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Subsurface Conditions Data Report South MSE Wall and Adjacent Embankment Third Runway Project Sea-Tac International Airport

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Prepared for
Port of Seattle and
HNTB

April 7, 2000
J-4978-23

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SOUTH MSE WALL AND ADJACENT EMBANKMENT
THIRD RUNWAY PROJECT
SEA-TAC INTERNATIONAL AIRPORT

INTRODUCTION

This data report presents information on subsurface conditions, based on geotechnical and hydrogeologic field and laboratory testing to support the South MSE Wall and adjacent embankment construction for the Third Runway Project at the Sea-Tac International Airport.

The site is located at the Sea-Tac International Airport, in SeaTac, Washington (refer to Figure 1, Vicinity Map). The shaded area on Figure 1 is presented on Figure 2, Site and Exploration Plan, showing exploration locations both for this report and those performed previously by Hart Crowser and others. A profile along the proposed mechanically stabilized earth (MSE) wall alignment showing subsurface conditions beneath the proposed wall is presented on Figure 3. Cross sections showing inferred geologic conditions are provided on Figures 4 and 5.

This data report discusses the subsurface soil conditions in the area of the South MSE Wall followed by a discussion of hydrogeologic conditions. Appendices A and B follow the main text and present results of our subsurface explorations and laboratory testing, respectively.

PURPOSE AND SCOPE

The purpose of this report is to provide information on subsurface soil and groundwater conditions affecting construction of the South MSE Wall. Proposed construction in this area includes the Third Runway embankment and the South MSE Wall adjacent to Wetland 44. Additional information in other reports is listed in the references at the end of this report. The information presented herein provides the basis for our geotechnical engineering analyses and recommendations.

Information presented herein was obtained in general accordance with Task 1.2 of Work Element No. 3 presented in Contract Modification No. 3.

GENERALIZED GEOLOGIC DESCRIPTION AND SUBSURFACE SOIL CONDITIONS

This section provides a description of the geologic and subsurface soil conditions in the area of the South MSE Wall, shown on Figure 2, based on Hart Crowser's explorations at the site and explorations by others.

Generalized Geologic Conditions

Generalized geologic conditions in the project area have been described in the Preliminary Engineering Report, Volume 2 (Applied Geotechnology Inc., 1994). The following is a summary of the geologic units identified at the Third Runway project site:

- Fill (loose to medium dense, locally dense, variably graded, silt, sand, and gravel);
- Alluvium (primarily soft to stiff peat, clay, and silt; and very loose to medium dense, fine to medium sand);
- Recessional Outwash (primarily loose to dense, silty sand and gravel, and/or medium stiff to hard, sandy silt and/or sandy clay);
- Glacial Till (dense to very dense, silty sand and gravel, and hard sandy silt);
- Advance Outwash (dense to very dense, non-silty to silty sand and gravel); and
- Lawton Clay (very stiff to hard silt and clay).

Subsurface Conditions

Subsurface soil conditions interpreted from materials encountered in explorations at the site and soil properties inferred from laboratory tests formed the basis for the information contained in this report. Variations between explorations occur due to the variability in gradation, moisture content, and density/consistency of soils at the site. The nature and extent of these variations may not become evident until construction. If variations become evident, it will be necessary to re-evaluate our interpretation of the soil conditions at the site, as well as any recommendations based on those interpretations.

Generalized subsurface conditions in the area of the South MSE Wall are shown on the Generalized Subsurface Profile on Figure 3 and Cross Sections C-C'

(Runway Station 142+73) and E-E' (Runway Station 145+44) on Figures 4 and 5, respectively.

The following soil materials were observed in this area:

Loose to medium dense, slightly gravelly to gravelly, slightly silty to very silty SAND (FILL). Surficial fill materials, in some cases as deep of 9 to 18 feet, were encountered in the some borings and several test pits in this area.

Very soft, peaty, organic SILT. One borings (HC00-B208) and one test pit (HC00-TP212) encountered peat in the upper 2 feet of the explorations. These explorations are located within or adjacent to Wetland 44. Other explorations planned in the vicinity of Wetland 44 have not yet been drilled because of access limitations. However, we presume peat likely occurs in this area.

Stiff to very stiff, very sandy SILT and CLAY and silty CLAY. A 5-foot-thick layer of clay was encountered in boring HC00-B205 and a 3-foot-thick layer of silty clay was encountered in Test Pit HC00-TP218. Discontinuous zones of or lenses of silt and clay may also occur elsewhere in this general area.

Medium dense to very dense, slightly gravelly to gravelly, slightly silty to very silty SAND. These soils were encountered in most of the explorations and have been inferred to be the primary unit underlying the soils described above. The top of these soils extends from near surface to depths of more than 40 feet. These soils may have originated as Glacial Till and/or Advance Outwash deposits. These materials are very similar in texture and density often making a determination of specific geologic origin difficult.

Hydrogeologic Conditions

Groundwater Occurrence

Five new wells (HC00-B203, HC00-B205, HC00-B208, HC00-B211, and HC00-B213) were installed during this phase of work;. The water levels observed in the open borings at the time of drilling (ATD) and subsequent to monitoring well installation and development are shown on the boring logs (Appendix A).

Groundwater is apparently discontinuous across the site within the depth of the explorations accomplished. Groundwater elevation varied considerably as indicated on the logs, in Table 1, and on Figures 3, 4, and 5.

Most of the observed groundwater levels appear to indicated unconfined conditions which likely are due to discontinuous perched water zones related to

more or less silty zones within the glacial till and outwash soils. In contrast, apparently confined groundwater was encountered in boring HC00-B208 at a depth of about 34 feet (elevation 242 feet) with an excess head of about 278 feet in elevation (approximately 2 feet above ground surface at the boring location).

Groundwater Monitoring

Hart Crowser has not been able to locate any previous recorded groundwater level measurements in the vicinity of the South MSE Wall, other than the observations at time of drilling (ATD).

Groundwater elevation data are now being collected monthly from ten wells in the area of the South MSE Wall, beginning with the monitoring event on March 10, 2000. The wells which are being monitored monthly include the five new wells listed above, and five existing wells. Well construction information, depth to water, and groundwater elevation data are presented in Table 1. As future monitoring events are completed, seasonal changes in groundwater elevation and flow patterns will be evaluated in the area of South MSE Wall.

Groundwater Flow Mapping

Data are currently being collected to prepare a groundwater elevation contour map of this area. This map and a discussion of flow patterns will be provided in a future report for the South MSE Wall.

USE OF THIS REPORT

This report has been prepared for the exclusive use of HNTB and the Port of Seattle, for the site and project described herein. We completed this work according to generally accepted geotechnical engineering practices in the same or similar localities, related to the nature of the work accomplished, at the time the services were accomplished. We make no other warranty, express or implied.

Hart Crowser appreciates the opportunity to provide this information. Please call if you have any questions.

Sincerely,

HART CROWSER, INC.

MICHAEL J. BAILEY, P.E.
Project Manager

GREGORY T. BOTH
Associate

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REFERENCES

Applied Geotechnology, Inc., 1994. First Draft: Seattle-Tacoma International Airport Third Dependent Runway Preliminary Engineering Report, Volume 2, March 31, 1994.

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Table 1 - South MSE Wall Area Water Level Data

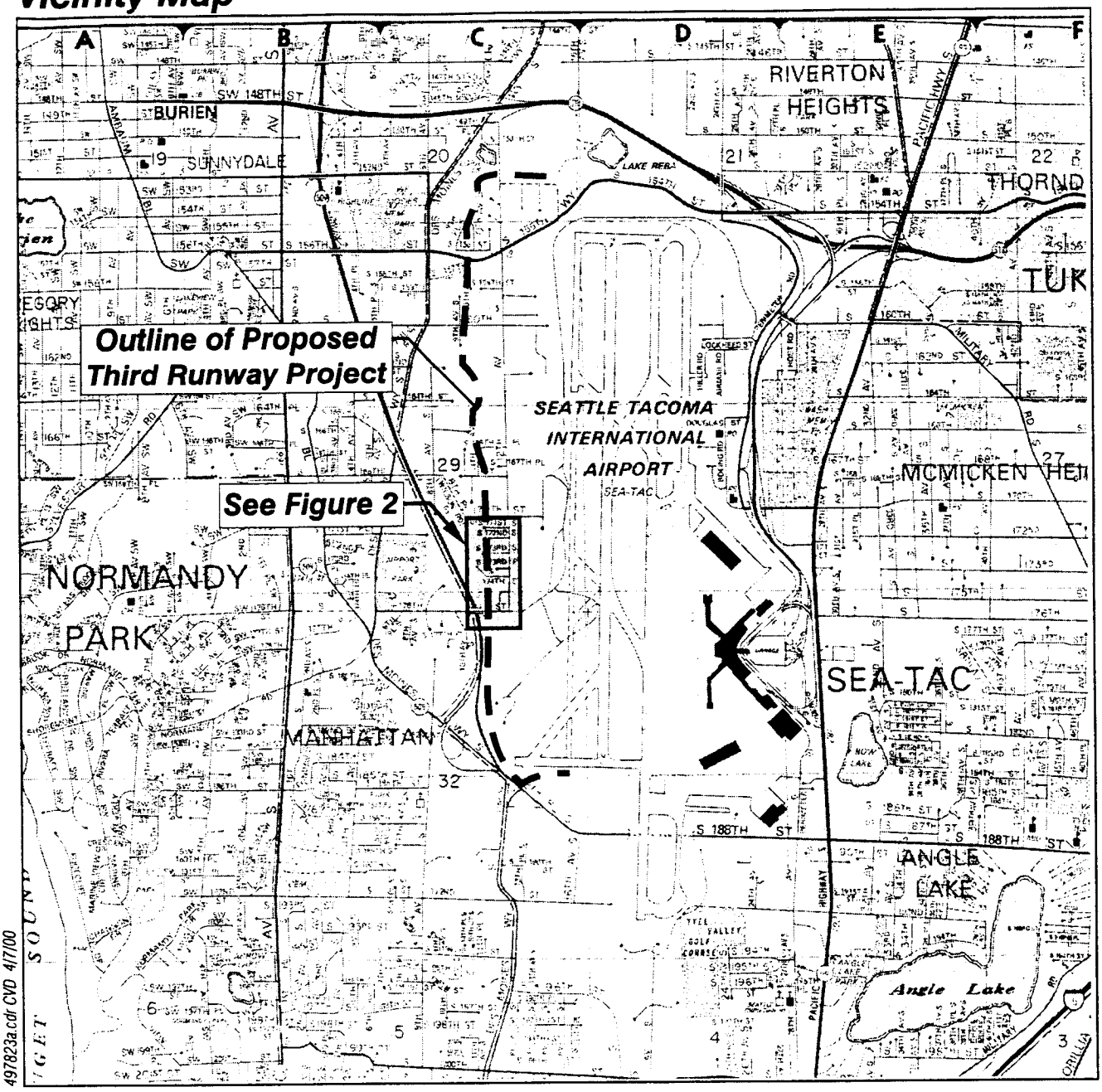
	AT94A-B1		AT97-B8		AT97-B59		AT97-B61		AT97-B63		HC00-B203		HC00-B205	
	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet
Measuring Point	0.00	*356.2*	0.00	*379.2*	0.00	*312.9*	0.00	*328.0*	0.00	*330.5*	0.00	310.95	0.00	306.19
Ground Level*	1.2	*355*	2.2	*377*	2.9	*310*	3.0	*325*	2.5	*328*	2.0	309.0	2.8	303.4
Top of Screen*	74.2	282.0	15.2	364.0	22.4	290.5	32.0	296.0	42.0	288.5	33.0	278.0	12.8	293.4
Bottom of Screen*	84.2	272.0	20.2	359.0	24.4	288.5	34.0	294.0	44.0	286.5	38.0	273.0	17.8	288.4
Date: 3/10/2000	62.50	293.7	4.65	374.6	14.35	298.6	33.01	295.0	37.94	292.6	25.32	285.63	13.55	292.64
Estimated Groundwater Elevation ATD (date shown)		*290* (12/21/94)		*359* (9/16/97)		*290* (10/10/97)		*295* (10/10/97)		Not observed (10/13/97)		*282* (2/21/00)		Not observed (2/18/00)

Italics = Estimated
Depth* All depths are below measuring point (NOT below the ground surface)
– Indicates data not available.
ATD = Information from AGI boring logs provided by HNTB.

Table 1 - South MSE Wall Area Water Level Data

	HC00-B208		HC00-B211		HC00-B213	
	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet
Measuring Point	0.00	278.67	0.00	301.70	0.00	313.35
Ground Level*	2.4	276.3	2.3	299.4	2.4	311.0
Top of Screen*	29.9	248.8	16.3	285.4	12.4	301.0
Bottom of Screen*	34.9	243.8	21.3	280.4	22.4	291.0
Date: 3/10/2000	0.43	278.24	1.51	300.19	15.47	297.88
Estimated Groundwater Elevation ATD (date shown)		*272* (2/17/00)		*291* (2/17/00)		*293* (2/23/00)

Vicinity Map



497823a.cdr CVD 4/7/00

0 2000 4000

Scale in Feet

N

AR 044391

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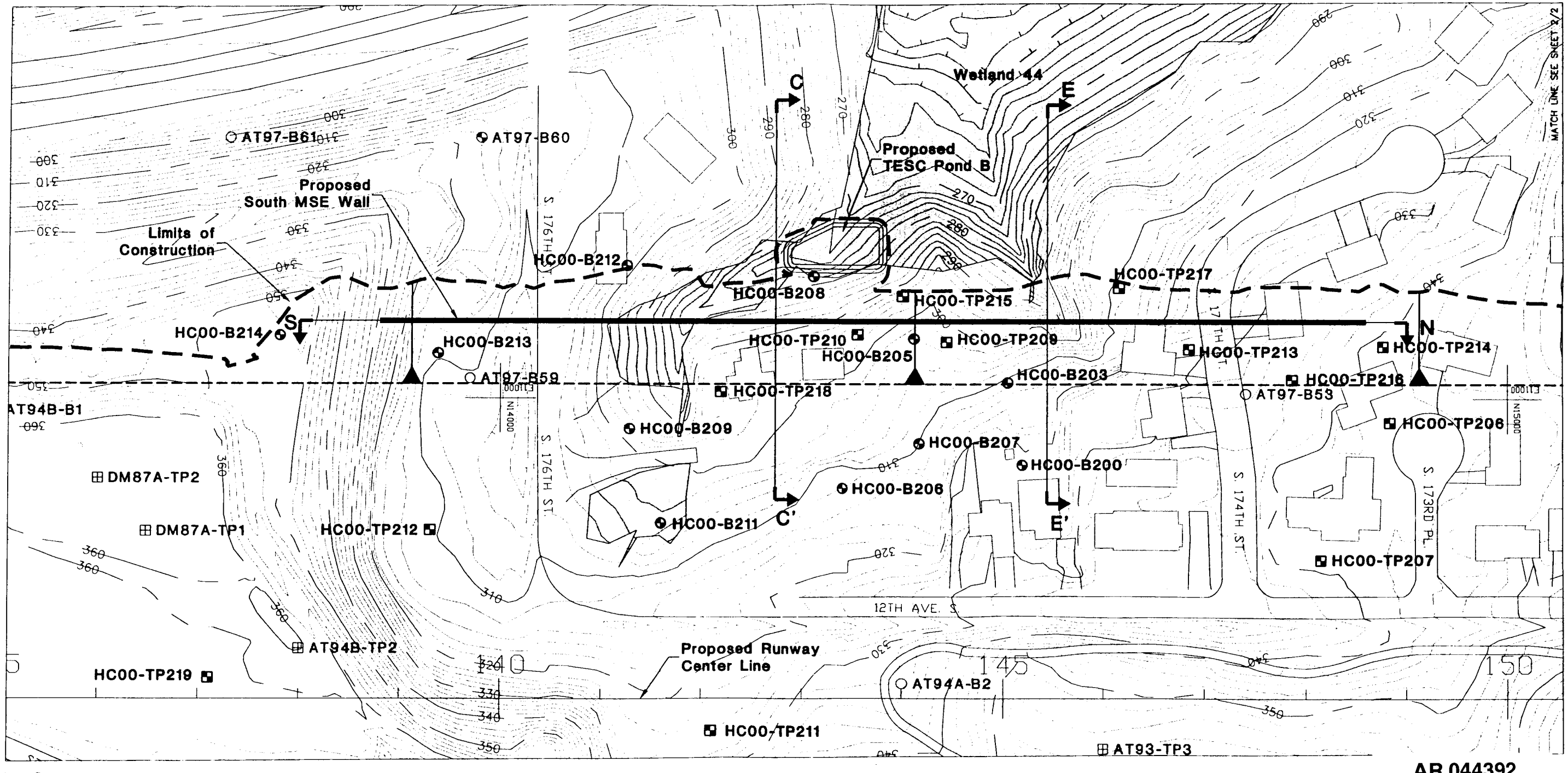
Figure 1

Site and Exploration Plan

South MSE Wall



Note: Base map prepared from drawing provided by HNTB entitled "Topo_Full.dwg," dated October 4, 1999. Wetland delineation prepared from drawing provided by Parametrix entitled "W_020800.dwg," dated February 8, 2000.

