need to be flushed by removing a minimum of two well volumes prior to sampling. Samples are taken once *in situ* readings taken at 5 minute intervals have three consecutive constant *in situ* readings.

- Fill sample containers with well water being careful that rims of caps and bottles are not contaminated with finger marks, containers are filled to top, containers are not overfilled to lose appropriate preservative, and are filled slowly to eliminate, as much as possible, air from getting into the container.

- Fill out sample log form and sample kit tag as thoroughly as possible to avoid possible confusion as to location of sample, sample procedures, *in situ* measurements, etc. Containers with preservatives must not be rinsed out prior to sampling.

- Prepare samples for shipment. Water samples must be iced down in ice chest and transported to the analytical laboratory within 24 hours of sampling.

- Complete "Transfer of Custody" form. The chain of custody between field and laboratory is documented using the "Transfer of Custody" form as illustrated in Table 6.6. This form includes signatures of the sending and receiving parties as well as a listing of the sampling kits transferred.

The procedures manual for groundwater monitoring at solid waste disposal facilities (USEPA, 1980) should be the guideline for groundwater monitoring.

Table 6.1

TYPICAL PROPERTIES OF COMPACTED MATERIALS

Group Symbol	Soil Type	Range of Maximum Dry Unit Weight, pcf	Range of Optimum Moisture, Percent	Typical Value of Compression At 1.4 tsf (20 psi) Percent of Original Height	Typical Value of Compression At 3.6 tsf (50 psi) Percent of Original Height	Typical Strength Characteristics Cohesion (as compacted) psf	Cohesion (saturated) psf	φ(Effective Stress Envelope) degrees	Tanφ	Typical Coefficient of Permeability ft/min.	Range of CBR Values	Range of Subgrade Modulus k lb/cu.in.
GW	Well graded clean gravels, gravel-sand mixtures	125-135	11-8	0.3	0.6	0	0	38	0.79	$5x10^{-2}$	40-80	300-500
GP	Poorly graded clean gravels, gravel-sand mix	115-125	14-11	0.4	0.9	0	0	37	0.74	10^{-1}	30-60	250-400
GM	Silty gravels, poorly graded gravel-sand silt	120-135	12-8	0.5	1.1	...	...	34	0.67	10^{-6}	20-60	100-400
GC	Clayey gravels, poorly graded gravel-sand-clay	115-130	14-9	0.7	1.6	...	...	31	0.60	10^{-7}	20-40	100-300
SW	Well graded clean sands, gravelly sands	110-130	16-9	0.6	1.2	0	0	38	0.79	10^{-3}	20-40	200-300
SP	Poorly graded clean sands, sand-gravel mix	100-120	21-12	0.8	1.4	0	0	37	0.74	10^{-3}	10-40	200-300
SM	Silty sands, poorly graded sand-silt mix	110-125	16-11	0.8	1.6	1050	420	34	0.67	$5x10^{-5}$	10-40	100-300
SM-SC	Sand-silt clay mix with slightly plastic fines	110-130	15-11	0.8	1.4	1050	300	33	0.66	$2x10^{-6}$	-	
SC	Clayey sands, poorly graded sand-clay mix	105-125	19-11	1.1	2.2	1550	230	31	0.60	$5x10^{-7}$	5-20	100-300
ML	Inorganic silts and clayey silts	95-120	24-12	0.9	1.7	1400	190	32	0.62	10^{-5}	15 or less	100-200
ML-CL	Mixture of inorganic silt and clay	100-120	22-12	1.0	2.2	1350	460	32	0.62	$5x10^{-7}$	-	
CL	Inorganic clays of low to medium plasticity	95-120	24-12	1.3	2.5	1800	270	28	0.54	10^{-7}	15 or less	50-200
OL	Organic silts and silt-clays, low plasticity	80-100	33-21	...	...	...	...	...	...	...	5 or less	50-100
MH	Inorganic clayey silts, elastic silts	70-95	40-24	2.0	3.8	1500	420	25	0.47	$5x10^{-7}$	10 or less	50-100
CH	Inorganic clays of high plasticity	75-105	36-19	2.6	3.9	2150	230	19	0.35	10^{-7}	15 or less	50-150
OH	Organic clays and silty clays...	65-100	45-21	...	...	...	...	...	...	...	5 or less	25-100

Notes:

1. All properties are for condition of "standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical strength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading with complete lateral confinement.
4. ( ) indicates that typical property is greater than the value shown.
   (...) indicates insufficient data available for an estimate.

Source: NAVFAC, 1971

Table 6.2

SITE COVER MATERIALS USING UNIFIED SOIL CLASSIFICATION SYSTEM

Unified Symbol	Name	Boring Profile Stratum Number	Boring Profile Soil Description
SW,SP	Well graded to poorly graded sands, little or no fines.	1	Sand tailings
CH	Inorganic clays of high plasticity, fat clays	2	Waste phosphatic clays
SC,SP	Poorly graded sands to clayey sands and sand-clay mixtures, which may be poorly graded.	3	Sand tailings mixed with waste phosphatic clays.
SP, SM, SC	Poorly graded sands, silty sands and sand-silt mixtures which may be poorly graded to clayey sands and sand-clay mixtures which may be poorly graded.	4	Mixed silty to clayey fine sands with traces of sandy clays, phosphates and cemented sands (fill)
SM	Silty sands and sand-silt mixtures which may be poorly graded.	5 & 6	Slightly silty to silty fine sands with occasional traces of roots, organic matter and/or seams of cemented sands
SC, ML, CL	Clayey sands, sand-clay mixtures, inorganic silts and very fine sands, sandy clays	7	Clayey sands to sandy clays with traces of cementation

Table 6.3

CALCULATED MINERALOGY BY PERCENT WEIGHTS FOR WASTE PHOSPHATIC CLAY

Phase	Percent by Weight		
	#2	#4	#7
Non-Clay:			
Quartz	1	3	3
Apatite	41	34	23
Dolomite	0	0	2
Crandallite	<1	<1	<1
Wavellite	<1	<1	<1
Clay:	58	63	72

Table 6.4

PIEZOMETERS/OBSERVATION WELLS

Hole	Diameter (inches)	Land Surface Elevation (feet, NGVD)	Riser Height (feet)	Collection Zone Elevation (feet, NGVD)	Aquifer	Remarks
TH-19	2	126.9	3.0	-13.0 to -23.0	Floridan	
TH-20	2	130.5	3.0	120.0 to 102.0	Surficial	
AB-21	6	122.1	3.5	122.1 to 110.0	Surficial	
TH-22	2	126.4	3.7	125.0 to 101.0	Surficial	
AB-22	2	113.0	2.7	109.0 to 97.0	Surficial	
TH-24	2	128.0	3.0	127.0 to 104.0	Surficial	
TH-26	2	125.1	3.0	121.0 to 107.0	Surficial	
TH-28	2	128.8	3.0	107.0 to 99.0	Surficial	
TH-30	2	125.9	3.0	106.0 to 83.0	Surficial	
TH-32	2	129.5	3.0	120.0 to 109.5	Surficial	
TH-33	2	142.3	3.0	117.0 to 94.0	Surficial	
TH-34A	2	150.0	3.0	112.5 to 89.0	Surficial	
TH-35	2	135.9	3.0	112.0 to 94.0	Surficial	
TH-36	2	145.6	2.25	116.5 to 98.0	Surficial	
AB-37	2	121.8	2.8	109.0 to 104.0	Surficial	Collection zone below clay
TH-37A	2	131.0	3.7	114.0 to 96.0	Surficial	
TH-38	2	134.0	3.0	116.0 to 108.5	Surficial	
TH-40	2	122.1	3.1	-30.0 to -42.0	Floridan	
TH-41	2	122.1	3.0	-68.0 to -91.0	Floridan	
TH-42	2	112.7	3.0	-42.0 to -51.0	Floridan	
TH-48	2	123.0	2.7	111.0 to 106.0	Surficial	Collection zone below clay
TH-56	2	130.0	2.8	116.0 to 111.0	Surficial	Collection zone below clay
Prod. Well	24	116.4	1.4	-85.6 to -764.6	Floridan	Agrico Well No. 10 Driller's Log
Prod. Well	24	128.25	0.25	30.2 to -17.2	Floridan	

Table 6.5

WATER SAMPLE LOG SHEET

Water Quality Studies

Project No. _____ Sample No. _____
Location _____ Well No. _____
Sampled By _____ Date _____ Time _____
Water Depth _____ Field pH _____
Volume Removed Before Sampling _____ Field Cond. _____
Preservative/Handling _____ Field Temp. _____
Sampling Comments _____
_____
Required Analyses _____
Notes: _____
_____

Received by _____ Lab _____
Date _____ Time _____
Comments _____
_____

Lab Results Rec. & Attached By _____ Date _____
Comments on Results:

Comments By _____ Date _____

Table 6.6

TRANSFER OF CUSTODY SHEET

I, _____ of _____
(Signature) (Company)

hereby transfer the items listed below to

_____ of _____
(Name) (Company)

Items Transferred

1.

2.

3.

4.

5.

6.

7.

8.

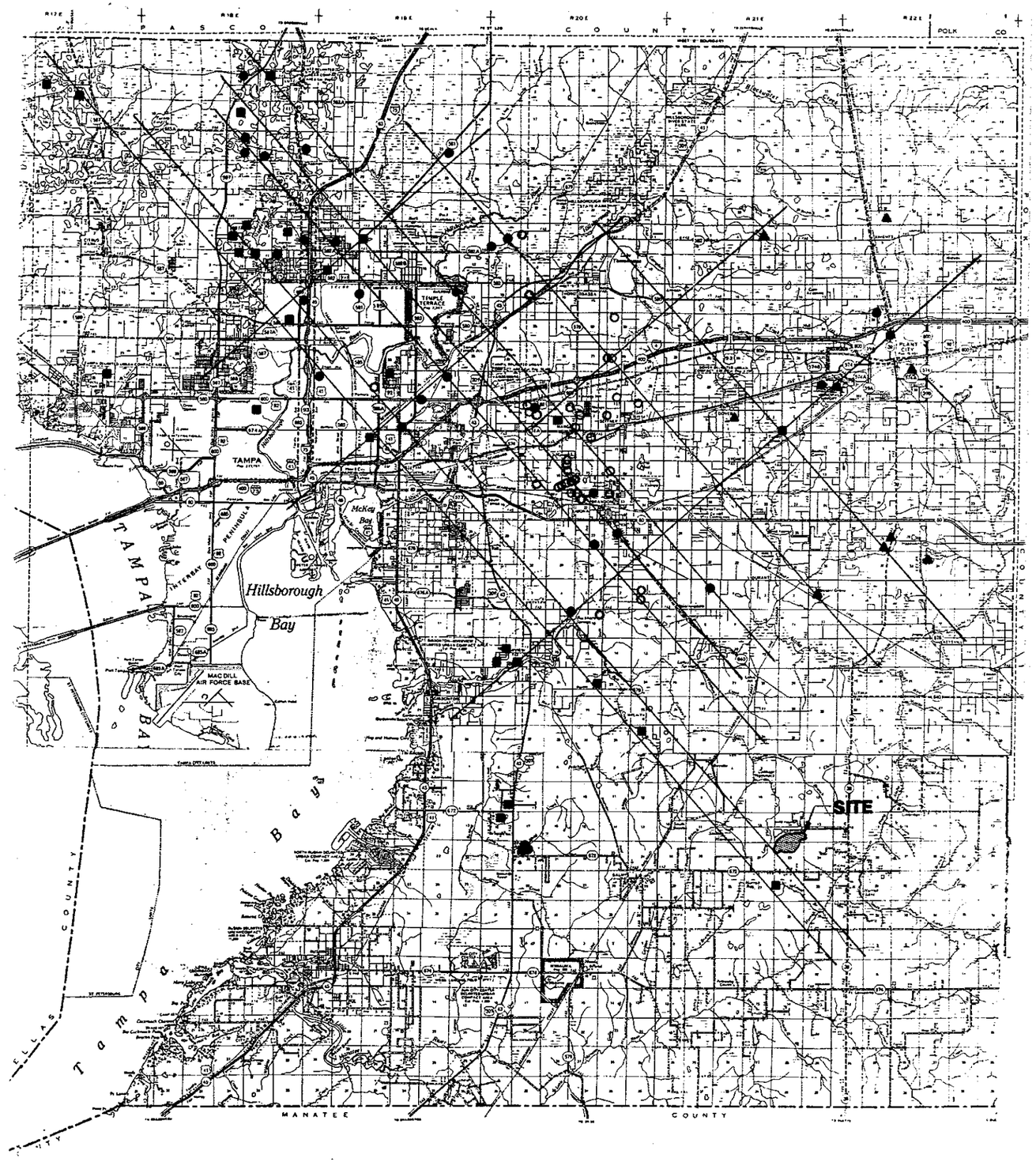
9.

10.

Receipt of above listed items acknowledged by

_____ _____ _____
(Signature) (Date) (Time)

KEE 19 1153 12-81 MC3813e



LEGEND

- ● SINKHOLE OCCURRENCE PRIOR TO 1970 USGS MAP SERIES NO. 39
- ○ SINKHOLE LOCATED FROM USGS QUAD MAP PRIOR TO 1974
- ■ RECENT SINKHOLE COLLAPSE
- △ SINKHOLE OCCURRENCE RECORDED DURING RECENT FIELD RECONNAISSANCE

SINKHOLE LOCATION MAP

HILLSBOROUGH COUNTY, FLORIDA

(REVISED FEBRUARY, 1981)

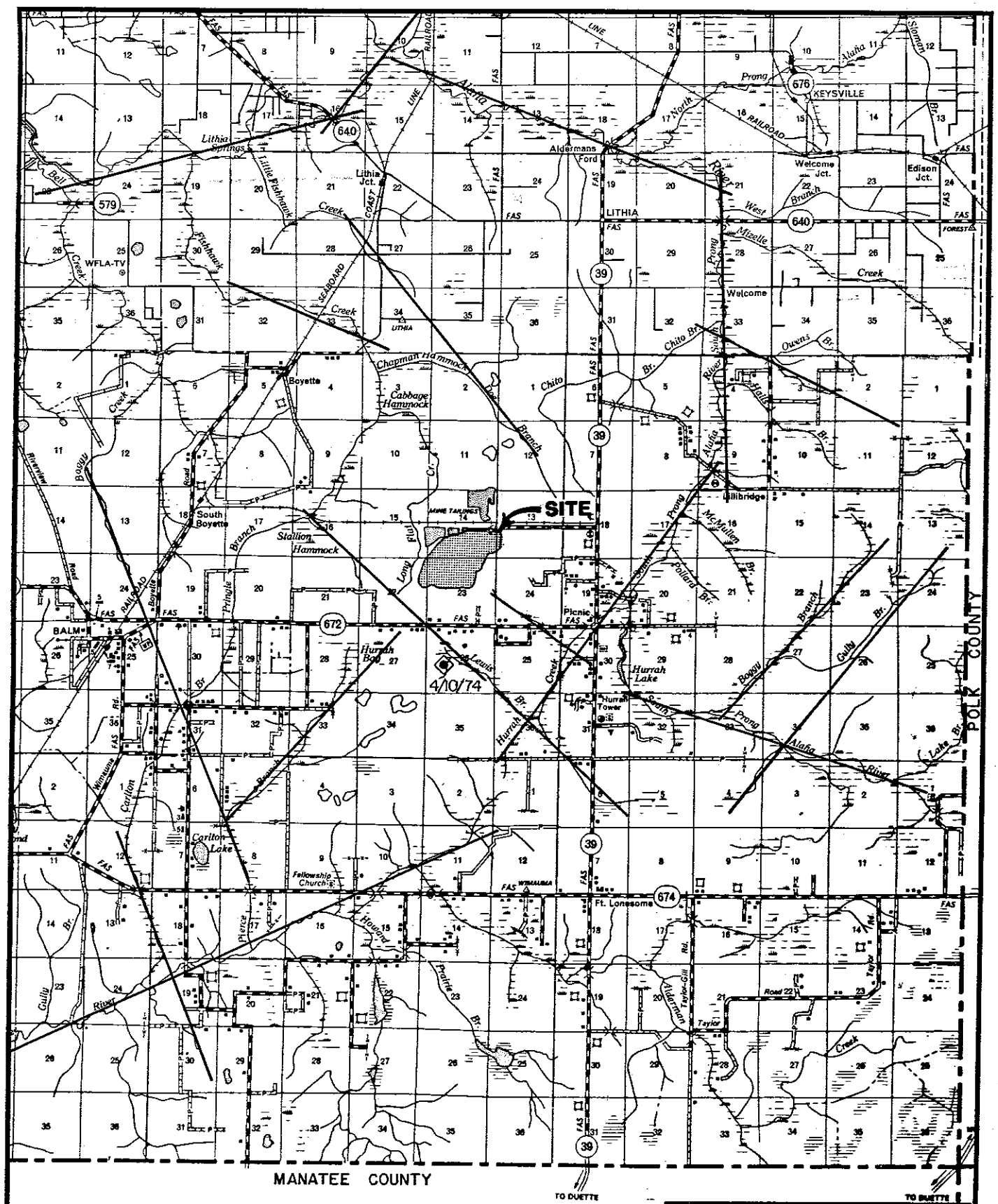
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: T.S.	CHECKED BY:	DATE: 2/15/83
FILE NO. 81-159	APPROVED BY: H.G. Stangland	

FIGURE 6.1

K&E 19 1153 12-80 MC1983e



LINEAMENT MAP

TOWNSHIPS 30, 31 AND 32 SOUTH
RANGES 20, 21, AND 22 EAST

◈ DOCUMENTED SINKHOLE OCCURRENCE

SCALE 0 2 MILES

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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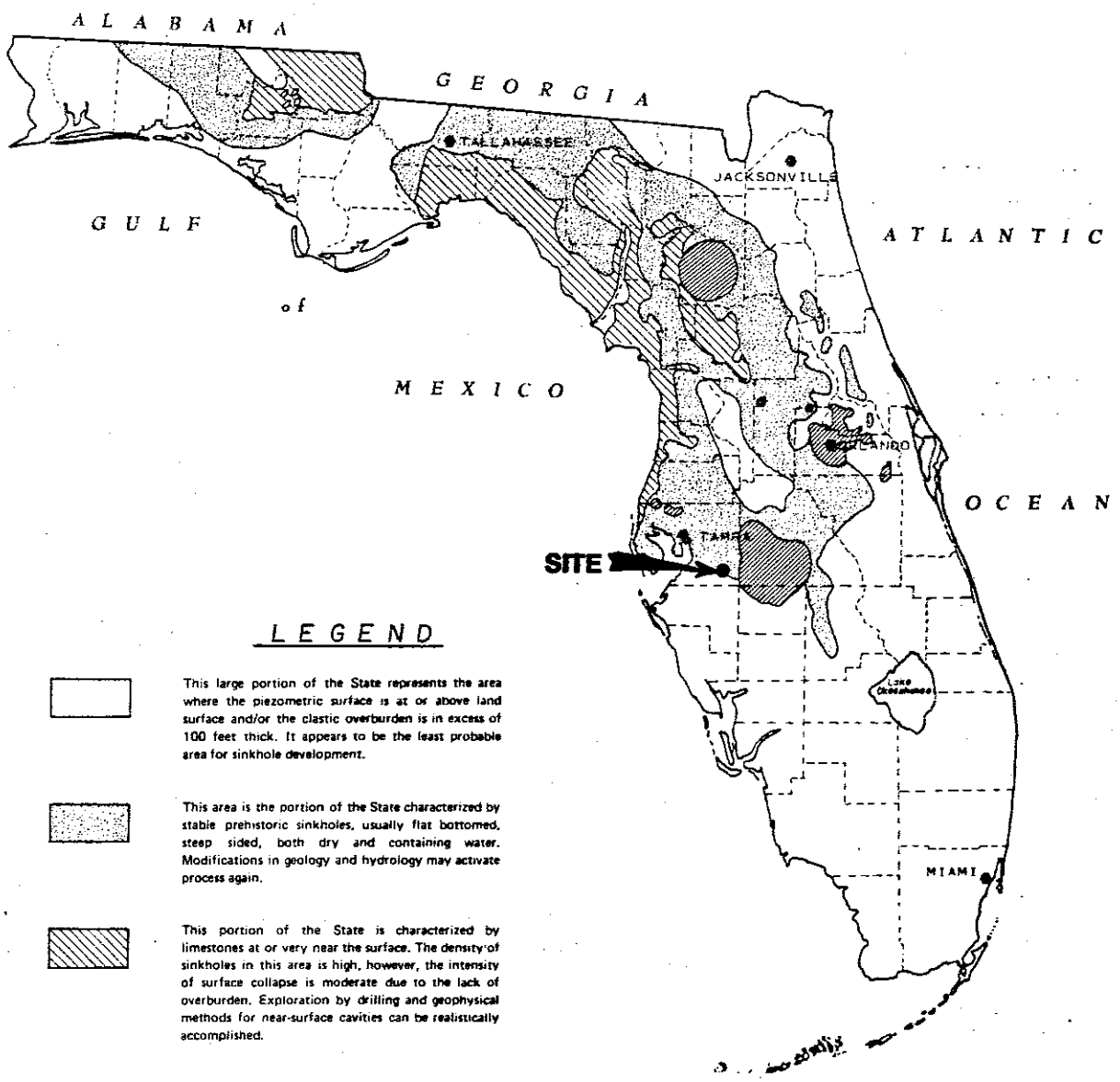
FILE NO. 81-159	APPROVED BY: H.G. Stanglund	

FIGURE 6.2



LEGEND

This large portion of the State represents the area where the piezometric surface is at or above land surface and/or the clastic overburden is in excess of 100 feet thick. It appears to be the least probable area for sinkhole development.

This area is the portion of the State characterized by stable prehistoric sinkholes, usually flat bottomed, steep sided, both dry and containing water. Modifications in geology and hydrology may activate process again.

This portion of the State is characterized by limestones at or very near the surface. The density of sinkholes in this area is high, however, the intensity of surface collapse is moderate due to the lack of overburden. Exploration by drilling and geophysical methods for near-surface cavities can be realistically accomplished.

This portion of the State has moderate overburden overlying cavernous limestones and appreciable water use. These areas have histories of steep-walled, wider sinkhole collapse but require more detailed study. A thick overburden or high water table present within these areas lessen the probability of sinks occurring.

MOST PROBABLE SINKHOLE REGIONS IN FLORIDA

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HILLSBOROUGH COUNTY, FLORIDA

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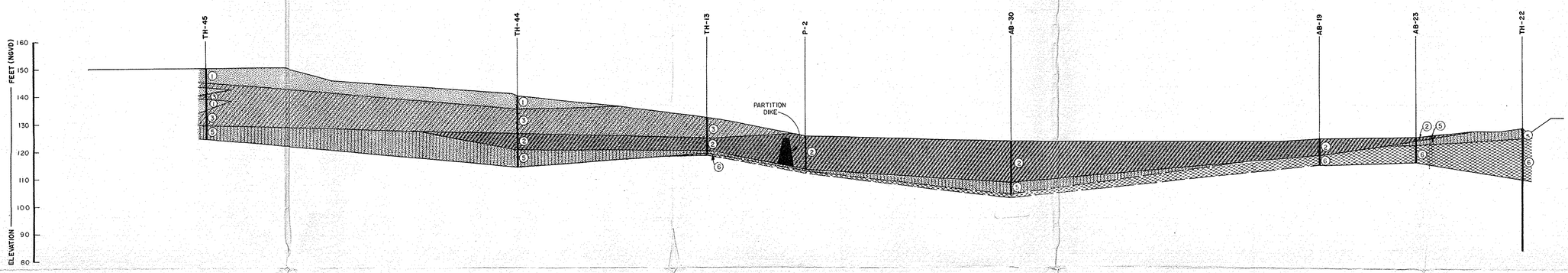
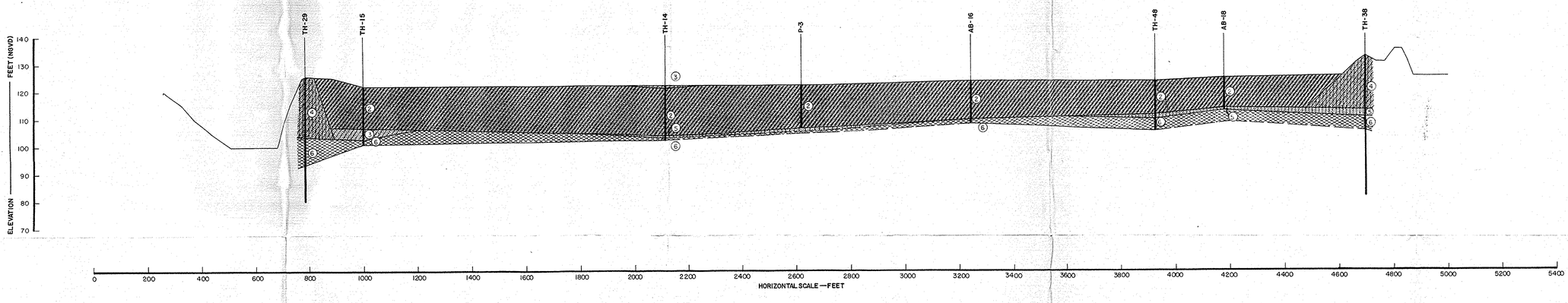
FIGURE 6.3

SECTION A-A



SECTION B-B



LEGEND

1. SAND TAILINGS
2. WASTE PHOSPHATIC CLAYS
3. SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
4. FILL
5. SLIGHTLY SILTY TO SILTY FINE SANDS
6. SLIGHTLY SILTY TO SILTY FINE SANDS (HARDPAN TYPE)

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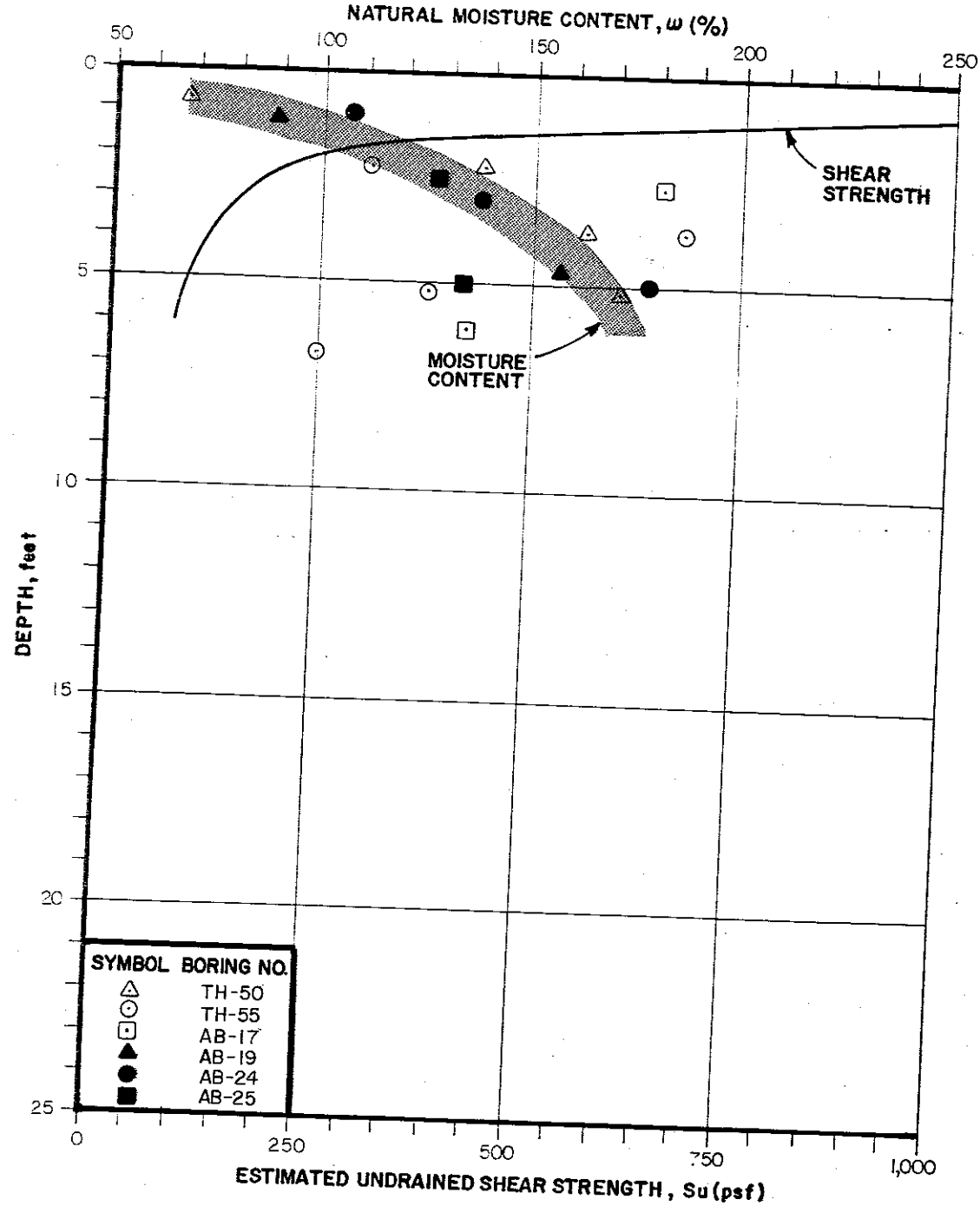
FIGURE 6.4

K&E 19 1153 12-81 MC 3313*

K&E 19 1153 12-80 MC1983e



MOISTURE CONTENT AND UNDRAINED SHEAR STRENGTH VS. DEPTH FOR 6-foot THICK WASTE PHOSPHATIC CLAY LAYER

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

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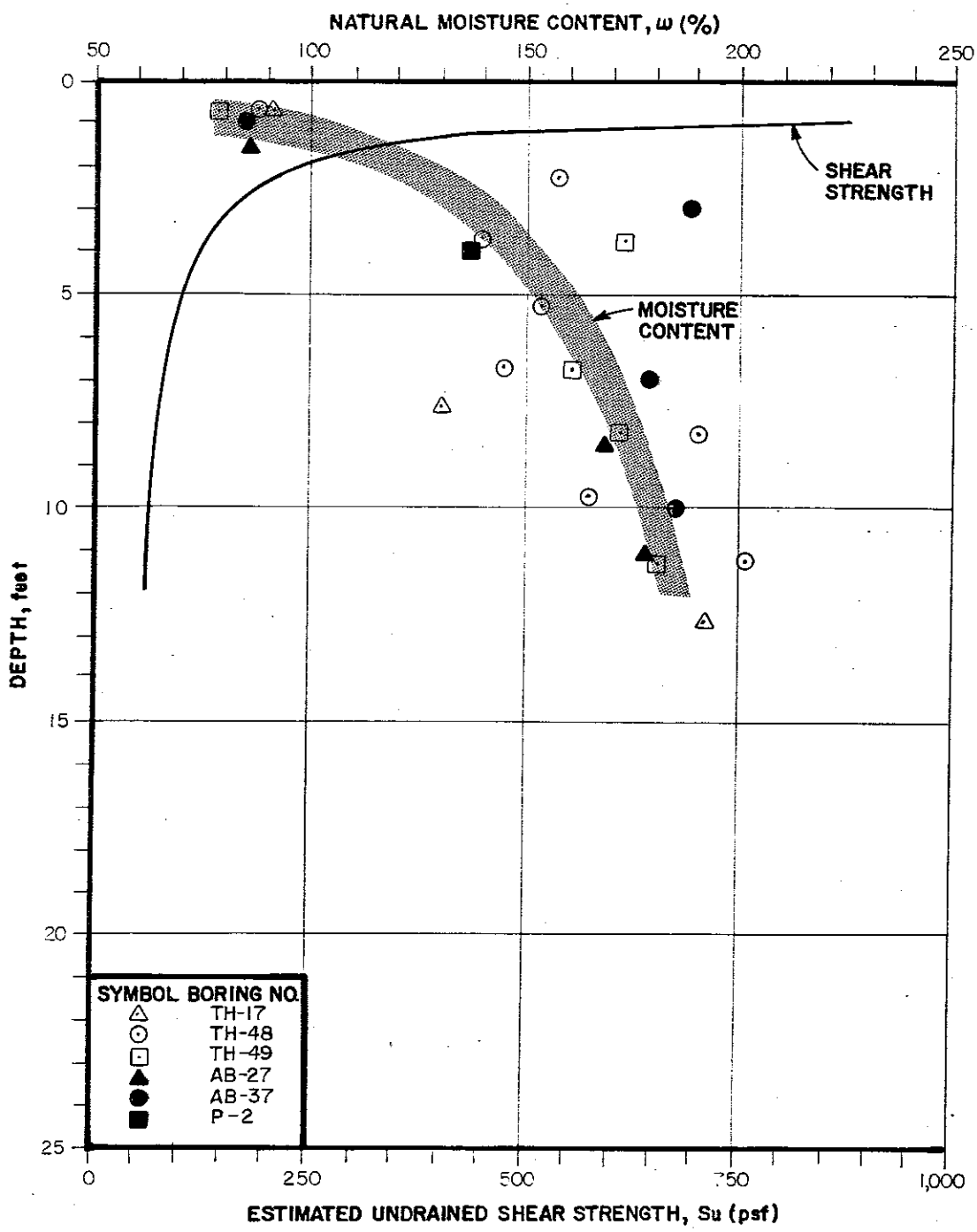
FIGURE 6.5



