

GEOTECHNICAL STUDY
CREEKSIDE PARK
MASS FILL
THE WOODLANDS, TEXAS

SUBMITTED TO
THE WOODLANDS OPERATING COMPANY, L.P.
2201 TIMBERLOCH PLACE
THE WOODLANDS, TEXAS 77380

BY
HVJ ASSOCIATES, INC.
APRIL 21, 2006

REPORT NO. HG-05-20940 (BG-2)



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April 21, 2006

Mr. Fred Leblanc, P.E.
The Woodlands Operating Company, L.P.
2201 Timberloch Place
The Woodlands, Texas 77380

Re: Geotechnical Investigation
Creeside Park Mass Fill
The Woodlands, Texas
Owner: The Woodlands Operating Company, L.P.
HVJ Report No. HG-05-20940 (BG-2)

Dear Mr. Leblanc:

Submitted herein is the draft report of our geotechnical investigation for the above project. The study was based on our proposal number HG-05-20940 dated October 7, 2005 (Revised October 14, 2005) and is subject to the limitations presented in this report.

It has been a pleasure working for you on this project and we appreciate the opportunity to be of service. Please read the entire report and notify us if there are questions or if we may be of further assistance.

Sincerely,

HVJ ASSOCIATES, INC.

Fadi Faraj, P.E.
Project Manager

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MH/HE/FF/SV/SP:pc

Copies submitted: 3

This document was released for the purpose of interim review under the authority of Fadi Faraj, P.E. 96707 on April 21, 2006. It is not to be used for construction, bidding, or permit purposes.

The following lists the pages which complete this report:

- Main Text – 18 pages
- Appendix A – 65 pages
- Plates – 24 pages
- Appendix B – 26 pages

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1. EXECUTIVE SUMMARY

HVJ Associates, Inc. was retained by The Woodlands Operating Company, L.P. to perform a preliminary geotechnical investigation for the proposed development of Creekside Park Mass Fill site in The Woodlands, Texas. The project involves filling up a 100 to 150-acre site to an approximate height of 60 feet. Ultimately, single family residences will be built on the top of the fill area. The fill material will be imported from several sites, and one of these sites is the Creekside Park Detention Pond. This report corresponds to the geotechnical investigation conducted on 50-acre project section, which is approximately half of the total project area.

Subsurface conditions for the project alignment were determined by drilling ten 80-foot borings below the existing ground surface. A brief summary of the investigational findings and pertinent recommendations are as follows:

1. Based on the field investigation, the subsurface soils generally consist of medium dense to very dense cohesionless clayey sands and silty sands at the top 2 to 4 feet, followed by firm to hard cohesive clays and sandy clays to a depth of 18 to 53 feet, followed by medium dense to very dense clayey sands, silty sands and sands to the maximum termination depth of the borings. Intermittent very dense silty sands and clayey sands were found in between 23 and 30 feet in boring B-1, between 23 and 28 feet in boring B-2, between 18 and 23 feet in borings B-3, B-4 and B-8, between 18 and 33 feet in boring B-5, and between 13 and 25 feet in boring B-6. Sand seams, ferrous nodules and gravel were encountered at various depths in all the borings.
2. Groundwater was encountered during the drilling operations in all the borings at depths between 4 and 20 feet below the existing ground surface. However, it should be noted that groundwater levels may fluctuate seasonally and with other climatic conditions.
3. The project area is located in an area subject to geologic faulting. Based on previous geologic fault delineation work conducted by HVJ Associates in the general project area, several echelon northeast to southwest trending linear features possibly indicative of geologic faulting seen on historical aerial photographs are located approximately 8000 ft. northwest of the project area.
4. Global slope stability analysis was performed for the mass fill site for an earthen slope of 3(H) to 1(V). Based on the computed factors of safety for the proposed depth, the mass fill slope does not have acceptable factors of safety for global stability for long term with high water table inside mass fill. Hence, we recommend using geogrid reinforcement along the slope. We also recommend a setback of about 30 feet for the construction of the houses from the edge of the slope in order to have acceptable factors of safety.
5. Settlement analysis was performed for the mass fill site at the center and along the edge of the mass fill site. The settlement values were mainly due to the thick clay and sandy clay layers below the existing ground surface. We recommend installing drains extending to a depth of about 55 feet throughout the clay layers to reduce the settlement to tolerable limits before constructing the houses. Settlement analysis results and estimated remaining settlement after construction is provided in the report.

Please note that this executive summary does not fully relate our findings and opinions. These findings and opinions are only presented through our full report.