Exploration Location and Number

- HC00-B214 Boring, Hart Crowser (Current Study)
- HC99-TP29 Test Pit, Hart Crowser (Current Study)
- AT97-B70 Boring, by Others (Previous Study)
- AT94B-TP14 Test Pit, by Others (Previous Study)

AA' Profile/Cross Section Location and Designation

Wetland Location

N

0 100 200

Scale in Feet

AR 044392

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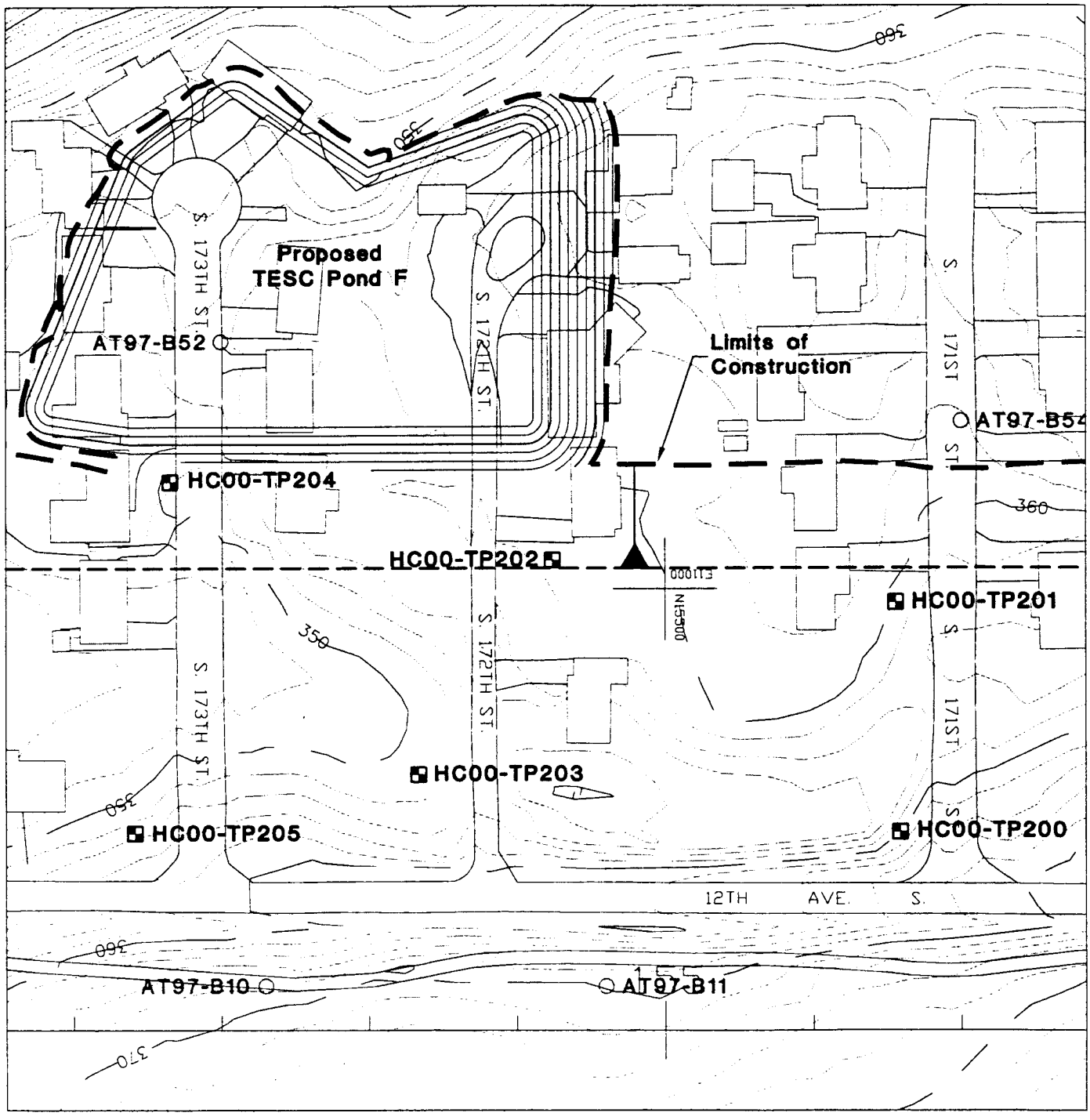
Figure 2 1/2

RC 4/5/00 1=100 (xref)see drawing file/woodstck.pc2 49782301

Site and Exploration Plan
Embankment Adjacent to TESC Pond F



Note: Base map prepared from drawing provided by HNTB entitled "Topo_Full.dwg," dated October 4, 1999.

N

0 100 200

Scale in Feet

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Figure 2 2/2

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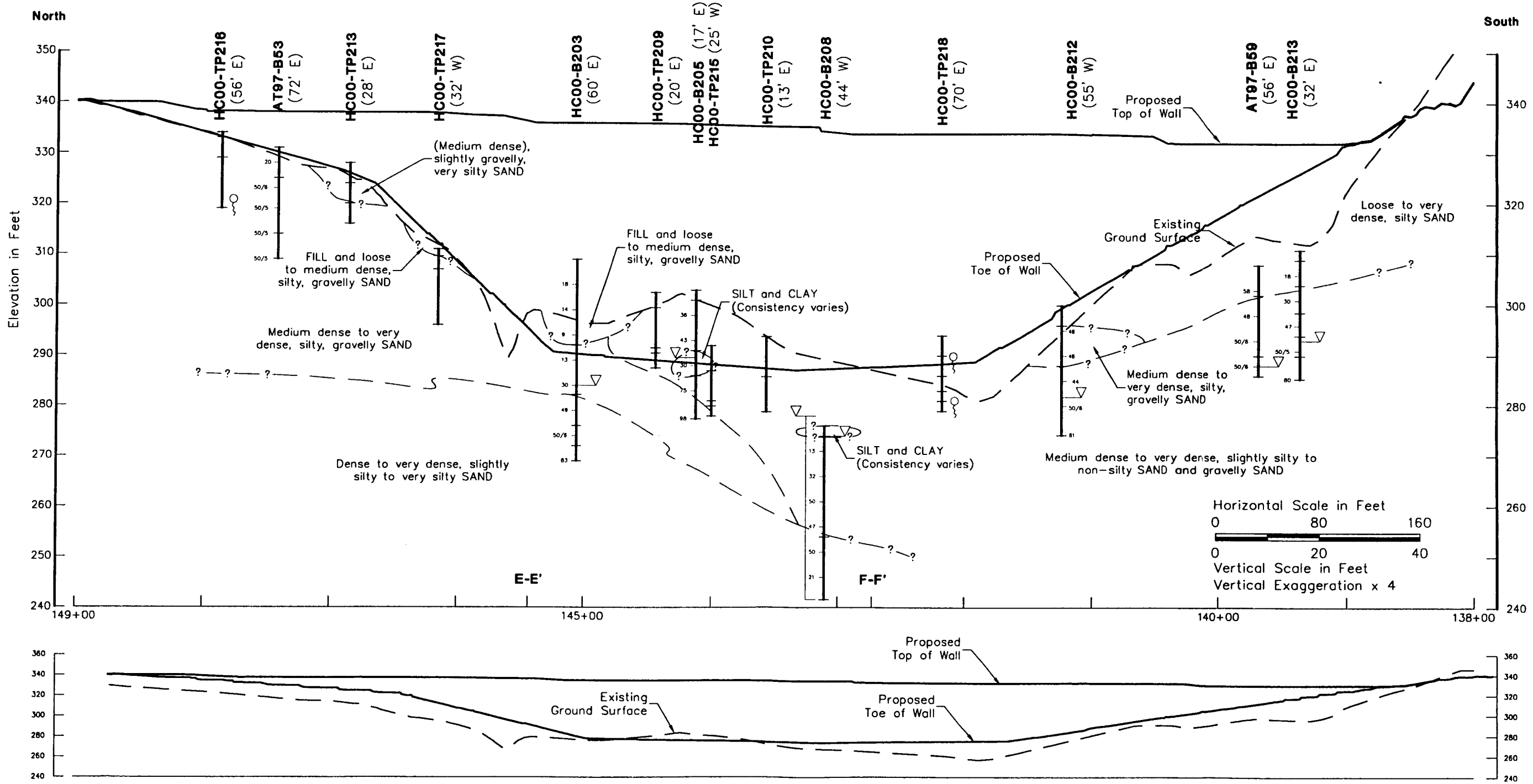
RC 3/29/00 1=100 (xref)see drawing files/color.pc2
49782302.dwg

Generalized Subsurface Profile N-S

South MSE Wall (Looking East)



Note: Contacts between soil units are based upon interpolation between borings and represent our interpretation of subsurface conditions based on currently available data. See exploration logs fro detailed information at specific locations.

HC00-B205
(17' E)
Exploration Number
(Offset Distance and Direction)

Exploration Location

Water Level

50/6
N Value

0 80 160
Scale in Feet

RC 4/6/00 1=80 woodstck.pc2
49782307.dwg

AR 044394

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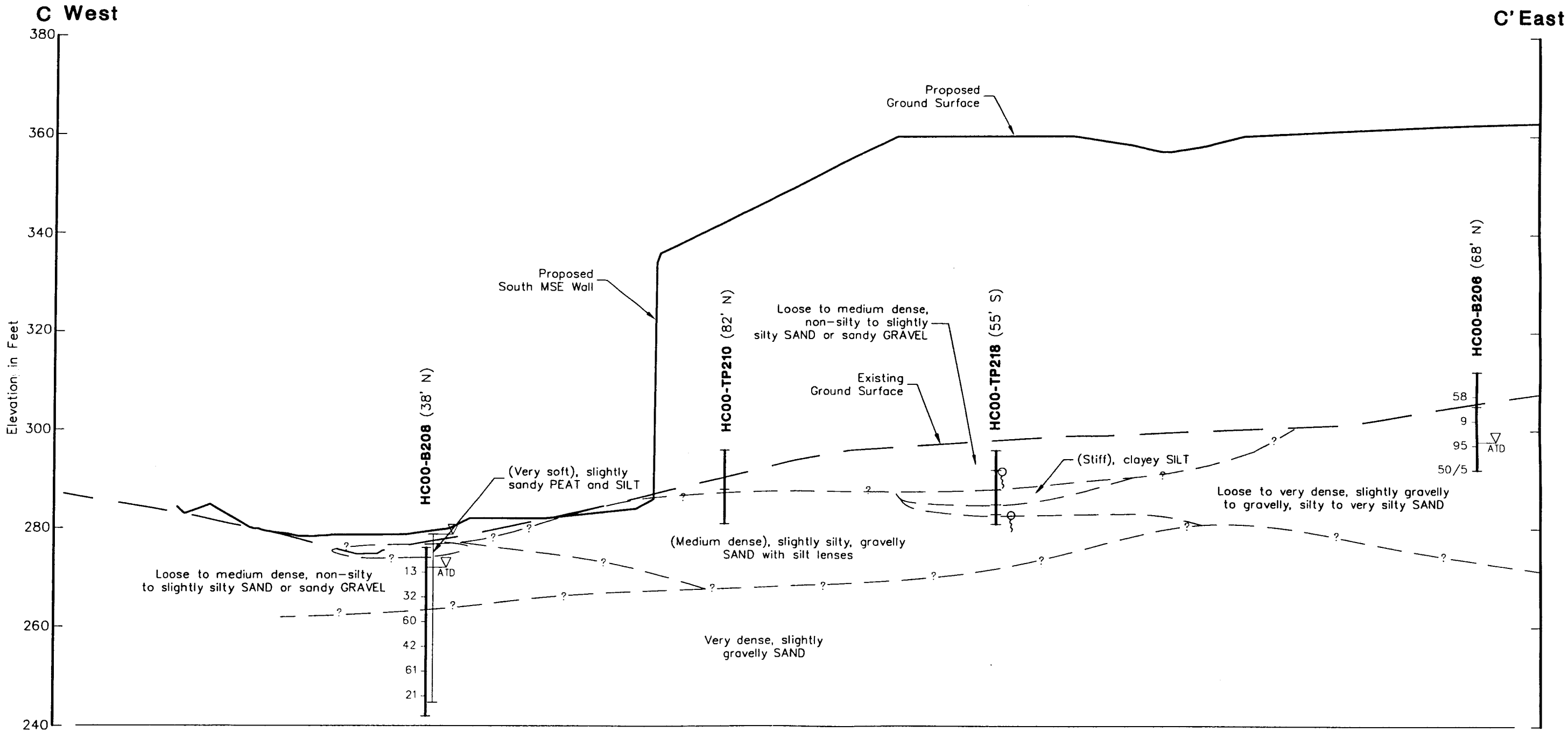
Figure 3

Generalized Subsurface Cross Section C-C'

South MSE Wall (Station 142+73) (Looking North)



Note: Contacts between soil units are based upon interpolation between borings and represent our interpretation of subsurface conditions based on currently available data. See exploration logs for detailed information at specific locations.

HC00-TP210 Exploration Number
(82' N) (Offset Distance and Direction)

Exploration Location

ATD Water Level

95 N Value

0 20 40
Scale in Feet

RC 4/6/00 1=20 woodstick.pc2
43782303.dwg

AR 044395

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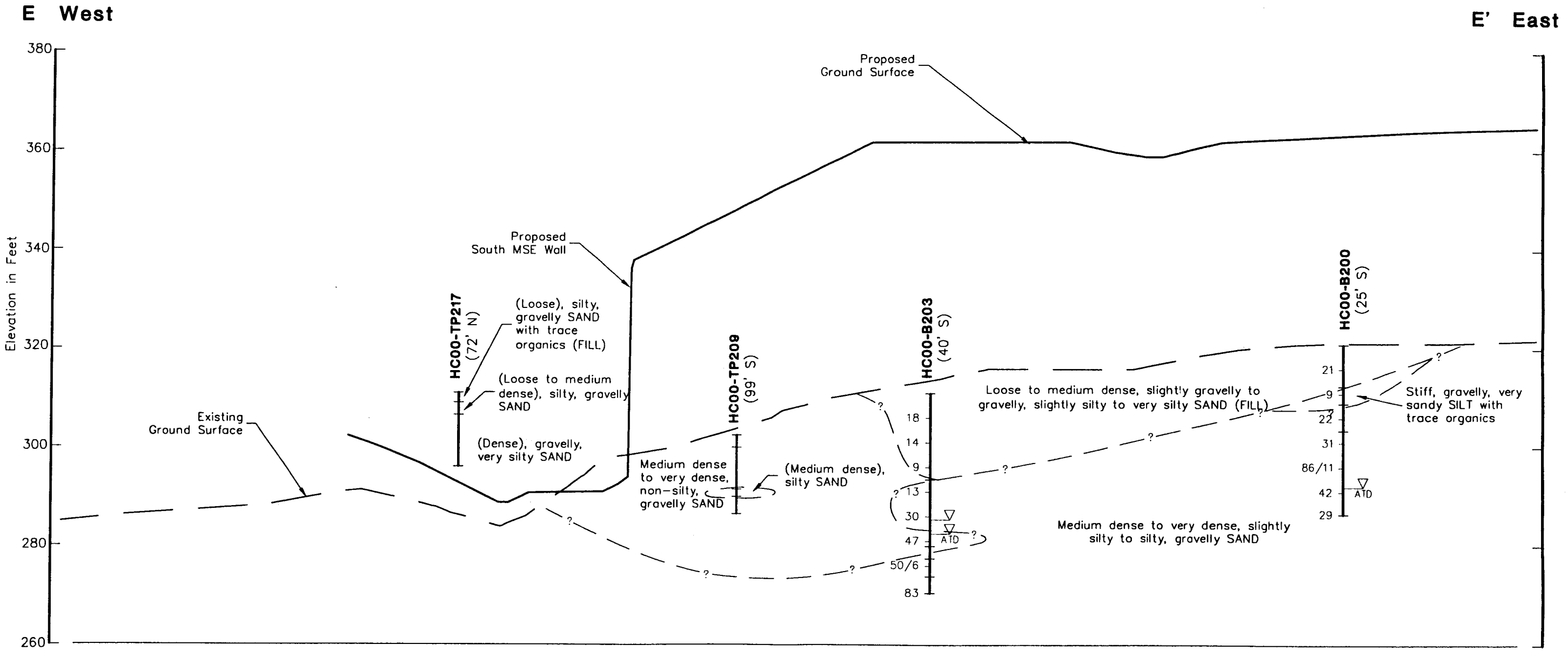
Figure 4

Generalized Subsurface Cross Section E-E'

South MSE Wall (Station 145+44) (Looking North)



Note: Contacts between soil units are based upon interpolation between borings and represent our interpretation of subsurface conditions based on currently available data. See exploration logs for detailed information at specific locations.

HC00-TP217 Exploration Number
(72' N) (Offset Distance and Direction)

Exploration Location

ATD Water Level

50/6 N Value

0 20 40
Scale in Feet

RC 4/6/00 1=20 woodstck.pc2
49782305.dwg

AR 044396

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Figure 5

APPENDIX A
FIELD EXPLORATIONS METHODS AND ANALYSIS

APPENDIX A
FIELD EXPLORATIONS METHODS AND ANALYSIS

This appendix documents the processes Hart Crowser used in determining the nature of the soils underlying the project site addressed by this report. The discussion includes information on the following subjects:

- Explorations and Their Location;
- The Use of Auger Borings;
- Standard Penetration Test (SPT) Procedures;
- Excavation of Test Pits;
- Monitoring Well Installation;
- Monitoring Well Development;
- Water Level Measurement; and
- References for Appendix A.

Explorations and Their Location

Subsurface explorations for this project include the following:

Borings
HC00-B200, HC00-B203, HC00-B205 through HC00-B209, and HC00-B211 through HC00-B214.

Test Pits
HC00-TP200 through HC00-TP207 and HC00-TP209 through HC00-TP219.

The exploration logs within this appendix show our interpretation of the material encountered based on drilling (or excavation), sampling, and testing data. They indicate the depth where the soils change. Note that the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1 - Key to Exploration Logs. This figure also provides a legend explaining the symbols and abbreviations used in the logs.

Location of Explorations. Figure 2 shows the location of explorations. Borings and test pits were located using a global positioning system (GPS) survey by Hart Crowser. Port of Seattle surveyors performed an x, y, z survey for the top of casing elevations of the wells and ground elevations for some borings completed without wells. Where available, the Port's survey supersedes the GPS locations. Where Port survey data are not available, ground surface elevations were

interpreted from the aerial survey topography shown on Figure 2. The method used determines the accuracy of the location and elevation of the explorations.