MOISTURE CONTENT AND UNDRAINED SHEAR STRENGTH VS. DEPTH FOR 12-foot THICK WASTE PHOSPHATIC CLAY LAYER

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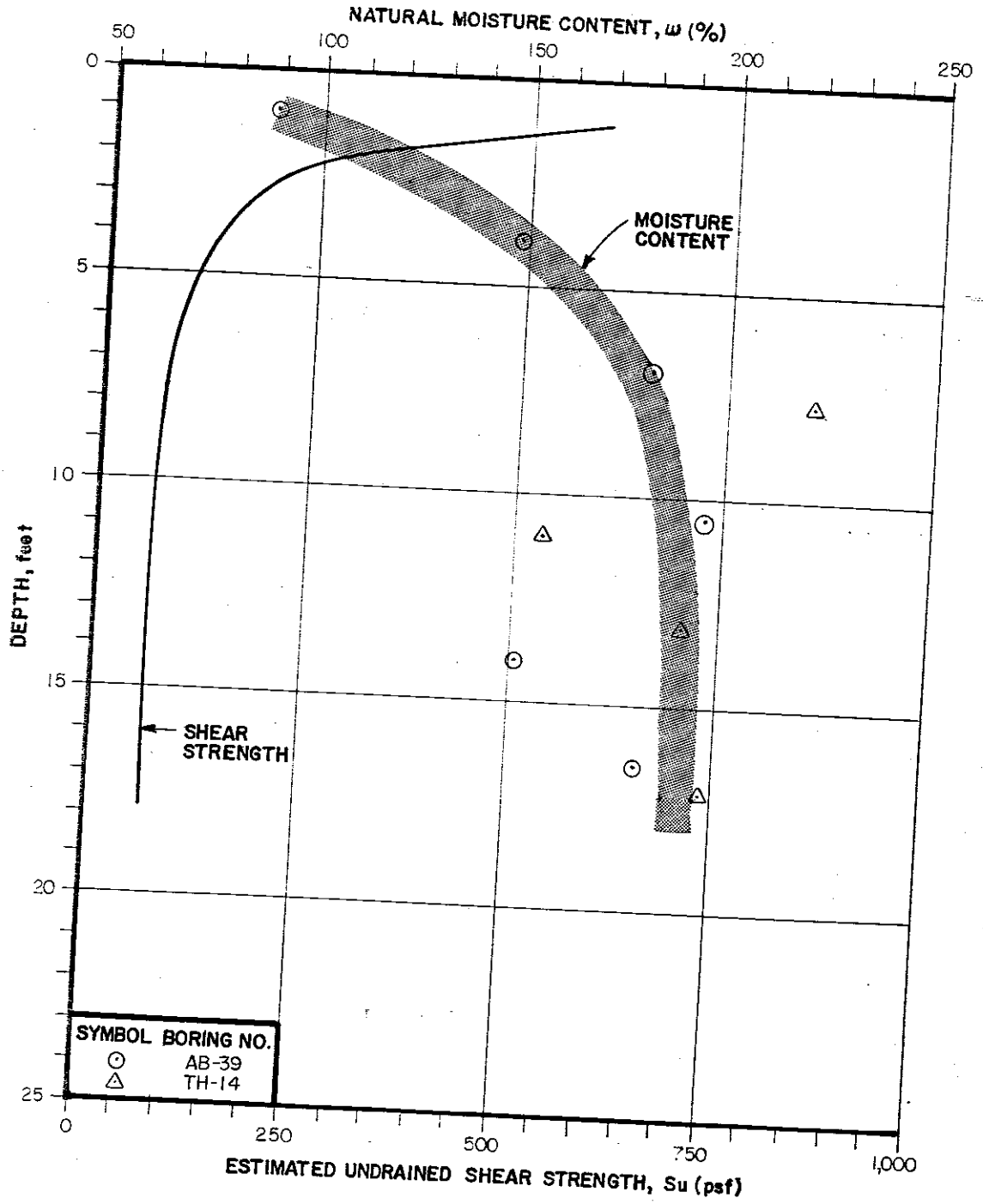
FIGURE 6.6

K&E 19 1153 12-80 MCI983e



MOISTURE CONTENT AND UNDRAINED SHEAR STRENGTH VS. DEPTH FOR 18-foot THICK WASTE PHOSPHATIC CLAY LAYER

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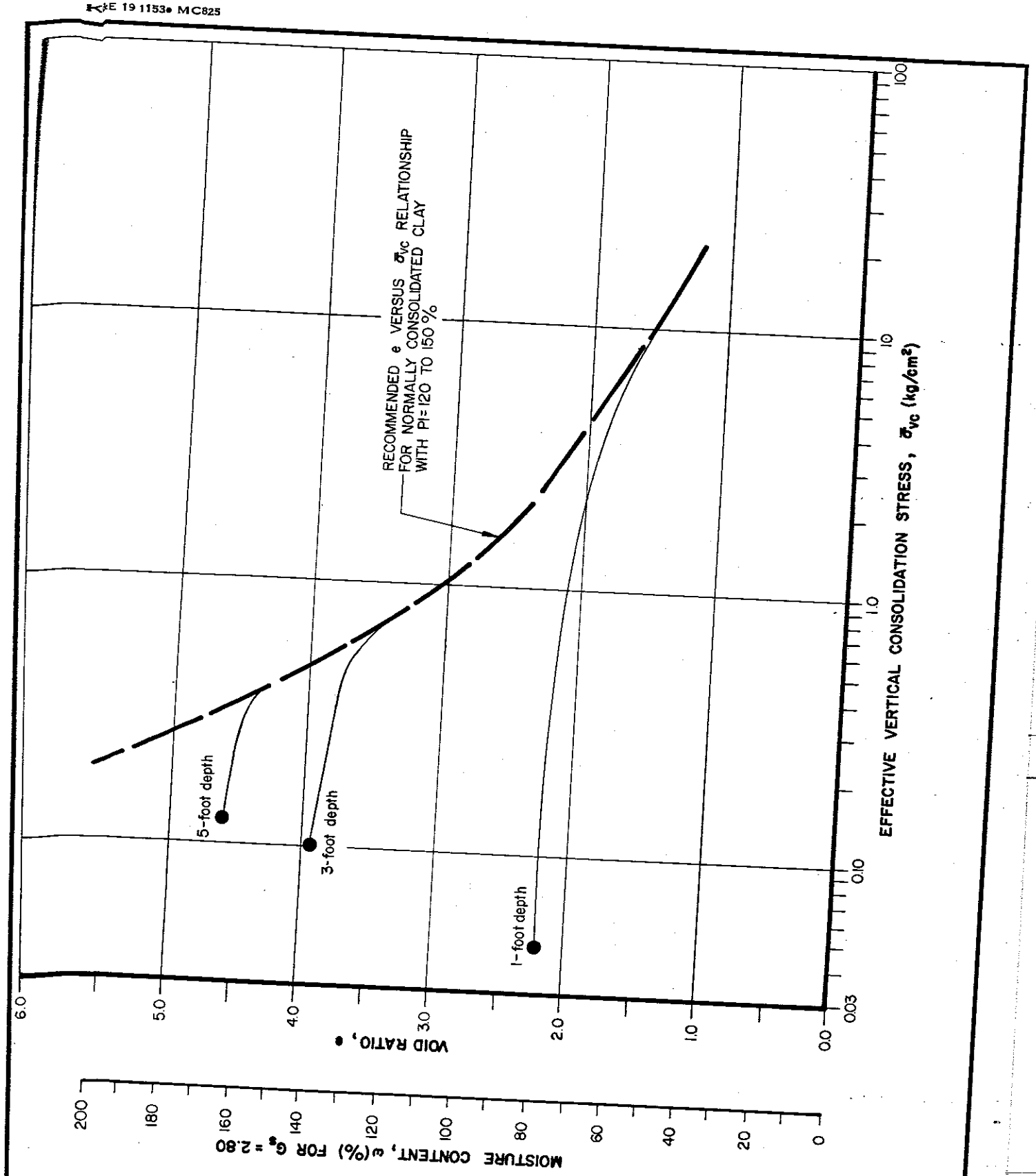
FIGURE 6.7

KE 19 1153e MC825



VARIATION IN EFFECTIVE VERTICAL CONSOLIDATION STRESS WITH VOID RATIO FOR 6 - foot THICK WASTE CLAY LAYER

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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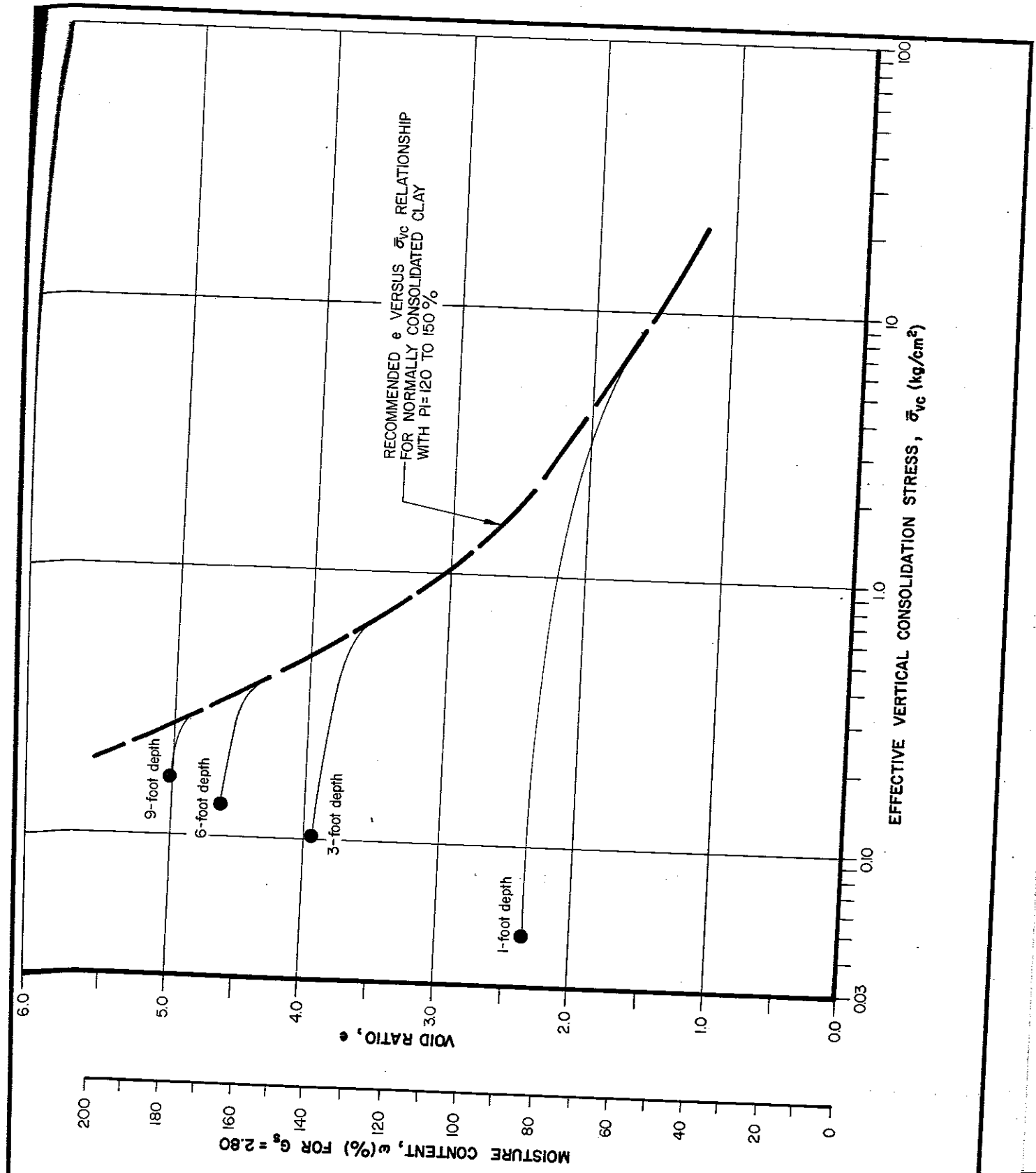
K&E 19 1153• MC825



VARIATION IN EFFECTIVE VERTICAL CONSOLIDATION STRESS WITH VOID RATIO FOR 12 - foot THICK WASTE CLAY LAYER

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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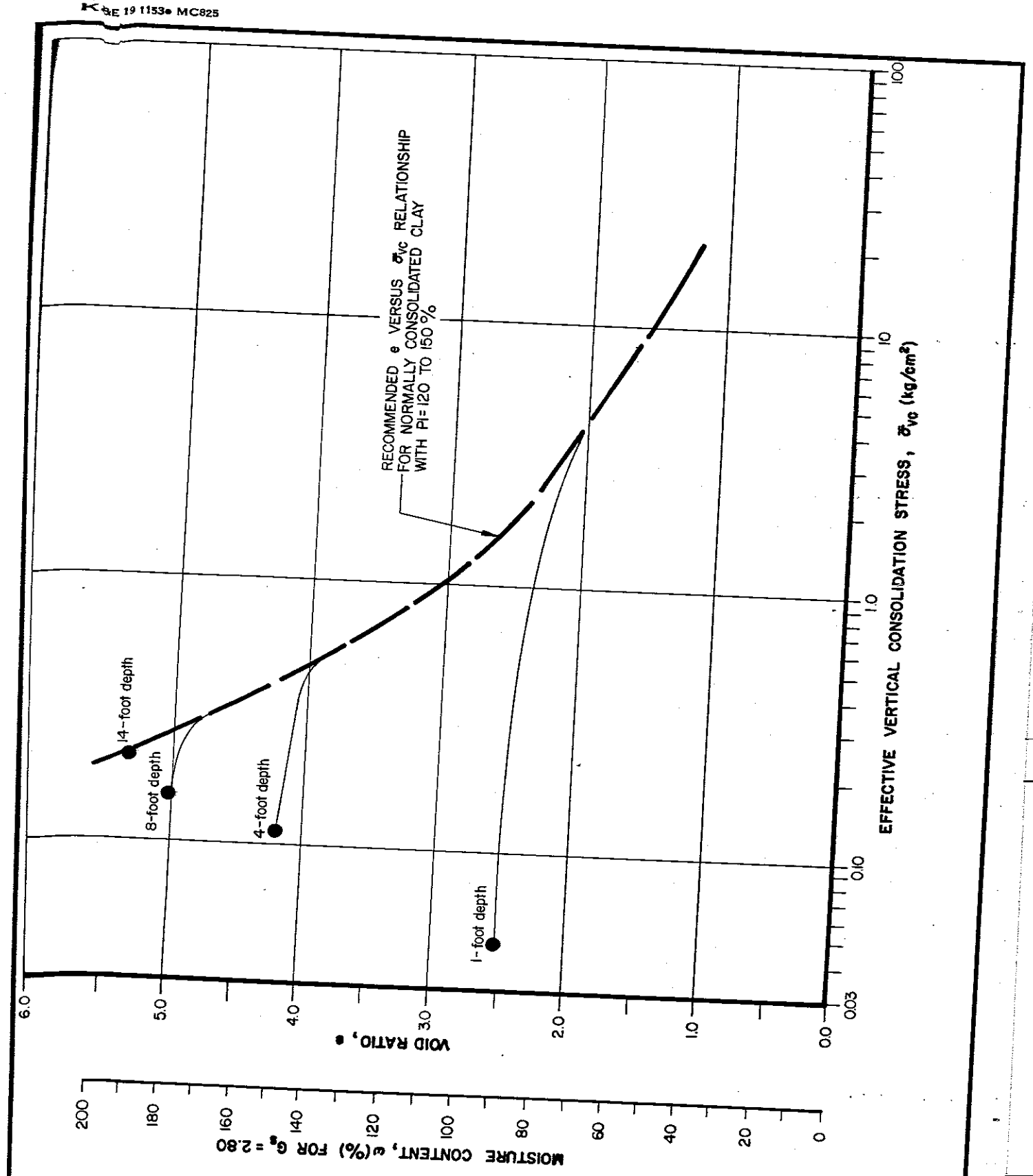
FILE NO. 81-159	APPROVED BY: H.G. Stanley	

K&E 19 1153• MC825



VARIATION IN EFFECTIVE VERTICAL CONSOLIDATION STRESS WITH VOID RATIO FOR 18 - foot THICK WASTE CLAY LAYER

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Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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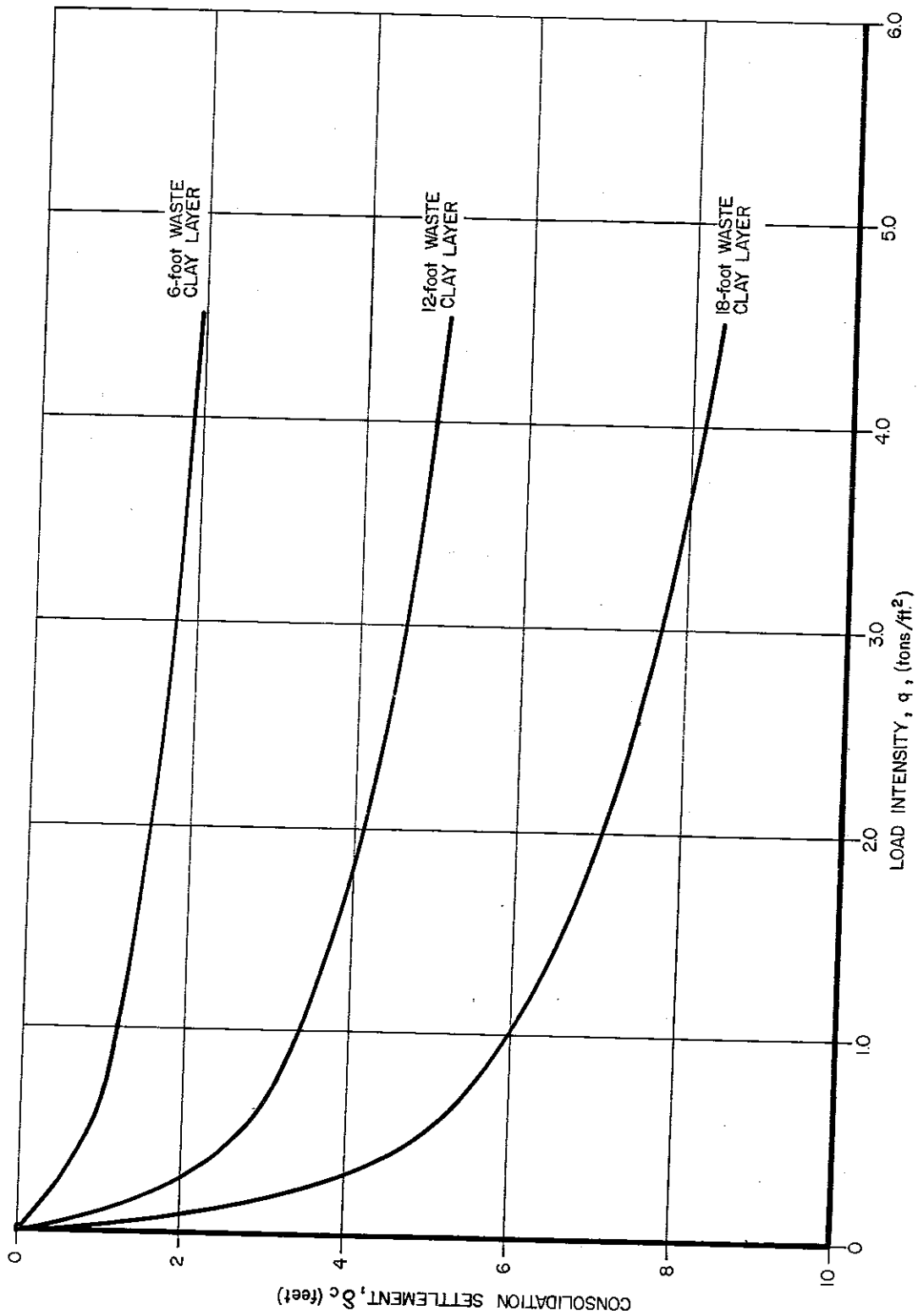
FIGURE 6-18

K&E 19 1153 12-80 MC1983



VARIATION OF CONSOLIDATION SETTLEMENT WITH LOAD INTENSITY FOR WASTE PHOSPHATIC CLAY LAYERS OF VARIOUS THICKNESS

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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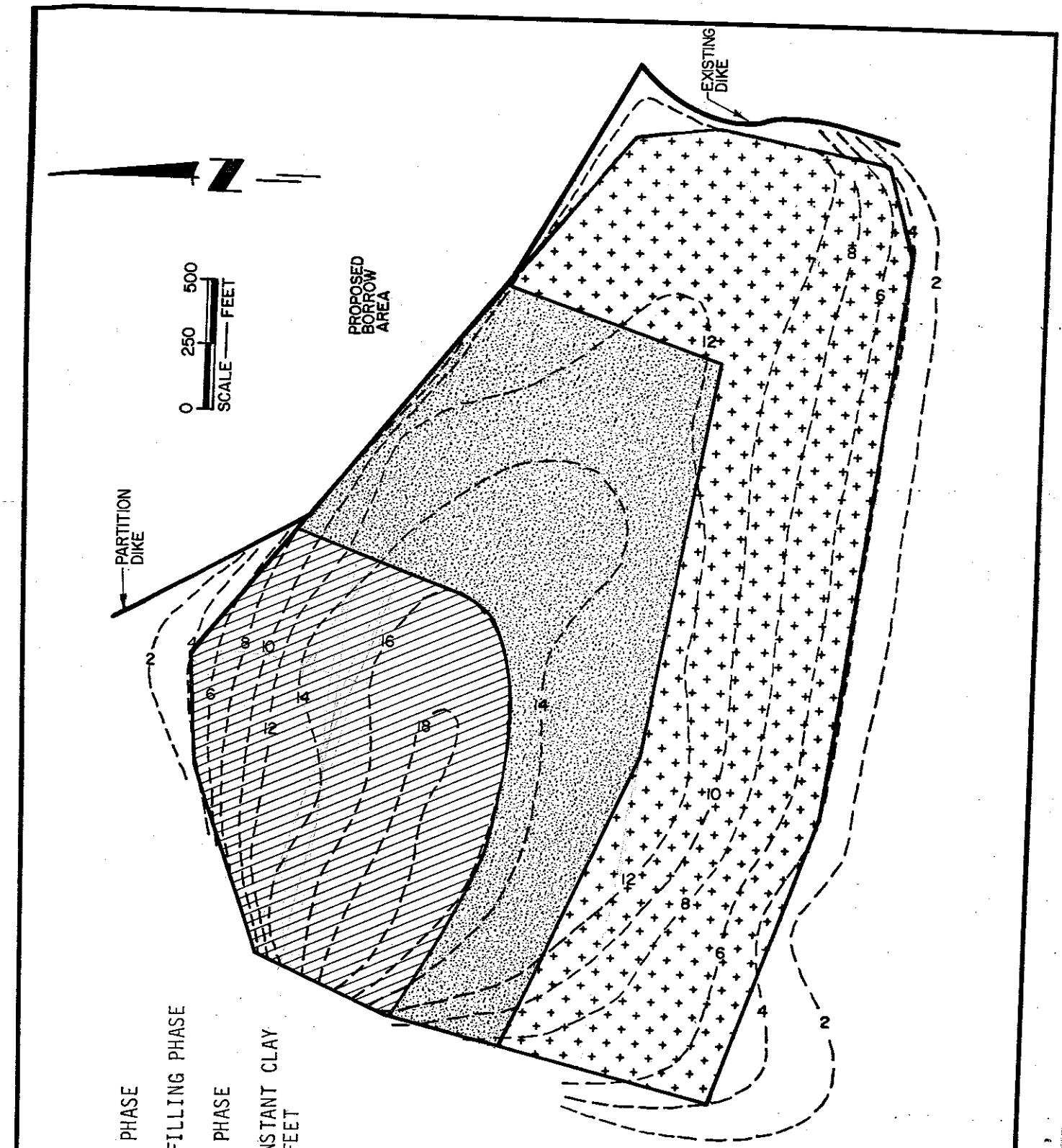
FILE NO. 81-159	APPROVED BY: H.G. Stangland	

FIGURE 6.11

SE 19 1153e MC825



SCHEMATIC FILLING PLAN

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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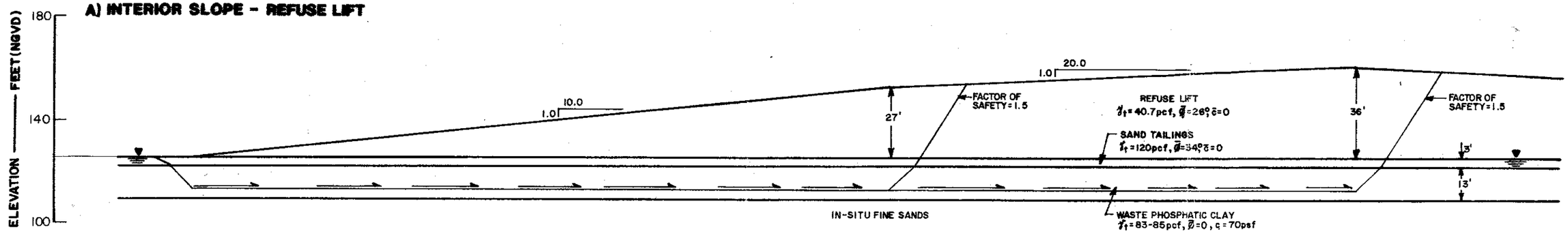
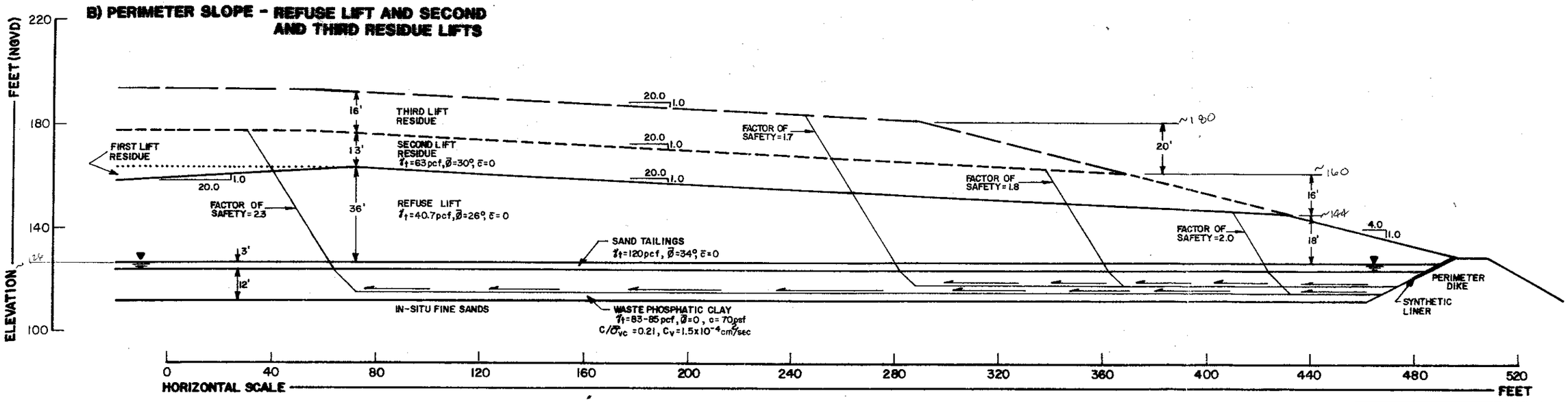
FIGURE 6.12

K&E 19 1153 12-81 MC3813e





SLIDING BLOCK STABILITY ANALYSES - FIRST FILLING PHASE

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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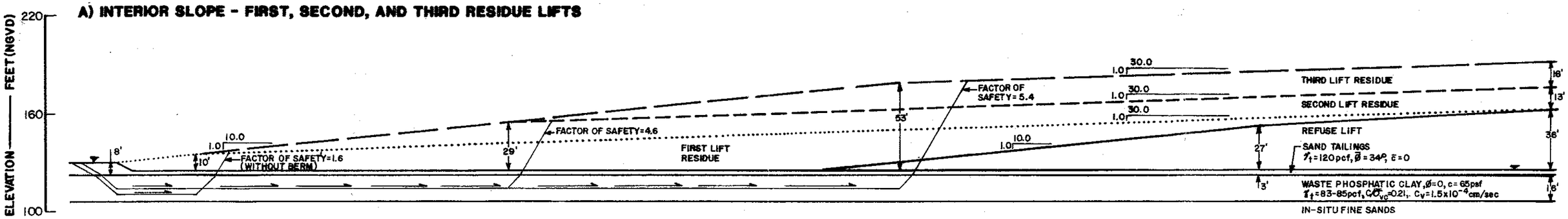
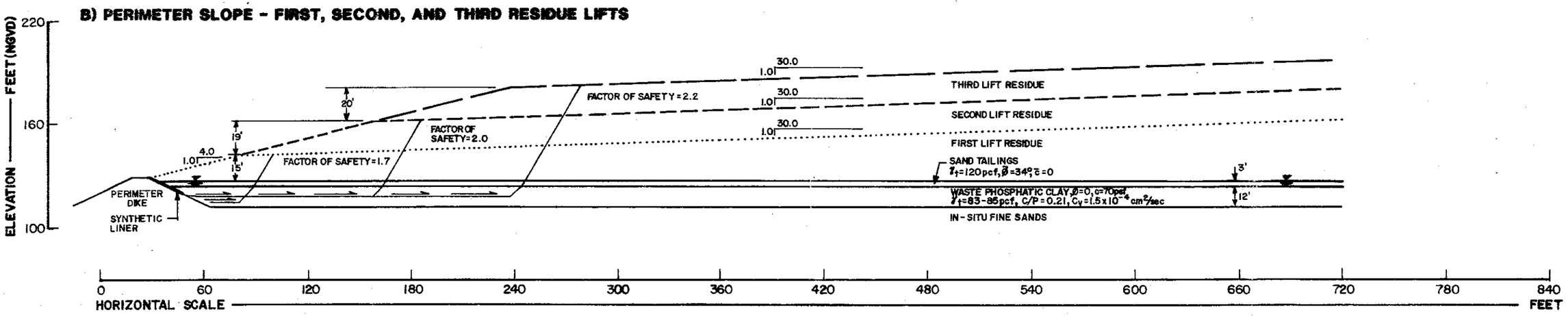
FILE NO. 81-159 | APPROVED BY: H.B. Stanland