The Use of Auger Borings

With depths ranging from 19.4 to 45.5 feet below the ground surface, eleven hollow-stem auger borings, designated HC00-B200, HC00-B203, HC00-B205 through HC00-B209, and HC00-B211 through HC00-B214, were drilled from February 16 through 23, 2000. The borings used a 3-3/8-inch inside diameter hollow-stem auger and were advanced with a truck-mounted drill rig subcontracted by Hart Crowser. An engineering geologist from Hart Crowser continuously observed the drilling. Detailed field logs were prepared of each boring. Using the Standard Penetration Test (SPT), we obtained samples at 2-1/2- to 5-foot-depth intervals for these borings.

Groundwater levels in the borings were noted at the time of drilling (ATD) and following installation and development of observation wells where noted on the boring logs and shown in Table 1.

The borings logs are presented on Figures A-2 through A-12 at the end of this appendix.

Standard Penetration Test (SPT) Procedures

This test is an approximate measure of soil density and consistency. To be useful, the results must be used with engineering judgment in conjunction with other tests. The SPT (as described in ASTM D 1587) was used to obtain disturbed samples. This test employs a standard 2-inch outside diameter split-spoon sampler. Using a 140-pound hammer, free falling 30 inches; the sampler is driven into the soil for 18 inches. The number of blows (N value) required to drive the sampler the last 12 inches only is the Standard Penetration Resistance. This resistance, or blow count, measures the relative density of granular soils and the consistency of cohesive soils. The blow counts are plotted on the boring logs at their respective sample depths.

Soil samples are recovered from the split-barrel sampler, field classified, and placed into water tight jars. They are then taken to Hart Crowser's laboratory for further testing.

Some instances of "heave" are noted on boring logs. Heave is a phenomenon that occurs typically within a sand soil where there is excess seepage pressure at the bottom of the auger (i.e., water within the augers is at a lower elevation than the groundwater level surrounding the boring). A sufficient difference in water

levels will cause the sandy soils to be displace upward into the auger, thereby disturbing the soil formation. Therefore, the corresponding SPT N values do not accurately indicate density. Heave is typically controlled by sustaining the water level within the auger at or near the surrounding groundwater level; no drilling mud was used in the explorations described in this report.

In the Event of Hard Driving

Occasionally very dense materials or the presence of gravel and/or cobbles prevented driving the total 18-inch sample. When this happens, the penetration resistance is entered on logs as follows:

Penetration less than six inches. The log indicates the total number of blows over the number of inches of penetration.

Penetration greater than six inches. The blow count noted on the log is the sum of the total number of blows completed after the first 6 inches of penetration. This sum is expressed over the number of inches driven that exceed the first 6 inches. The number of blows needed to drive the first 6 inches is not reported. For example, a blow count series of 12 blows for 6 inches, 30 blows for 6 inches, and 50 (the maximum number of blows counted within a 6-inch increment for SPT) for 3 inches would be recorded as 80/9.

Excavation of Test Pits

Nineteen test pits, designated HC00-TP200 through HC00-TP207 and HC00-TP209 through HC00-TP219, were excavated across the site with a tractor-mounted backhoe provided by Port Construction Services. The test pits were excavated between February 16 and March 2, 2000. The sides of these excavated pits offer direct observation of the subgrade soils. The test pits were located by and excavated under the direction of an engineering geologist from Hart Crowser. The geologist observed the soil exposed in the test pits and reported the findings on a field log. Our geologist took representative samples of soil types for testing at Hart Crowser's laboratory The field geologist noted groundwater levels or seepage during excavation on the log. The density/ consistency of the soils (as presented parenthetically on the test pit logs to indicate their having been estimated) is based on visual observation only, as disturbed soils cannot be measured for in-place density.

The test pit logs are presented on Figures A-13 through A-22.

Monitoring Well Installation

Monitoring wells were completed in selected borings as noted on the logs to allow long-term groundwater elevation monitoring. The wells were drilled using standard hollow-stem auger equipment. Two-inch-diameter Schedule 40 PVC riser pipe and 2-inch-diameter 0.020-inch machine-slotted screen were used for the well casings and screens. The well screen and casing riser is lowered down through the hollow-stem auger. As the auger is withdrawn, No. 10/20 silica sand is placed in the annular space from the base of the boring to approximately 2 to 3 feet above the top of the well screen.

Well seals were constructed by placing bentonite chips in the annular space on top of the filter sand to within 3 feet of ground surface. The remaining annular space was backfilled with concrete to complete the surface seal. For security, the monitoring wells were completed with locking stick-up steel monuments set in concrete. The monitoring well construction details are illustrated on the boring logs.

The monitoring well installations were constructed in accordance with Washington State Department of Ecology regulations.

Monitoring Well Development

The monitoring wells were developed using a Whale electric submersible pump, surge block, and/or a stainless steel bailer. First, sediment was removed from the bottom of the wells using a stainless steel bailer. Then the wells were surged during development using either a surge block, a stainless steel bailer, or by moving the submersible pump up and down within the well screen depth interval.

A minimum of ten casing volumes was removed during development, in addition to the volume of water added during drilling, if any. Where possible, development continued until negligible turbidity was visible. Sediment thickness at the bottom of the well was measured and recorded before and after development. Observations were recorded on a Well Development data form. Visual changes in turbidity during development were recorded in the comments space on this form. All development water was discharged to the ground surface in accordance with the Third Runway project Storm Water Pollution Prevention Plan (Parametrix and Hart Crowser, 1999).

Water Level Measurement

Water levels were measured using a Solinst water level probe, graduated in 0.01-foot increments. Depth to water was measured below the top of casing and recorded to the nearest hundredth of a foot. Depth to water was converted to groundwater elevation using survey information for the top of casing in the wells. Depth to water data and groundwater elevations are summarized in Table 1.

References for Appendix A

Parametrix Inc. and Hart Crowser Inc., 1999. Seattle-Tacoma International Airport Third Runway Project, Geotechnical Explorations, Storm Water Pollution Prevention Plan, Prepared for Port of Seattle, revised November 3, 1999.

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Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance.
Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 – 4	Very soft	0 – 2	<0.125
Loose	4 – 10	Soft	2 – 4	0.125 – 0.25
Medium dense	10 – 30	Medium stiff	4 – 8	0.25 – 0.5
Dense	30 – 50	Stiff	8 – 15	0.5 – 1.0
Very dense	>50	Very stiff	15 – 30	1.0 – 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

	Estimated Percentage
Not identified in description	0 – 5
Slightly (clayey, silty, etc.)	5 – 12
Clayey, silty, sandy, gravelly	12 – 30
Very (clayey, silty, etc.)	30 – 50

Legends

Sampling Test Symbols

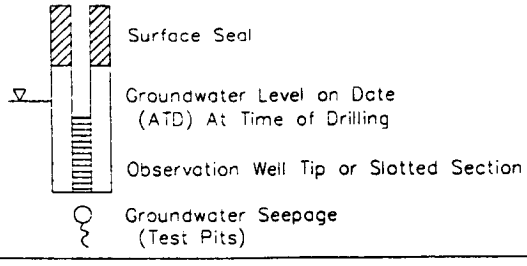
BORING SAMPLES

- Split Spoon
- Shelby Tube
- Cuttings
- Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

TEST PIT SAMPLES

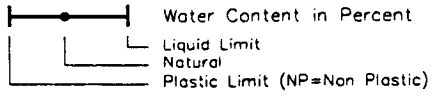
- Grab (Jar)
- Bag
- Shelby Tube

Groundwater Observations



Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits
PID	Photoionization Detector Reading
CA	Chemical Analysis
DT	In Situ Density Test



1=1 49/823 BORING1.DWG

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Figure A-1

AR 044403

Boring Log HC00-B200

N 14519
E 11067

Soil Descriptions
Approx. Ground Surface Elevation in Feet: 321

Depth in Feet

Loose to medium dense, wet to moist, brown, slightly gravelly to gravelly, slightly silty to very silty SAND. (FILL)

Trash and debris in soil from 2 1/2 to 6 feet.

Stiff, moist, brown, gravelly, very sandy SILT with trace organic material.

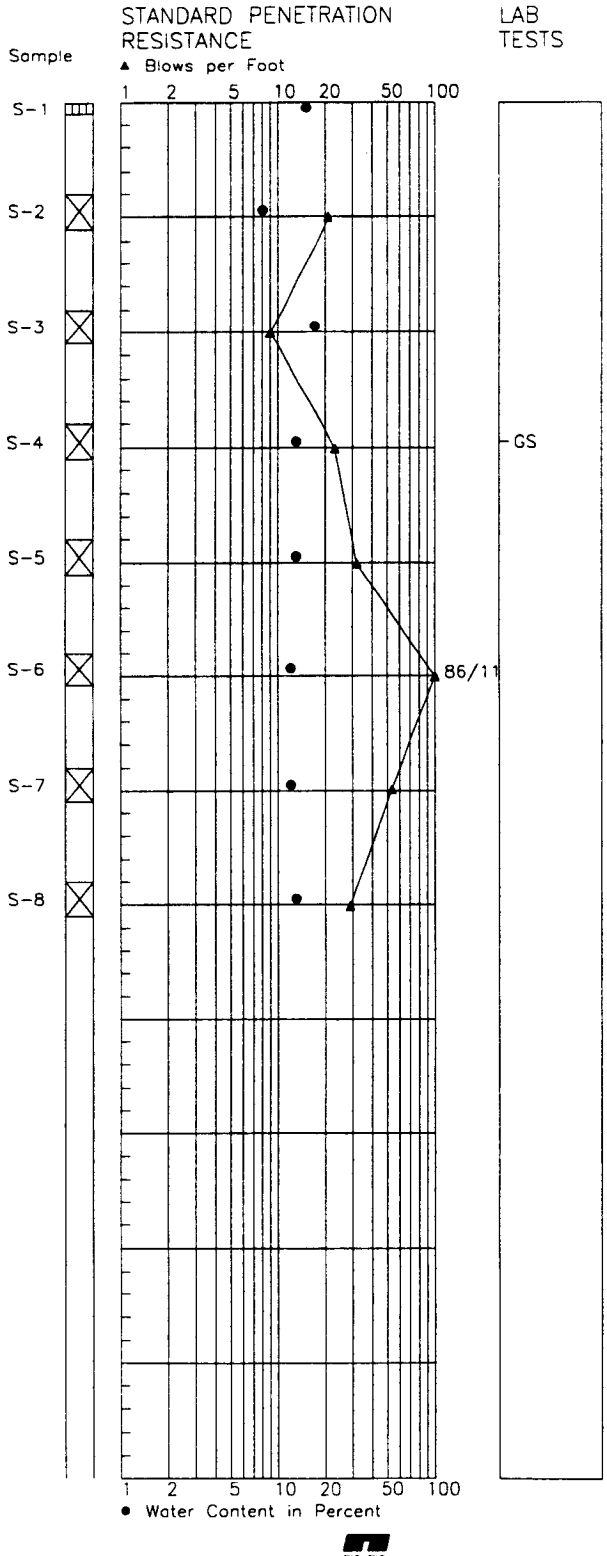
Medium dense, wet, tan, slightly gravelly, silty SAND.

Dense to very dense, wet, tan, gravelly, silty to very silty SAND.

ATD

Note 4.

Bottom of Boring at 34.0 Feet.
Completed 2/16/00.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
4. N value may be nonrepresentative of actual density due to potential disturbance (heave) below groundwater level.

HEM 497823 Logs 3/24/00

HARTCROWSER
J-4978-23 2/00
Figure A-2

AR 044404

Boring Log HC00-B203

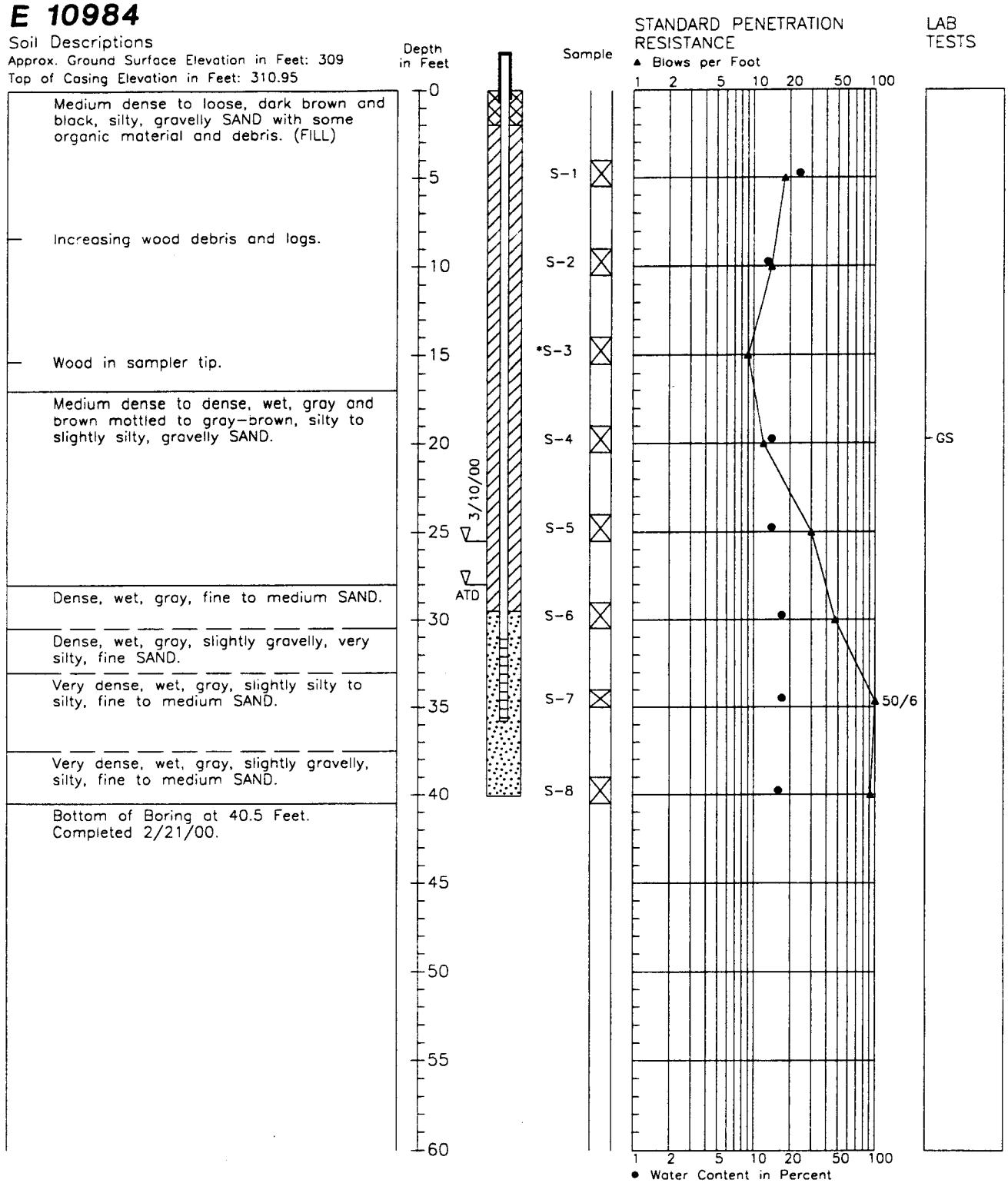
N 14504

E 10984

Soil Descriptions

Approx. Ground Surface Elevation in Feet: 309

Top of Casing Elevation in Feet: 310.95



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-4978-23 2/00

Figure A-3

AR 044405

HEM 497823 Logs 3/24/00

Boring Log HC00-B205

N 14411

E 10940

Soil Descriptions

Approx. Ground Surface Elevation in Feet: 303

Top of Casing Elevation in Feet: 306.19

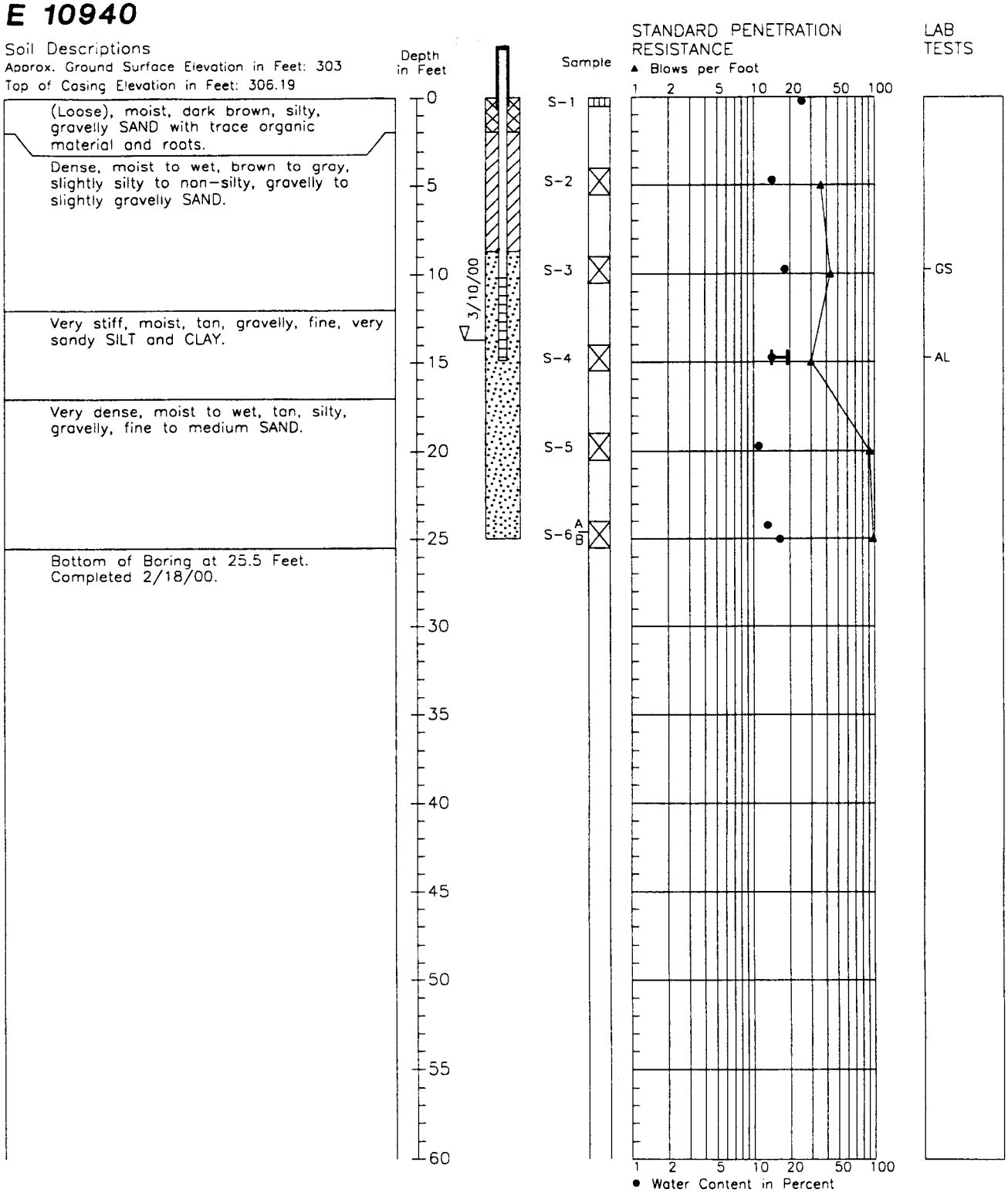
(Loose), moist, dark brown, silty, gravelly SAND with trace organic material and roots.

Dense, moist to wet, brown to gray, slightly silty to non-silty, gravelly to slightly gravelly SAND.

Very stiff, moist, tan, gravelly, fine, very sandy SILT and CLAY.

Very dense, moist to wet, tan, silty, gravelly, fine to medium SAND.

Bottom of Boring at 25.5 Feet.
Completed 2/18/00.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HEM 497823 Logs 3/24/00

HARTCROWSER

J-4978-23 2/00

Figure A-4

AR 044406

Boring Log HC00-B206

N 14340

E 11090

Soil Descriptions

Approx. Ground Surface Elevation in Feet: 312

Depth in Feet

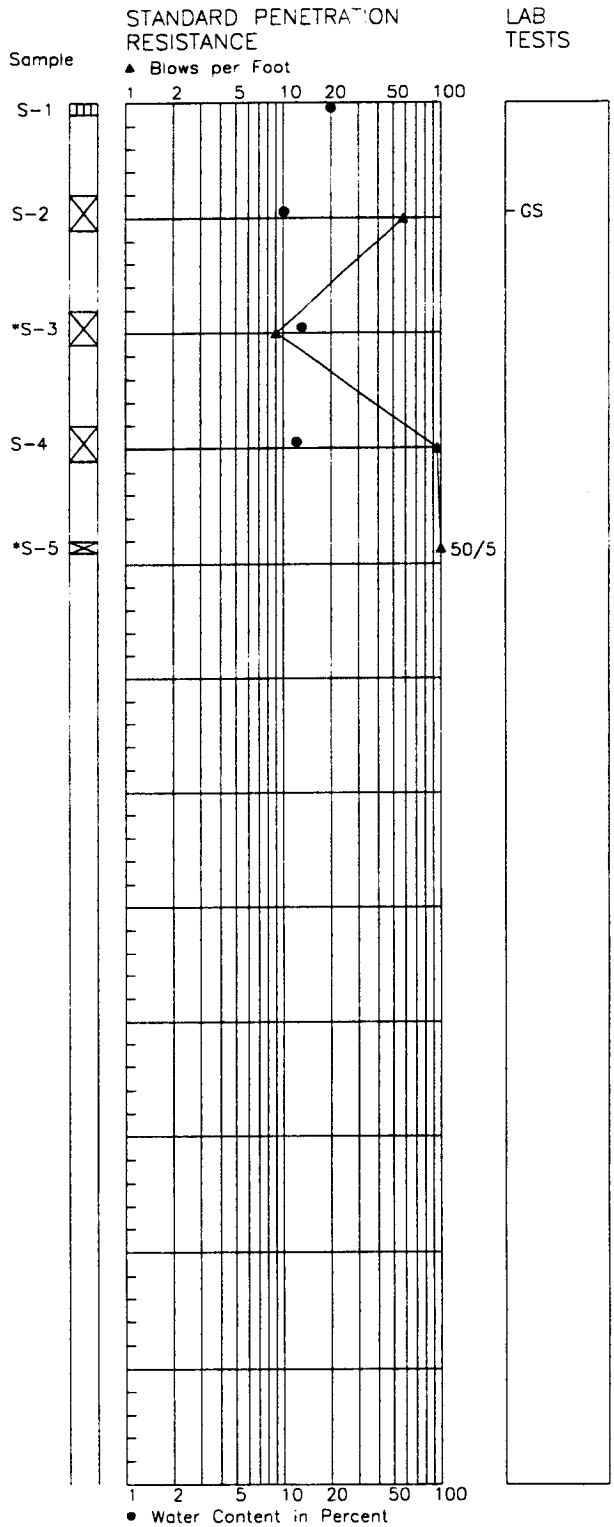
Loose (to very dense?), wet, brown to gray–brown, slightly gravelly to gravelly, silty SAND. (PROBABLE FILL)

See Note 4.

Loose to very dense, wet, tan, gravelly to slightly gravelly, silty, fine to medium SAND.

ATD

Bottom of Boring at 19.4 Feet.
Completed 2/16/00.



1. Refer to Figure A–1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
4. N value may be nonrepresentative of actual density due to presence of gravels.

HARTCROWSER

J-4978-23 2/00

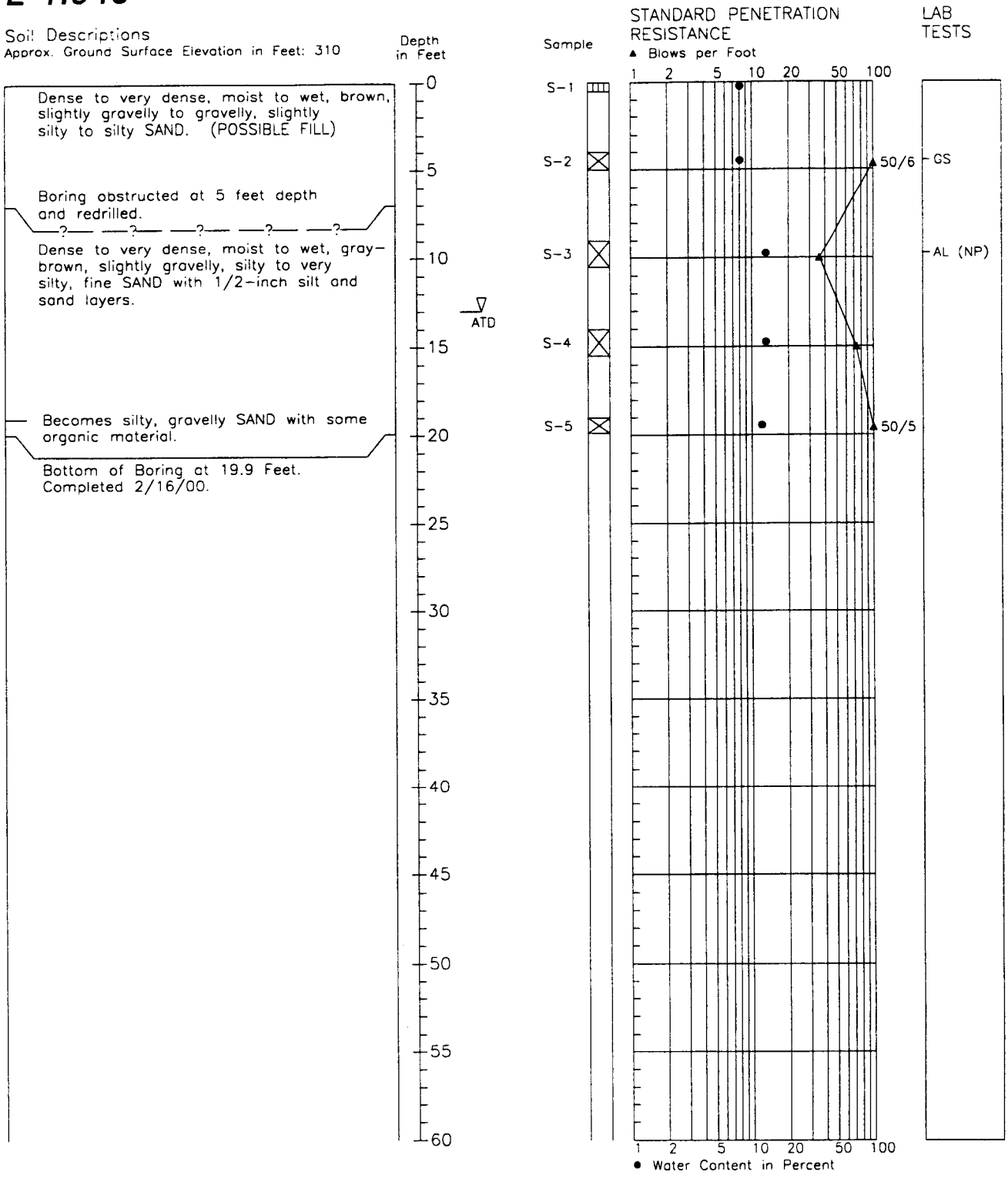
Figure A-5

AR 044407

HEM 497823 Logs 3/24/00

Boring Log HC00-B207

N 14416
E 11045



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HEM 497823 Logs 3/24/00

HARTCROWSER

J-4978-23 2/00

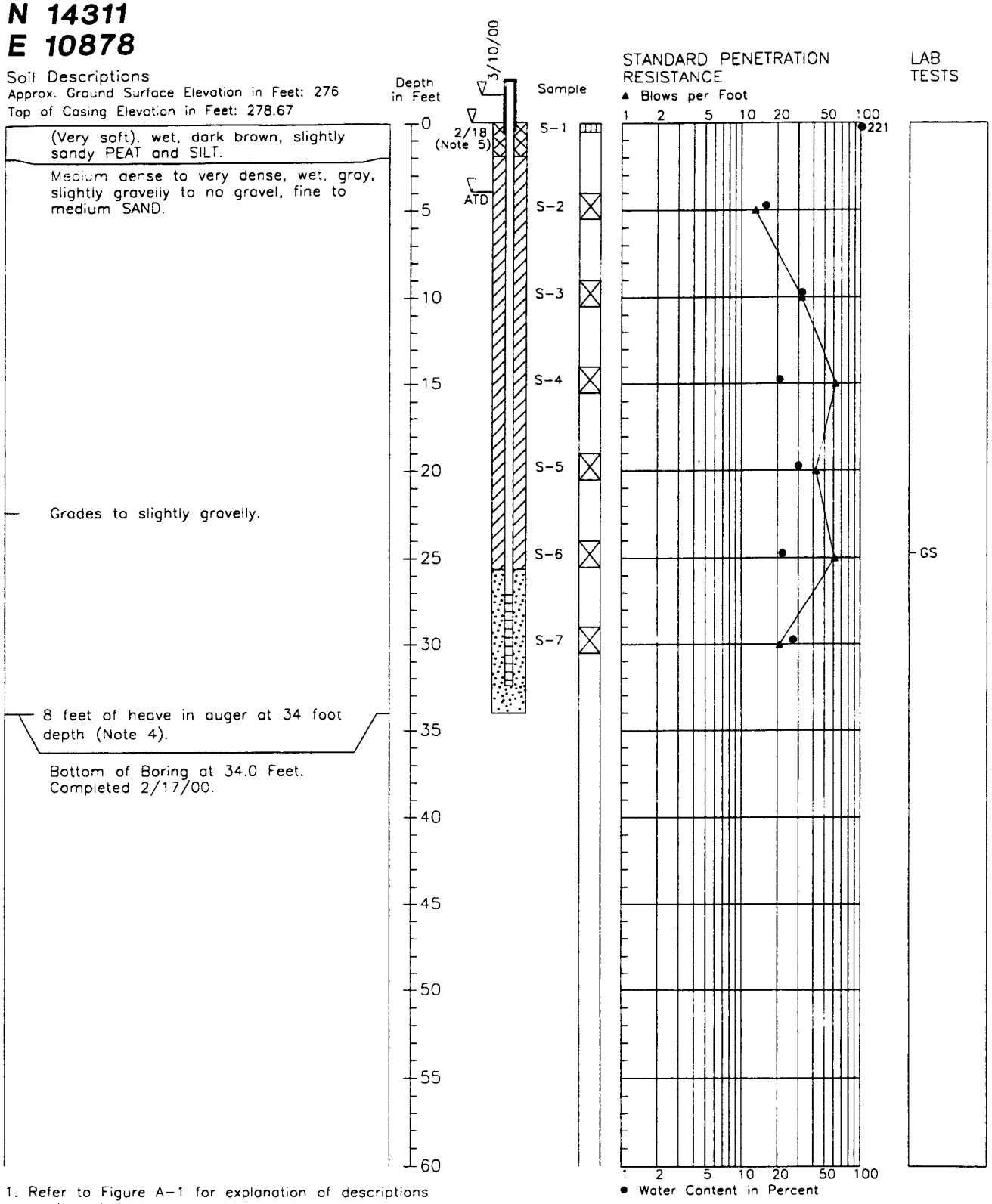
Figure A-6

AR 044408

Boring Log HC00-B208

N 14311
E 10878

Soil Descriptions
Approx. Ground Surface Elevation in Feet: 276
Top of Casing Elevation in Feet: 278.67



(Very soft), wet, dark brown, slightly sandy PEAT and SILT.

Medium dense to very dense, wet, gray, slightly gravelly to no gravel, fine to medium SAND.

Grades to slightly gravelly.

8 feet of heave in auger at 34 foot depth (Note 4).

Bottom of Boring at 34.0 Feet.
Completed 2/17/00.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
4. Heaving ground conditions prevented well installation 2/17; boring redrilled and observation wellinstalled 2/18/00.
5. Estimated 1.5 gpm artesion groundwater flow at surface 2/18/00; water level was about 2 feet above ground surface on 3/10/00, see Table 1.

HEM 497823 Logs 3/24/00

HARTCROWSER
J-4978-23 2/00
Figure A-7

AR 044409

Boring Log HC00-B209

N 14129
E 11030

Soil Descriptions
Approx. Ground Surface Elevation in Feet: 302

Depth in Feet

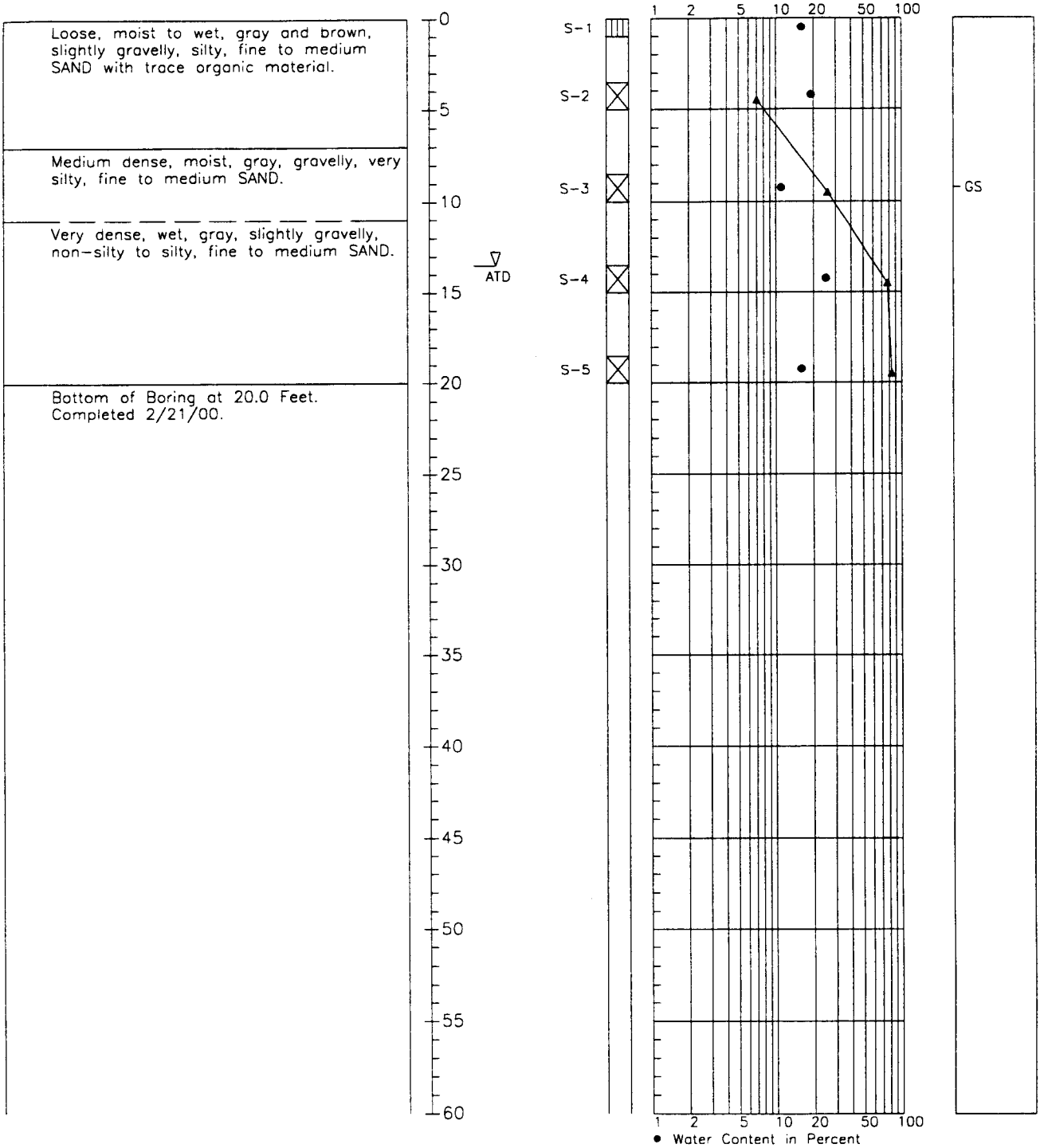
Loose, moist to wet, gray and brown, slightly gravelly, silty, fine to medium SAND with trace organic material.