FIGURE 6.13

K&E 19 1153 12-81 MC3313a





SLIDING BLOCK STABILITY ANALYSES - INTERMEDIATE FILLING PHASE

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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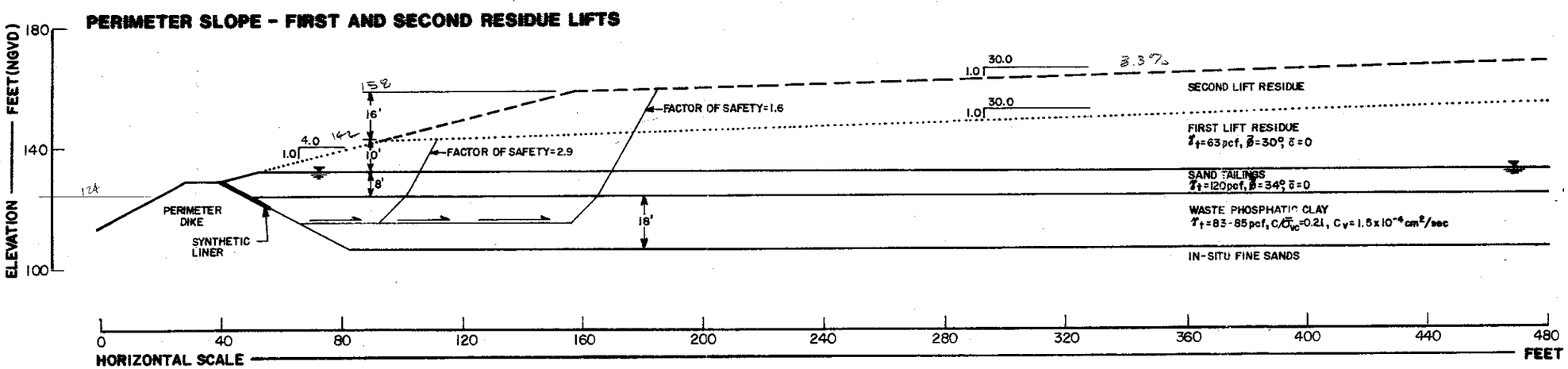
FILE NO. 81-159	APPROVED BY: H.G. Stangland	

FIGURE 6.14

K&E 19 1153 12-81 MC3313●



SLIDING BLOCK STABILITY ANALYSES - FINAL FILLING PHASE

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Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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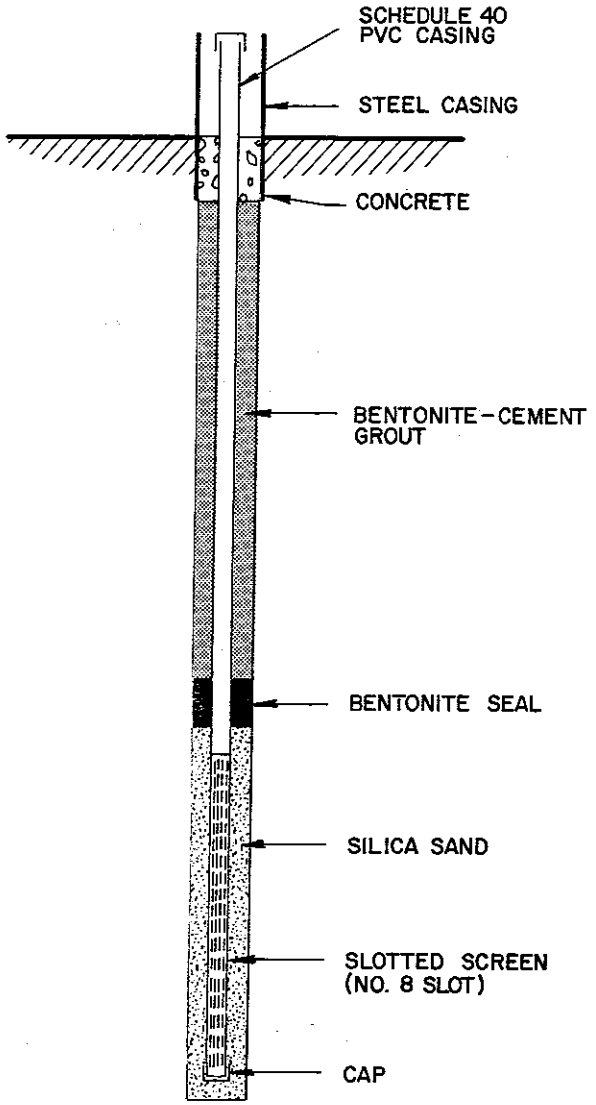
FILE NO. 81-159	APPROVED BY: H. S. Stanglund	

FIGURE 6.15



MONITOR WELL

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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FILE NO. 81-159	APPROVED BY: H.E. Stanglund	

FIGURE 6.16

Chapter 7

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Appendix A.1

SPT METHODOLOGY

STANDARD PENETRATION TEST

The standard penetration test is a widely accepted method of *in situ* testing of foundation soils (ASTM D-1586). A 2-foot long, 2-inch O.D. split-barrel sampler attached to the end of a string of drilling rods is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each 6 inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load.

The tests are usually performed at 5-foot intervals. However, more frequent or continuous testing is done by our firm through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is a bentonitic drilling mud, is also used to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, NX-size flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or to prevent the loss of circulating fluid.

Representative split-spoon samples from soils at every 5 feet of drilled depth and from every different stratum are brought to our laboratory in air-tight jars for further evaluation and testing, if necessary. Samples not used in testing are stored for at least six months prior to being discarded. After completion of a test boring, the hole is kept open until a steady state groundwater level is recorded. The hole is then sealed, if necessary, and backfilled.

Appendix A.2

UNDISTURBED SAMPLING

UNDISTURBED SAMPLING

Undisturbed sampling implies the recovery of soil samples in a state as close to their natural condition as possible. Complete preservation of *in situ* conditions cannot be realized; however, with careful handling and proper sampling techniques, disturbance during sampling can be minimized for most geotechnical engineering purposes. Examination and testing of undisturbed samples gives a more accurate estimate of *in situ* soil behavior than is possible with disturbed samples.

Normally, we obtain undisturbed samples by pushing a 2.33-inch I.D., 16-gauge wall, brass tube 24 inches into the soil with a single stroke of a hydraulic ram. The sampler, which is a Shelby tube, is 30 inches long. After the sampler is retrieved, the ends are sealed in the field and it is transported to our laboratory for further examination and testing, as needed.

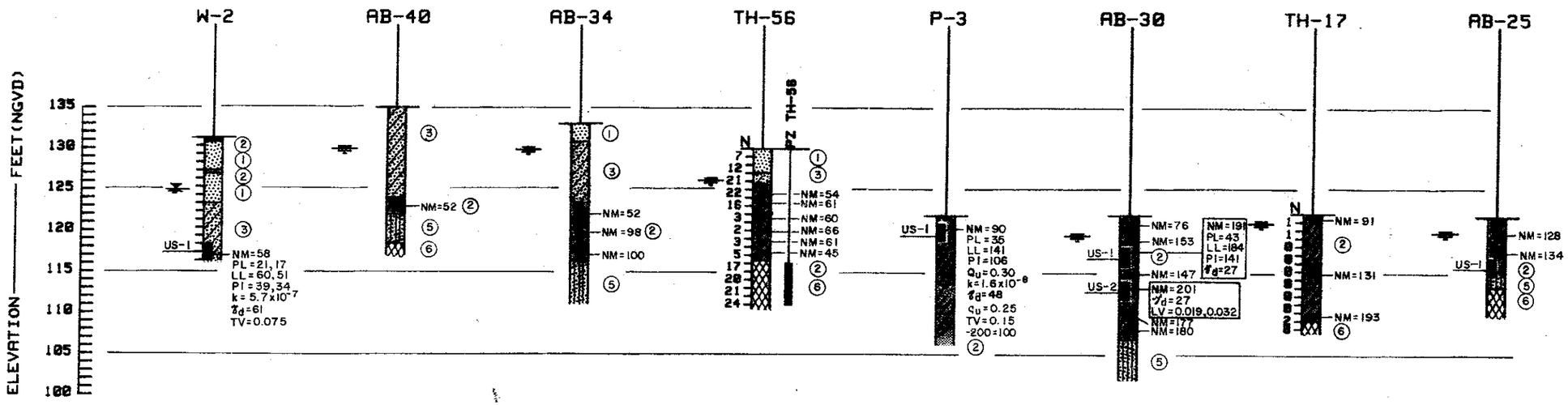
In some instances, when even less disturbed samples are required, a fixed-piston sampling device is used. The fixed-piston sampler is a 2.88-inch I.D. Shelby tube with a piston inside it. While the sampler is lowered into the bore hole, the piston is located at the lower end of the sampling tube. The piston is then placed at the bottom of the hole on top of the soil to be sampled, and is held stationary while the tube is smoothly pushed past the piston 24 inches into the soil. The sample is sheared from the parent soil by rotating the sampling device. After the sampler is brought out of the hole, the ends of the tube are sealed and the sample is brought back to our laboratory.

Four major improvements over our conventional undisturbed sampling procedures are achieved with the piston sampler; a larger sample is obtained; no soil enters the tube as the sampler is lowered to the sampling depth; excess soil does not enter the tube during the sampling operation; and a vacuum is generated between the piston and the sample as the sampler is being retrieved, thus helping to retain the sample in the tube.

Appendix A.3

BORING PROFILES

K&E 19 1153 12-81 MC3313a



LEGEND

①	SAND TAILINGS
②	WASTE PHOSPHATIC CLAYS
③	SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
④	MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
⑤	LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
⑥	LIGHT TO DARK BROWN SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL SEAMS OF CEMENTED SANDS (HARDPAN)
⑦	LIGHT GRAY TO LIGHT BROWN CLAYEY SANDS TO SANDY CLAYS WITH TRACES OF CEMENTATION
⑧	GREENISH GRAY TO YELLOWISH BROWN CLAYEY FINE SANDS TO SANDY CLAYS WITH PHOSPHATES (BONE VALLEY FORMATION)
⑨	GRAY TO YELLOWISH BROWN CONSOLIDATED CALCAREOUS SILTS AND CLAYS WITH PHOSPHATES (HAWTHORN FORMATION)
⑩	DENSE, GRAY AND BROWN DOLOMITIC LIMESTONE
⑪	GREENISH GRAY SANDY CLAY
⑫	CREAM, SOFT, FOSSILIFEROUS LIMESTONE
⑬	SOFT, POROUS, LIGHT BROWN TO TAN LIMESTONE
⑭	LIGHT BROWN, SANDY CALCAREOUS CLAY
⑮	DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE

TH	STANDARD PENETRATION TEST HOLE
AB	AUGER BORING
P	PROBING WITH PVC PIPE
W	WASH BORING
⊽	GROUNDWATER LEVEL
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5	50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL
US-1	UNDISTURBED SHELBY TUBE SAMPLE
PI	PLASTICITY INDEX IN PERCENT
NM	NATURAL MOISTURE IN PERCENT
PL	PLASTIC LIMIT IN PERCENT
LL	LIQUID LIMIT IN PERCENT
Q_u	UNCONFINED COMPRESSIVE STRENGTH FROM UNCONFINED COMPRESSION TEST, tsf
k	COEFFICIENT OF PERMEABILITY, cm/sec
γ_d	IN-SITU DRY DENSITY, lb/ft^3
q_u	UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf
TV	UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf
-200	PERCENT PASSING THE NO. 200 SIEVE
LV	UNDRAINED SHEAR STRENGTH FROM LABORATORY VANE, tsf

ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS."

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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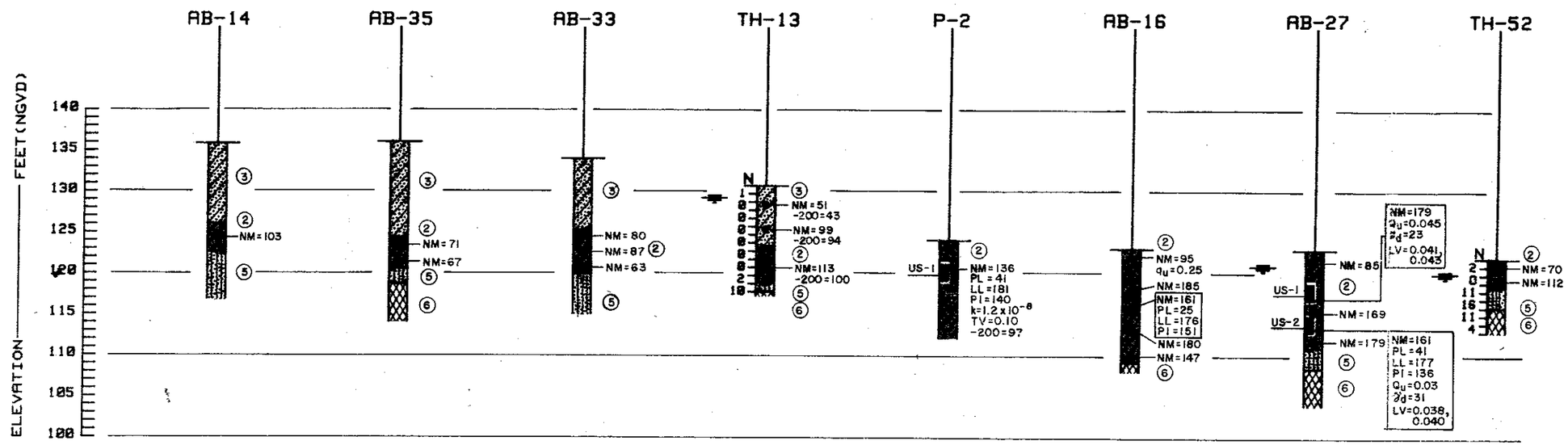
FIGURE A-2.1



LEGEND

	①	SAND TAILINGS
	②	WASTE PHOSPHATIC CLAYS
	③	SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
	④	MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
	⑤	LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
	⑥	LIGHT TO DARK BROWN SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL SEAMS OF CEMENTED SANDS (HARDPAN)
	⑦	LIGHT GRAY TO LIGHT BROWN CLAYEY SANDS TO SANDY CLAYS WITH TRACES OF CEMENTATION
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	⑪	GREENISH GRAY SANDY CLAY
	⑫	CREAM, SOFT, FOSSILIFEROUS LIMESTONE
	⑬	SOFT, POROUS, LIGHT BROWN TO TAN LIMESTONE
	⑭	LIGHT BROWN, SANDY CALCAREOUS CLAY
	⑮	DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE

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⏚	GROUNDWATER LEVEL
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LL	LIQUID LIMIT IN PERCENT
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k	COEFFICIENT OF PERMEABILITY, cm/sec
γ_d	IN-SITU DRY DENSITY, lb/ft^3
q_u	UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf
TV	UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf
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LV	UNDRAINED SHEAR STRENGTH FROM LABORATORY VANE, tsf

ENGINEERING CLASSIFICATION

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LOOSE	4 TO 10
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DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

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VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

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SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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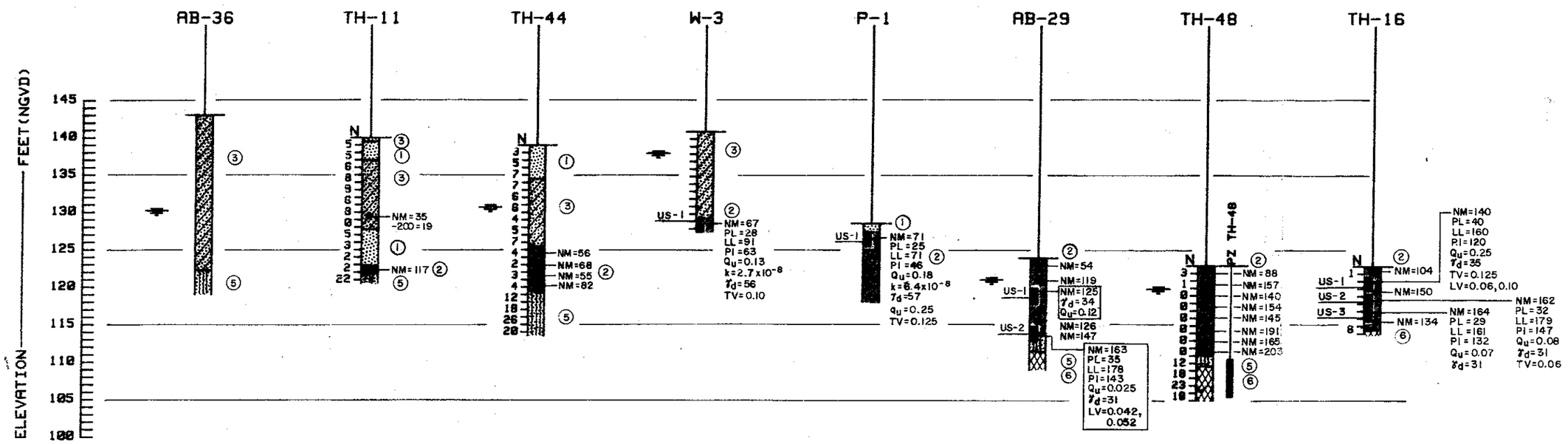
FILE NO. 81-159 | APPROVED BY: H.G. Stanglard

FIGURE A-3.2



LEGEND

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⑧	GREENISH GRAY TO YELLOWISH BROWN CLAYEY FINE SANDS TO SANDY CLAYS WITH PHOSPHATES (BONE VALLEY FORMATION)
⑨	GRAY TO YELLOWISH BROWN CONSOLIDATED CALCAREOUS SILTS AND CLAYS WITH PHOSPHATES (HAWTHORN FORMATION)
⑩	DENSE, GRAY AND BROWN DOLOMITIC LIMESTONE
⑪	GREENISH GRAY SANDY CLAY
⑫	CREAM, SOFT, FOSSILIFEROUS LIMESTONE
⑬	SOFT, POROUS, LIGHT BROWN TO TAN LIMESTONE
⑭	LIGHT BROWN, SANDY CALCAREOUS CLAY
⑮	DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE

TH	STANDARD PENETRATION TEST HOLE
AB	AUGER BORING
P	PROBING WITH PVC PIPE
W	WASH BORING
⏚	GROUNDWATER LEVEL
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5	50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL
US-1	UNDISTURBED SHELBY TUBE SAMPLE
PI	PLASTICITY INDEX IN PERCENT
NM	NATURAL MOISTURE IN PERCENT
PL	PLASTIC LIMIT IN PERCENT
LL	LIQUID LIMIT IN PERCENT
q_u	UNCONFINED COMPRESSIVE STRENGTH FROM UNCONFINED COMPRESSION TEST, tsf
k	COEFFICIENT OF PERMEABILITY, cm/sec
γ_d	IN-SITU DRY DENSITY, lb/ft^3
q_u	UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf
TV	UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf
-200	PERCENT PASSING THE NO. 200 SIEVE
LV	UNDRAINED SHEAR STRENGTH FROM LABORATORY VANE, tsf

ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

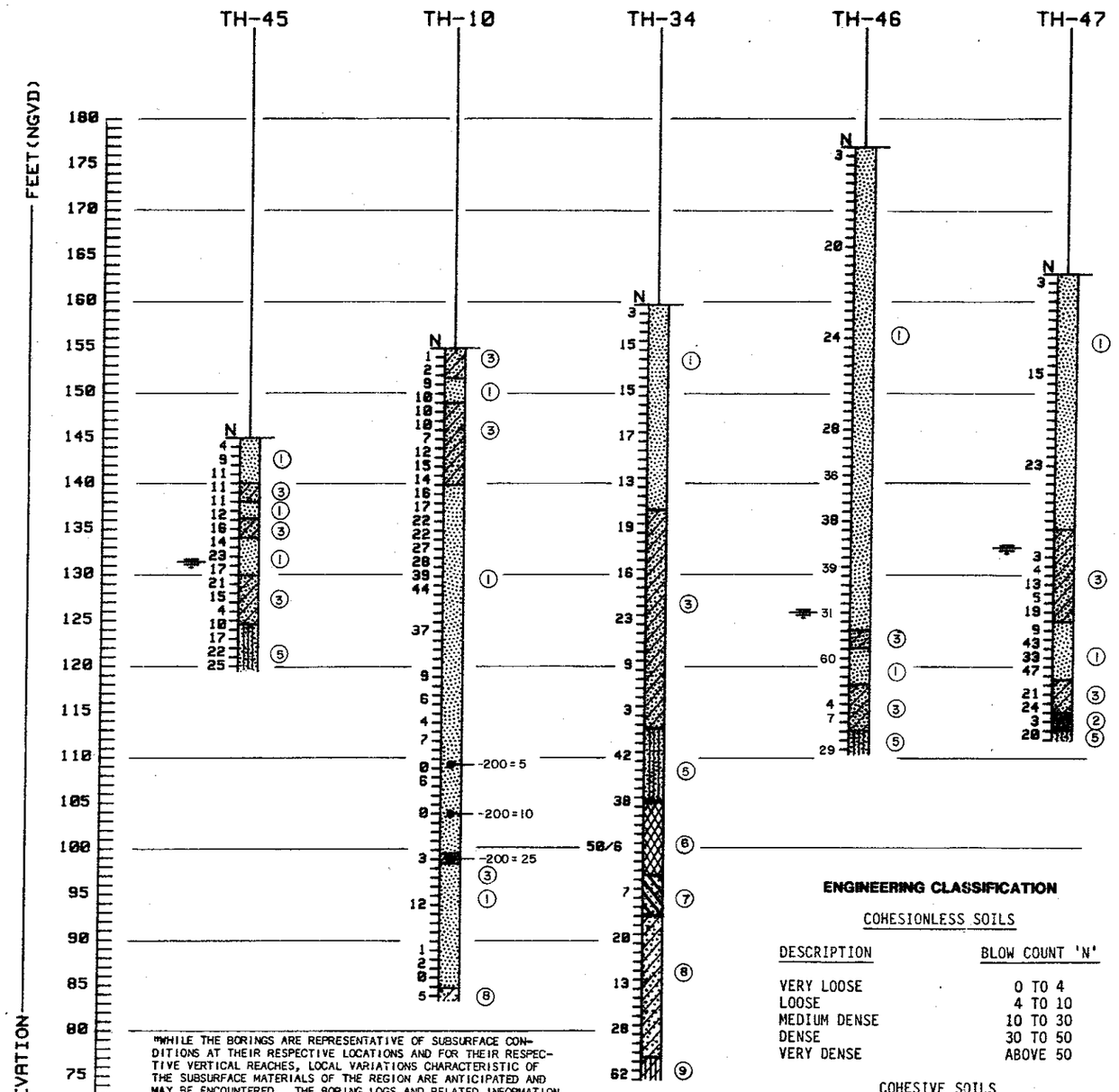
GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT, NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS."

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KCR | CHECKED BY: SNC | DATE: 1/14/83
FILE NO. 81-159 | APPROVED BY: H.G. Stanglund

FIGURE A-3-3



"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS."

ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

LEGEND

① SAND TAILINGS
② WASTE PHOSPHATIC CLAYS
③ SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
④ MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
⑤ LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
⑥ LIGHT TO DARK BROWN SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL SEAMS OF CEMENTED SANDS (HARDPAN)
⑦ LIGHT GRAY TO LIGHT BROWN CLAYEY SANDS TO SANDY CLAYS WITH TRACES OF CEMENTATION
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⑨ GRAY TO YELLOWISH BROWN CONSOLIDATED CALCAREOUS SILTS AND CLAYS WITH PHOSPHATES (HAWTHORN FORMATION)
⑩ DENSE, GRAY AND BROWN DOLOMITIC LIMESTONE
⑪ GREENISH GRAY SANDY CLAY
⑫ CREAM, SOFT, FOSSILIFEROUS LIMESTONE
⑬ SOFT, POROUS, LIGHT BROWN TO TAN LIMESTONE
⑭ LIGHT BROWN, SANDY CALCAREOUS CLAY
⑮ DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE

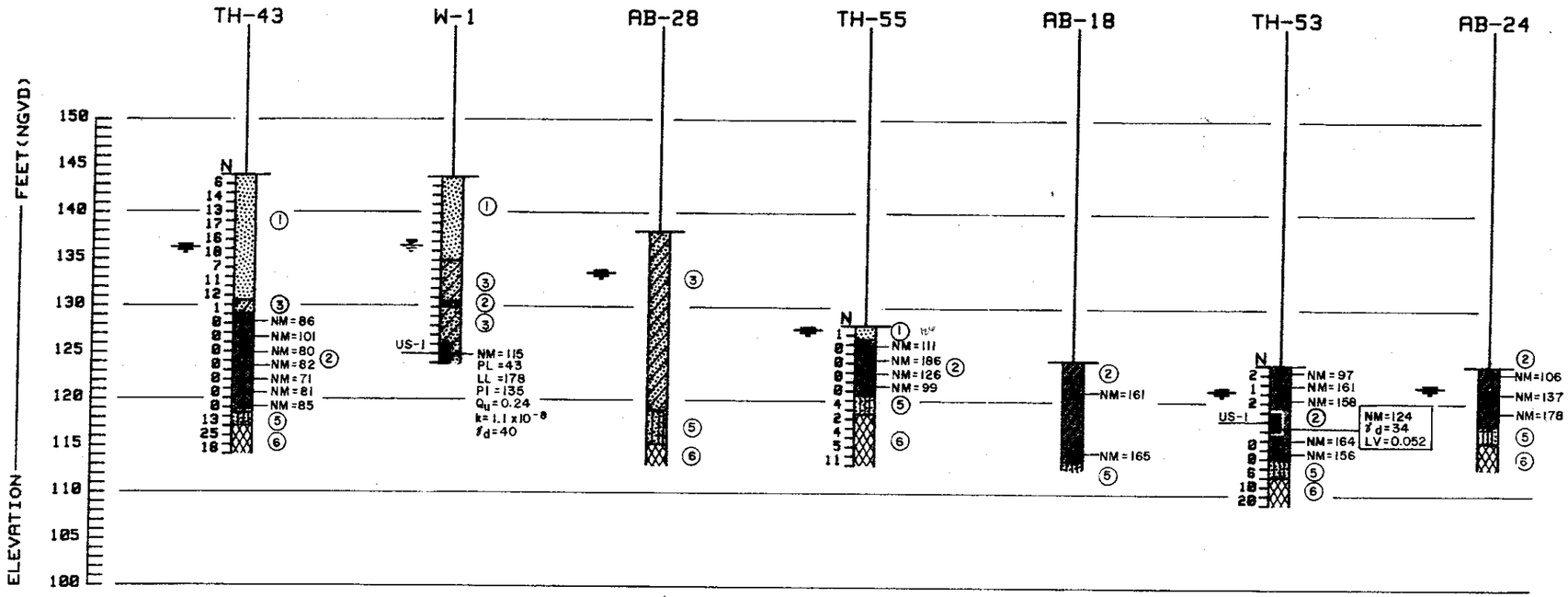
TH STANDARD PENETRATION TEST HOLE
AB AUGER BORING
P PROBING WITH PVC PIPE
W WASH BORING
GROUNDWATER LEVEL
N STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5 90 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL
US-1 UNDISTURBED SHELBY TUBE SAMPLE
LOSS OF DRILLING FLUID
NM NATURAL MOISTURE IN PERCENT
PL PLASTIC LIMIT IN PERCENT
LL LIQUID LIMIT IN PERCENT
Q_u UNCONFINED COMPRESSIVE STRENGTH FROM UNCONFINED COMPRESSION TEST, tsf
k COEFFICIENT OF PERMEABILITY, cm/sec
γ_d IN-SITU DRY DENSITY, lb/ft^3
q_u UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf
TV UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf
-200 PERCENT PASSING THE NO. 200 SIEVE
LV UNDRAINED SHEAR STRENGTH FROM LABORATORY VANE, tsf

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KR | CHECKED BY: HGS | DATE: 1/14/83
FILE NO. 81-159 | APPROVED BY: H.G. Stangland

FIGURE A 3-4



LEGEND

⑴	SAND TAILINGS
⑵	WASTE PHOSPHATIC CLAYS
⑶	SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
⑷	MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
⑸	LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
⑹	LIGHT TO DARK BROWN SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL SEAMS OF CEMENTED SANDS (HARDPAN)
⑺	LIGHT GRAY TO LIGHT BROWN CLAYEY SANDS TO SANDY CLAYS WITH TRACES OF CEMENTATION
⑻	GREENISH GRAY TO YELLOWISH BROWN CLAYEY FINE SANDS TO SANDY CLAYS WITH PHOSPHATES (BONE VALLEY FORMATION)
⑼	GRAY TO YELLOWISH BROWN CONSOLIDATED CALCAREOUS SILTS AND CLAYS WITH PHOSPHATES (HAWTHORN FORMATION)
⑩	DENSE, GRAY AND BROWN DOLOMITIC LIMESTONE
⑪	GREENISH GRAY SANDY CLAY
⑫	CREAM, SOFT, FOSSILIFEROUS LIMESTONE
⑬	SOFT, POROUS, LIGHT BROWN TO TAN LIMESTONE
⑭	LIGHT BROWN, SANDY CALCAREOUS CLAY
⑮	DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE

TH	STANDARD PENETRATION TEST HOLE
AB	AUGER BORING
P	PROBING WITH PVC PIPE
W	WASH BORING
⏚	GROUNDWATER LEVEL
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5	50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL
US-1	UNDISTURBED SHELBY TUBE SAMPLE
PI	PLASTICITY INDEX IN PERCENT
NM	NATURAL MOISTURE IN PERCENT
PL	PLASTIC LIMIT IN PERCENT
LL	LIQUID LIMIT IN PERCENT
Q_u	UNCONFINED COMPRESSIVE STRENGTH FROM UNCONFINED COMPRESSION TEST, tsf
k	COEFFICIENT OF PERMEABILITY, cm/sec
γ_d	IN-SITU DRY DENSITY, lb/ft^3
q_u	UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf
TV	UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf
-200	PERCENT PASSING THE NO. 200 SIEVE
LV	UNDRAINED SHEAR STRENGTH FROM LABORATORY VANE, tsf

ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

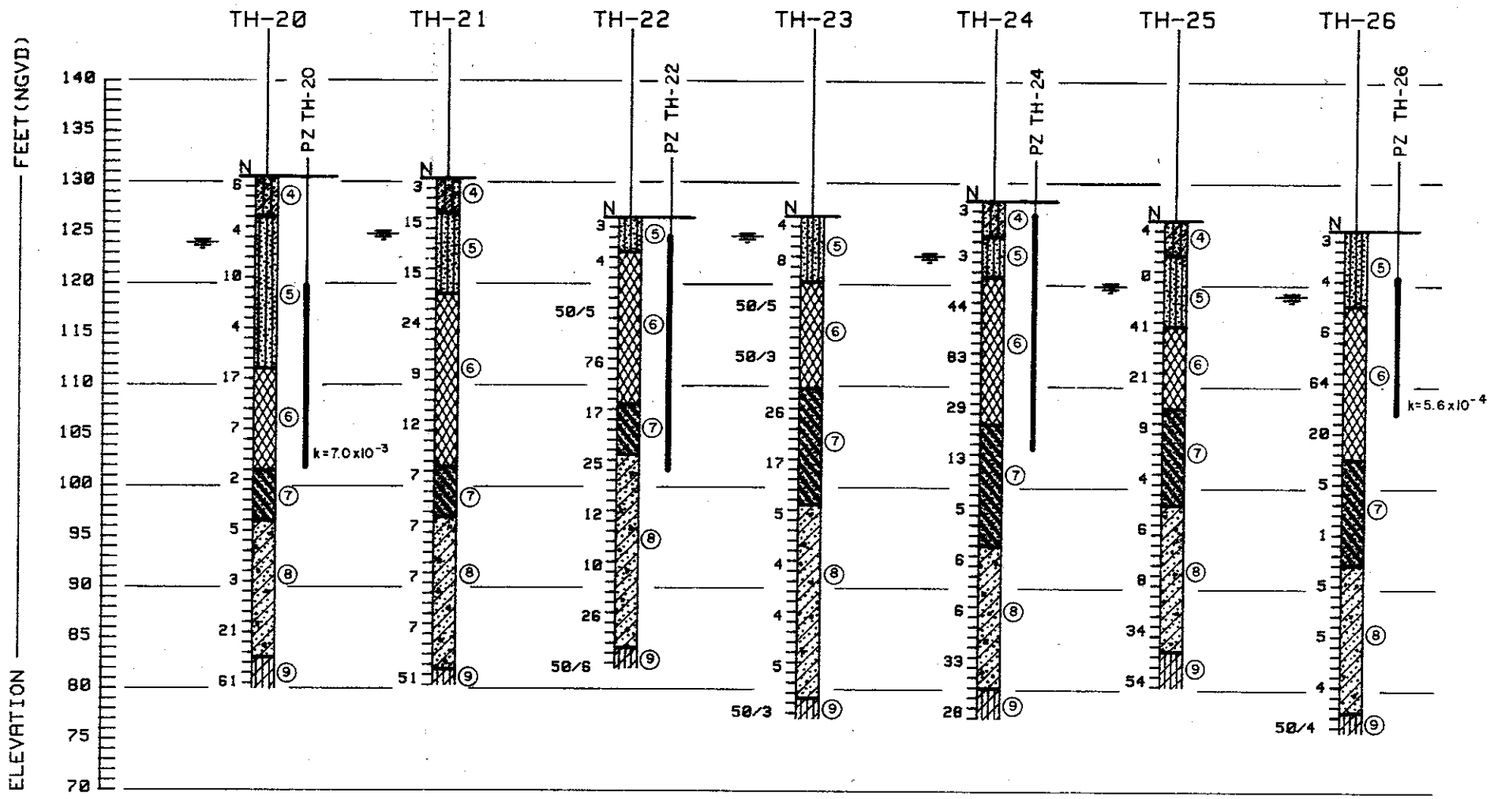
GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS."