Medium dense, moist, gray, gravelly, very silty, fine to medium SAND.

Very dense, wet, gray, slightly gravelly, non-silty to silty, fine to medium SAND.

ATD

Bottom of Boring at 20.0 Feet.
Completed 2/21/00.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HEM 497823 Logs 3/24/00

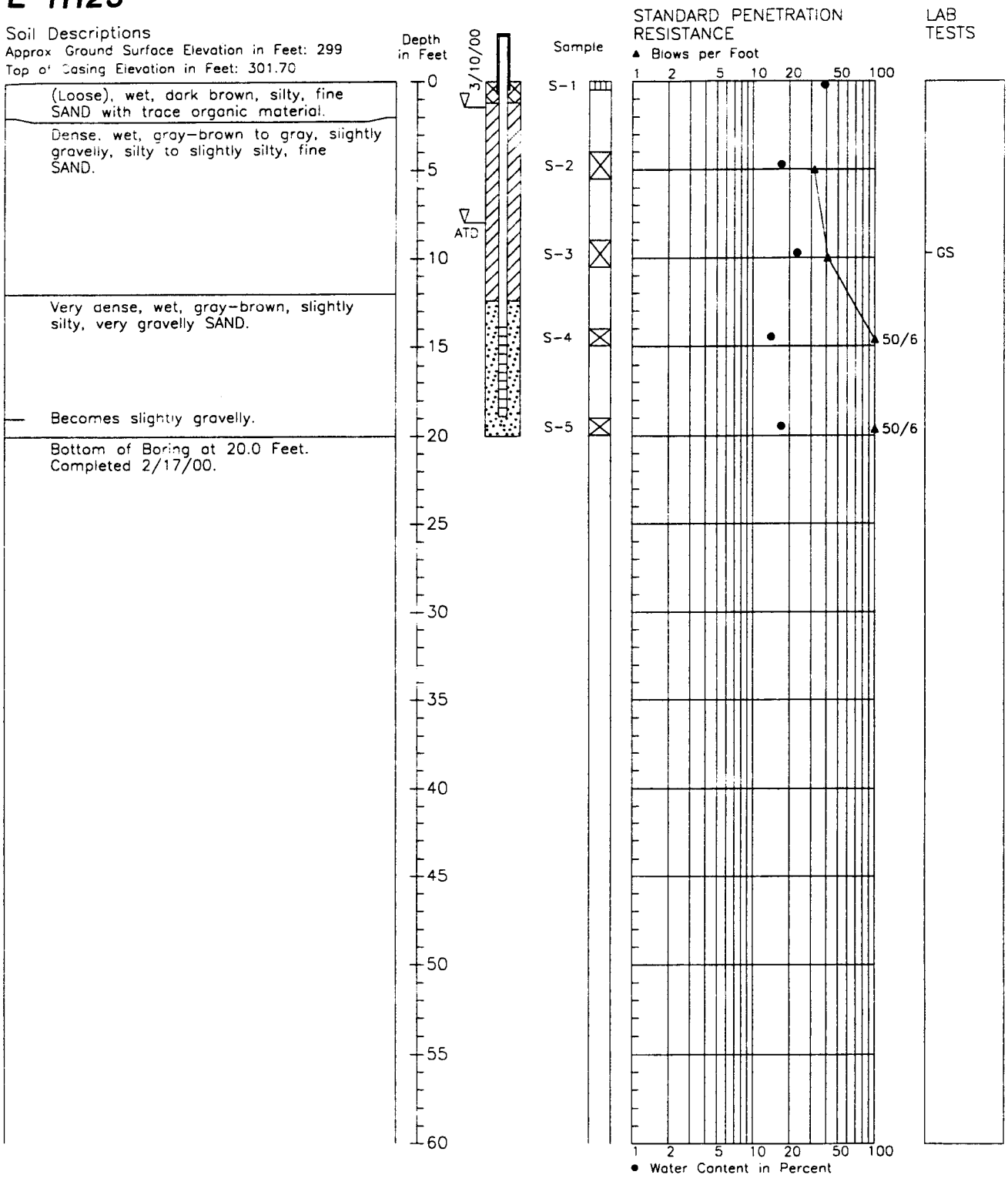
HARTCROWSER
J-4978-23 2/00
Figure A-8

AR 044410

Boring Log HC00-B211

N 14160

E 11125



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HEM 497823 Logs 3/24/00

HARTCROWSER

J-4978-23 2/00

Figure A-9

AR 044411

Boring Log HC00-B212

N 14126
E 10867

Soil Descriptions

Approx. Ground Surface Elevation in Feet: 302

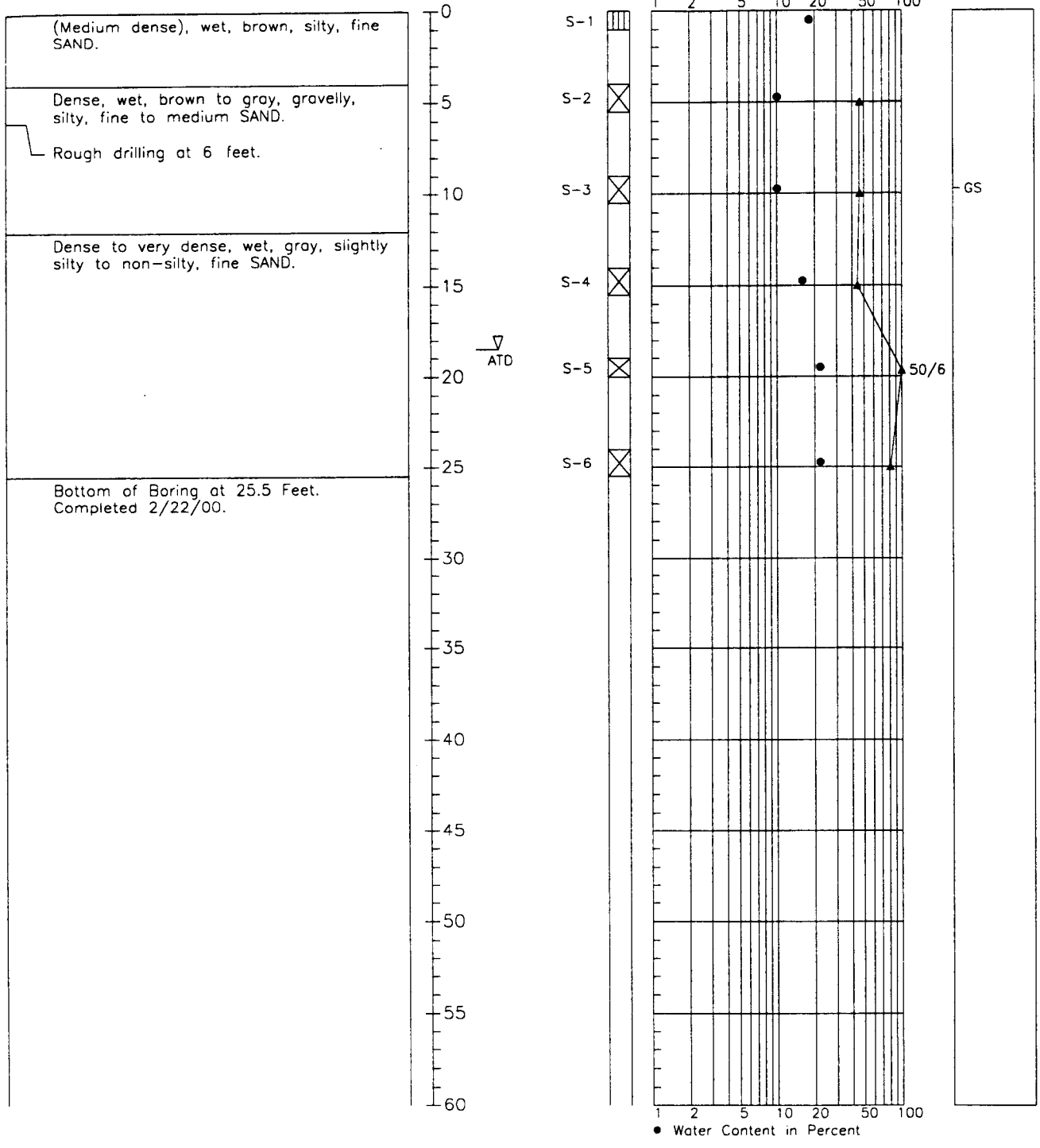
(Medium dense), wet, brown, silty, fine SAND.

Dense, wet, brown to gray, gravelly, silty, fine to medium SAND.

Rough drilling at 6 feet.

Dense to very dense, wet, gray, slightly silty to non-silty, fine SAND.

Bottom of Boring at 25.5 Feet.
Completed 2/22/00.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HEM 497823 Logs 3/24/00

HARTCROWSER

J-4978-23 2/00

Figure A-10

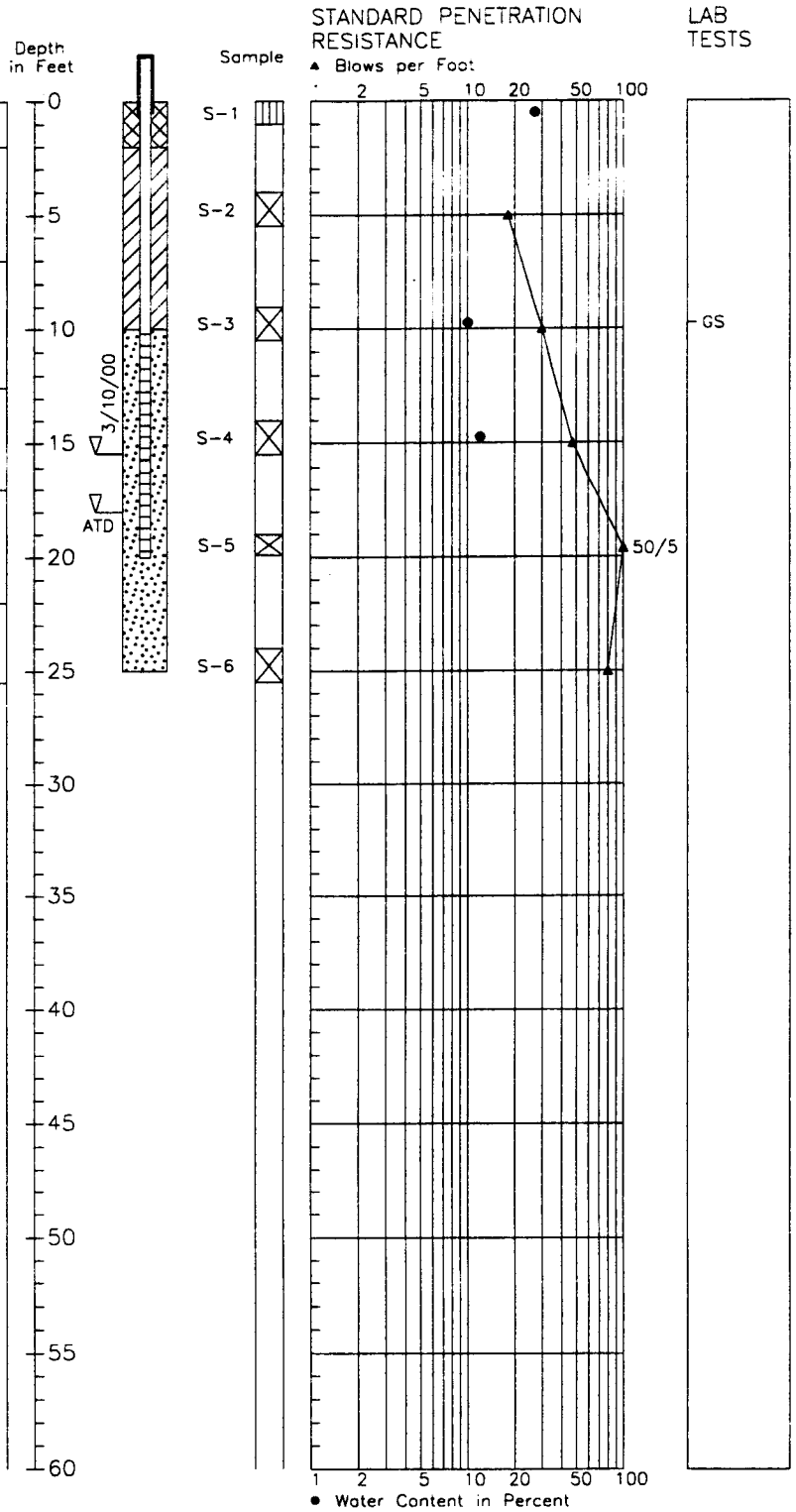
AR 044412

Boring Log HC00-B213

N 13938
E 10955

Soil Descriptions
Approx. Ground Surface Elevation in Feet: 311
Top of Casing Elevation in Feet: 313.35

Soil Descriptions
(Very loose), dark brown, silty, fine to medium SAND and organic material.
Medium dense, wet, gray, very silty SAND.
Medium dense, moist, gray, slightly silty, medium to fine SAND.
Dense, wet, gray, silty, gravelly SAND.
Very dense, wet, gray, slightly silty to non-silty, slightly gravelly to gravelly SAND.
Very dense, wet, gray SAND.
Bottom of Boring at 25.5 Feet. Completed 2/23/00.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HEW 497823 Logs 3/24/00

HARTCROWSER
J-4978-23 2/00
Figure A-11

AR 044413

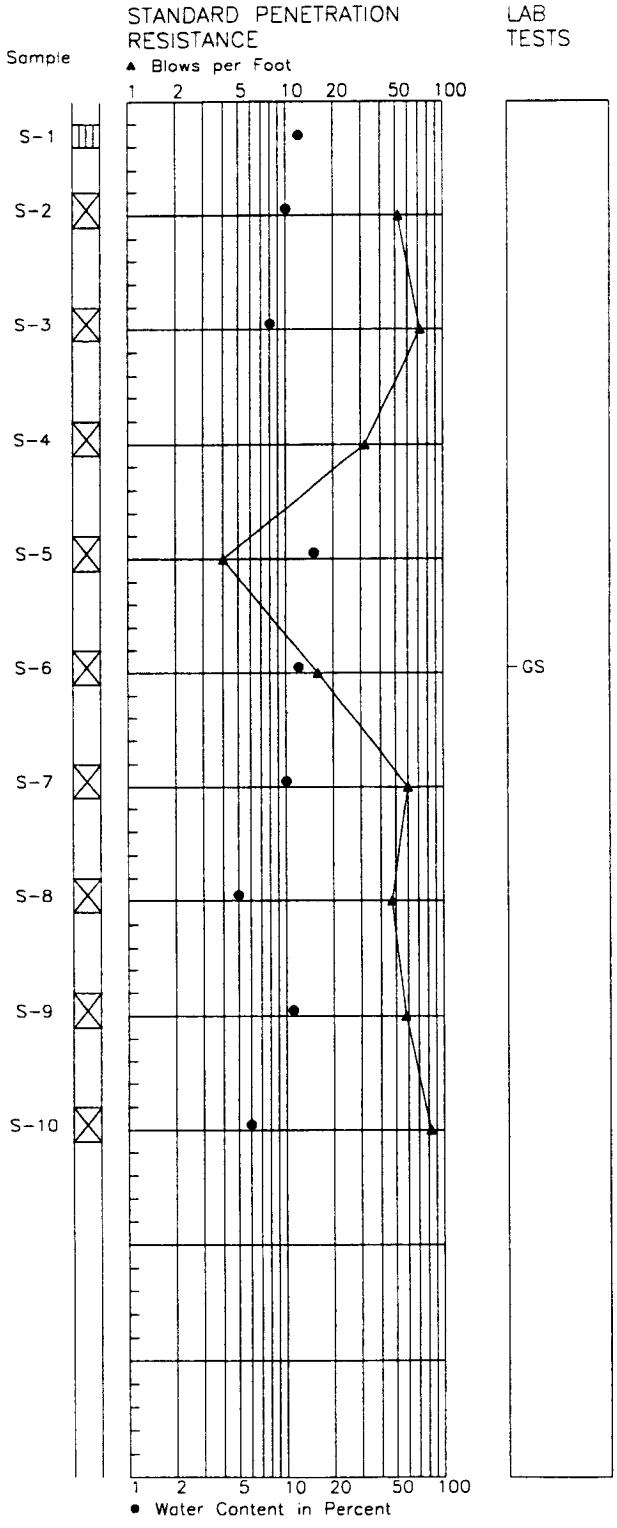
Boring Log HC00-B214

N 13780
E 10937

Soil Descriptions
Approx. Ground Surface Elevation in Feet: 352

Depth in Feet

Dense to very dense, wet to moist, silty, gravelly, fine to medium SAND. (FILL) (Note 4)	0
Grades to dense.	5
	10
	15
Loose, wet, gray and brown, silty, gravelly SAND with trace organic material. (FILL)	20
Medium dense to very dense, wet, gray to brown, silty, gravelly, fine to medium SAND with some organic material near bottom. (FILL)	25
	30
Dense, moist, gray and brown mottled, gravelly, silty SAND.	35
Very dense, moist, gray SAND.	40
Grades to gravelly.	45
Bottom of Boring at 45.5 Feet. Completed 2/23/00.	50
	55
	60



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
4. N value may be nonrepresentative of actual density due to presence of gravels.
5. No groundwater observed ATD.