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KR	CHECKED BY: JSC	DATE: 1/14/83
FILE NO. 81-159	APPROVED BY: HG Stanglund	

FIGURE A.3-5



LEGEND

1. SAND TAILINGS
2. WASTE PHOSPHATIC CLAYS
3. SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
4. MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
5. LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
6. LIGHT TO DARK BROWN SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL SEAMS OF CEMENTED SANDS (HARDPAN)
7. LIGHT GRAY TO LIGHT BROWN CLAYEY SANDS TO SANDY CLAYS WITH TRACES OF CEMENTATION
8. GREENISH GRAY TO YELLOWISH BROWN CLAYEY FINE SANDS TO SANDY CLAYS WITH PHOSPHATES (BONE VALLEY FORMATION)
9. GRAY TO YELLOWISH BROWN CONSOLIDATED CALCAREOUS SILTS AND CLAYS WITH PHOSPHATES (HAWTHORN FORMATION)

TH STANDARD PENETRATION TEST HOLE

GROUNDWATER LEVEL

N STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT

50/5 50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL

k COEFFICIENT OF PERMEABILITY IN cm/sec

ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

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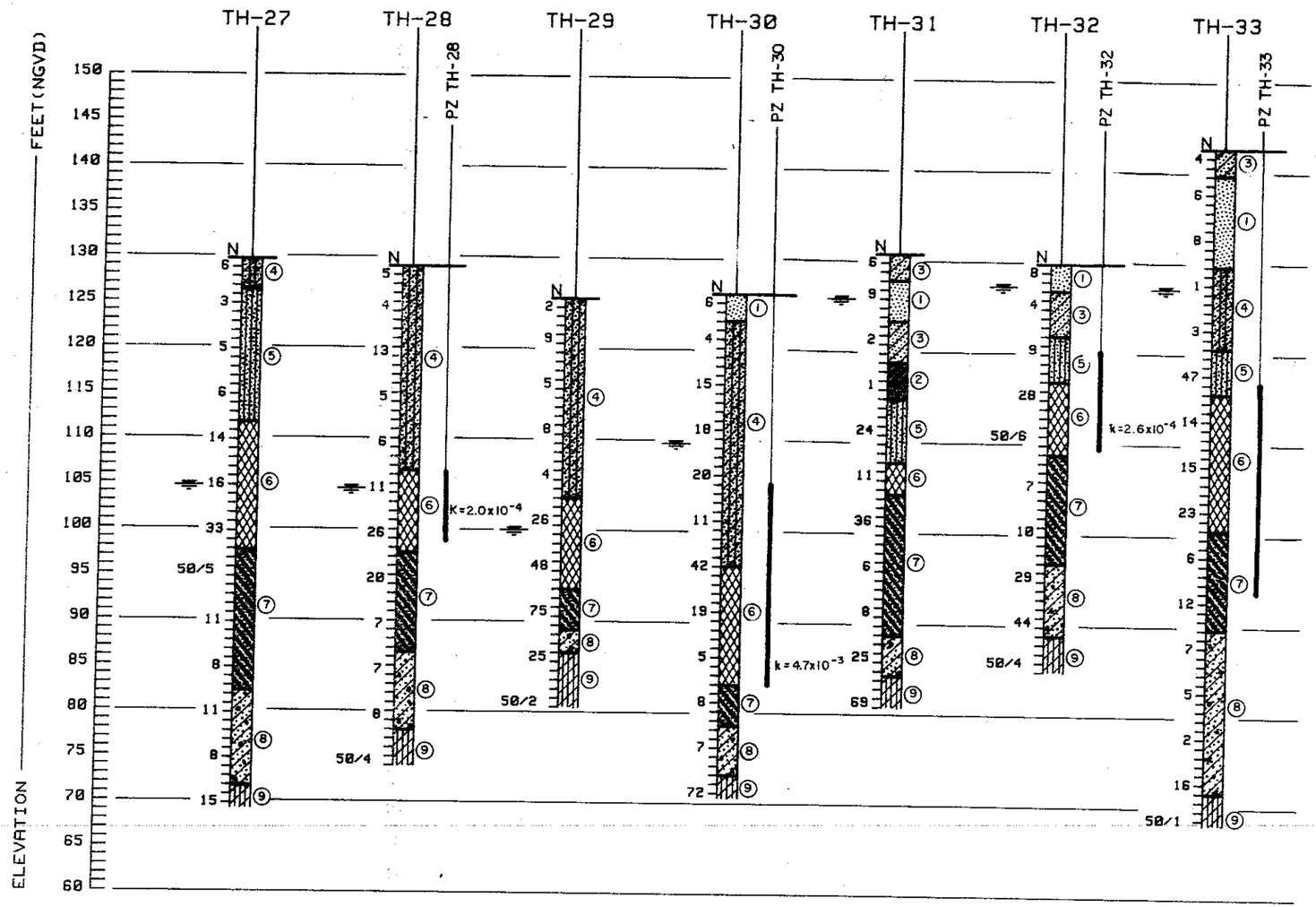
HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: R.J.F. | CHECKED BY: J.E.C. | DATE: 11/4/82
FILE NO. 81-159 | APPROVED BY: H.G. Stanglund

FIGURE A.3-6

KE E19 1153 12-81 M C3313a



LEGEND

1. SAND TAILINGS
2. WASTE PHOSPHATIC CLAYS
3. SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
4. MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
5. LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
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TH STANDARD PENETRATION TEST HOLE

GROUNDWATER LEVEL

N STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT

50/5 50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL

k COEFFICIENT OF PERMEABILITY IN cm/sec

ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

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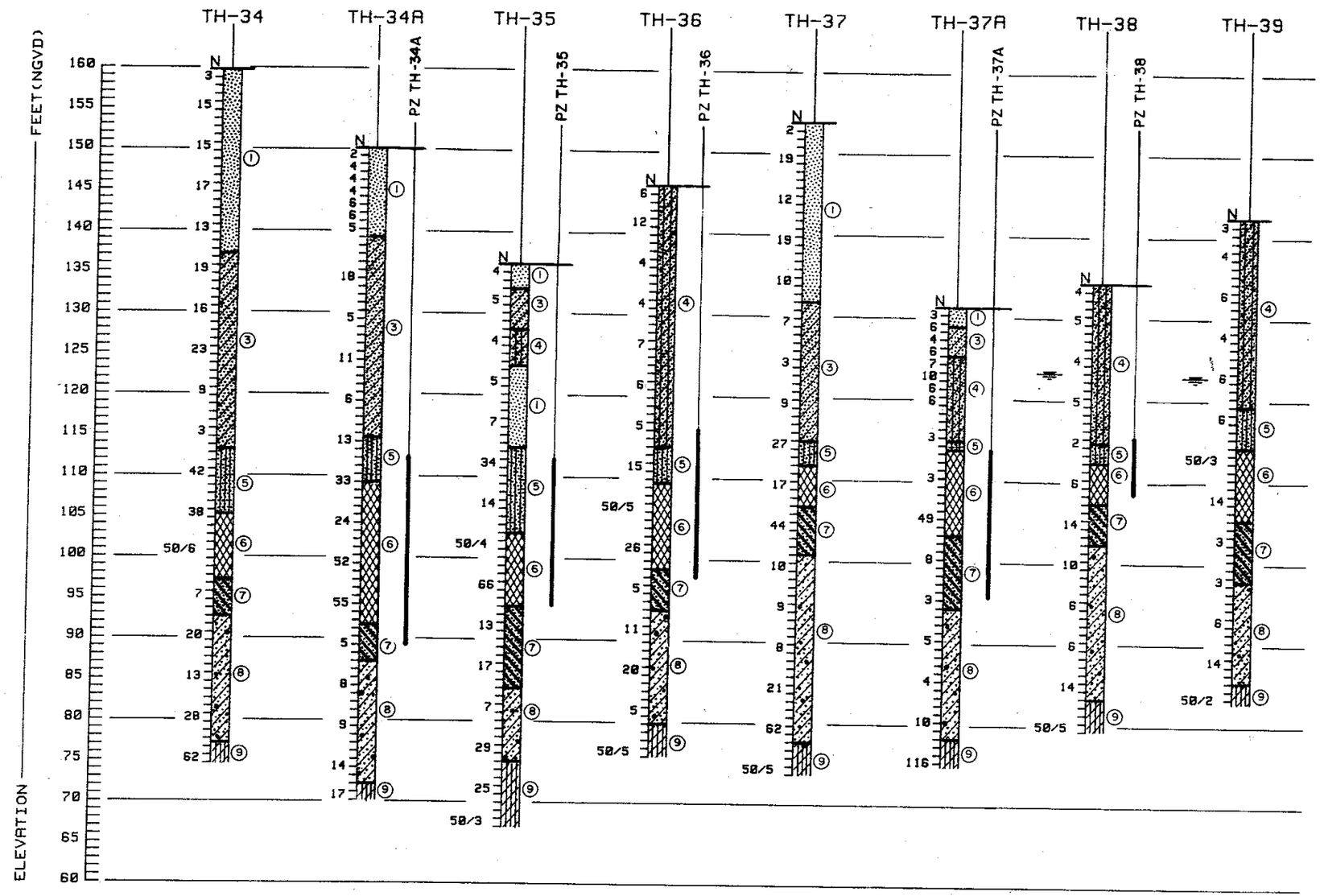
HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: R.J.F.	CHECKED BY: J.S.C.	DATE: 11/4/82
FILE NO. 81-159	APPROVED BY: H.E. Stangland	

FIGURE A.3-7



LEGEND

1. SAND TAILINGS
2. WASTE PHOSPHATIC CLAYS
3. SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
4. MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
5. LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
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7. LIGHT GRAY TO LIGHT BROWN CLAYEY SANDS TO SANDY CLAYS WITH TRACES OF CEMENTATION
8. GREENISH GRAY TO YELLOWISH BROWN CLAYEY FINE SANDS TO SANDY CLAYS WITH PHOSPHATES (BONE VALLEY FORMATION)
9. GRAY TO YELLOWISH BROWN CONSOLIDATED CALCAREOUS SILTS AND CLAYS WITH PHOSPHATES (HAWTHORN FORMATION)

TH — STANDARD PENETRATION TEST HOLE

GROUNDWATER LEVEL

N — STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT

50/5 — 50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL

k — COEFFICIENT OF PERMEABILITY IN cm/sec

ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: R. J. F. | CHECKED BY: J.S.C. | DATE: 11/12/82
FILE NO. 81-159 | APPROVED BY: A.G. Stangland

FIGURE A.3-8

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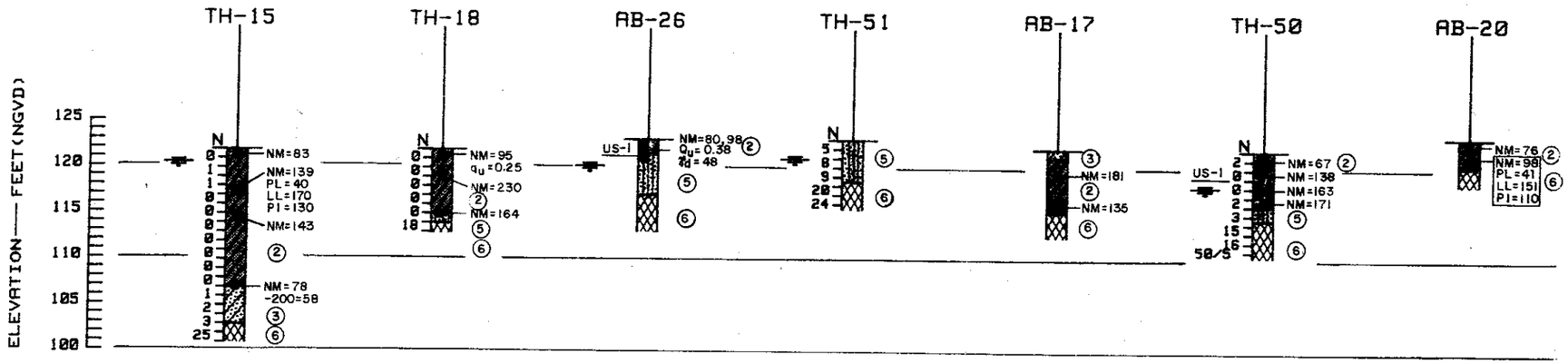

LEGEND

▒	①	SAND TAILINGS
■	②	WASTE PHOSPHATIC CLAYS
▨	③	SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
▩	④	MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
▥	⑤	LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
▩	⑥	LIGHT TO DARK BROWN SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL SEAMS OF CEMENTED SANDS (HARDPAN)
▨	⑦	LIGHT GRAY TO LIGHT BROWN CLAYEY SANDS TO SANDY CLAYS WITH TRACES OF CEMENTATION
▨	⑧	GREENISH GRAY TO YELLOWISH BROWN CLAYEY FINE SANDS TO SANDY CLAYS WITH PHOSPHATES (BONE VALLEY FORMATION)
▨	⑨	GRAY TO YELLOWISH BROWN CONSOLIDATED CALCAREOUS SILTS AND CLAYS WITH PHOSPHATES (HAWTHORN FORMATION)
▤	⑩	DENSE, GRAY AND BROWN DOLOMITIC LIMESTONE
▨	⑪	GREENISH GRAY SANDY CLAY
▤	⑫	CREAM, SOFT, FOSSILIFEROUS LIMESTONE
▤	⑬	SOFT, POROUS, LIGHT BROWN TO TAN LIMESTONE
▨	⑭	LIGHT BROWN, SANDY CALCAREOUS CLAY
▨	⑮	DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE

TH	STANDARD PENETRATION TEST HOLE
AB	AUGER BORING
P	PROBING WITH PVC PIPE
W	WASH BORING
⊻	GROUNDWATER LEVEL
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5	50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL
US-1 ▮	UNDISTURBED SHELBY TUBE SAMPLE
PI	PLASTICITY INDEX IN PERCENT
NM	NATURAL MOISTURE IN PERCENT
PL	PLASTIC LIMIT IN PERCENT
LL	LIQUID LIMIT IN PERCENT
Q_u	UNCONFINED COMPRESSIVE STRENGTH FROM UNCONFINED COMPRESSION TEST, tsf
k	COEFFICIENT OF PERMEABILITY, cm/sec
γ_d	IN-SITU DRY DENSITY, lb/ft^3
q_u	UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf
TV	UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf
-200	PERCENT PASSING THE NO. 200 SIEVE
LV	UNDRAINED SHEAR STRENGTH FROM LABORATORY VANE, tsf

ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

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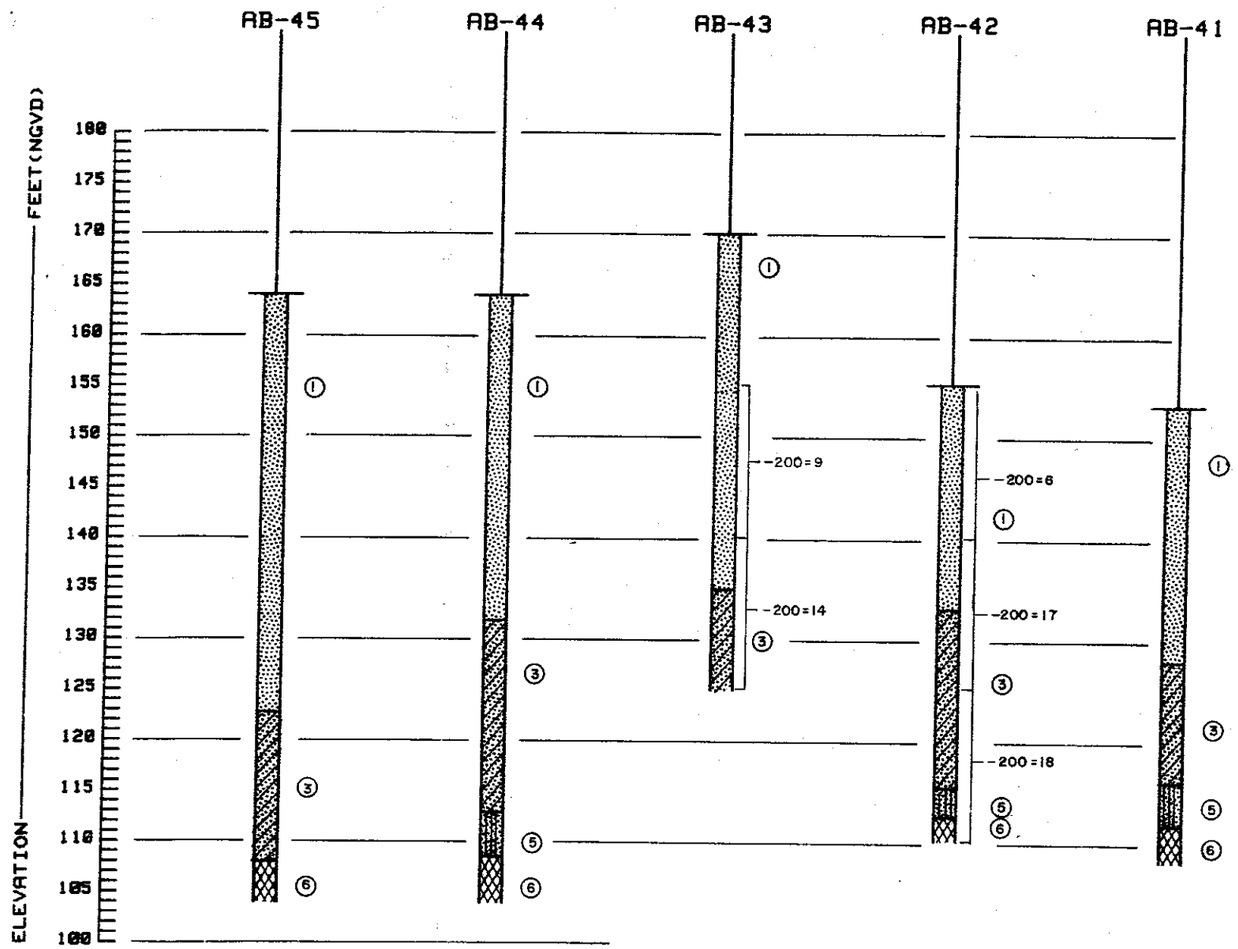
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KR | CHECKED BY: AEC | DATE: 1/14/83
FILE NO. 81-159 | APPROVED BY: A.E. Stanglund

FIGURE A-2.0

KODAK 19 1155 12-81 MCS819e



LEGEND

①	SAND TAILINGS
②	WASTE PHOSPHATIC CLAYS
③	SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
④	MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
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⑦	LIGHT GRAY TO LIGHT BROWN CLAYEY SANDS TO SANDY CLAYS WITH TRACES OF CEMENTATION
⑧	GREENISH GRAY TO YELLOWISH BROWN CLAYEY FINE SANDS TO SANDY CLAYS WITH PHOSPHATES (BONE VALLEY FORMATION)
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⑫	CREAM, SOFT, FOSSILIFEROUS LIMESTONE
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⑭	LIGHT BROWN, SANDY CALCAREOUS CLAY
⑮	DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE
TH	STANDARD PENETRATION TEST HOLE
AB	AUGER BORING
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W	WASH BORING
▽	GROUNDWATER LEVEL
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5	50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL
US-1	UNDISTURBED SHELBY TUBE SAMPLE
	LOSS OF DRILLING FLUID
NM	NATURAL MOISTURE IN PERCENT
PL	PLASTIC LIMIT IN PERCENT
LL	LIQUID LIMIT IN PERCENT
Q_u	UNCONFINED COMPRESSIVE STRENGTH FROM UNCONFINED COMPRESSION TEST, tsf
k	COEFFICIENT OF PERMEABILITY, cm/sec
γ_d	IN-SITU DRY DENSITY, lb/ft^3
q_u	UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf
TV	UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf
-200	PERCENT PASSING THE NO. 200 SIEVE
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"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

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ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

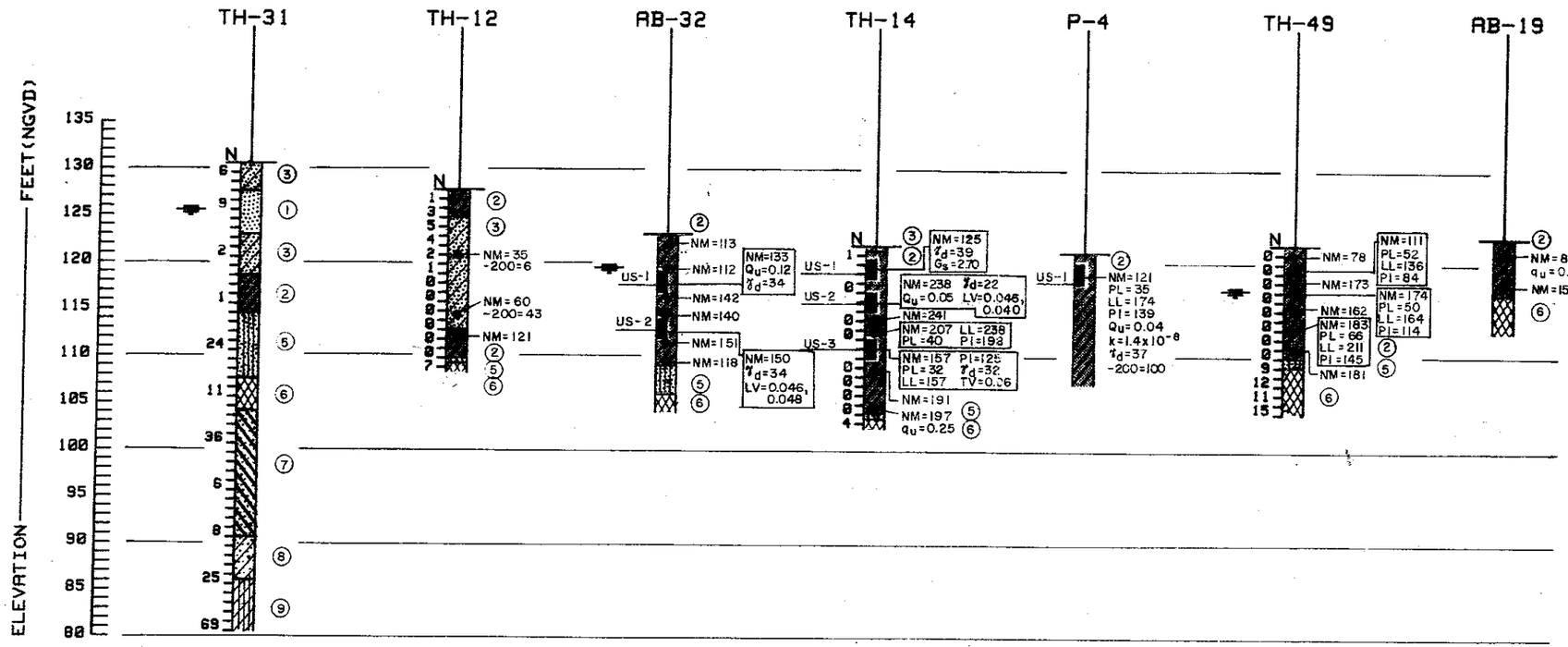
DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KR | CHECKED BY: DSC | DATE: 1/14/83
FILE NO. 81-159 | APPROVED BY: H.G. Stangland

FIGURE A-3.10



LEGEND

▨	①	SAND TAILINGS
▩	②	WASTE PHOSPHATIC CLAYS
▨	③	SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
▨	④	MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
▨	⑤	LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
▨	⑥	LIGHT TO DARK BROWN SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL SEAMS OF CEMENTED SANDS (HARDPAN)
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▨	⑨	GRAY TO YELLOWISH BROWN CONSOLIDATED CALCAREOUS SILTS AND CLAYS WITH PHOSPHATES (HAWTHORN FORMATION)
▨	⑩	DENSE, GRAY AND BROWN DOLOMITIC LIMESTONE
▨	⑪	GREENISH GRAY SANDY CLAY
▨	⑫	CREAM, SOFT, FOSSILIFEROUS LIMESTONE
▨	⑬	SOFT, POROUS, LIGHT BROWN TO TAN LIMESTONE
▨	⑭	LIGHT BROWN, SANDY CALCAREOUS CLAY
▨	⑮	DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE

TH	STANDARD PENETRATION TEST HOLE
AB	AUGER BORING
P	PROBING WITH PVC PIPE
W	WASH BORING
⏚	GROUNDWATER LEVEL
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5	50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL
US-1	UNDISTURBED SHELBY TUBE SAMPLE
PI	PLASTICITY INDEX IN PERCENT
NM	NATURAL MOISTURE IN PERCENT
PL	PLASTIC LIMIT IN PERCENT
LL	LIQUID LIMIT IN PERCENT
Q_u	UNCONFINED COMPRESSIVE STRENGTH FROM UNCONFINED COMPRESSION TEST, tsf
k	COEFFICIENT OF PERMEABILITY, cm/sec
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q_u	UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf
TV	UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf
-200	PERCENT PASSING THE NO. 200 SIEVE
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ENGINEERING CLASSIFICATION

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LOOSE	4 TO 10
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DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

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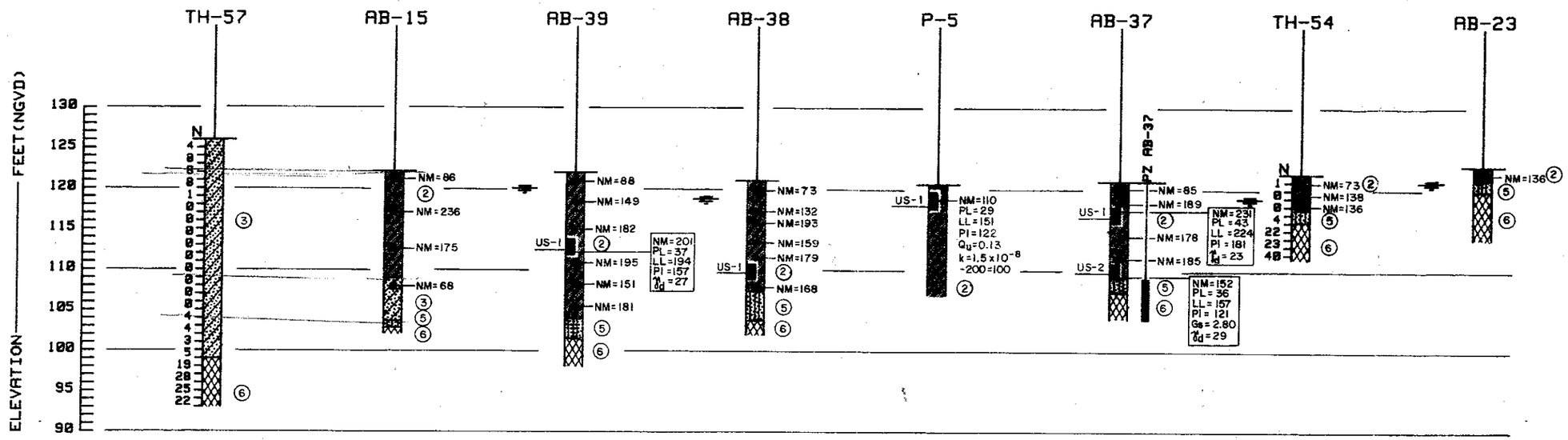
HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KR | CHECKED BY: H.C. | DATE: 1/14/83
FILE NO. 81-159 | APPROVED BY: H.G. Stanglund

FIGURE A.3-11

K&E 19 ITSS 12-81 MC3313a



LEGEND

①	SAND TAILINGS
②	WASTE PHOSPHATIC CLAYS
③	SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
④	MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
⑤	LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
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⑦	LIGHT GRAY TO LIGHT BROWN CLAYEY SANDS TO SANDY CLAYS WITH TRACES OF CEMENTATION
⑧	GREENISH GRAY TO YELLOWISH BROWN CLAYEY FINE SANDS TO SANDY CLAYS WITH PHOSPHATES (BONE VALLEY FORMATION)
⑨	GRAY TO YELLOWISH BROWN CONSOLIDATED CALCAREOUS SILTS AND CLAYS WITH PHOSPHATES (HAWTHORN FORMATION)
⑩	DENSE, GRAY AND BROWN DOLOMITIC LIMESTONE
⑪	GREENISH GRAY SANDY CLAY
⑫	CREAM, SOFT, FOSSILIFEROUS LIMESTONE
⑬	SOFT, POROUS, LIGHT BROWN TO TAN LIMESTONE
⑭	LIGHT BROWN, SANDY CALCAREOUS CLAY
⑮	DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE

TH	STANDARD PENETRATION TEST HOLE
AB	AUGER BORING
P	PROBING WITH PVC PIPE
W	WASH BORING
⊻	GROUNDWATER LEVEL
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5	50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL
US-1	UNDISTURBED SHELBY TUBE SAMPLE
PI	PLASTICITY INDEX IN PERCENT
NM	NATURAL MOISTURE IN PERCENT
PL	PLASTIC LIMIT IN PERCENT
LL	LIQUID LIMIT IN PERCENT
q_u	UNCONFINED COMPRESSIVE STRENGTH FROM UNCONFINED COMPRESSION TEST, tsf
Gs	SPECIFIC GRAVITY
γ_d	IN-SITU DRY DENSITY, lb/ft^3
q_u	UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf
TV	UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf
-200	PERCENT PASSING THE NO. 200 SIEVE
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ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KR	CHECKED BY: SSC	DATE: 1/14/83
FILE NO. 81-159	APPROVED BY: H.E. Stanglund	

FIGURE A.3-12

LEGEND

①	SAND TAILINGS
②	WASTE PHOSPHATIC CLAYS
③	SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS
④	MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)
⑤	LIGHT TO DARK GRAY SLIGHTLY SILTY TO SILTY FINE SANDS WITH OCCASIONAL TRACES OF ROOTS AND OTHER ORGANIC MATTER
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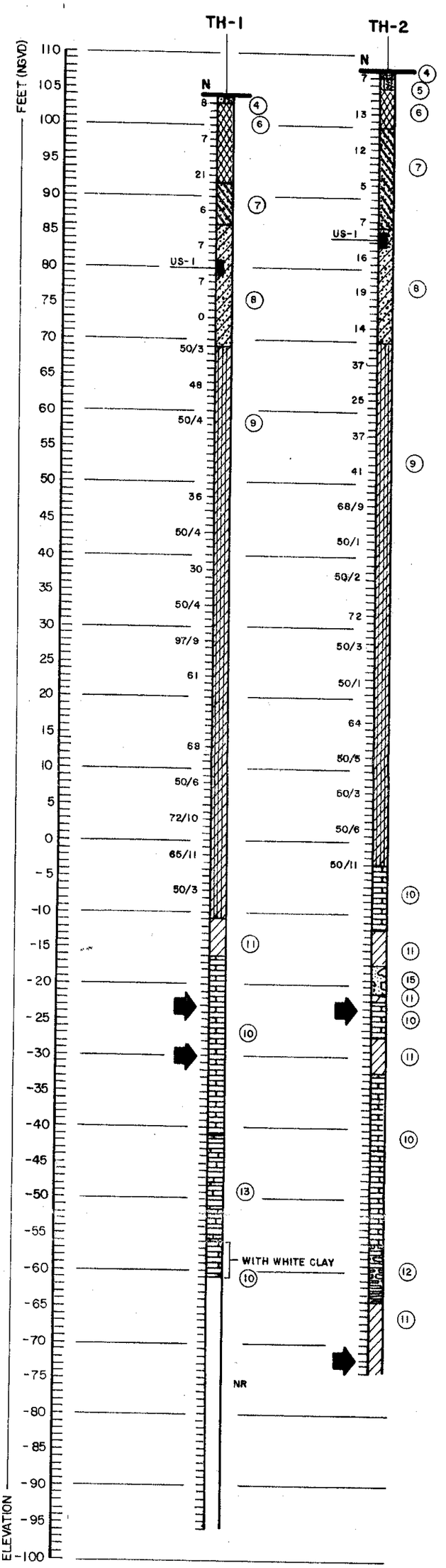
⑫	CREAM, SOFT, FOSSILIFEROUS LIMESTONE
⑬	SOFT, POROUS, LIGHT BROWN TO TAN LIMESTONE
⑭	LIGHT BROWN, SANDY CALCAREOUS CLAY
⑮	DENSE, WHITE TO LIGHT GRAY PHOSPHATIC, FOSSILIFEROUS LIMESTONE AND DOLOMITE
TH	STANDARD PENETRATION TEST HOLE
NR	NO RECOVERY
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5	50 BLOWS FOR 5 INCHEES PENETRATION INTO THE SOIL
US-1	UNDISTURBED SHELBY TUBE SAMPLE
	LOSS OF DRILLING FLUID



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ENGINEERING CLASSIFICATION

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DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA | CHECKED BY: RSC | DATE: 1/19/83
FILE NO. 81-159 | APPROVED BY: H.B. Stanford

KE E 10 X 10 TO 12-81 MADE IN U.S.A.