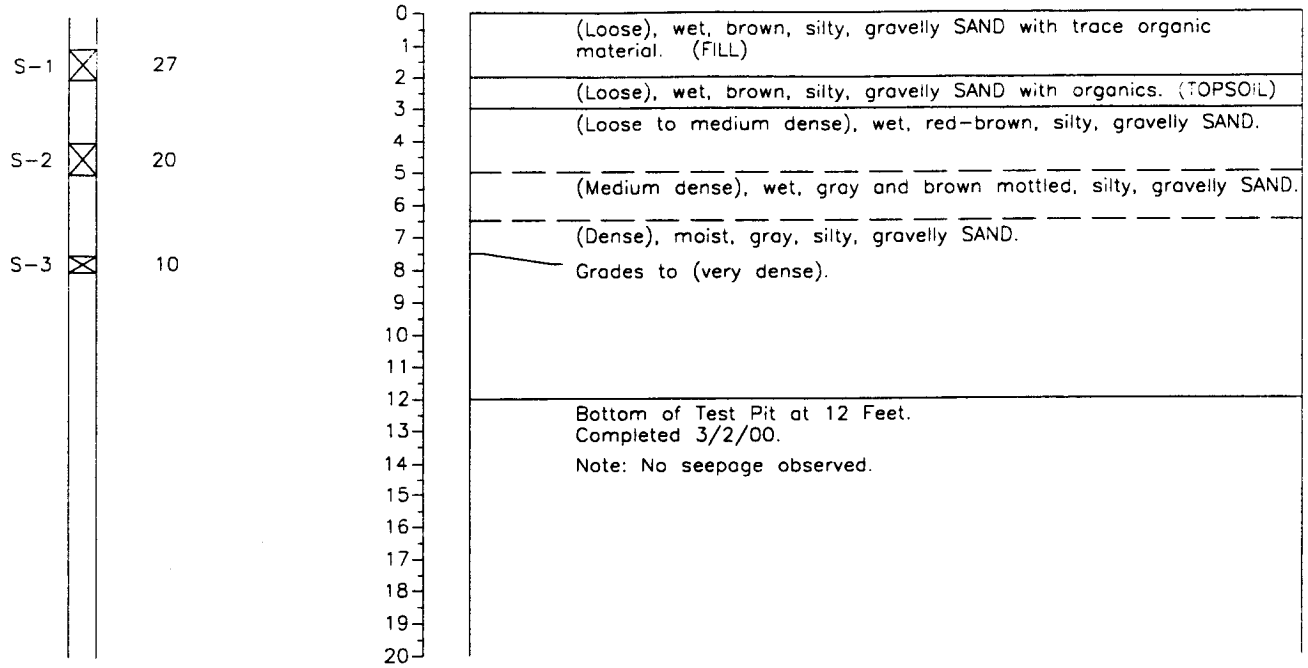
HEM 497823 Logs 3/24/00

HARTCROWSER
J-4978-23 2/00
Figure A-12

AR 044414

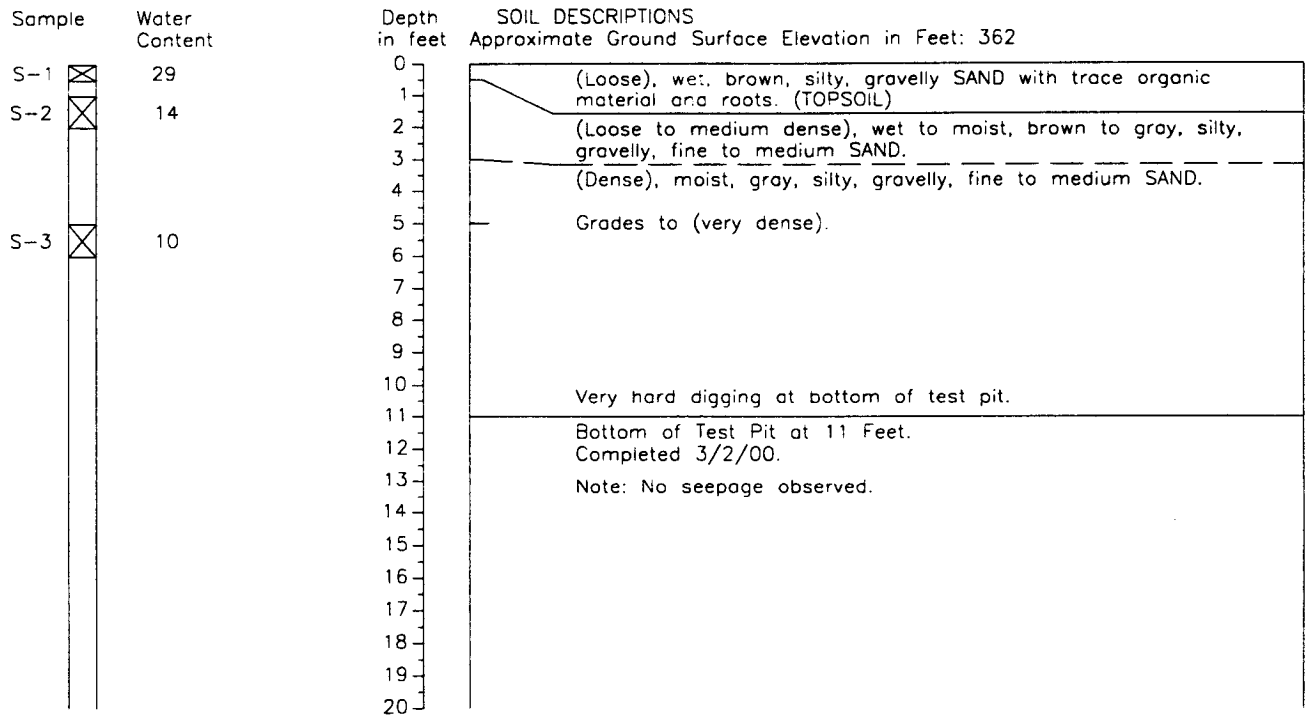
Test Pit Log HC00-TP200

N 15663
E 11181



Test Pit Log HC00-TP201

N 15640
E 10950



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

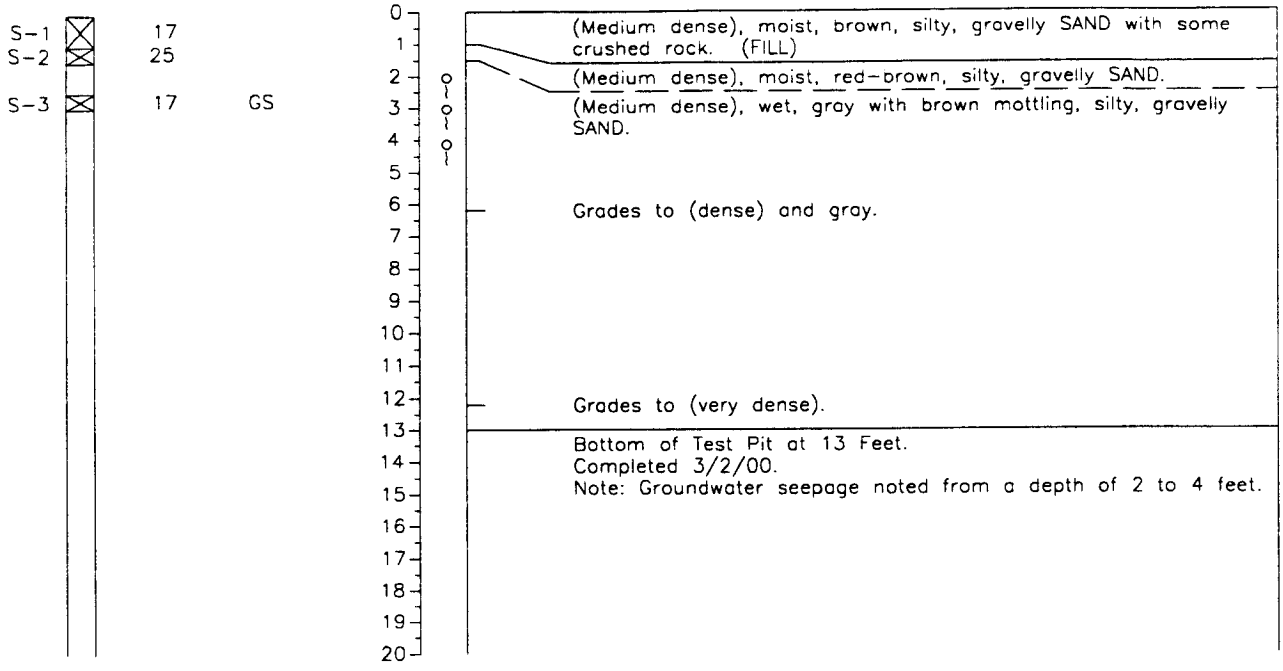
HEM 497823 Pits 3/24/00

HARTCROWSER
J-4978-23 3/00
Figure A-13

AR 044415

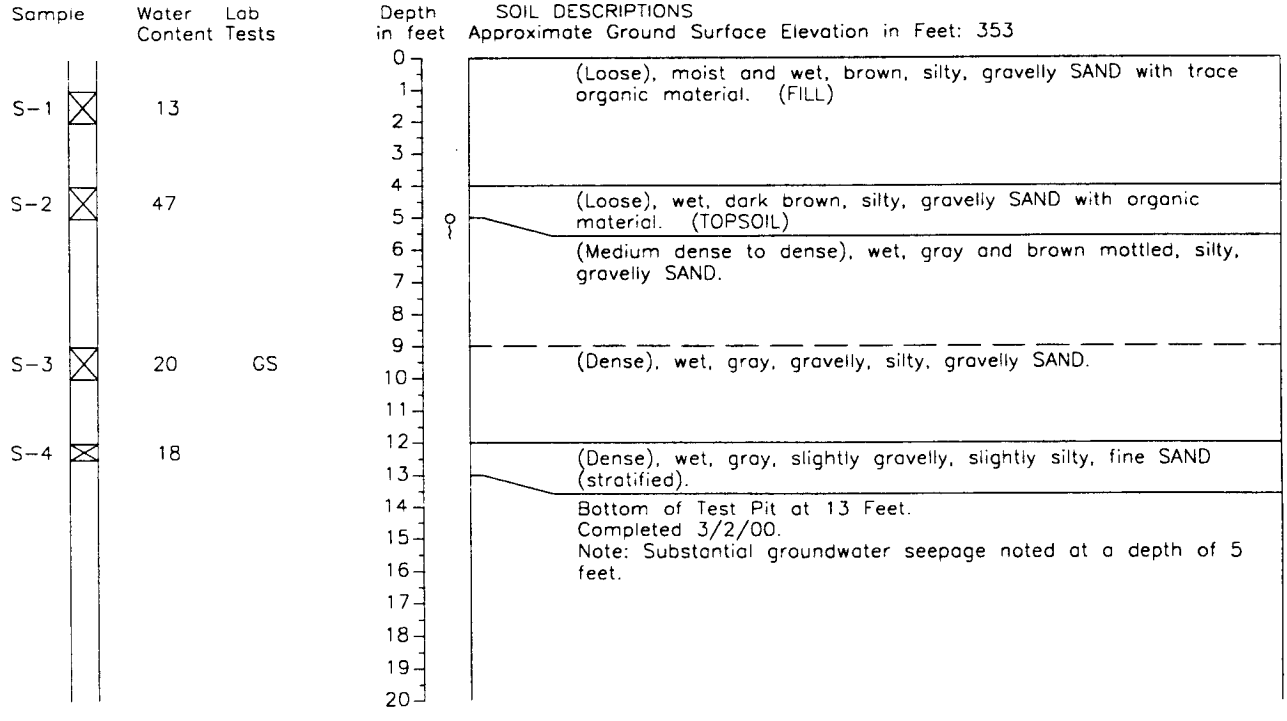
Test Pit Log HC00-TP202

N 15424
E 10963



Test Pit Log HC00-TP203

N 15411
E 11101



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

HEM 497823 Pits 3/24/00

HARTCROWSER
J-4978-23 3/00
Figure A-14

AR 044416

Test Pit Log HC00-TP204

N 15161
E 10951

Sample	Water Content	Lab Tests	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 351
S-1	20		0–1	(Loose), moist, brown, silty, gravelly SAND with trace organic material.
S-2	13	GS	1–6	(Medium dense), wet, gray, slightly silty, gravelly, medium to fine SAND. Grades to (dense).
S-3	14		6–11	(Dense to very dense), moist, gray, slightly gravelly, silty, fine SAND. Grades to gravelly.
			11	Bottom of Test Pit at 11 Feet. Completed 3/2/00. Note: No seepage observed.

Test Pit Log HC00-TP205

N 15157
E 11181

Sample	Water Content	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 356
S-1	17	0–1	(Loose), moist, red-brown, silty, gravelly SAND.
S-2	13	1–4	(Medium dense to dense), moist to wet, gray with brown mottling, silty, gravelly SAND.
S-3	11	4–7	(Dense), moist, gray, silty, gravelly, fine to medium SAND. (TILL)
		9	Bottom of Test Pit at 9 Feet. Completed 3/2/00. Note: Groundwater seepage noted at a depth of 3½ feet. Very hard digging at 9 feet.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

HEM 497823 Pits 3/24/00

HARTCROWSER
J-4978-23 3/00
Figure A-15

AR 044417

Test Pit Log HC00-TP206

N 14883
E 11024

Sample	Water Content	Lab Tests	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 341
S-1	17		0	(Medium dense), moist, brown, silty, gravelly SAND.
S-2	13	GS	3	(Dense), moist, gray, slightly gravelly, very silty, fine SAND.
			9	Grades to (very dense).
			12	Bottom of Test Pit at 12 Feet. Completed 2/18/00. Note: Very hard digging at 12 feet. No seepage observed.

Test Pit Log HC00-TP207

N 14815
E 11162

Sample	Water Content	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 341
S-1	14	0	(Medium dense), wet, gray-brown, silty, gravelly SAND. (FILL)
S-2	13	3	Crushed rock. (FILL)
		3	(Very dense), moist, gray with brown mottling, silty, gravelly, fine SAND.
		9	Bottom of Test Pit at 9 Feet. Completed 2/18/00. Note: Very hard digging at 9 feet. No seepage observed.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

HEM 497823 Pits 3/24/00

HARTCROWSER
J-4978-23 3/00
Figure A-16

AR 044418

Test Pit Log HC00-TP209

N 14444
E 10943

Sample	Water Content	Lab Tests	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 302
S-1	32		0–1	(Loose), moist, black, silty, gravelly SAND with organic material.
S-2	6	GS	1–3	(Medium dense), damp, brown to gray, very gravelly SAND.
S-3	8		3–11	(Medium dense), damp, gray, slightly gravelly SAND.
			11–12	(Medium dense), moist, gray, silty SAND.
			12–15	(Medium dense), damp, gray, gravelly SAND.
			15	Bottom of Test Pit at 15 Feet. Completed 2/17/00. Note: No seepage observed.

Test Pit Log HC00-TP210

N 14355
E 10936

Sample	Water Content	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 297
S-1	8	0–8	(Loose to medium dense), damp, gray-brown, slightly silty, slightly gravelly SAND with roots near surface and few silt lenses.
S-2	15	8–15	(Medium dense), moist to wet, gray, slightly silty, gravelly, fine to medium SAND with few silt lenses up to 1-foot-thick.
		15	Bottom of Test Pit at 15 Feet. Completed 2/17/00. Note: No seepage observed.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

HEM 497823 Pits 3/24/00

HARTCROWSER
J-4978-23 3/00
Figure A-17

AR 044419

Test Pit Log HC00-TP211

N 14210
E 11332

Sample	Water Content	Lab Tests	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 324
S-1	28		0–4	(Soft), wet, gray and brown, fine, sandy, gravelly SILT with trace organic material and debris (pieces of concrete about 4 to 6 feet in diameter). (FILL)
S-2	20	AL	4–6	(Stiff), wet, gray and brown mottled, sandy, silty CLAY intermixed with (medium dense), silty SAND. (FILL)
S-3	16		6–9	(Dense), wet, gray, slightly silty, slightly gravelly SAND with silt and sand lenses. (FILL)
			9–10	Adjacent concrete slab and wall.
			11–14	(Very dense), moist, gray with brown mottling, gravelly, very silty fine SAND.
S-4	9	GS	14	Bottom of Test Pit at 14 Feet. Completed 2/18/00. Note: Very hard drilling at bottom of test pit. No seepage observed.

Test Pit Log HC00-TP212

N 13931
E 11132

Sample	Water Content	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 311
S-1	48	0–2	(Very soft), wet, dark brown, slightly gravelly PEAT and organic SILT with some roots.
S-2	19	2–7	(Medium dense), wet, gray with brown mottling, slightly gravelly, very silty, fine SAND. Grades to gravelly.
S-3	12	7–15	(Dense), wet, gray, silty, gravelly, fine to medium SAND with some non-silty sand lenses.
		15	Bottom of Test Pit at 15 Feet. Completed 2/18/00. Note: Groundwater seepage noted at a depth of 2½ feet.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

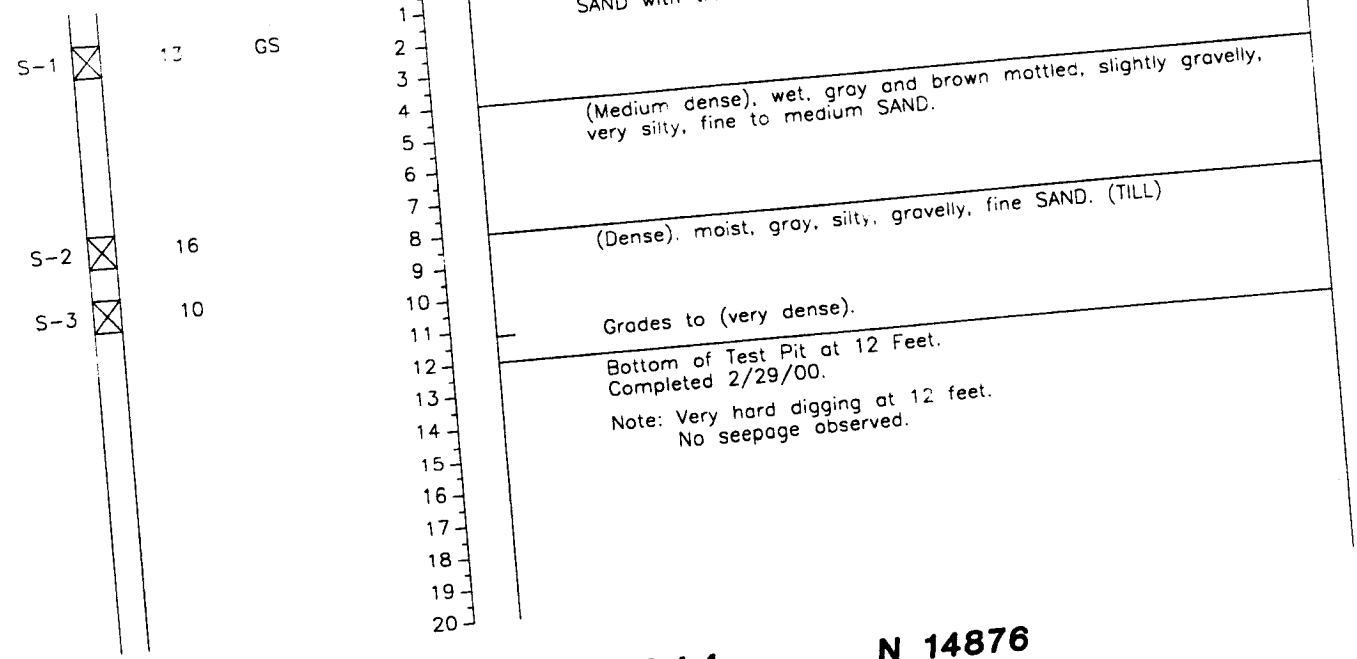
HEM 497823 Pits 3/24/00

HARTCROWSER
J-4978-23 3/00
Figure A-18

AR 044420

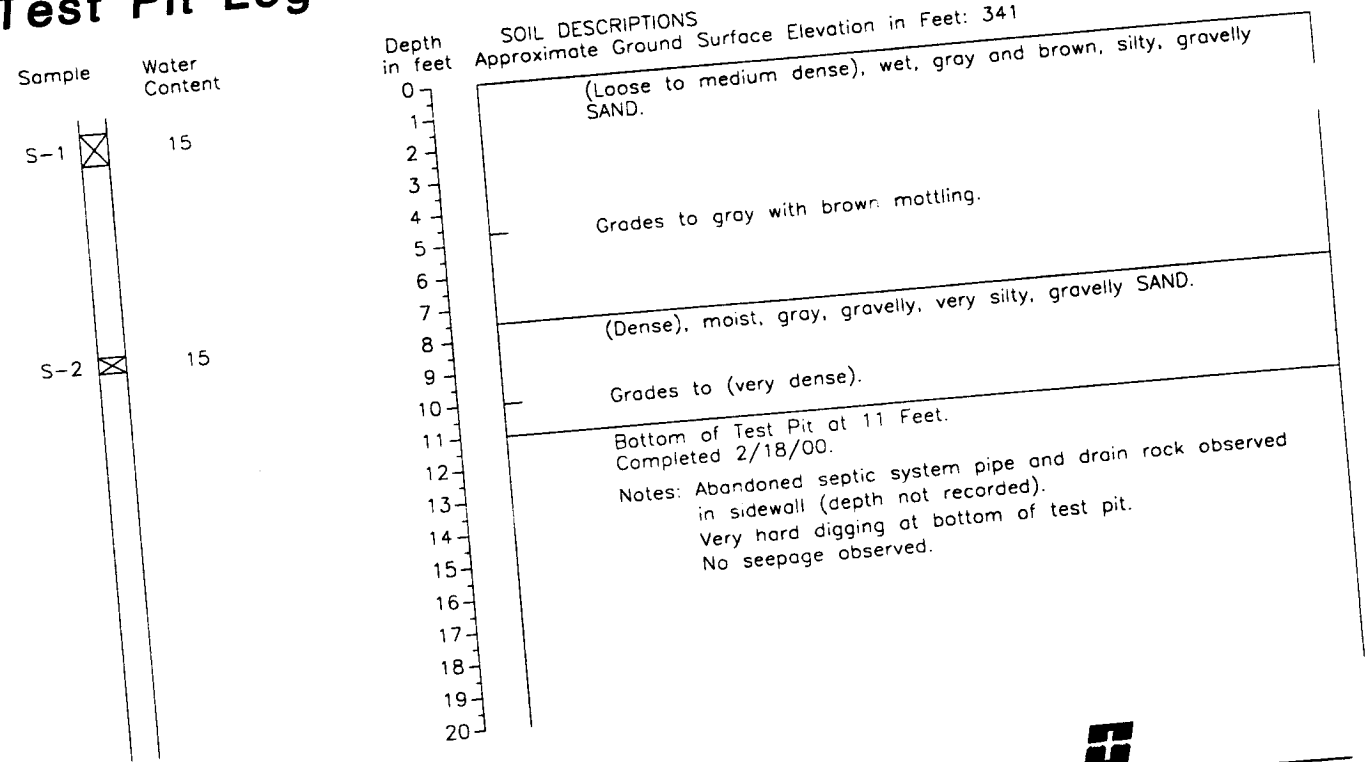
Test Pit Log HC00-TP213

N 14685
E 10950



Test Pit Log HC00-TP214

N 14876
E 10948



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

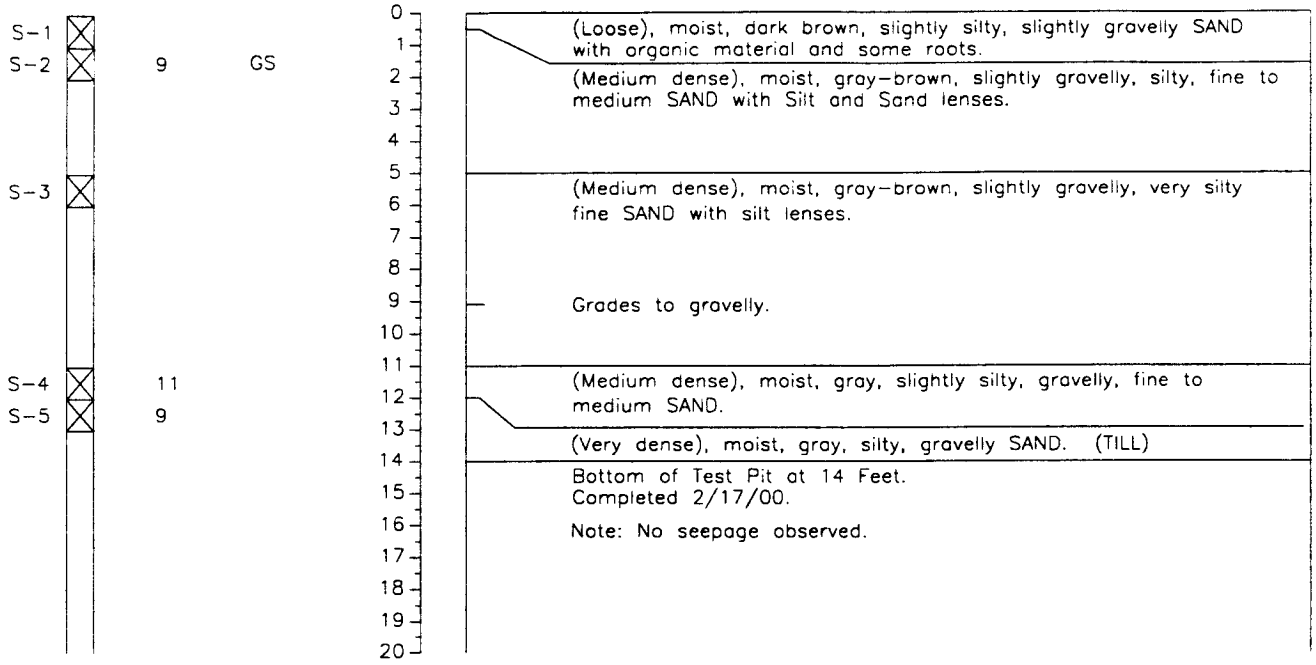
HEM 497823 Pits 3/24/00

HARTCROWSER 3/00
J-4978-23
Figure A-19

AR 044421

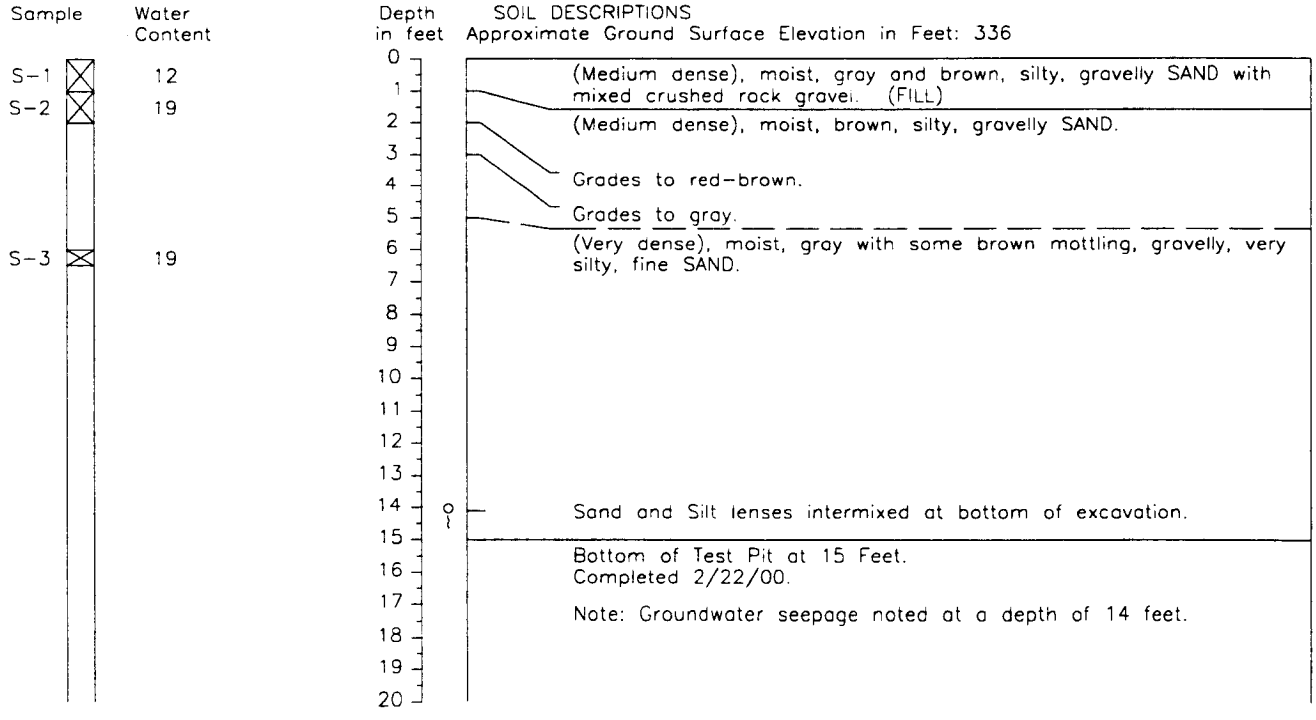
Test Pit Log HC00-TP215

N 14400
E 10898



Test Pit Log HC00-TP216

N 14786
E 10981



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

HEM 497823 Pits 3/24/00

HARTCROWSER
J-4978-23 3/00
Figure A-20

AR 044422

Test Pit Log HC00-TP217

N 14615
E 10889

Sample	Water Content	Lab Tests	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 311
S-1	16		0–1	(Loose), wet, brown, silty, gravelly SAND with trace organic material. (FILL and TOPSOIL)
S-2	12		1–4	(Loose to medium dense), moist, gray and brown, silty, gravelly fine SAND.
S-3	12	GS	4–15	(Dense), moist, gray, gravelly, very silty, fine to medium SAND.
			15–20	Bottom of Test Pit at 15 Feet. Completed 2/22/00. Note: No seepage observed.

Test Pit Log HC00-TP218

N 14219
E 10993

Sample	Water Content	Lab Tests	Depth in feet	SOIL DESCRIPTIONS Approximate Ground Surface Elevation in Feet: 296
S-1	7		0–4	(Medium dense), moist, gray–brown, slightly silty, fine to medium SAND.
S-2	13		4–8	(Medium dense), wet, brown SAND. Grades to gravelly.
S-3	23	AL	8–11	(Stiff), wet, gray with brown mottling to gray, silty CLAY.
S-4	14		11–13	(Medium dense), wet, gray, slightly gravelly, very silty, fine SAND.
S-5	13		13–15	(Medium dense), wet, gray, slightly silty, gravelly SAND.
			15–20	Bottom of Test Pit at 15 Feet. Completed 2/17/00. Notes: Groundwater seepage noted at a depth of 4½ feet and 13 feet. Sidewalls caving from 0 to 8 feet depth.

1. Refer to Figure A–1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

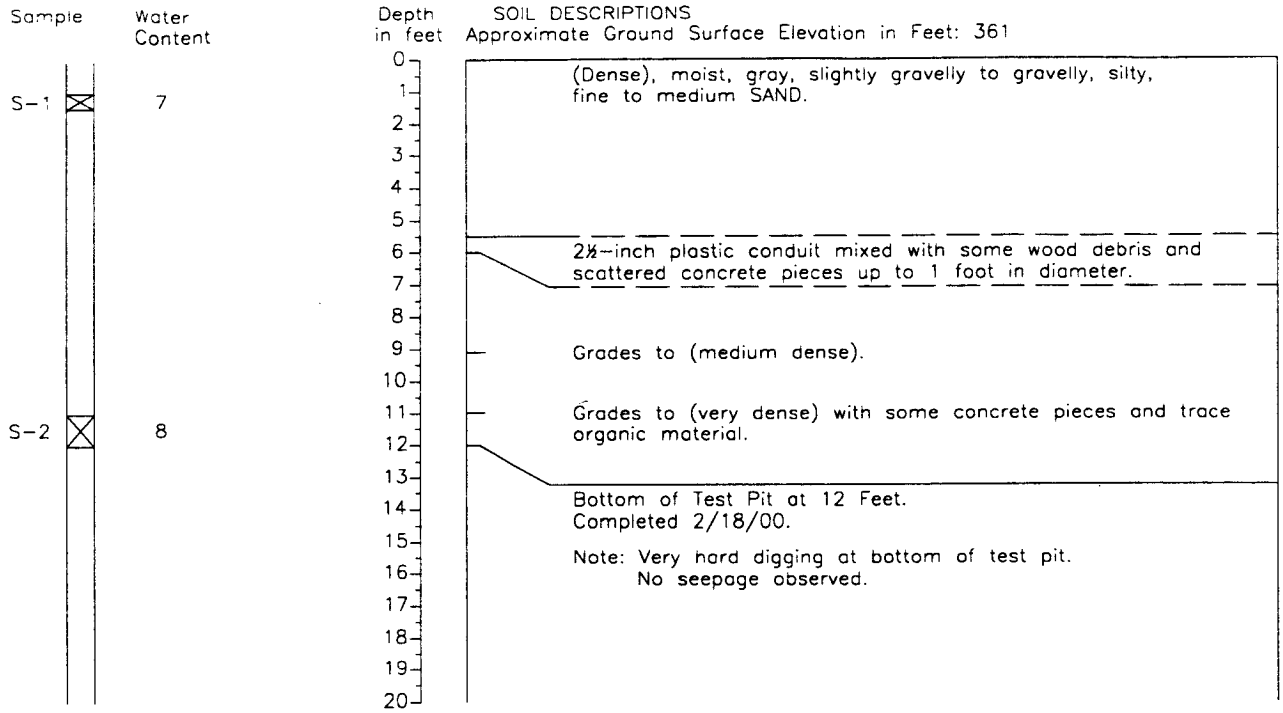
HARTCROWSER
J-4978-23 3/00
Figure A-21

AR 044423

HEM 497823 Pits 3/24/00

Test Pit Log HC00-TP219

N 13710
E 11279



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

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Figure A-22

AR 044424

APPENDIX B
LABORATORY TESTING PROGRAM

APPENDIX B
LABORATORY TESTING PROGRAM

A laboratory testing program was performed for this study to evaluate the basic index and geotechnical engineering properties of the site soils. Disturbed samples were tested. The tests performed and the procedures followed are outlined below.

Soil Classification

Field Observation and Laboratory Analysis. Soil samples from the explorations were visually classified in the field and then taken to our laboratory where the classifications were verified in a relatively controlled laboratory environment. Field and laboratory observations include density/consistency, moisture condition, and grain size and plasticity estimates.

The classifications of selected samples were checked by laboratory tests such as Atterberg limits determinations and grain size analyses. Classifications were made in general accordance with the Unified Soil Classification (USC) System, ASTM D 2487, as presented on Figure B-1.

Note that the term "trace" used on exploration logs generally indicate a material within the soil matrix that constitutes a relatively small fraction by weight of the total soil. The usage of this term in not associated with the ASTM-simplified classification procedure.

Water Content Determinations

Water contents were determined for most samples recovered in the explorations in general accordance with ASTM D 2216, as soon as possible following their arrival in our laboratory. The results of these tests are plotted or recorded at the respective sample depth on the exploration logs. In addition, water contents are routinely determined for samples subjected to other testing. These are also presented on the exploration logs.