LEGEND

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② WASTE PHOSPHATIC CLAYS

③ SAND TAILINGS MIXED WITH WASTE PHOSPHATIC CLAYS

④ MIXED GRAY AND BROWN SILTY TO CLAYEY FINE SANDS WITH TRACES OF SANDY CLAYS, PHOSPHATES, AND CEMENTED SANDS (FILL)

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P PROBING WITH PVC PIPE

W WASH BORING

GROUNDWATER LEVEL

N STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT

50/5 50 BLOWS FOR 5 INCHES PENETRATION INTO THE SOIL

US-1 UNDISTURBED SHELBY TUBE SAMPLE

LOSS OF DRILLING FLUID

NM NATURAL MOISTURE IN PERCENT

PL PLASTIC LIMIT IN PERCENT

LL LIQUID LIMIT IN PERCENT

Q_u UNCONFINED COMPRESSIVE STRENGTH FROM UNCONFINED COMPRESSION TEST, tsf

k COEFFICIENT OF PERMEABILITY, cm/sec

γ_d IN-SITU DRY DENSITY, lb/ft^3

q_u UNCONFINED COMPRESSIVE STRENGTH WITH POCKET PENETROMETER, tsf

TV UNDRAINED SHEAR STRENGTH FROM TORVANE, tsf

-200 PERCENT PASSING THE NO. 200 SIEVE

LV UNDRAINED SHEAR STRENGTH FROM LABORATORY VANE, tsf

NR NO RECOVERY

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS."

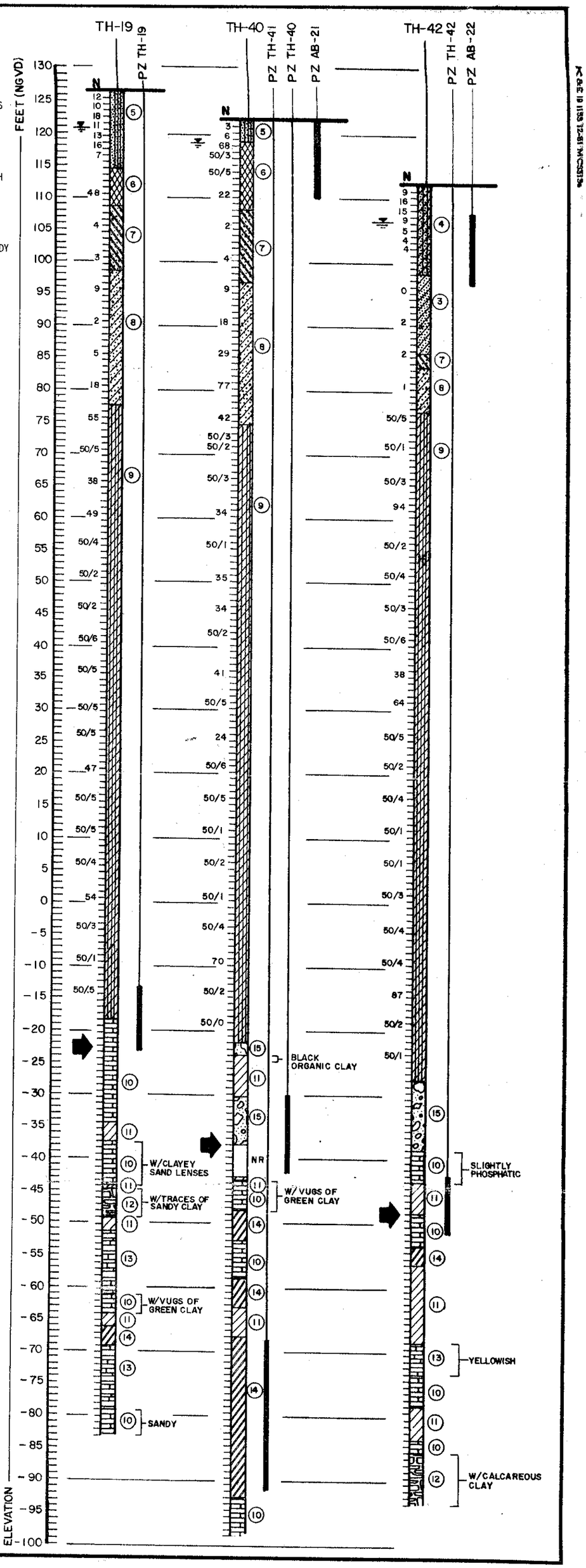
ENGINEERING CLASSIFICATION

COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT 'N'
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30



Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA | CHECKED BY: HCS | APPROVED BY: HCS | DATE: 1/14/83 | FILE NO. 81-159

FIGURE A-3.14

Appendix A.4

WELL INVENTORY DATA FROM SWFWMD

REPORT-42090

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

PAGE- 1585

WELL CONSTRUCTION LIST

DATE 06/03/82

OPUSE	PERMIT	DRILL	USE	ACTY	LOCTN SETNRG	DIA	CASE	HOLE	QUALN	VLIM	DRILLED	ELEV	SWL DATE	SP GAC	SEDSZ	SEDCLR	DPL1CL	CL1CL	THK1CL	1CAB	CL1CLR	DPCLRK	CLCLRK	UNFEA	OWNER
WPC	371062	1995	O	11 29	023122	2	35	35	1		R														IMC CORP
WPC	371232	1995	O	11 29	023122	4	72	150	1		R														IMC CORP
WPC	371231	1995	O	11 29	023122	4	80	150	1		R														IMC CORP
WPN	346077	1233	A	11 29	03312212		222	750	1		C		76												HALL, J. R.
WPC	356898	1995	Y	11 29	SWNW03312210		80	140			R														INTERNATION
WPC	366280	1104	O	11 29	033122	4																			CONRAD, LAR
WPC	366654	1104	A	11 29	033122	8																			ALLEN, FRED
WPN	344459	1995	G	11 53	043122	8																			IMC
WPC	317342	0023	O	11 29	043122	3	21	35			C		10												L PORTOR
WPC	318729	0023	A	11 29	043122	4	32	242			C		24							33	999				W L EVERS
WPN	344458	1995	G	11 53	053122	8														31	31				IMC
WPN	344462	1995	G	11 53	053122	8																			IMC
WPN	344463	1995	G	11 53	053122	8																			IMC
WPN	344460	1995	G	11 53	053122	8																			IMC
WPN	344457	1995	G	11 53	053122	8																			IMC
WPN	344456	1995	G	11 53	053122	8																			IMC
WPN	344461	1995	G	11 53	053122	8																			IMC
WPC	345037	1995	Y	11 53	053122	8	91	350	1		R														INTERNATION
WPC	358901	1995	Y	11 53	053122	8	100	350	1		R														INTERNATION
WPC	358900	1995	Y	11 53	053122	8	100	350	1		R														INTERNATION
WPC	344605	1995	Y	20 53	063122	10	95	350	1		R														INTERNATION
WPN	356154	1995	G	20 53	063122	8	*** CANCELLED ***																		INTERNATION
WPC	358899	1995	Y	11 53	SENW063122	8	130	300	1		R														INTERNATION
WPC	327746	1226	A	11 29	063122	4	42	100	1	D	C		11		MS		2 NR	18	27 WH	8	35		35		C F INDUSTR
WPC	328845	1135	A	11 29	063122	6	70	401	1	D	C		20		MS		21 MY	21			42 WH		42 WH		GLOVER FORM
WPC	305487	0062	L	11 29	NENE063122	3	50	85			C		15								48		48		M THOMPSON
WPC	344420	1558	O	11 29	073122	4																			COOPER, R
WPC	344407	1558	D	11 29	073122	4																			ZAGROCKI, R
WPC	345286	1899	D	11 29	073122	4	31	90	1		C		15												JENKINS, WI
WPC	348570	1094	A	11 29	SWNW073122	4	120	163	1		R														ALDERMANN,
WPC	360905	0000	D	11 29	073122	2																			LUDDEN, CYR
WPC	362063	1343	D	11 29	073122	2	16	90	1		C		1												LUDDEN, CYR
WPC	371992	1299	A	11 29	07312212																				ALDERMAN FA
WPC	374059	1204	D	11 29	073122	4																			BOOTH, DIAN
WPC	341251	1299	D	11 29	073122	4	57	76	1		C		7	A		45	15	9	29 MY	11	57		57		ALDERMAN, S
WPC	344089	1899	D	11 29	073122	4																			PHILLIPS, D
WPC	313945	0013	D	11 29	NWNE073122	4	32	50		5	C		4								32		32		S SHIRLEY
		1570	D	11 29	083122	4																			HILL, HERB
		1104	D	11 29	083122	4	122	214	1		C		50												HILL SR, HE

Use Codes: G = recharge, D = domestic, A = Irrigation, Y = abandoned or plugged, L = Livestock, T = Test, K = Connector, B = Public Supply, O = Observation, I = Industrial

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SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

PAGE- 1453

06/05/82

WELL CONSTRUCTION LIST

DATE 09/22/81

USE	PERMIT	DRILL	BASIN	CNTY	SEC TNRG	DIA	CASE	WELL	QUAL	LIME	DEPTH	SWL	SPEC	SEED	DEPTH	CASE	TEST	DEPTH	CASE	TEST	CAP	DRAW	CASE	USE	OWNER
WPE	310710	0027	A	11 29	323120	8	175	800		C	80							175							JOE SUMNER
WPE	311938	L036	D	11 29NENW	323120	3	62	180		C	52							60		60					VIRGIL SMIT
WPE	309782	0031	A	11 29SENW	323120	6	117	767		C	47							73							
WPE	305559	1392	A	11 29	333120	6																			
WPE	308290	0016	D	11 29	343120	3	96	181		C															PASS, NORPI
WPE	332362	1336	D	11 29	363120	4	95	270	1	D C								97		97					W FULBRIGHT
WPE	316723	0031	D	11 29SENW	363120	4	199	270		C	95	MS	MB			15	15 MA	33	95	WH	95	WH			R TAYLOR
WPE	319165	0294	D	11 29NWSW	363120	4	74	200			20								50		190				G DAVIS
WPE	319557	0062	A	11 29NWNW	363120	12	110	765		S C	90								70		70				I DAVIS
WPE	320396	0054	D	11 29	363120	4	83	350		C	45								61		86				B SWEAT
WPE	322956	0031	D	11 29SWNW	363120	4	114	198		C	70								30		70				S G CLAVILL
WPE	315251	0052	D	11 29	363120	4	130	115		C	105								110		114				M L DAVIS
WPE	308119	0065	D	11 29SWNE	363120	4	71	248		C	35								76		170				B J SWEAT
WPE	309651	0016	D	11 29NWSE	363120	3	54	90		C	24								236						R TAYLOR
WPE	356006	1204	D	11 29	023121	4	*** CANCELLED ***												42		42				D A BROWN
WPC	361233	1056	D	11 29NENE	043121	4	63	360	1	C	50														
WPC	361563	1056	D	13 29NENE	043121	4	95	320	1	C	60														CLOUSE, FRE
WPE	369152	1057	T	11 29	043121	12	267	883	1	D C	63														CLOUSE, FRE
WPE	329147	1057	T	11 29	043121	6	42	42		D C	8	MS		10	MB	45	55 MG	74	129	WH	180	WH	ADPX		AGRICO CHEM
WPE	329152	1057	D	11 29	043121	24	265	874		D C	65	MS		12		21	33 TA	9					ACM		AGRICO CHEM
WPE	329151	1057	D	11 29	043121	12	276	878		D C	72	MS		10	MG	137	76 MG	69	147	MA	147	MA	ACZ		AGRICO CHEM
WPE	329153	1057	D	11 29	043121	12	255	878		D C	73	MS		10	ME	10	20 MY	20	100	WH	130	WH	ACU		AGRICO CHEM
WPE	329149	1057	T	11 29	043121	12	60	174		D C	40	MS		20	MP	20	48 ME	102	150	WH	150	WH	ADP		AGRICO CHEM
WPE	329148	1057	D	11 29	043121	12	200	255		D C	55	MS		19	WH	5	23 MY	19	42	WH	42	WH			AGRICO CHEM
WPE	321504	1336	D	11 29	043121	4	32	52	1	D C	9	MS		18	MA	36	57 ME	52	57	WH	115	WH	ADN		AGRICO CHEM
WPE	316872	0196	D	11 29NWSW	043121	4	60	200		S C	35				MY	30			38	MY	30	MA			V R SIMMS
WPC	364229	1099	D	11 29	053121	4	31	85	1	C									75		90				PIPS
WPC	364849	2193	D	11 29	053121	4	101	137	1	C															OLIVER, MA
WPC	366152	1809	D	11 29	053121	4																			ELLIOT, BUD
WPC	347027	1043	D	11 29	053121	4	94	210		C															NAVA, JAY
WPC	347215	1072	A	11 29	053121	8	335	875	1	C	89														DINES, BOB
WPC	337926	1160	D	11 29	053121	4	63	155	1	C	33	CY				21	21 ME	21	42		63				CAIN GROVES
WPC	333016	1358	D	11 29	053121	4	126	245		D C	58	MS	MA	25	MA	25	75 WH	40	45	MA	115	WH	AEP		BOYETTE BLD
WPE	310084	0013	L	11 29SESE	053121	4	36	51		C	5								35		35				B W GUNN
WPC	360380	1456	D	11 29NENE	063121	4																			REY G PYYAN
WPC	368266	3945	Z	11 33NESW	063121	8	147	360	1	B	120														MILLS, CHAR
WPE	335311	1699	D	11 29	063121	4	55	110	1	C															IMC CORP
WPE	335369	1699	D	11 29	063121	4	55	110	1	C		MS	WH	55	MA	25			80		80				CARSFREE FA
WPE	331187	1057	A	11 29	063121	6	160	398	1	D C	79	MS	WH	55	MA	25			80		80				PARR,M
												MS		32	ME	48	176 MG	19	112	WH	125	WH	AEV		W T V T TV

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SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

WELL CONSTRUCTION LIST

PAGE- 1458

DATE 09/02/81

USE	PERMIT	DRILL	BASIN	CNTY	LOC SEC TWP RNG	DIA	CASE	WELL	OPEN LIT	VOL CLE	DEPTH SWL	SPC	SEC	DPL1	CL1	DPL2	CL2	DPL3	CL3	DPL4	CL4	UNK	OWNER
WPE	333387	1169	D	11	29 063121	4	42	118	1	C	25												MARTENEZ P
WPE	328365	PC36	D	11	29SENW063121	3	65	135		C	53		MS	30	ME	2	32	MB	13	32	MB	32	MB	J CRACR
WPC	333552	1104	D	11	29 073121	4	50	60	1	C										60		60		ROUIS, DALE
WPC	347329	1336	D	11	29 073121	4	109	275	1	C	52													SIMMONS, H
WPC	341406	1336	D	11	29NWNE073121	4	*** CANCELLED ***																	
WPE	335602	C046	D	11	29NENW073121	3	24	100		C	50 14													
WPE	309716	0027	L	11	29 093121	8	93	670		C	30									16		30		O SUMMERALL
WPE	341842	1024	A	11	29 103121	10														90				
WPL	354791	1094	D	11	29 123121	2	210	276	1	R	66													LEHMAN,P H
WPC	346859	1094	D	11	29 123121	2	*** CANCELLED ***																	WRIGHT, KEN
WPC	346794	1271	D	11	29 123121	4	52	108	1	C	22													
WPC	347694	1183	D	11	29 123121	4	34	153	1	C	8													GREEN JR,
WPE	343143	1271	D	11	29 123121	4	21	160	1	C			MS	8		7								MOONEY, FRE
WPE	343491	1271	D	11	29 123121	4	31	130	1	C			MS	8	MR	12				15		21		DODSON, J
WPL	331662	1011	I	11	29 123121	10	115	315	D	R			MS	MB	20	WH	17			20		30		GREENE,E
WPC	350218	1298	D	11	29 133121	2	21	80	1	J	8									37	WH	37	WH	BREWSTER PH
WPC	350219	1298	D	11	29 133121	2	27	70	1	J	8													PARKS, JOHN
WPC	346152	D358	D	11	29 NW153121	3	52	110		C	30													PARKS, WOOD
WPH	317780	C069	I	11	29NWNW103121	3	71	103		C	31									50		50		AGRICO CHEM
WPE	318199	0215	A	11	29 183121	3	21	35		C	10									96		71		M SIMMONS
WPC	363263	1043	D	11	29 193121	4	126	215	1	T	122									999		999		R HAMILTON
WPE	336984	1233	D	11	29 193121	4	84	195	1	C	100		MS	MB	38	MB	19			57	MA	130	MA	AILER, RAUL
WPL	337833	1056	D	11	29 193121	4	53	220	1	C	50		MS	MB	14	MA	36			50	WH	50	WH	MACK,R
WPL	339259	1598	D	11	29 193121	4	150	370	1	C	120	L	MS		85	ME	10	95	70	140		220		ALLSTATE MO
WPC	339756	1699	D	11	29 193121	4	65	320	1	C			MS	WH	55	MA	10			65		65		HUNTER,G
WPE	339123	1233	D	11	29 193121	4	73	204	1	D C	76		MS		36	MA	30			66	WH	66	WH	RIVERA
WPE	331868	1056	D	11	29 193121	4	93	220	1	D C	90		MS							200		200	AH2	MCCULLOUGH
WPE	313171	D086	D	11	29 193121	4		365		R														E WICKLINE
WPE	318709	1086	D	11	29SW 193121	4	329	350		R														K K JOHNS
WPE	325484	1336	D	11	29 203121	4	109	228		C										91				W JOHNS
WPE	306544	D013	L	11	29 203121	6	9	19		C	4											59		G SUMNER
WPC	320134	1057	D	11	29 213121	6	325	383		D C	108													
WPL	332705	1043	D	11	29 213121	4	136	221	1	D C	110		MS	DB	45	DA	58	135	MG	33	168	WH	168	WH	B GARCIA
WPC	347640	1043	D	11	29 243121	4	180	247	1	C	111		MS	LB	30	LA	15	45	MG	20	65		134	WH	E MCDONALD
WPC	334314	1185	D	11	29 243121	4	94	155	1	C	105													LINNE, TOM
WPC	339755	1699	D	11	29 243121	4	60	320	1	C			MS		20		20			40		80		BARNES P H
WPE	331003	1233	A	11	29 243121	8	200	350	1	D C	85		MS	WH	55	MA	5			60		60		SWINT,E E
WPL	326412	1043	D	11	29 103121	4	77	161		L C	54	F	NS		28	PE	38			46		189	WH 3HBX	F WILSON
WPL	340504	1094	D	11	29 253121	3	135	343	1	D	66		MS	WH	16	GA	9	67	WH	8	55	LB	55	LB ADL	J MARTINES
WPE	372625	1233	D	11	29 093121	4							MS		8		9	17	LA	6	77		135		DEBORD,B
																								Bettis, GRA

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SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

WELL CONSTRUCTION LIST

PAGE- 1457

DATE 09/02/81

SP USE	PERMIT	SOIL	SEC	TWN	RNG	LOCATION	DIA	CASE	WELL	QUAL	VCL	DRILL	ELEV	SNL SD	SP CAP	SFD SZ	SED CL	DPL1 CLA	CL1 CLA	THK1 CLA	DPL2 CLA	CL2 CLA	TH2 CLA	1 CAP BR	CL 1 BR	DP CK	CL CK	UN FA	OWNER
WPC	360[illegible]	1[illegible]30	D	11	29	073122	2																						
WPC	362063	1343	D	11	29	073122	2	16	90	1	C		1																
WPC	348572	1394	A	11	29	073122	4	120	163	1	C																		LUDDEN, CYR
WPC	341251	1299	D	11	29	073122	4	57	76	1	C		7	A		MS		15		9	24	MY	11	57		57			LUDDEN, CYR
WPC	344[illegible]	1[illegible]9	D	11	29	073122	4																						ALDERMANN,
WPC	344402	1558	D	11	29	073122	4																						ALDERMAN, S
WPC	344407	1558	D	11	29	073122	4																						PHILLIPS, D
WPC	345[illegible]	1[illegible]9	D	11	29	073122	4	31	90	1	C		15																COOPER, M
WPC	213946	0213	D	11	29	NWNE 073122	4	32	50		C		9																ZAGROCKI, R
WPC	301955	1570	D	11	29	083122	4			S	C																		JENKINS, WI
WPC	351160	1134	D	11	29	083122	4																	32		32			S SHIRLEY
WPC	323160	1155	D	11	29	083122	4	122	214	1	C		50																HILL, HE
WPC	362956	1056	D	11	29	083122	4	63	185	1	D C		65																HILL SR, HE
WPC	304383	0023	D	11	29	083122	4	95	210	1	D C					MS		20		25				45	WH	45	WH		W E IOSS
WPC	347922	0368	D	11	29	093122	4	103	176		C		80			MS		8		19	30		51	90	MA	90	MA		V BARCEY
WPC	367553	1945	T	11	29	103122	2	42	42	1	R													80		110			M JAMERSON
WPC	367554	1945	T	11	29	103122	2	50	50	1	R													50		50			E BEACH
WPC	367555	1945	T	11	29	103122	2	42	42	1	R																		BREWSTER PH
WPC	367558	1945	T	11	29	103122	2	40	40	1	R																		BREWSTER PH
WPC	367559	1945	T	11	29	103122	2	45	45	1	R																		BREWSTER PH
WPC	367558	1945	T	11	29	103122	2	50	50	1	R																		BREWSTER PH
WPC	367550	1945	T	11	29	103122	2	47	47	1	R																		BREWSTER PH
WPC	367556	1945	T	11	29	103122	2	41	41	1	R																		BREWSTER PH
WPC	367557	1945	T	11	29	103122	2	49	49	1	R																		BREWSTER PH
WPC	367552	1945	T	11	29	103122	2	50	50	1	R																		BREWSTER PH
WPC	367583	1336	D	11	29	NESE 103122	3	53	160	1	C																		BREWSTER PH
WPC	326741	0368	D	11	29	NW 103122	4	84	259		C		70																LEDFORD, JA
WPC	360711	1945	C	11	29	113122	8																	64					RALPH SIEWA
WPC	360717	1945	O	11	29	113122	2																						IMC CORP
WPC	360724	1945	O	11	29	113122	2																						IMC CORP
WPC	360721	1945	O	11	29	113122	2																						IMC CORP
WPC	360723	1945	O	11	29	113122	2																						IMC CORP
WPC	360725	1945	O	11	29	113122	2																						IMC CORP
WPC	360714	1945	C	11	29	113122	8																						IMC CORP
WPC	360713	1945	C	11	29	113122	8																						IMC CORP
WPC	360722	1945	O	11	29	113122	2																						IMC CORP
WPC	360712	1945	C	11	29	113122	8																						IMC CORP
WPC	360719	1945	O	11	29	113122	2																						IMC CORP
WPC	360710	1945	O	11	29	113122	2																						IMC CORP
WPC	374625	1945	T	11	29	083122	2	20	40																				Brewster Ph
WCP	374624	1945	T	11	29	083122	2	20	40																				Brewster Ph
WPC	374620	1945	T	11	29	093122	2	20	40																				Brewster Ph
WPC	374621	1945	T	11	29	093122	2	20	40																				Brewster Ph

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WELL CONSTRUCTION LIST

DATE 09/22/81

OPUSC	PERMIT	DRILL	USE	BASIN	CNTY	LOCATION SETNRGM	DIAS	CASED	DEEP WELL	OUCTALN	VDRTILH	ELEV	SWLSAD	SWPLEV	SECDPCC	TOPCLL	THKCLL	DEPCLL	CLRCLL	THKCLL	TOPCLL	CLRCLL	DEPCLL	CLRCLL	UNFCLL		
WPC	350299	1945	Z	11	29	12312210	21	388	1		R																
WPH	322822	1011	T	11	29	123122 6	83	600			R	115															INC DEVELOP
WPH	322823	1011	T	11	29	123122 6	82	525			R	121											69	100			I M C
WPC	327174	1011	D	11	29	123122 8	122	428		D	R	94											89	196			I M C
WPC	332030	1011	I	11	29	153122 10	100	430		D	R				FS	TA	20	ME	20	80	ME	20	70	110			I M C
WPC	332029	1011	K	11	29	163122 10	106	558		D	R				MS		50		20	100	ME	30	70	70		ADL	BROWSTER PH
WPC	358672	1943	D	11	29	LTO3183122 4	21	85	1		C	6			MS	DB	20	MY	28	129	WH	9	48	TA	48	TA	AMERICAN CY
WPC	348437	1933	D	11	29	183122 4	31	115	1		C	8															ADAMS, STEV
WPC	347125	1477	D	11	29	193122 4	83	200	1		C	73	C														WAXASEE, GA
WPC	325283	1160	D	11	29	5ENW193122 3	46	158			C																CHURCHWELL
WPC	321421	1368	L	11	29	NWSW193122 3	51	160			C	27												31			S COKAR?
WPC	315553	1945	T	11	29	203122 2	42	118			C	15											50	50			J BOYNTON
WPC	356077	1067	L	11	29	NWSW213122 6	151	320			C	8											20	20			D DAVIS
WPC	345158	1945	H	11	29	233122 6	40	40	1		R	74	D														BORDEN CHEM
WPC	342346	1376	G	11	29	233122 6		30	1		R												95	225			J M NICHOLS
WPC	355825	1945	C	11	29	233122 6		30	1		R																AMAX PHOSPH
WPC	357072	1376	Y	11	29	233122 2		40	1		R																BORDEN CHEM
WPH	342589	1893	I	11	29	23312210																					AMAX PHOSPH
WPC	333754	1945	Y	11	29	233122 6	125	820	1		R				MS		85	MG	30				115	115			BORDEN CHEM
WPC	362765	1945	Y	11	29	243122 3	95	95	1		R																BORDEN CH C
WPC	362764	1945	Y	11	29	243122 3	100	150	1		R																AMAX PHOSPH
WPC	36276	1945	G	11	29	243122 8	62	68	1		C																AMAX PHOSPH
WPC	367432	1945	G	11	29	243122 6	98	340	1		R																AMAX PHOSPH
WPE	333804	1343	D	11	29	243122 4	70	98	1	D	C	21			MS		21	MY	21	48	MR	21	42	WH	69	WH	AMAX PHOSPH
WPE	333755	1893	G	11	29	243122 6	325	405	1		R				MS			MA	35	65		25	65		320		B C CHANCY
WPE	333756	1893	G	11	29	243122 6	125	605	1		R				MS		40		20	125	LA	35	125	LA	125	LA	BORDEN CH C
WPC	355843	1376	P	11	29	NENW253122 4	160	295	1		R	65															BORDEN CH C
WPC	344180	1945	D	11	29	253122 8																					BORDEN CHEM
WPH	345084	1945	Y	11	29	253122 8																					BORDEN CHEM
WPE	331824	1800	A	11	29	25312230	324	910		D	R	69			MS	WH	5	BK	5	90	ME	20	80	WH	250	WH	BORDEN CHEM
WPE	331823	1800	D	11	29	25312212	101	400		D	R	65			MS	WH	20	WH	13	130	ME	24	20		115		BORDEN CHEM
WPE	333757	1893	G	11	29	253122 6	125	745	1		R				MS		15		25	40		60	120		120		BORDEN CH C
WPE	333753	1893	G	11	29	253122 6	125	355	1		R				MS		25		10	35		55	35		125		BORDEN CH C
WPE	333759	1893	G	11	29	25312210	98	355	1		R				MS		45		15	165		60	30		60		BORDEN CH C
WPC	324540	1011	T	11	29	25312230	253	800		D	R	81			FS	MB	10	MB	30	50	CR	45	50	CR	50	CR ACJX	BORDEN CHEM
WPE	324539	1011	O	11	29	25312212	276	755		D	R	79			FS	DB	20	LA	25	75	LA	10	45	WH	50	WH ACLX	BORDEN CHEM
WPC	324542	1011	T	11	29	253122 8	91	245		D	R	13			FS	TA	15	LY	15	30	MG	60	46	TA	46	TA ACZX	BORDEN CHEM
WPC	324541	1011	T	11	29	253122 8	91	245		D	C	13			MS	TA	15	MY	15	60	MA	25	90		90		BORDEN CHEM