Grain Size Analysis (GS)

Grain size distribution was analyzed on representative samples in general accordance with ASTM D 422. Wet sieve analysis was used to determine the size distribution greater than the U.S. No. 200 mesh sieve. The size distribution for particles smaller than the No. 200 mesh sieve was determined by the hydrometer method for selected samples. The results of the tests are presented

as curves on Figures B-2 through B-8 plotting percent finer by weight versus sieve size.

Atterberg Limits (AL)

We determined Atterberg limits for selected fine-grained soil samples. The liquid limit and plastic limit were determined in general accordance with ASTM D 4318-84. The results of the Atterberg Limits analyses and the plasticity characteristics are summarized in the Liquid and Plastic Limits Test Report, Figure B-9. This relates the plasticity index (liquid limit minus the plastic limit) to the liquid limit. The results of the Atterberg limits tests are also shown graphically on the boring logs.

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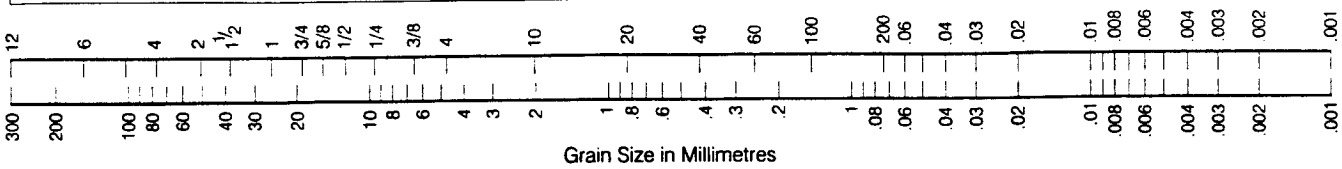
Unified Soil Classification (USC) System

Soil Grain Size

Size of Opening In Inches	Number of Mesh per Inch (US Standard)	Grain Size in Millimetres



Grain Size in Millimetres

COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines	*	GRAVEL with >12% fines		Clean SAND <5% fines	*	SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W & $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A line with PI <4

G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases required use of dual symbols.

D_{10}, D_{30}, and D_{60} are the particles diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						

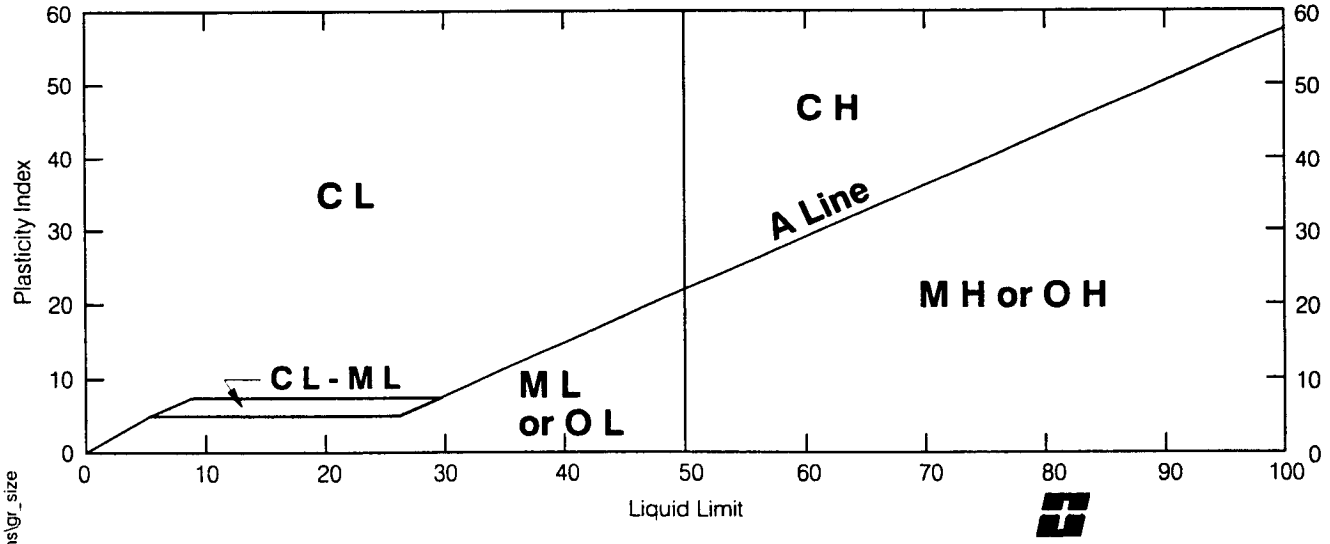


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Figure B-1

AR 044428

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	8.7	3.5	3.1	12.0	32.8	39.9	
□	0.0	5.9	24.0	5.1	11.6	27.0	26.4	
△	0.0	0.0	1.2	1.0	26.6	65.6	5.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			2.19	0.256	0.165					
□			13.1	0.754	0.360	0.119				
△			0.615	0.341	0.287	0.207	0.155	0.109	1.16	3.13

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Gravelly, very silty, medium to fine SAND	SM	13%
□ Silty, gravelly SAND	SM	14%
△ Slightly silty, medium to fine SAND	SP-SM	18%

Remarks:

○

□

△

Project: Third Runway South End

Client: HNTB

○ **Source:** HC00-B200 **Sample No.:** S-4

□ **Source:** HC00-B203 **Sample No.:** S-4

△ **Source:** HC00-B205 **Sample No.:** S-3

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Figure No. B-2

AR 044429

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	22.7	10.5	5.9	12.5	25.5	22.9	
□	0.0	8.6	10.6	5.2	22.7	43.6	9.3	
△	0.0	0.0	4.1	1.0	21.6	44.7	28.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			26.1	1.70	0.473	0.152				
□			8.67	0.542	0.393	0.242	0.129	0.0815	1.33	6.65
△			0.619	0.319	0.258	0.113				

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Silty, very gravelly SAND	SM	10%
□ Slightly silty, gravelly SAND	SW-SM	8%
△ Silty, medium to fine SAND	SM	22%

Remarks:

○

□

△

Project: Third Runway South End

Client: HNTB

○ **Source:** HC00-B206 **Sample No.:** S-2

□ **Source:** HC00-B207 **Sample No.:** S-2

△ **Source:** HC00-B208 **Sample No.:** S-6

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Figure No. B-3

AR 044430

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	4.2	10.5	2.8	13.1	36.8	32.6	
□	0.0	0.0	1.1	0.2	1.5	83.4	13.8	
△	0.0	6.3	9.5	4.3	14.5	36.5	28.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			4.22	0.317	0.235					
□			0.226	0.176	0.156	0.114	0.0777			
△			5.43	0.351	0.256	0.0847				

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Gravelly, very silty, medium to fine SAND	SM	11%
□ Silty fine SAND	SM	23%
△ Gravelly, silty, medium to fine SAND	SM	10%

Remarks:

○

□

△

Project: Third Runway South End

Client: HNTB

○ **Source:** HC00-B209 **Sample No.:** S-3

□ **Source:** HC00-B211 **Sample No.:** S-3

△ **Source:** HC00-B212 **Sample No.:** S-3

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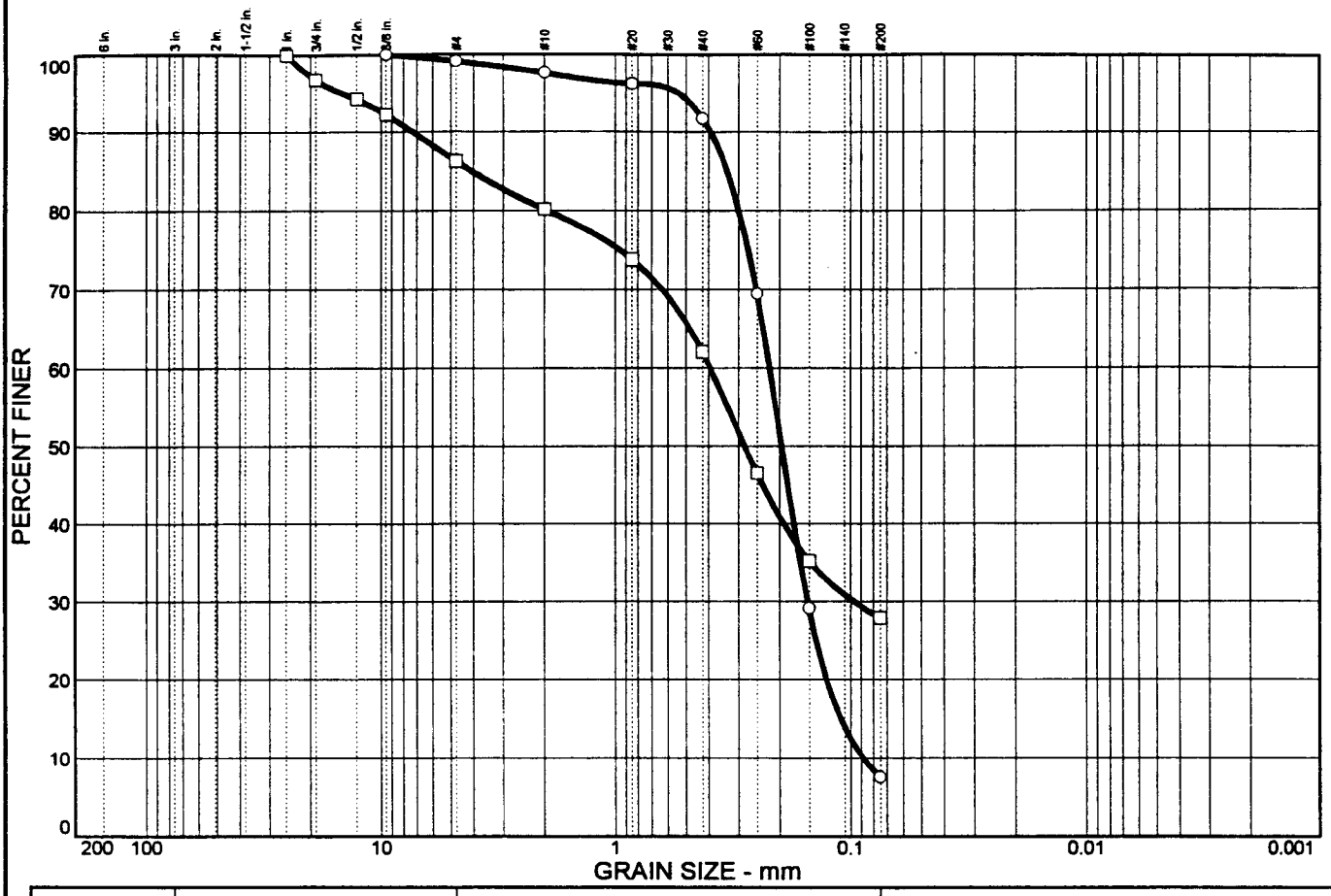
Figure No. B-4

AR 044431

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.9	1.5	5.8	84.2	7.6	
□	0.0	3.2	10.6	6.0	18.2	34.1	27.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.335	0.221	0.196	0.152	0.110	0.0880	1.19	2.51
□			4.09	0.394	0.282	0.0964				

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Slightly silty, medium to fine SAND	SP-SM	10%
□ Gravelly, silty SAND	SM	12%

Remarks:

○

□

Project: Third Runway South End

Client: HNTB

○ **Source:** HC00-B213 **Sample No.:** S-3

□ **Source:** HC00-B214 **Sample No.:** S-6

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Figure No. B-5

AR 044432

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	9.1	5.4	5.2	16.2	38.6	25.5	
□	0.0	4.2	11.2	5.0	14.3	42.1	23.2	
△	0.0	13.7	4.6	2.4	10.8	47.6	20.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			4.27	0.366	0.266	0.112				
□			5.13	0.354	0.264	0.123				
△			13.1	0.327	0.253	0.137				

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Gravelly, silty SAND	SM	17%
□ Gravelly, silty SAND	SM	20%
△ Gravelly, silty, medium to fine SAND	SM	13%

Remarks:

○

□

△

Project: Third Runway South End

Client: HNTB

○ **Source:** HC00-TP202 **Sample No.:** S-3

□ **Source:** HC00-TP203 **Sample No.:** S-3

△ **Source:** HC00-TP204 **Sample No.:** S-2

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Figure No. B-6

AR 044433

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	4.1	2.9	1.3	9.7	48.4	33.6	
□	0.0	15.3	23.0	7.7	19.0	31.9	3.1	
△	0.0	8.6	3.2	2.2	9.8	28.7	47.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.487	0.233	0.176					
□			19.2	3.91	1.18	0.362	0.224	0.176	0.19	22.25
△			1.27	0.209	0.101					

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Slightly gravelly,very silty, medium to fine SAND	SM	13%
□ Very gravelly SAND	SP	6%
△ Slightly gravelly, very silty, medium to fine SAND	SM	9%

Remarks:

○

□

△

Project: Third Runway South End

Client: HNTB

○ **Source:** HC00-TP206 **Sample No.:** S-2

□ **Source:** HC00-TP209 **Sample No.:** S-2

△ **Source:** HC00-TP211 **Sample No.:** S-4

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Figure No. B-7

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	9.6	13.7	9.6	15.1	30.3	21.7	
□	0.0	0.0	5.6	4.6	23.3	50.3	16.2	
△	0.0	12.2	2.2	3.3	13.6	32.8	35.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			11.3	0.779	0.387	0.155				
□			0.906	0.366	0.295	0.165				
△			3.98	0.302	0.204					

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Silty, gravelly SAND	SM	13%
□ Slightly gravelly, silty, medium to fine SAND	SM	9%
△ Gravelly, very silty, medium to fine SAND	SM	12%

Remarks:

○

□

△

Project: Third Runway South End

Client: HNTB

○ **Source:** HC00-TP213 **Sample No.:** S-1

□ **Source:** HC00-TP215 **Sample No.:** S-2

△ **Source:** HC00-TP217 **Sample No.:** S-3

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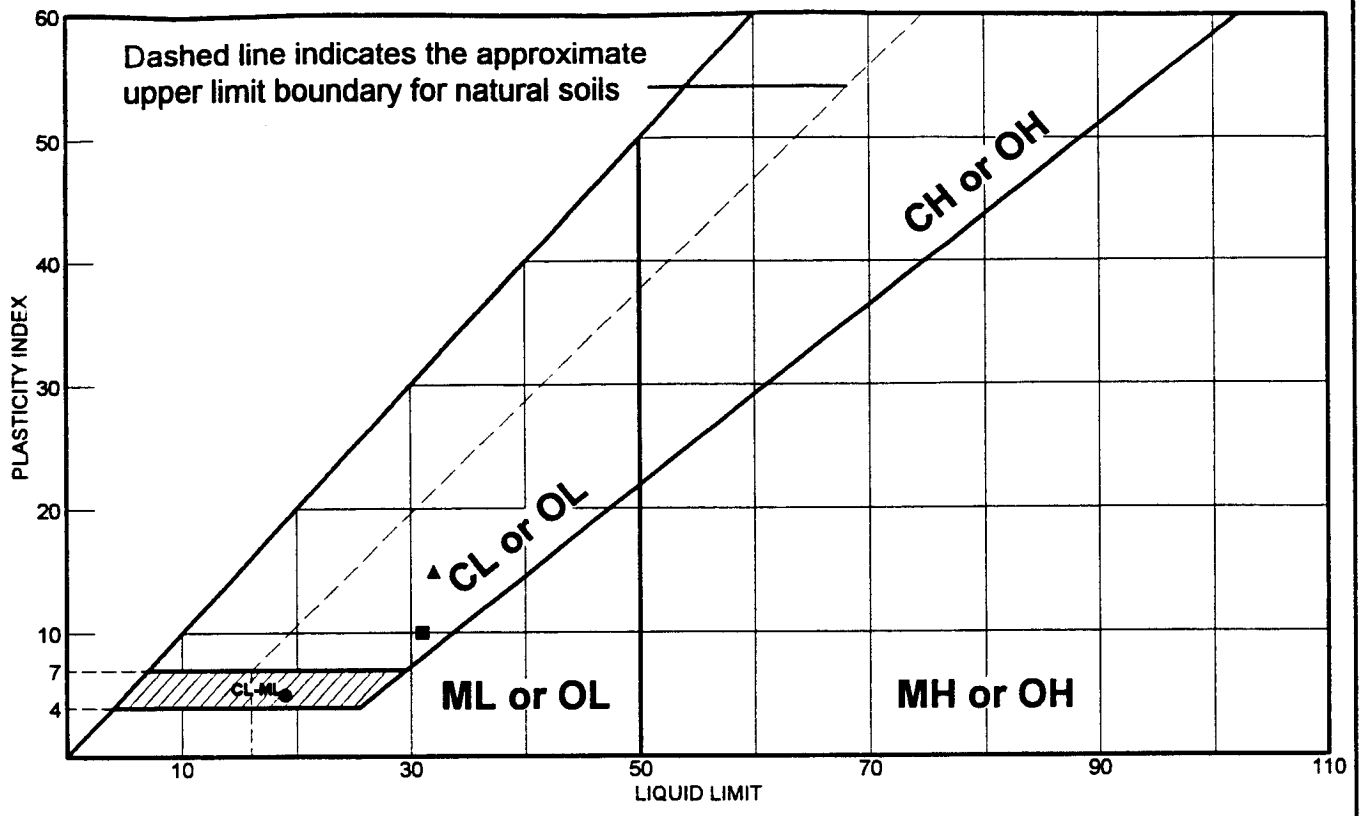
Figure No. B-8

AR 044435

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS
● Source: HC00-B205 Sample No.: S-4 CLAY-SILT	19	14	5		CL-ML
■ Source: HC00-TP211 Sample No.: S-2 Lean CLAY	31	21	10		CL
▲ Source: HC00-TP218 Sample No.: S-3 Lean CLAY	32	17	15		CL

Remarks:

●

■

▲

Project: Third Runway South End

Client: HNTB

Location:

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Figure No. B-9

AR 044436

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