WPC 374615 1945 T 11 29 153122 2 20 40 Brew Ph

WPC 374614 1945 T 11 29 153122 2 20 40 Brew Ph

WPE 368872 1104 B 11 29 SWSE 193122 4 Franklin, R

WPC 372715 1945 Y 11 29 203122 10 250 810 Brew Ph

WPC 373057 1945 Y 11 29 203122 10 250 800 Brew Ph

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WELL CONSTRUCTION LIST DATE 06/03/82

DPUSE	PERMIT	DIST	BASIN	SECTY	LOCATION SETNRG	DIAM	CASL	WELL DEPTH	QUALTY	LICNUM	ELEV	SWL	SP	SSEDZ	SSEDC	DPRAT	CLRAT	THRAT	DCLRAT	THRAT	ICLRAT	CDPRAT	CUNRAT	OWNER
WPE	331868	1056	D	11	29	193121	4	93	220	1	D	C	90		MS					200		200	AHZ	E WICKLINE
WPE	313171	0006	D	11	29	193121	4		365			R												W K JOHNS
WPE	308209	0006	D	11	29SW	193121	4	129	350			R								91				W JOHNS
WPE	325484	1336	D	11	29	203121	4	109	223			C										59		G SUMNER
WPE	306644	0013	L	11	29	203121	6	9	19			C	4											
WPE	330114	1057	D	11	29	213121	6	325	383		D	C	108		MS	08	45	DA	58	135	MG	33	168 WH	168 WH		B GARCIA
WPE	332705	1043	D	11	29	213121	4	136	221	1	D	C	110		MS	LB	30	LA	15	45	MG	20	65	134 WH		E MCDONALD
WPE	367640	1185	D	11	29	243121	4	180	247	1		C	111													LINNE, ROSE
WPE	334304	1699	D	11	29	243121	4	94	155	1		C	105		MS		20		20							BARNES P H
WPE	339755	1043	D	11	29	243121	4	60	120	1		C			MS	WH	55	MA	5			40	80			SWINT, P E
WPE	326412	1043	D	11	29	243121	4	77	161		D	C	94	F	MS	WH	16	GA	9	67	WH	8	55 LB	55 LB	ADL	J MARTINES
WPE	331003	1233	A	11	29	243121	8	208	350	1	D	C	85		MS		28	ME	38				46	189 WH	BHBX	F WILSON
WPE	340504	1094	D	11	29	253121	3	135	343	1		R	66		MS		8		9	17	LA	6	77	135		DEBORD, B
WPE	328814	1056	D	11	29	253121	4	125	175	1	D	C			MS								120 MA	120 MA	ADZX	O EDMONSON
WPE	328516	1056	D	11	29	253121	4	94	171	1	D	C			MS								80	80	ADS	J KICKLITER
WPE	313863	0031	A	11	29SWNW	253121	10	246	729			C	82										256	305		W L DURRANC
WPE	320058	0016	D	11	29SENW	253121	3	83	180			C	69										80	80		G R DRIVER
WPE	365294	1195	A	11	29	263121	8	180	700	1		C	103													PARDEE, MAR
WPE	368846	1558	A	11	29	263121	8	92	470			C														SIMMONS, J.
WPE	337578	1160	D	11	29	263121	4	105	208	1		C	126		MS	BK	20	MY	20	40	MA	20	108 MA	108 MA		LEACH, A
WPE	313998	0016	D	11	29	263121	3	84	160			C	25										75	75		R M ROBINSO
WPE	307602	0013	D	11	29NWNW	263121	4	103																		
WPE	341434	1043	A	11	29	273121	4	94	190	1		C	96	I	MS		13	DA	32	45		42	93	94		MCBRIDE, C A
WPE	323452	1233	A	11	29	273121	4	63	175			C	115										40	60		JACK FELTY
WPE	352981	1104	A	11	29SWSW	293121	4																			SWEAT, H. G
WPE	369101	1104	D	11	29	293121	4																			CAPPS, BILL
WPE	339198	1233	D	11	29	293121	4	95	171	1		C	98		MS	MB	30	MB	18	48	ME	44	92 WH	92 WH		JEFFREY, W
WPE	323196	1104	A	11	29	293121	4	109	190			C	115										45	173		G SWEAT
WPE	317407	0013	D	11	29NWNW	293121	3	103	193			C	90										66	145		J PARSONS
WPE	362001	1855	D	11	29	303121	4	100	250	1		C	135													SMITH, RONA
WPE	363776	1204	D	11	29	303121	4	168	296	1		C														MOSES, JEFF
WPE	366136	1104	A	11	29	303121	8																			SWEAT, H. G
WPE	371598	1043	D	11	29	303121	4	147	240	1		T	128													EDDY JR., W
WPE	333793	1056	D	11	29	303121	4	105	225	1		C	100		MS		43		55				98	98		PICKERD E
WPE	322203	0069	D	11	29	303121	3	122	208	1	D	C			MS		50	MA	40	93	MA	29	122 WH	122 WH		H GROFF
WPE	323861	1589	D	11	29	303121	4	136	235			C											95	180		T C SCALES
WPE	324976	1477	D	11	29	303121	4	118	265			C												118		R LEWIS
WPE	325345	1369	D	11	29	303121	4	78	225	1	D	C	102										78 LA	63 LA		E BARDANELL
WPE	320117	0069	D	11	29	NW303121	3	132	240			C	118		MS	WH	21	MA	42	84	MG	21	102	176		D MARSHALL

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WELL CONSTRUCTION LIST

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OPUSE	PCRMIY	DRILL	BUSEN	CNTY	LOCATION SEC TWNG RNG M	DIAM	DEPTH	WELL	QUALIFIER	LEVEL	DRILLER	SWP	SEE DESC	SEE DEPTH	SEE CLASS	SEE ACFSZ	DPTH1	CLASS1	THK1	DPTH2	CLASS2	THK2	ICAR	CDPR	CUNK	OWNER
WPE	306939	0013	L	11	29 SC	30	3121	5	166	440	S	C	115										112	260		
WPE	307263	0086	D	11	29	30	3121	3	115	140		R	85										100	100		G N STANLEY
WPE	308819	0006	D	11	29	30	3121	3	166	225		R	155										93	135		J ELLINGTON
WPC	363335	1056	D	11	29NENW	31	3121	4	95	205	1	C	105													RUTH, DONAL
WPC	367701	2193	D	11	29NWSE	31	3121	4		220	1	C														STEARNS, RT
WPE	373927	1809	D	11	29NENW	31	3121	4																		WILLIAMS, H
WPE	334626	1056	D	11	29	31	3121	4	83	285	1	C		MS		12	MB	16	28	MB	22	75		81	MB	HUDSON J
WPE	334632	1056	D	11	29	31	3121	4	109	315	1	C		MS		9		30	39		21	60		104		WILLIAMS E
WPE	334631	1056	D	11	29	31	3121	4	109	315	1	C		MS		9	MB	30	39		21	60	WH	104	WH	WILLIAMS E
WPE	338012	1358	D	11	29SWNE	31	3121	4	110	205	1	C	110	MS	HA	40	MA	20				60		160	CR	TYLER,W B
WPE	322899	1336	D	11	29	31	3121	3		204		C	93									195		195		EDDIE WILLI
WPE	323266	1477	D	11	29NENW	31	3121	4	96	202		S C	102									95		128		W ELDRIGE J
WPE	326603	1056	D	11	29	31	3121	4	80	195	1	D C	90	MS		51		28				79	MB	79	MB	K PHILLIPS
WPE	331675	1056	D	11	29	31	3121	4	85	228	1	D C	131	MS								146		146	AHX	W OBRIEN
WPE	320381	1233	D	11	29	31	3121	4	95	225		C	77									80		150		J WENGER
WPE	308150	0016	D	11	29SWSE	31	3121	3	105	218		C	40									86		90		J R LAGHLIN
WPC	357045	1598	L	11	29	32	3121	4	133	590	1	C														WILKERSON,
WPE	370353	1109	A	11	29	32	3121	8																		CAPPS, C. W
WPC	371959	1160	D	11	29	32	3121	4	84	222	1	C	S 60													RENSHAW, ED
WPE	373609	1299	A	11	29	32	3121	10																		ALDERMAN, T
WPC	322163	1056	D	11	29	32	3121	4	92	192	1	D C		MS		10	MR	37	71	MA	16	47	MB	47	MB	J BROWN JR
WPE	327407	1336	D	11	29	32	3121	4	84	300	1	D C	110	MS		17	LO	32	49	LE	18	84	WH	84	WH AGL	R GREEN
WPE	313315	0016	D	11	29SWSE	32	3121	3	111	216		C	37									82		109		A PIANGA
WPE	313211	0031	A	11	29SWNW	32	3121	4	120	220		C	40									102				M L DAVIS S
WPE	313984	0165	D	11	29	32	3121	4	63	175		C	10											50		T P SANDERS
WPE	315811	0016	D	11	29	32	3121	3	84	195		C	12									82		82		H M SUTTON
WPE	317158	0086	D	11	29	32	3121	4	86	304		C	63									83		83		C SCRIVEN
WPE	317576	0223	A	11	29NENE	32	3121	8	140	320		C	95									135		135		H SWEET
WPE	309957	0022	D	11	29NESE	32	3121	4	82	207		C	60									110				
WPE	310691	0069	D	11	29 NE	32	3121	4	86	193		C	103									84				D L SCOTT
WPE	339059	1299	A	11	29	33	3121	8	159	752	1	C	93	MS	LO	47	MO	54	132	WH	26	101	LA	158	WH	REESE,S L
WPC	367479	1185	A	11	29	34	3121	8	318	607	1	C	51													HARRIS FARM
WPE	317747	0223	A	11	29SWNW	35	3121	8	135	300		C	80									165		165		PALM GRV SE
WPC	357506	1945	Z	20	53SWNW	01	3122	8	120	363	1	R	100													INTERNATIONAL
WPE	336006	1893	G	11	29	01	3122	10	108	348	1	R		MS	DB	55	LA	30	90		25	80		80	AFZ	INT MINERAL
WPC	357505	1945	Z	20	53SWNE	02	3122	8	120	363	1	R	118													INTERNATION
WPN	370283	1945	O	11	29	02	3122	2	*** CANCELLED ***																	
WPC	371061	1945	O	11	29	02	3122	2	20	32	1	R														IMC CORP
WPC	371060	1945	O	11	29	02	3122	2	40	40	1	R														IMC CORP

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WELL CONSTRUCTION LIST

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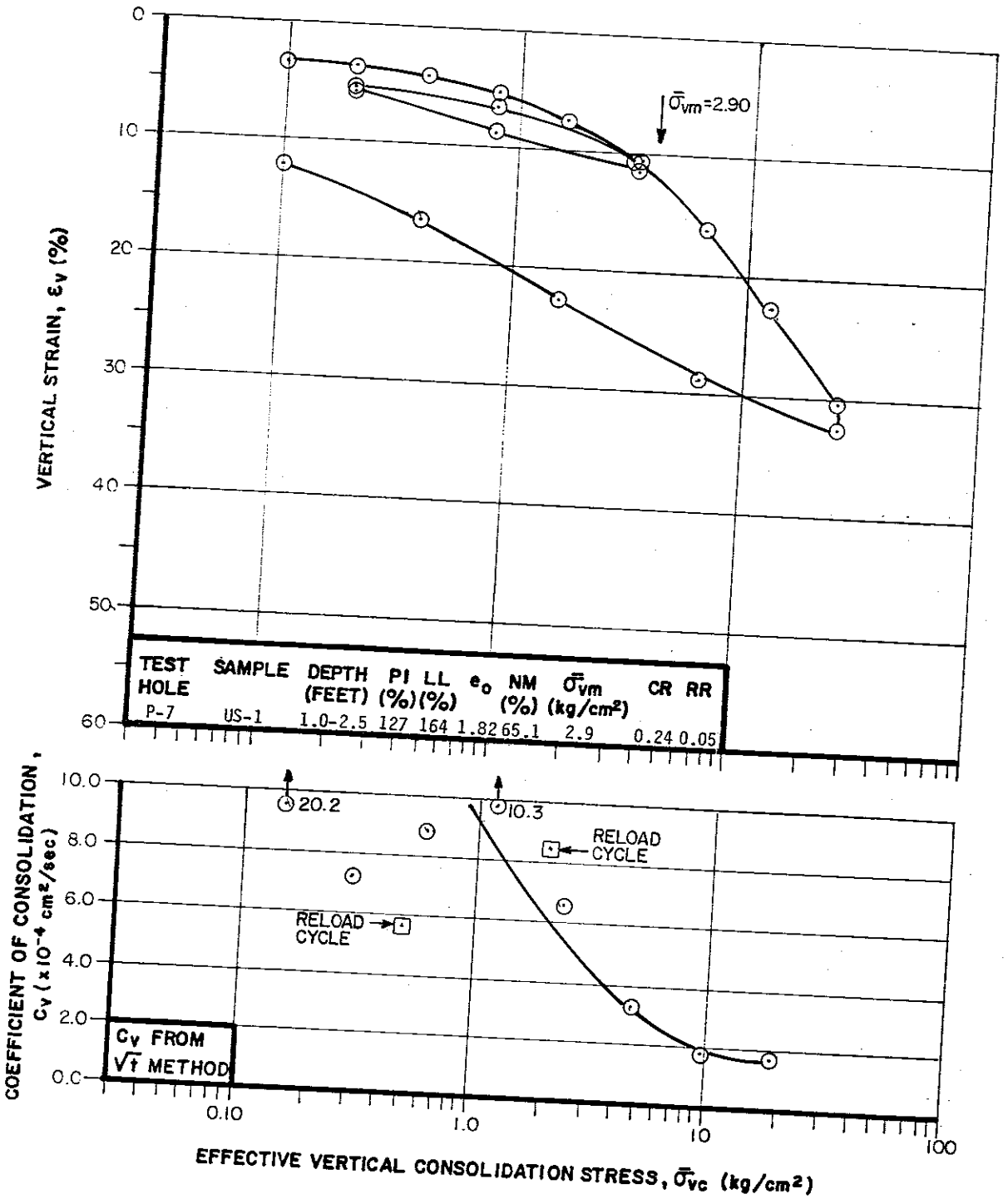
DP	PERMIT	DRILL	BUSEN	ACNTY	LOT SETNRG	DIAM	CASE	WELL	DUAL	VDR CLTL	ELEV	SWL	SP	SEZ	SSDSCR	DPTH	DCLR	THZ	DPTH	DCLR	THZ	ICLR	DPTH	DCLR	UNIT	DWNE
WPC	355857	1376	G 11	29	27312210	15		15	1	C																
WPC	355856	1376	G 11	29	27312210	15		15	1	R																
WPC	355822	1376	G 11	29	273122 6			30	1	R		30														
WPE	339266	1233	A 11	29	283122 4	260		560	1	G																
WPE	305813	0067	A 11	29	28312212	298		879		C		88			MS	18		17	37	WH	5	50	MG	160	WH		BORDEN BIG
WPE	327764	1299	D 11	29	293122 4					C		90										42		142		BORDEN BIG
WPE	342668	1093	D 11	29	303122 4	86		125		D C		34			CY	MB		MB	23	39	LA	47	84	LA	84	LA	BORDEN CHEM
WPE	327445	1094	D 11	29	303122 6	139		270	1	D C					MS	MA	15	MA	13	39	ME	7	28	WH	46	WH	BORDEN BIG
WPE	329385	1392	D 11	29	303122 4	79		140	1	D C		30			MS	MY	20	MS	25	45	WH	35	80	MB	80	MB	PICNIC GROV
WPE	340295	1943	D 13	29	313122 4	84		140	1	C		20	B		MS		40		20	60	MB	18	70		84		BREWSTER PH
WPE	329991	1764	O 11	29	313122 8	95		61		D R		17			FS		5	MB	10	30	ME	13	43	TA	43	TA	DOWNING, J M
WPE	326990	1764	O 11	29	313122 8	215		542		D R		81			FS		5	MB	10	30	ME	55	85		85		L MERCIER
WPE	323761	1233	T 11	29	333122 4	63		65	1	D C					MS	WH	26		39								D WALKER
WPE	323760	1233	T 11	29	333122 4	147		160	1	D C					MS		25		40	65	MA	38	103	MA	124		OUSBURN, P
WPE	323762	1233	T 11	29	33312216	276		993		D C		100			MS		33	MB	54	162		30	87		87	AGM	S W F W M D
WPE	323759	1233	T 11	29	333122 4	63		125	1	D C		35			MS		47		78								S W F W M D
WPE	323757	1233	O 11	29	333122 8	246		826		C																	BREWSTER PO
WPE	323758	1233	T 11	29	333122 4	136		175	1	D C		30			MS		50		50				100		100		BREWSTER PO
WPC	332027	1011	I 11	29	33312210	115		552		D R					MS	MB	12	LA	73	247	MG	20	85		85	ACM	BREWSTER PH
WPE	332028	1011	I 11	29	33312210	115		405		D R					MS	DB	10	WH	20	60	MA	15	30	WH	75	ACR	BREWSTER PH
WPC	362761	1945	Y 11	29	343122 6	95		750	1	R																	BREWSTER PO
WPC	362763	1945	Y 11	29	343122 8	50		50	1	R																	AMERICAN CY
WPE	332026	1011	I 11	29	34312210	115		520		D R																	AMERICAN CY
WPE	340530	1699	D 11	29	353122 4	55		120	1	C					MS	BK	5	WH	5	12	LE	37	51	WH	51	WH ACM	AMAX PHOSPH
WPE	333760	1893	G 11	29	363122 6	125		300	1	R					MS		55	MA	35				90		55		AMAX PHOSPH
WPE	333763	1893	G 11	29	363122 6	125		203	1	R					MS		25		5	30		55	30		125		AMERICAN CY
WPE	339017	1699	D 11	29	363122 4	65		120	1	C		42			MS		30		5	35		10	30		125		CHURCHWELL,E
WPE	325797	1011	D 11	53	33123 6	84		200		D R		45			MS		55		15				70		70		BORDEN CH C
WPE	339290	1521	D 11	53	013123 4	103		168	1	C		63			MS		22		20	55	MA	47	102	MA	102	MA AFIX	BORDEN CH C
WPE	325854	1011	D 11	53	013123 4	87		200		R					MS	MA	70	MG	5	85	MA	51	85	CR	85	CR	MEM FOSTER
WPE	324308	1298	D 11	53	023123 4	84		110	1	D J		15															IMC
WPE	328279	1011	I 11	29	023123 8	79		580		D R					MS	WH	19		8	57		8	27		27		TAYLOR,L
WPE	328281	1011	I 11	53	023123 8	90		300		D R					MS	WH	13	WH	14	27	ME	7	50	WH	50	WH CLA	R DILLARD
WPE	328280	1011	I 11	29	023123 8	79		600		D R					MS	WH	3	DB	27	55	MC	23	78	WH	78	WH	J CARGILE
WPE	331657	1011	I 11	53	023123 8	87		540		D R					MS	MB	20	LA	5	25	WH	36	67	WH	67	WH AGJ	I M C
WPE	331654	1011	I 11	53	023123 8	79		565		D R					MS	MB	5	WH	27	41	WH	44	85		85	ADI	I M C
WPE	331653	1011	I 11	53	023123 9	93		463		D R					MS	TA	65	MG	5	90		30	70		105	AEN	I M C
WPE	331655	1011	I 11	53	023123 8	97		460		D R					MS	DB	27	MY	30				87		87	ACR	I M C
															CY	DB		DB	94				85		94	AGM	I M C

Appendix A.5

CONSOLIDATION TEST RESULTS



CONSOLIDATION TEST RESULTS FOR WASTE PHOSPHATIC CLAY FROM P-7 US-1

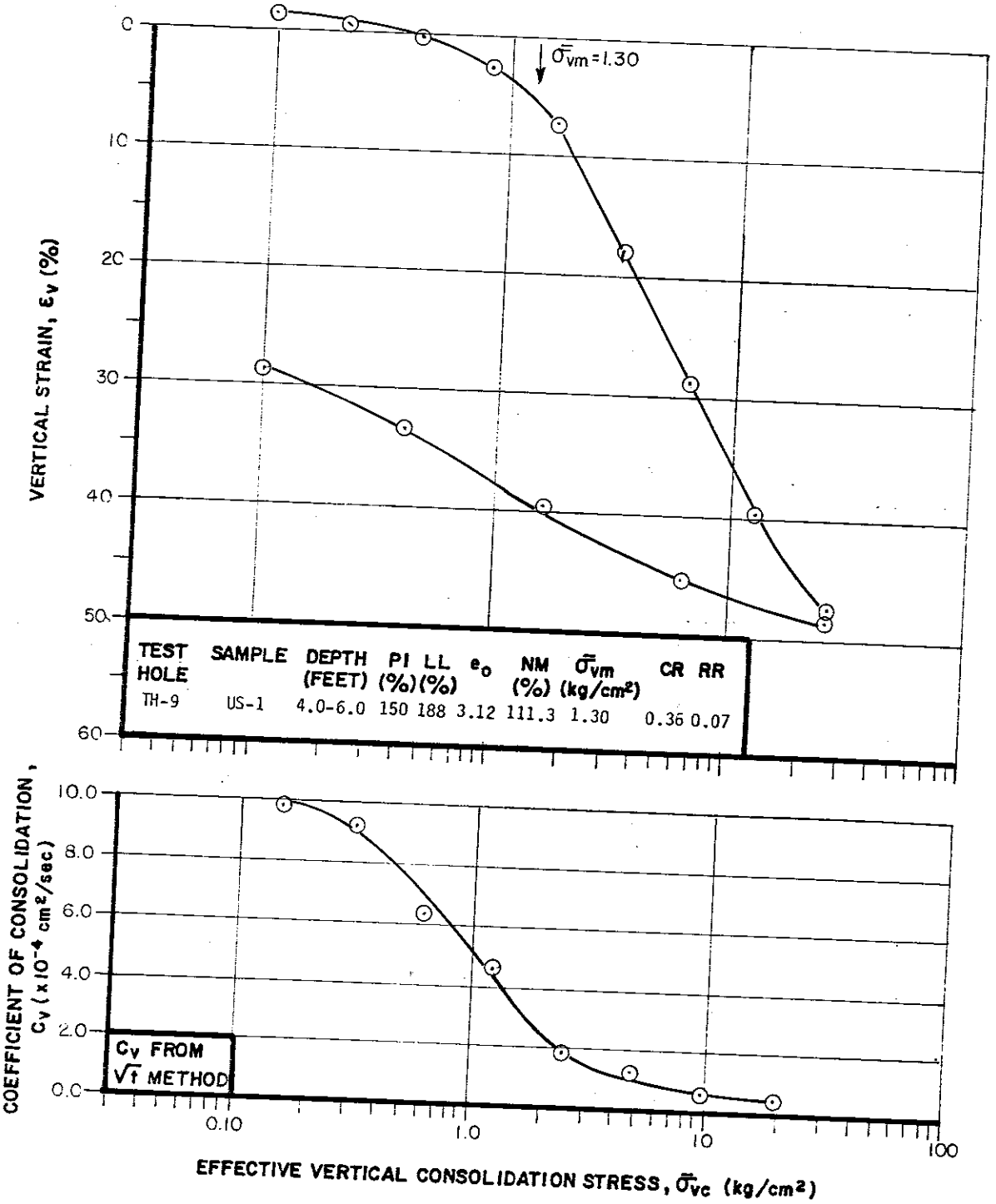
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA | CHECKED BY: ASC | DATE: 1/20/83
FILE NO. 81-159 | APPROVED BY: H.G. Stanley

FIGURE A-5.1

K&E 19 1153 12-80 MC1983e



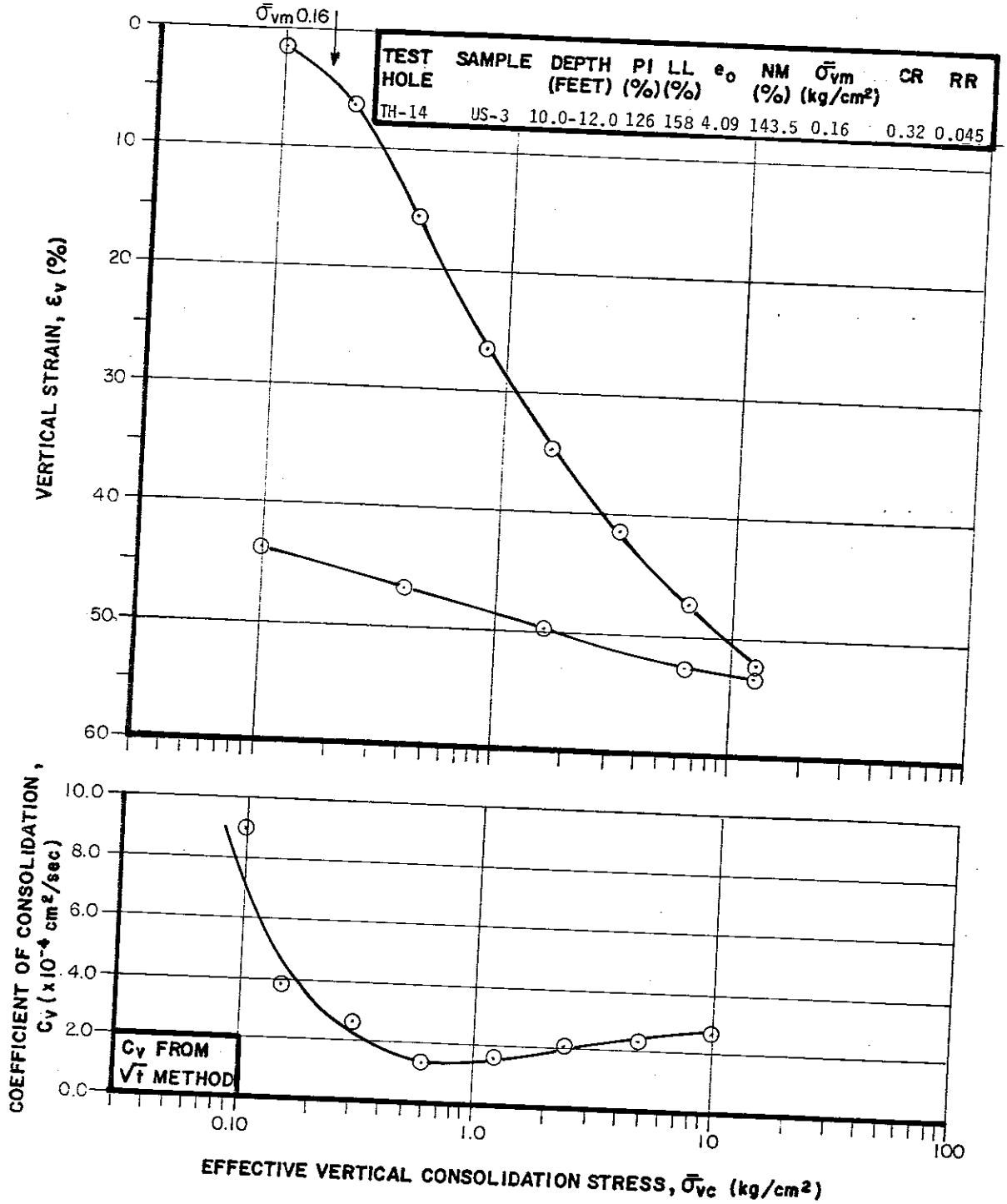
CONSOLIDATION TEST RESULTS FOR WASTE PHOSPHATIC CLAY FROM TH-9 US-1

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA | CHECKED BY: J.J.C | DATE: 1/20/83
FILE NO. 81-159 | APPROVED BY: H.G. Ardaman II

K&E 19 1153 12-80 MC1983e



CONSOLIDATION TEST RESULTS FOR WASTE PHOSPHATIC CLAY FROM TH-14 US-3

Ardaman & Associates, Inc.
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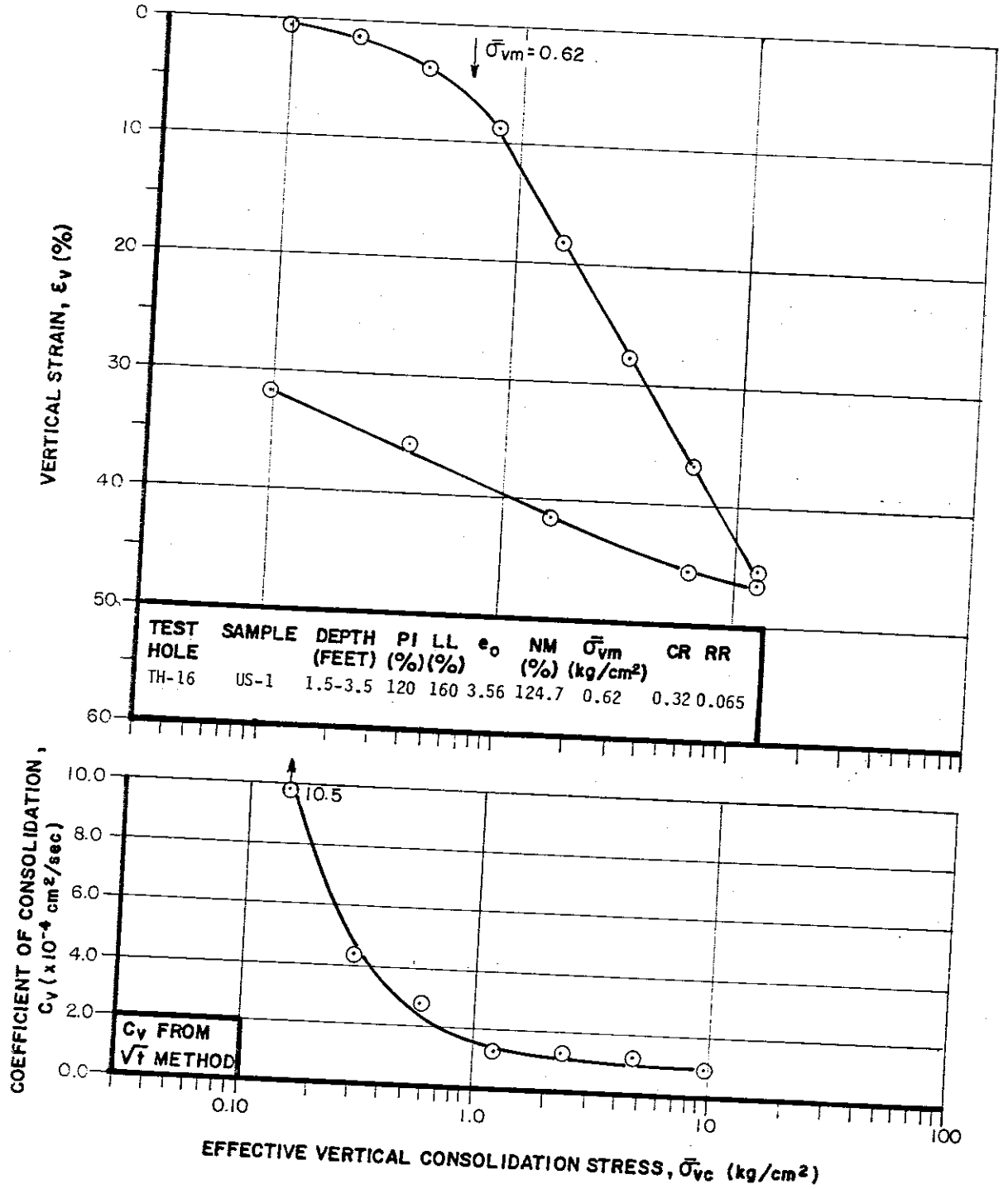
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA	CHECKED BY:	DATE: 1/20/83
FILE NO. 81-159	APPROVED BY:	

K&E 19 1153 12-80 MC1983e



CONSOLIDATION TEST RESULTS FOR WASTE PHOSPHATIC CLAY FROM TH-16 US-1

Ardaman & Associates, Inc.
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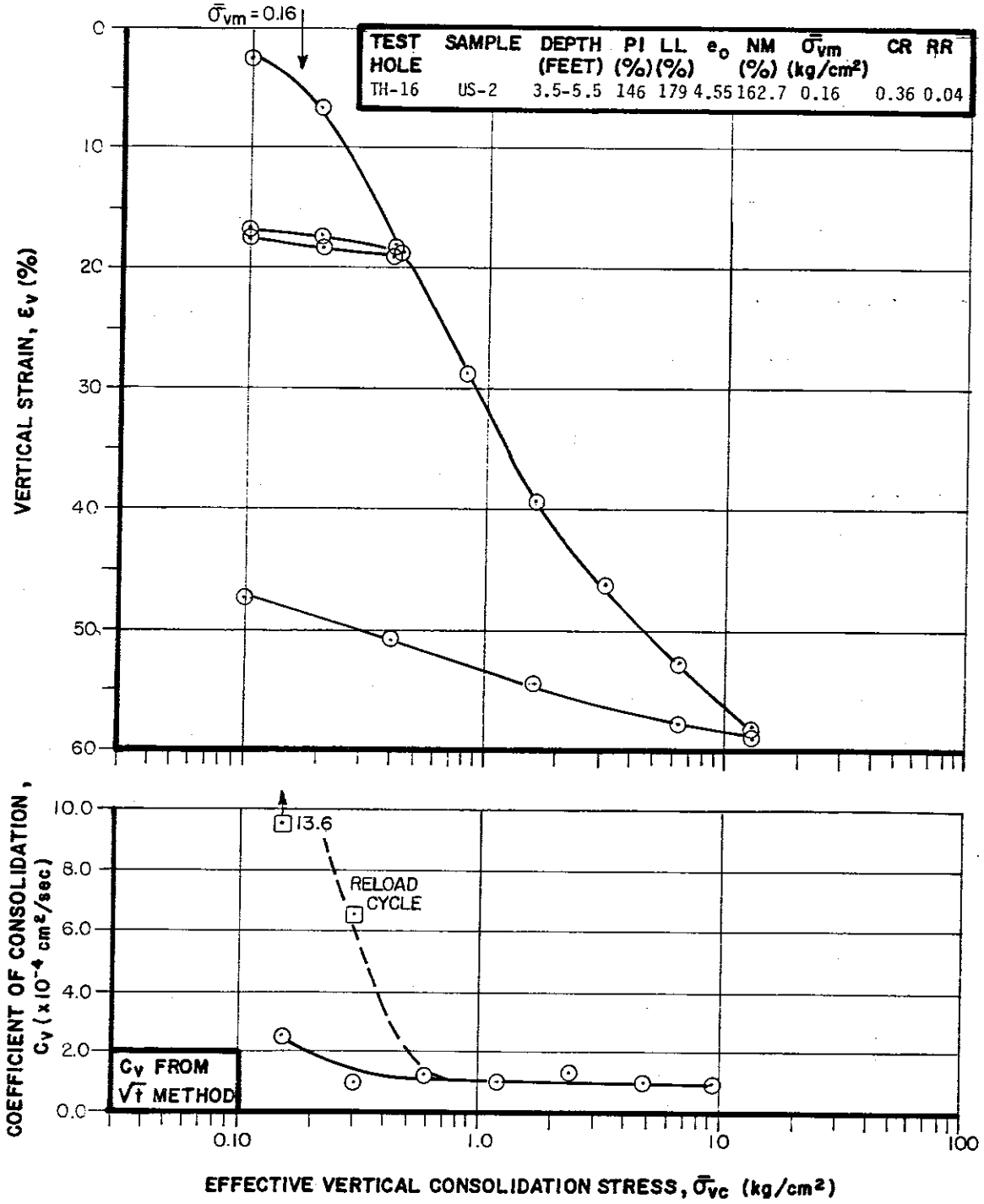
HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA | CHECKED BY: [illegible] | DATE: 1/20/83
FILE NO. 81-159 | APPROVED BY: H.B. Stanley II

FIGURE



CONSOLIDATION TEST RESULTS FOR WASTE PHOSPHATIC CLAY FROM TH-16 US-2

Ardaman & Associates, Inc.
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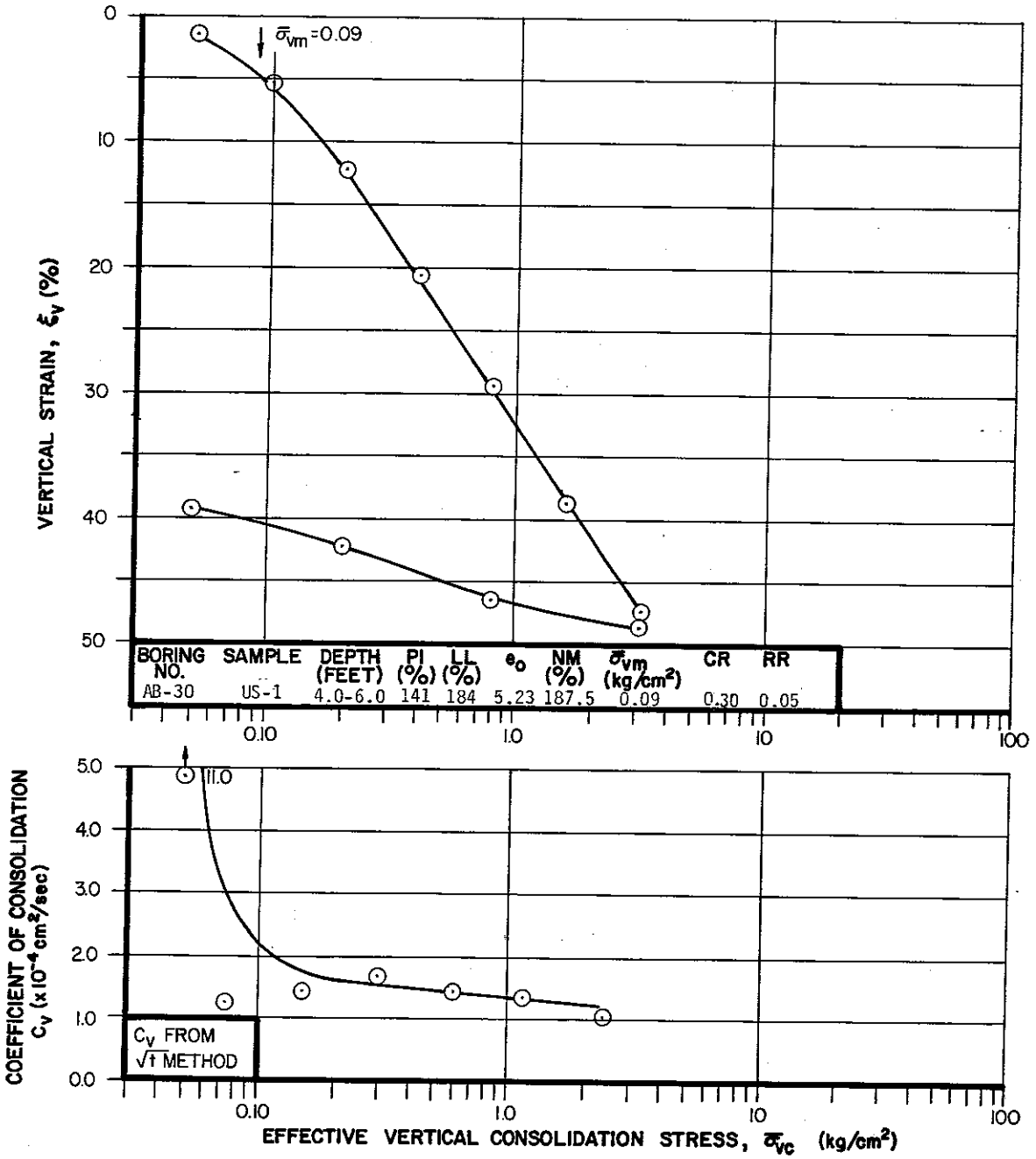
HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: KA | CHECKED BY: [illegible] | DATE: 1/20/83
FILE NO. 81-159 | APPROVED BY: H.G. Stangland

FIGURE A.5-5

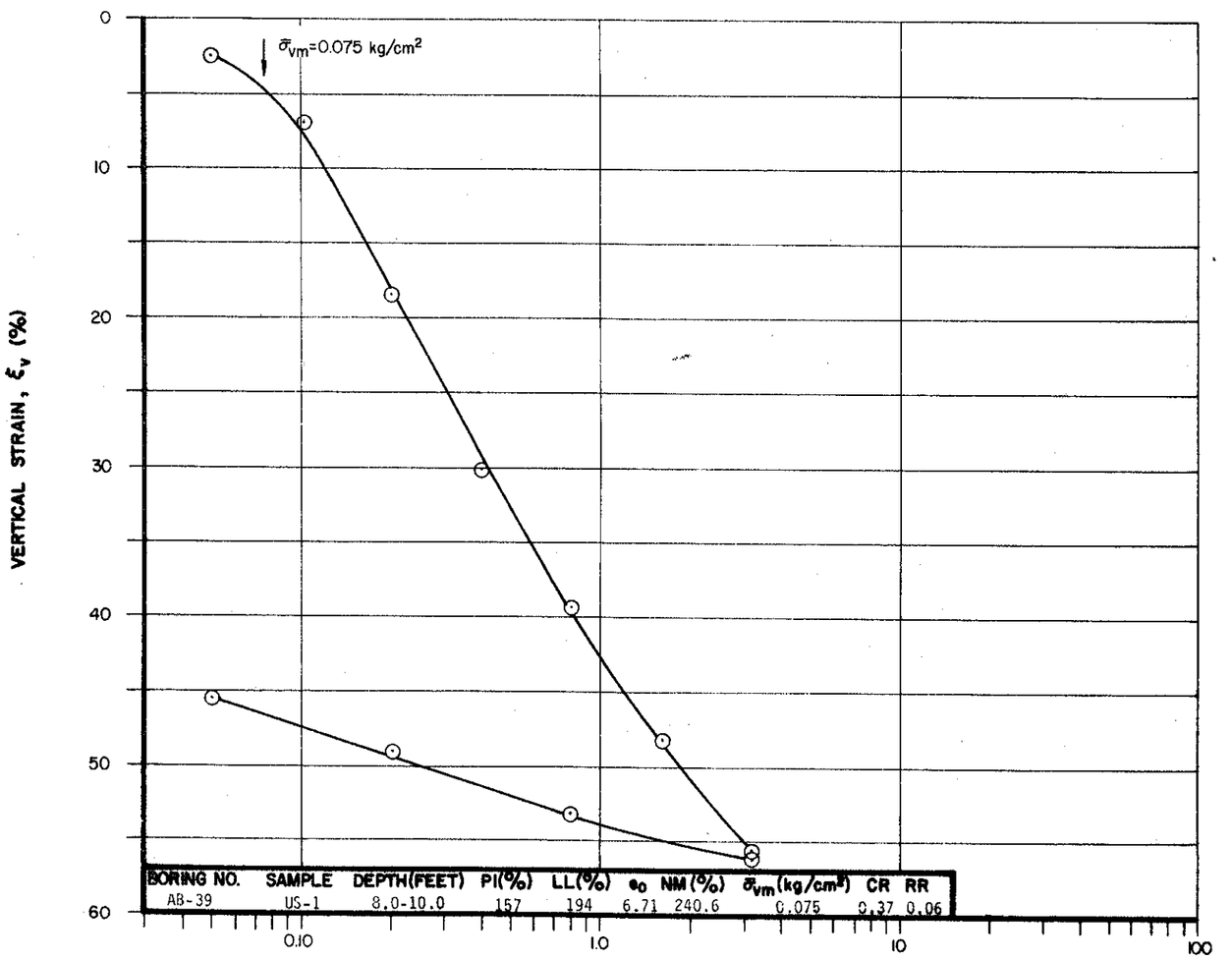


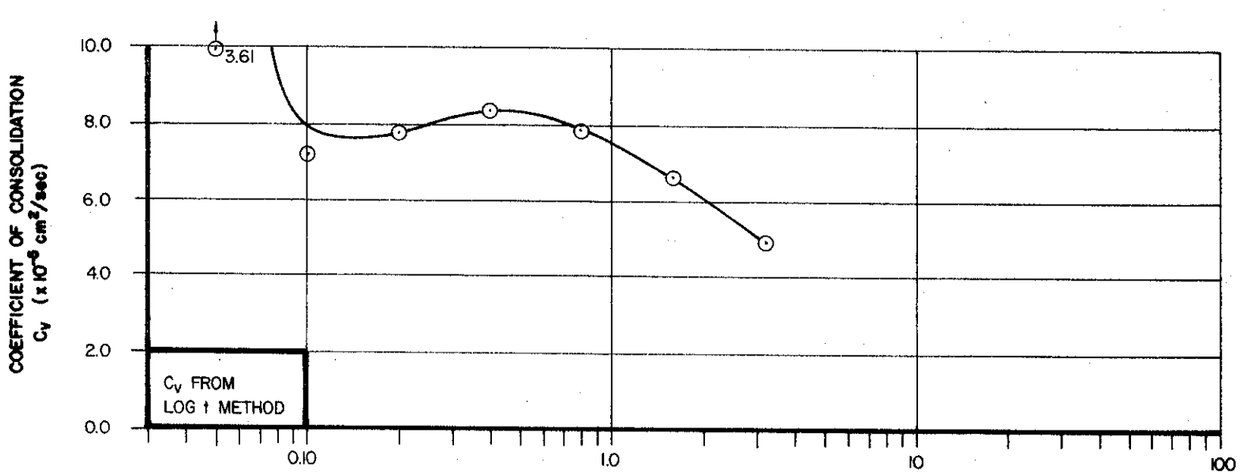
CONSOLIDATION TEST RESULTS FOR WASTE PHOSPHATIC CLAY FROM AB-30 US-1

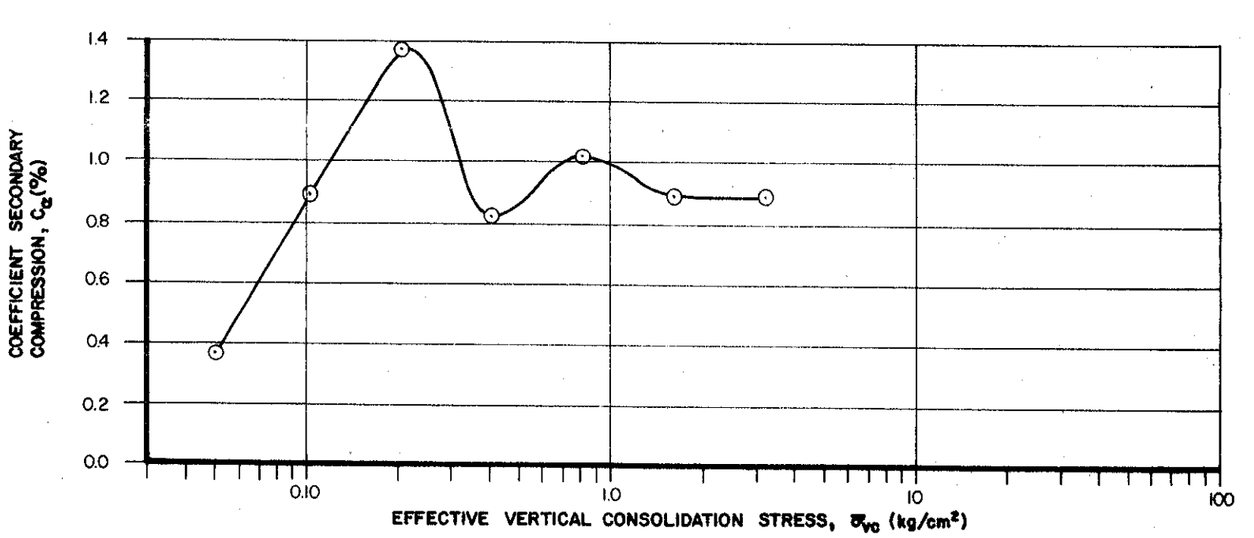
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: T.S.	CHECKED BY:	DATE: 2/9/83
FILE NO. 81-159	APPROVED BY:	







CONSOLIDATION TEST RESULTS FOR WASTE PHOSPHATIC CLAY FROM AB-39 US-1

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

FILE NO. 81-159
DRAWN BY: T.S.
CHECKED BY:
APPROVED BY:
DATE: 2/8/83

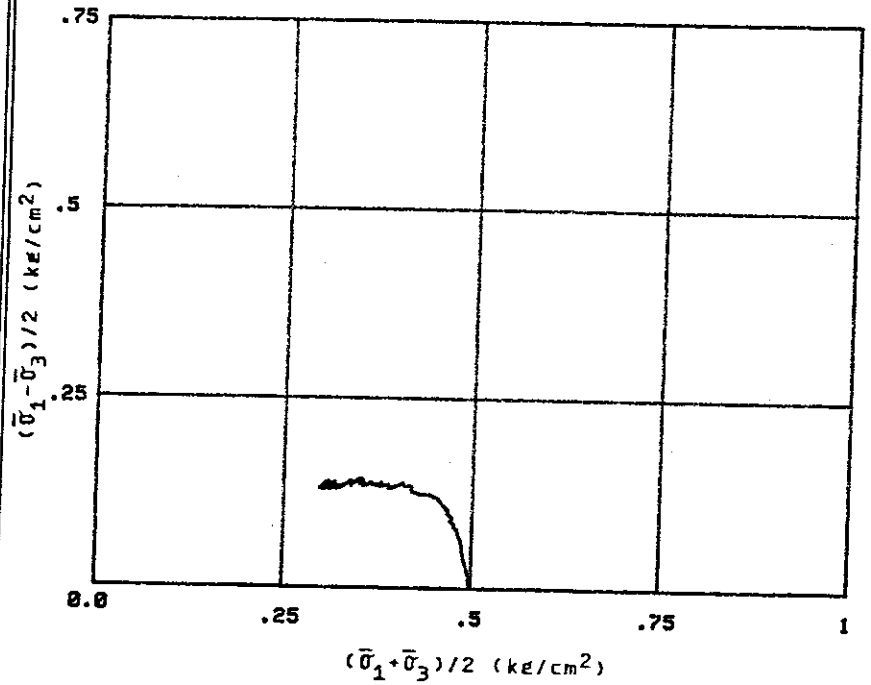
Appendix A.6

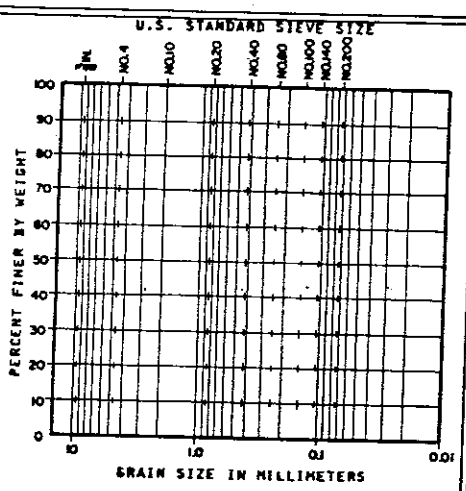
STRENGTH TEST RESULTS

TEST HOLE 16 SAMPLE 2US2 SPECIMEN DEPTH (ft) 3.5-5.5

SOIL DESCRIPTION SLIME TYPE OF SPECIMEN UNDISTURBED

UNIFIED CLASSIFICATION _____ STRAIN LOADING RATE .017 (%/min.)





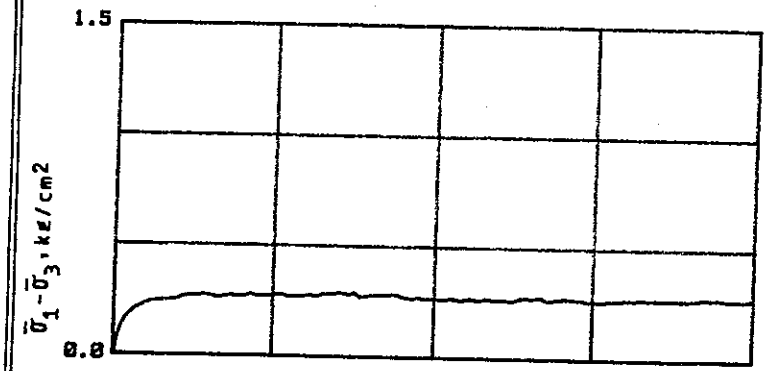
% PASSING -200 _____

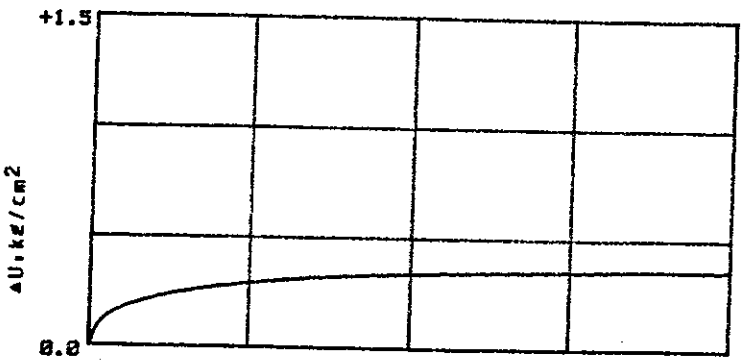
LIQUID LIMIT _____

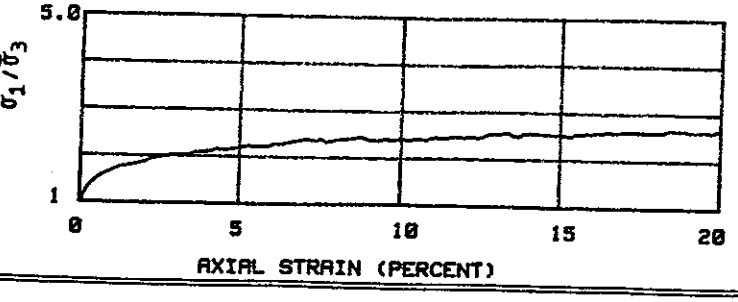
PLASTIC LIMIT _____

SPECIFIC GRAVITY 2.80

REMARKS *ASSUMED VALUE







SPECIMEN DATA		
INITIAL	WATER CONTENT (PERCENT)	173.2
	DRY DENSITY (pcf)	30.1
	VOID RATIO	4.82
	SATURATION (PERCENT)	100.0
AFTER CONSOLIDATION	CONSOLIDATION PRESSURE (kg/cm²)	.5
	BACK PRESSURE (kg/cm²)	12.5
	PERMEABILITY (cm/sec)	N/A
	WATER CONTENT (PERCENT)	128.1
	DRY DENSITY (pcf)	38.1
	VOID RATIO	3.59
	B	.99
	SATURATION (PERCENT)	100.0 *
@ MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	AXIAL STRAIN (PERCENT)	20.2
	$\bar{\sigma}_1$ (kg/cm²)	.4
	$\bar{\sigma}_3$ (kg/cm²)	.2
	A	1.3
@ ULTIMATE	AXIAL STRAIN (PERCENT)	19.9
	$\bar{\sigma}_1$ (kg/cm²)	.4
	$\bar{\sigma}_3$ (kg/cm²)	.2
	A	1.3

UNDRAINED TRIAXIAL COMPRESSION TEST

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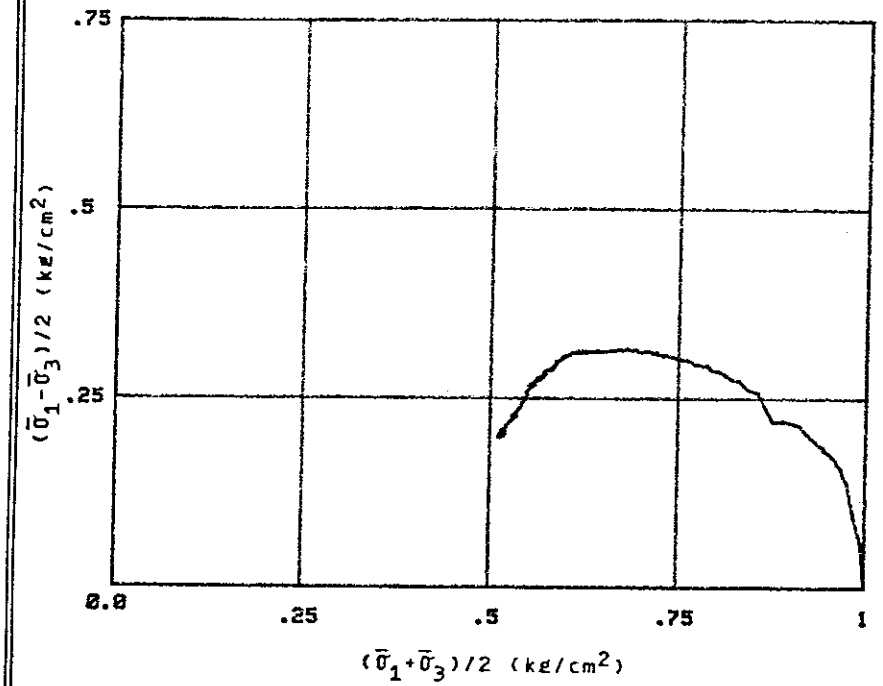
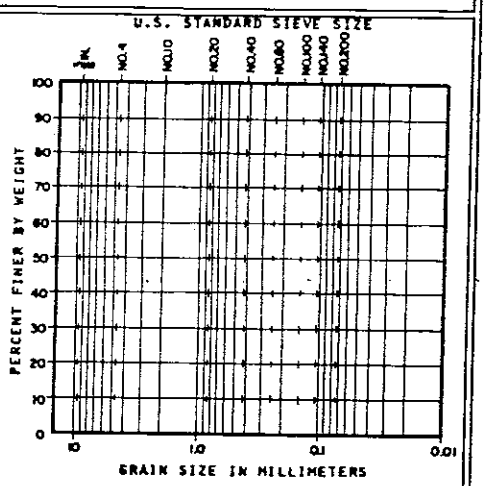
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY:	DATE:	CHECKED BY:
J.W.	2/4/83	David Clark

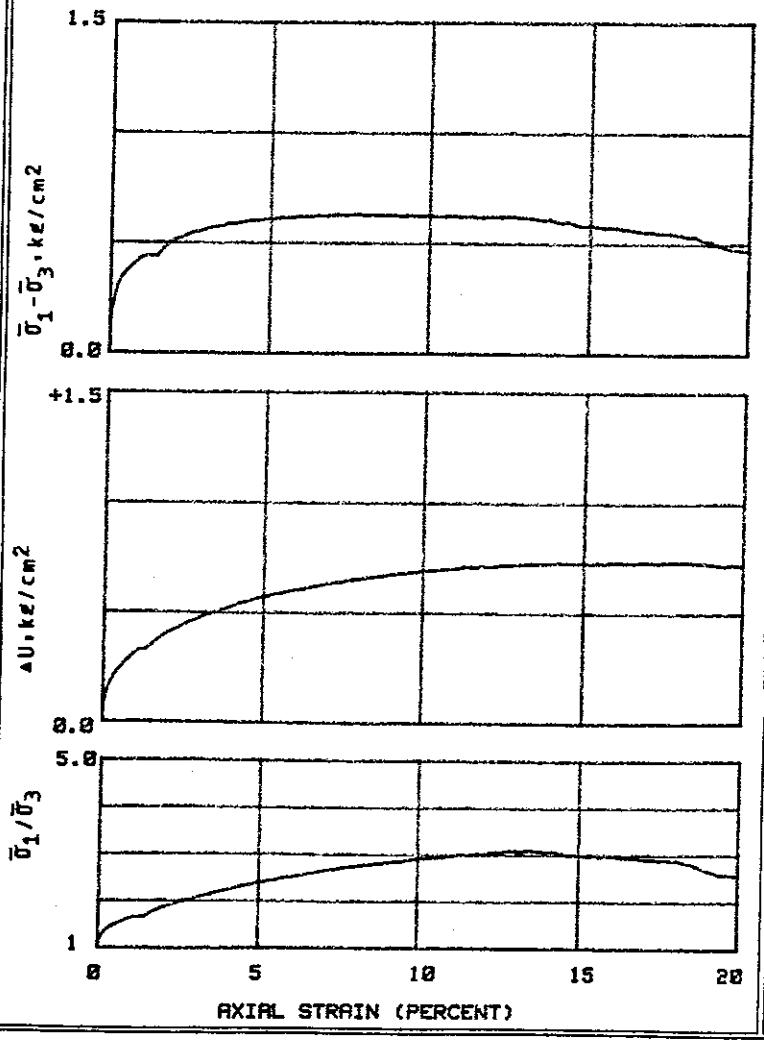
FIGURE A.6-1

TEST HOLE 16 SAMPLE 1US3 SPECIMEN DEPTH (ft) 5.5-7.5
SOIL DESCRIPTION CLAY SLIME TYPE OF SPECIMEN UNDISTURBED
UNIFIED CLASSIFICATION _____ STRAIN LOADING RATE .017 (%/min.)





% PASSING -200 _____
LIQUID LIMIT _____
PLASTIC LIMIT _____
SPECIFIC GRAVITY 2.80
REMARKS *ASSUMED VALUE



SPECIMEN DATA		
INITIAL	WATER CONTENT (PERCENT)	169.9
	DRY DENSITY (pcf)	30.5
	VOID RATIO	4.72
	SATURATION (PERCENT)	100.0
AFTER CONSOLIDATION	CONSOLIDATION PRESSURE (kg/cm²)	1.0
	BACK PRESSURE (kg/cm²)	12.0
	PERMEABILITY (cm/sec)	N/A
	WATER CONTENT (PERCENT)	93.9
	DRY DENSITY (pcf)	48.2
	VOID RATIO	2.63
	B	.99
	SATURATION (PERCENT)	100.0 *
@ MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	AXIAL STRAIN (PERCENT)	13.4
	$\bar{\sigma}_1$ (kg/cm²)	.9
	$\bar{\sigma}_3$ (kg/cm²)	.3
	A	1.2
@ ULTIMATE	AXIAL STRAIN (PERCENT)	19.9
	$\bar{\sigma}_1$ (kg/cm²)	.8
	$\bar{\sigma}_3$ (kg/cm²)	.3
	A	1.5

UNDRAINED TRIAXIAL COMPRESSION TEST

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HILLSBOROUGH COUNTY, FLORIDA

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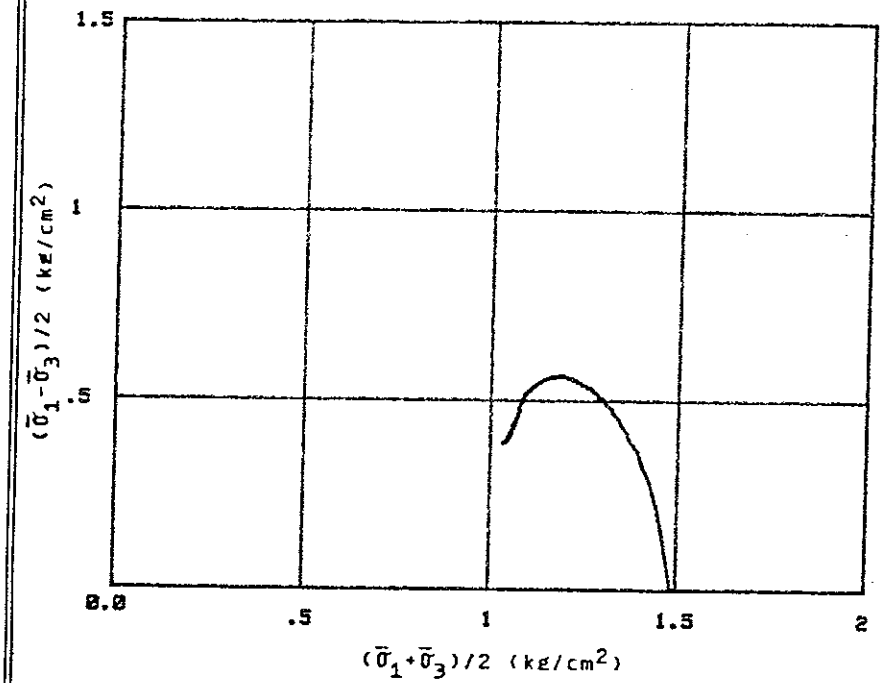
J.W.	2/4/83	David Cloud

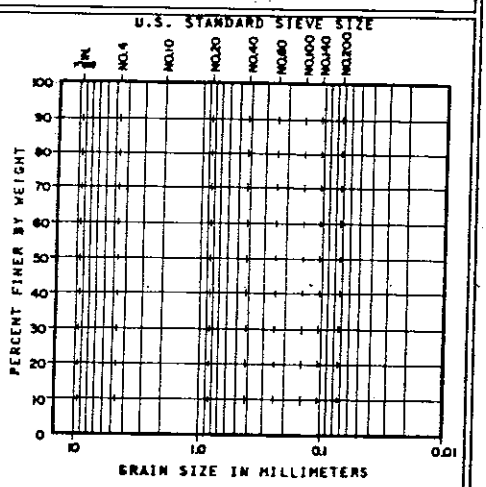
FIGURE A.6-2

TEST HOLE TH9 SAMPLE 2US1 SPECIMEN DEPTH (ft) 4-6

SOIL DESCRIPTION LT TAN SLIME TYPE OF SPECIMEN UNDISTURBED

UNIFIED CLASSIFICATION _____ STRAIN LOADING RATE .017 (%/min.)





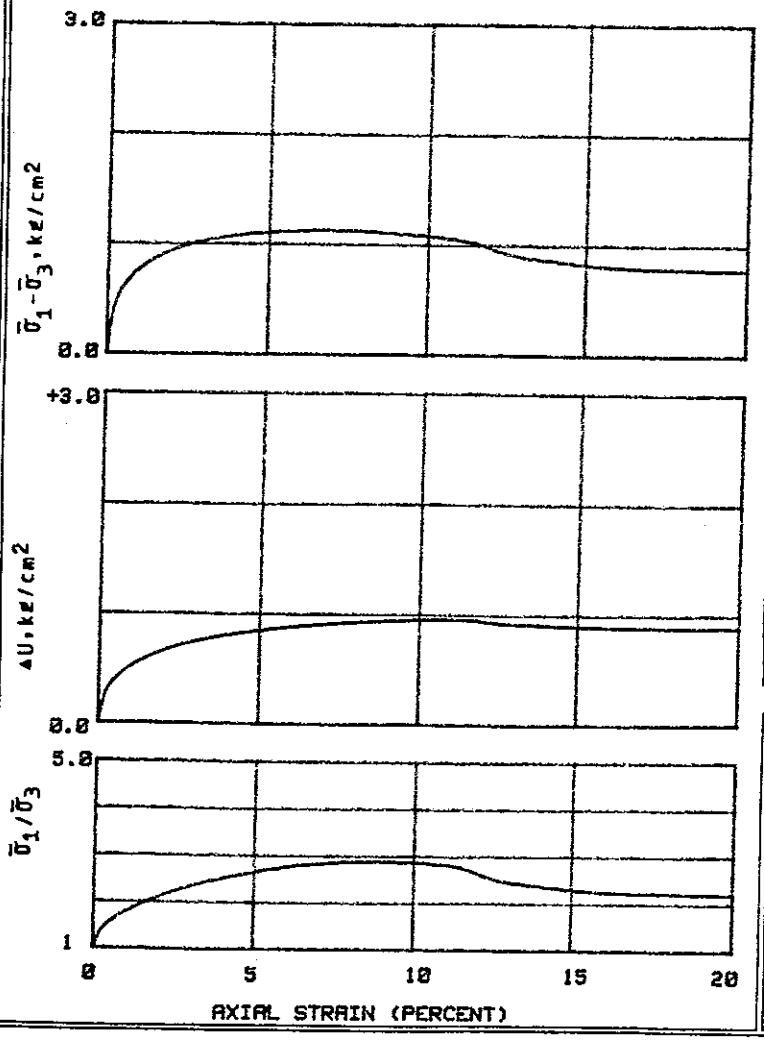
% PASSING -200 99

LIQUID LIMIT _____

PLASTIC LIMIT _____

SPECIFIC GRAVITY 2.80*

REMARKS *ASSUMED VALUE



SPECIMEN DATA		
INITIAL	WATER CONTENT (PERCENT)	104.0
	DRY DENSITY (pcf)	44.5
	VOID RATIO	2.93
	SATURATION (PERCENT)	99.5
AFTER CONSOLIDATION	CONSOLIDATION PRESSURE (kg/cm²)	1.5
	BACK PRESSURE (kg/cm²)	11.5
	PERMEABILITY (cm/sec)	N/A
	WATER CONTENT (PERCENT)	91.1
	DRY DENSITY (pcf)	49.2
	VOID RATIO	2.55
	B	.99
	SATURATION (PERCENT)	100.0 *
@ MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	AXIAL STRAIN (PERCENT)	8.8
	$\bar{\sigma}_1$ (kg/cm²)	1.7
	$\bar{\sigma}_3$ (kg/cm²)	.6
	A	.8
@ ULTIMATE	AXIAL STRAIN (PERCENT)	19.9
	$\bar{\sigma}_1$ (kg/cm²)	1.4
	$\bar{\sigma}_3$ (kg/cm²)	.6
	A	1.1

UNDRAINED TRIAXIAL COMPRESSION TEST

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HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

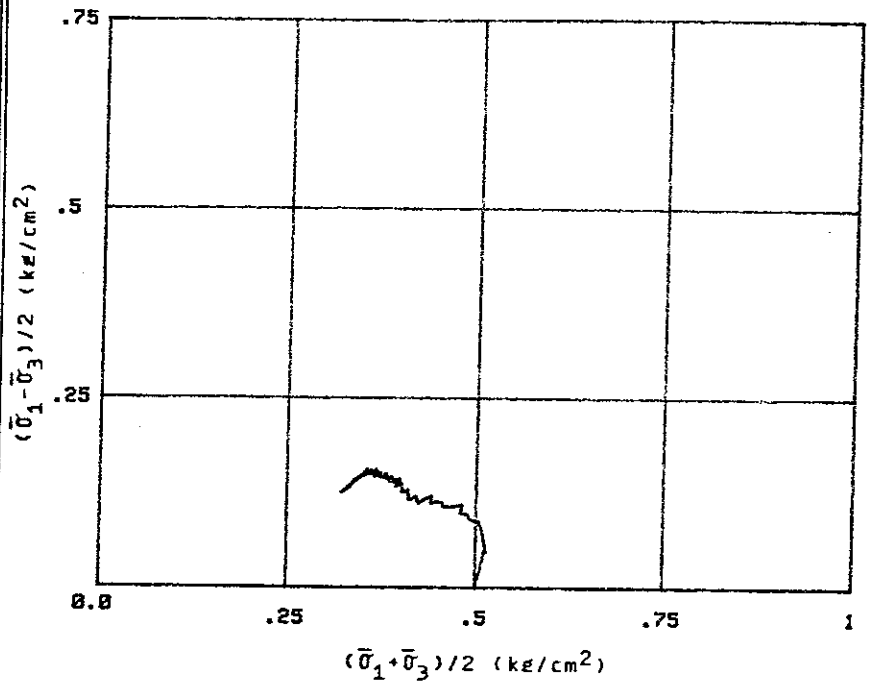
DRAWN BY:	DATE:	CHECKED BY:
J.W.	2/4/83	David Clark

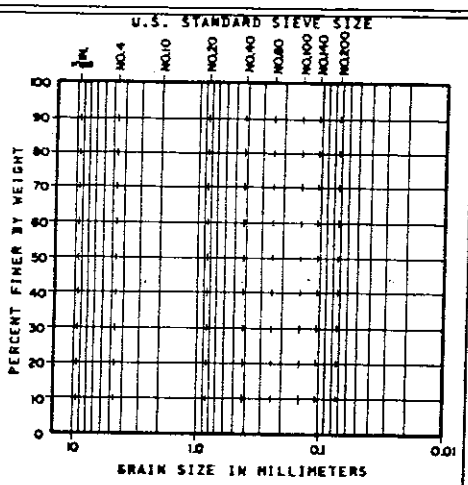
FIGURE A.6-3

TEST HOLE AB37 SAMPLE 2UD1 SPECIMEN DEPTH (ft) 3-5

SOIL DESCRIPTION BROWNISH GRAY SLIME TYPE OF SPECIMEN UNDISTURBED

UNIFIED CLASSIFICATION _____ STRAIN LOADING RATE .017 (%/min.)





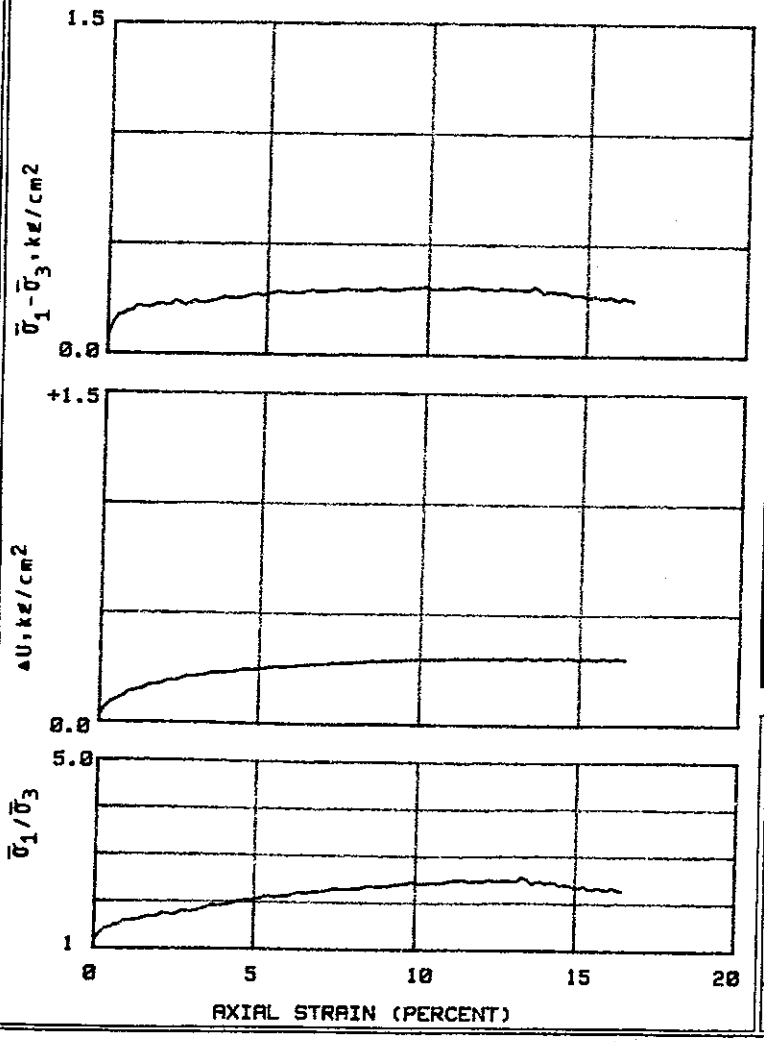
% PASSING -200 100

LIQUID LIMIT _____

PLASTIC LIMIT _____

SPECIFIC GRAVITY 2.75*

REMARKS *ASSUMED VALUE



SPECIMEN DATA		
INITIAL	WATER CONTENT (PERCENT)	224.6
	DRY DENSITY (pcf)	23.1
	VOID RATIO	6.43
	SATURATION (PERCENT)	96.1
AFTER CONSOLIDATION	CONSOLIDATION PRESSURE (kg/cm²)	.5
	BACK PRESSURE (kg/cm²)	12.5
	PERMEABILITY (cm/sec)	N/A
	WATER CONTENT (PERCENT)	150.6
	DRY DENSITY (pcf)	33.4
	VOID RATIO	4.14
	B	.99
	SATURATION (PERCENT)	100.0 *
@ MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	AXIAL STRAIN (PERCENT)	13.3
	$\bar{\sigma}_1$ (kg/cm²)	.5
	$\bar{\sigma}_3$ (kg/cm²)	.2
	A	1.0
@ ULTIMATE	AXIAL STRAIN (PERCENT)	16.4
	$\bar{\sigma}_1$ (kg/cm²)	.4
	$\bar{\sigma}_3$ (kg/cm²)	.2
	A	1.2

UNDRAINED TRIAXIAL COMPRESSION TEST

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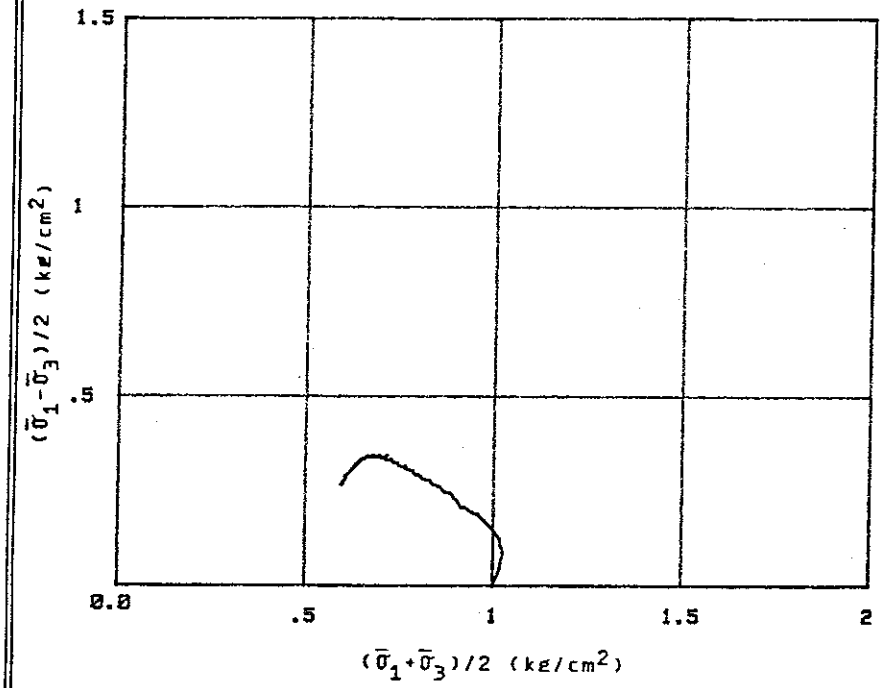
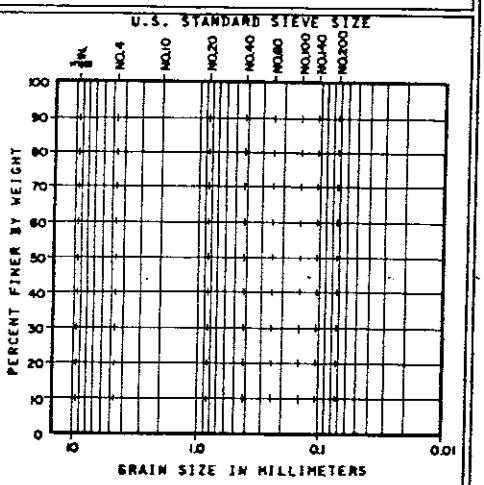
HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY:	DATE:	CHECKED BY:
J.W.	2/4/83	David Clardy

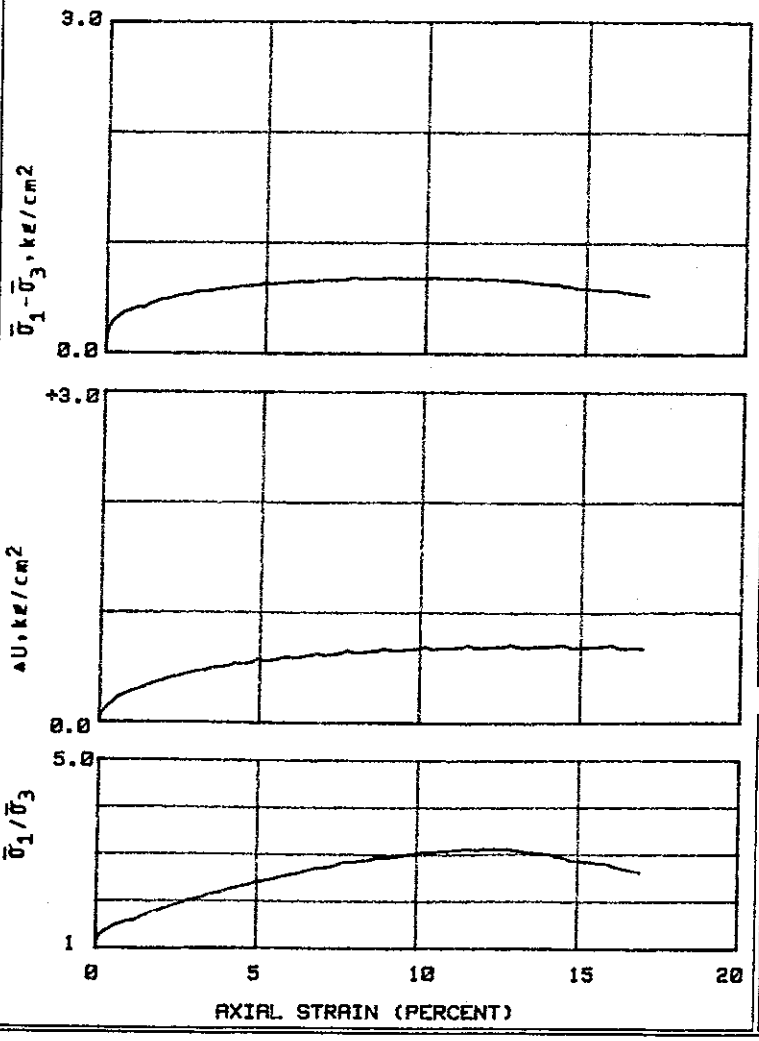
FIGURE A.6-4

TEST HOLE RB37 SAMPLE US2 SPECIMEN DEPTH (ft) 10-12
SOIL DESCRIPTION GRAYISH BROWN SLIME TYPE OF SPECIMEN UNDISTURBED
UNIFIED CLASSIFICATION _____ STRAIN LOADING RATE .017 (%/min.)





% PASSING -200 _____
LIQUID LIMIT _____
PLASTIC LIMIT _____
SPECIFIC GRAVITY 2.75
REMARKS *ASSUMED VALUE



SPECIMEN DATA		
INITIAL	WATER CONTENT (PERCENT)	199.9
	DRY DENSITY (pcf)	24.9
	VOID RATIO	5.89
	SATURATION (PERCENT)	93.4
AFTER CONSOLIDATION	CONSOLIDATION PRESSURE (kg/cm^2)	1.0
	BACK PRESSURE (kg/cm^2)	12.0
	PERMEABILITY (cm/sec)	N/A
	WATER CONTENT (PERCENT)	118.4
	DRY DENSITY (pcf)	40.4
	VOID RATIO	3.25
	B	.99
	SATURATION (PERCENT)	100.0 *
@ MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	AXIAL STRAIN (PERCENT)	11.5
	$\bar{\sigma}_1$ (kg/cm^2)	1.0
	$\bar{\sigma}_3$ (kg/cm^2)	.3
	A	1.0
@ ULTIMATE	AXIAL STRAIN (PERCENT)	16.9
	$\bar{\sigma}_1$ (kg/cm^2)	.9
	$\bar{\sigma}_3$ (kg/cm^2)	.3
	A	1.3

UNDRAINED TRIAXIAL COMPRESSION TEST

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ENGINEERING TESTING LABORATORIES

HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

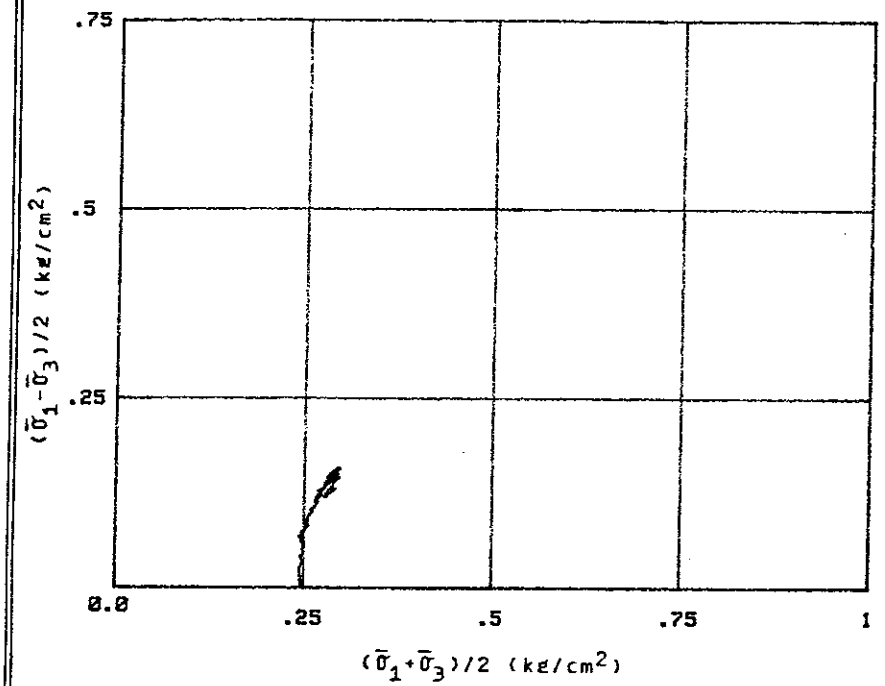
DRAWN BY:	DATE:	CHECKED BY:
J.W.	2/4/83	David Clardy

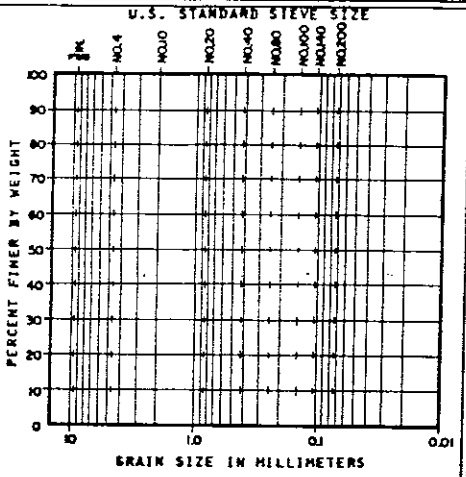
FIGURE A.6-5

TEST HOLE BB37 SAMPLE 3UD1 SPECIMEN DEPTH (ft) 3-5

SOIL DESCRIPTION GRAY CLAY SLIME TYPE OF SPECIMEN UNDISTURBED

UNIFIED CLASSIFICATION _____ STRAIN LOADING RATE .017 (%/min.)





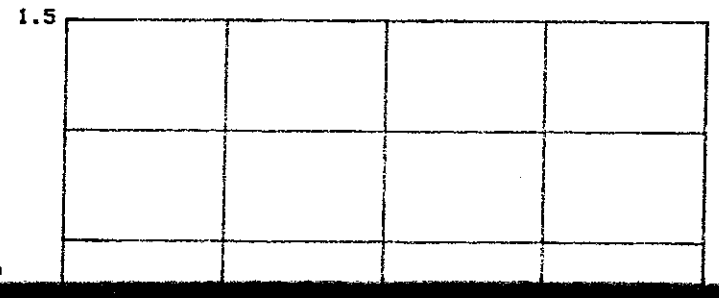
% PASSING -200 _____

LIQUID LIMIT _____

PLASTIC LIMIT _____

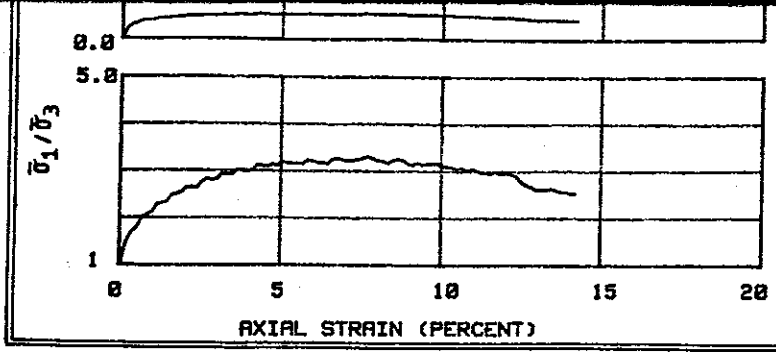
SPECIFIC GRAVITY 2.75*

REMARKS *ASSUMED VALUE



	SPECIMEN DATA	
INITIAL	WATER CONTENT (PERCENT)	226.9
	DRY DENSITY (pcf)	26.0
	VOID RATIO	5.61
	SATURATION (PERCENT)	100.0
CONSOLIDATION	CONSOLIDATION PRESSURE (kg/cm²)	.3
	BACK PRESSURE (kg/cm²)	12.8
	PERMEABILITY (cm/sec)	N/A
	WATER CONTENT (PERCENT)	1[illegible]

[redacted]



UNDRAINED TRIAXIAL COMPRESSION TEST

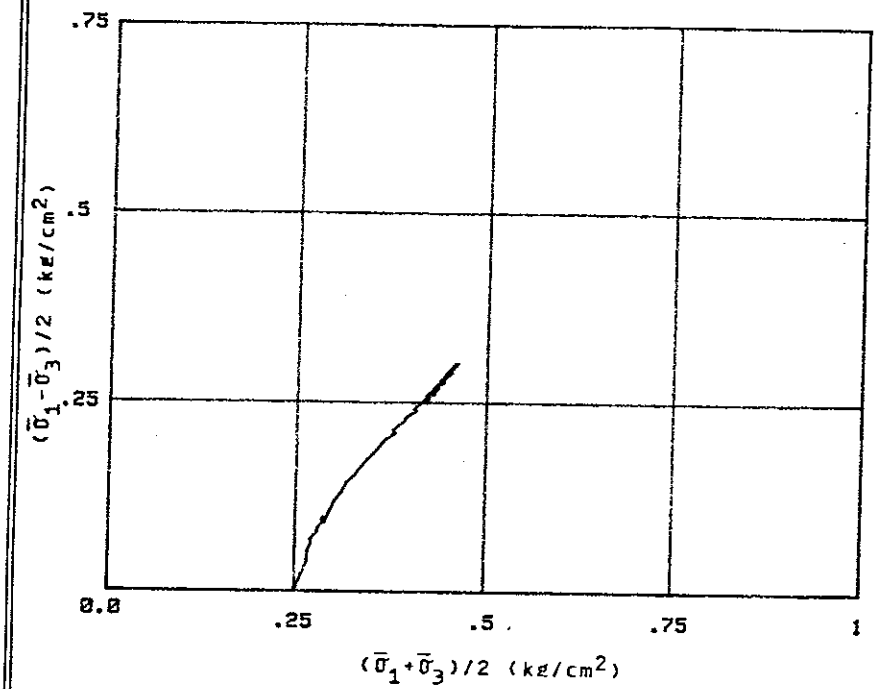
Ardaman & Associates, Inc.
ENGINEERING TESTING/ LABORATORIES

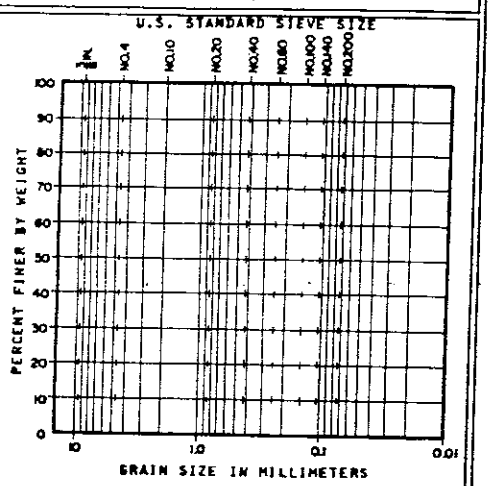
HYDROGEOLOGICAL INVESTIGATION
SOUTHEAST COUNTY LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY:	DATE:	CHECKED BY:
J.W.	2/4/83	David Clardy

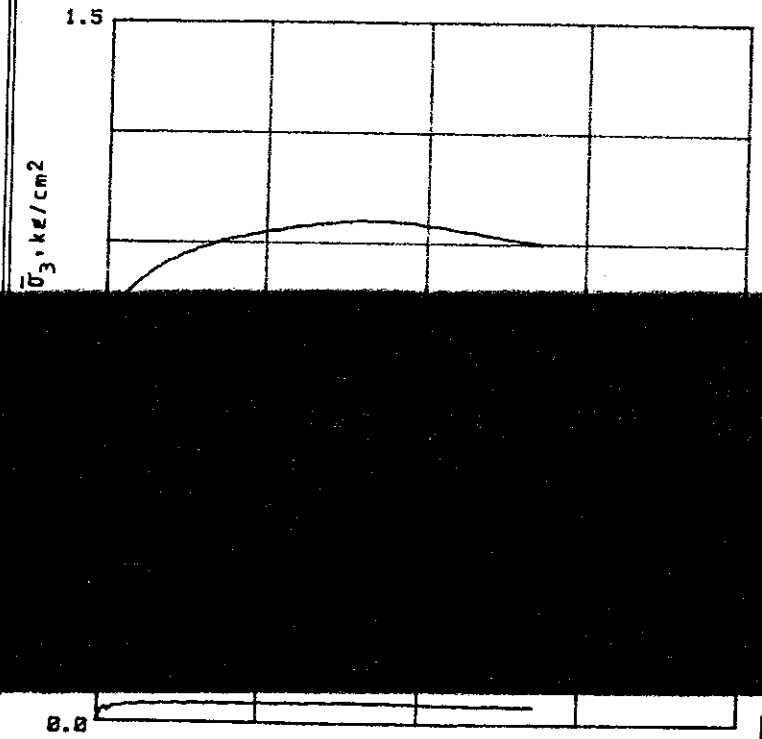
FIGURE A.6-6

TEST HOLE BB37 SAMPLE US2 SPECIMEN DEPTH (ft) 10-12
SOIL DESCRIPTION GRAYISH BROWN SLIME TYPE OF SPECIMEN UNDISTURBED
UNIFIED CLASSIFICATION _____ STRAIN LOADING RATE .017 (%/min.)





% PASSING -200 _____
LIQUID LIMIT _____
PLASTIC LIMIT _____
SPECIFIC GRAVITY 2.75*
REMARKS *ASSUMED VALUE



SPECIMEN DATA		
INITIAL	WATER CONTENT (PERCENT)	136.4
	DRY DENSITY (pcf)	34.6
	VOID RATIO	3.96
	SATURATION (PERCENT)	94.7
CONSOLIDATION	CONSOLIDATION PRESSURE (kg/cm²)	.3
	BACK PRESSURE (kg/cm²)	12.8
	PERMEABILITY (cm/sec)	N/A
	WATER CONTENT (PERCENT)	[redacted]

[redacted]

UNDRAINED TRIAXIAL COMPRESSION TEST

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HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY:	DATE:	CHECKED BY:
J.W.	2/4/83	David Clarke

FIGURE A.6-7