2. INTRODUCTION

2.1 General

HVJ Associates, Inc. was retained by The Woodlands Operating Company, L.P. to perform a preliminary geotechnical investigation for the proposed development of Creekside Park Mass Fill site in The Woodlands, Texas. The project involves filling up a 100 to 150-acre site to an approximate height of 60 feet. Ultimately, single family residences will be built on the top of the fill area. The fill material will be imported from several sites, and one of these sites is the Creekside Park Detention Pond. This report corresponds to the geotechnical investigation conducted on 50-acre project section, which is approximately half of the total project area.

2.2 Geotechnical Study Program

The primary objectives of this study were to gather information on subsurface conditions along the alignment and to develop design and construction recommendations for the proposed structures. The objectives were accomplished by:

1. Drilling and field testing ten 80-foot deep soil borings to investigate soil stratigraphy and to obtain samples for laboratory testing,
2. Performing laboratory tests to determine physical characteristics of the soils, and
3. Performing engineering analyses to develop design guidelines and recommendations for the mass fill site.

Subsequent sections of this report contain descriptions of the field exploration, laboratory testing program, general site and subsurface conditions, design recommendations, and construction considerations.

3. FIELD EXPLORATION

3.1 General

The field exploration program undertaken for the project was performed between December 7, 2005 and December 11, 2005. Subsurface conditions at the project site were evaluated by drilling and sampling ten 80-foot borings below the existing ground surface. All borings were drilled with a truck mounted drilling rig at the approximate locations indicated on the Plan of Borings, Plate 1. The borings were backfilled with soil cuttings.

3.2 Sampling Method

Samples were obtained continuously to a depth of 12 feet, and at 5-foot intervals thereafter until the termination depth of the borings. Samples of cohesive soils were generally obtained with a three-inch thin-walled (Shelby) tube sampler in general accordance with ASTM D 1587. The shear strength of the cohesive soils was estimated by a hand penetrometer in the field. Cohesionless soils were sampled with the split spoon sampler in accordance with ASTM D 1586 standard. Suitable portions of each sample were sealed and packaged for transport to our laboratory.

Detailed descriptions of the soils encountered in the borings are given in the boring logs presented from Plates 2 to 11. A key to the terms and symbols used for soil classification on the boring logs is presented on Plate 12.

3.3 Water Level Measurements

Groundwater levels in the borings were obtained during and after completion of drilling. The water levels measured during drilling are reported on the boring logs presented on Plates 2 to 11.

4. LABORATORY TESTING

Selected soil samples were tested in the laboratory to determine applicable physical and engineering properties. All tests were performed according to the relevant ASTM Standards. These tests consisted of moisture content measurements, pocket penetrometer, Percent Passing No. 200 Sieve, Atterberg Limits, unconfined (UC) compression, unconsolidated undrained (UU) triaxial compression, one dimensional consolidation and dry unit weight tests.

The Atterberg limits, grain size distribution and percent passing No. 200 sieve tests were utilized to verify field classification by the Unified Soils Classification System. The compression tests were performed to obtain the shear strength parameters of the soil. The one dimensional consolidation test was performed to estimate the settlement of the subsurface soils.

The type and number of tests performed for this investigation are summarized below:

Type of Test	Number of Tests
Moisture Content (ASTM D2216)	117
Atterberg Limits (ASTM D4318)	25
Percent Passing No. 200 Sieve (ASTM D1140)	63
Hand Penetrometer	86
Unconfined Compression (ASTM D2166)	20
Unconsolidated Undrained Triaxial (ASTM D2850)	12
One Dimensional Consolidation (ASTM D2435)	8
Unit Dry Weight (ASTM D2166)	32

The laboratory test results are shown on the boring logs presented on Plates 2 to 11. The consolidation test results are provided in Appendix A.

5. SITE CHARACTERIZATION

5.1 General Geology

The site of the proposed development is located in the Willis Formation, with sediments of the Lissie Formation exposed just south of the site. The Willis Formation is the oldest Pleistocene formation in the area, and is considered middle Pleistocene in age. The Willis Formation typically consists of clays, silts, sands, and iron concretions. The iron oxide concretions are commonly found in the zone between 1 and 3 feet, and generally are the size of pebbles. These concretions are mined locally and are used for paving roads.

The Lissie Formation is similar to the Willis Formation; however, the Lissie contains slightly less granular material. The Lissie is heterogeneous, containing interbedded layers of clay, sand, and silt. It was deposited in mid-Pleistocene times in shallow coastal river channels and flood plains.

The coastal plain in this region has a complex tectonic geology, several major features of which are: Gulf Coastal geosyncline, salt domes, major sea level fluctuations during the glacial stages, subsidence and faulting. Most faulting has ceased for millions of years, but some faults are still active.

5.2 Geologic Faulting

HVJ Associates, Inc. conducted a fault study close to the project area and the results were presented in HVJ Report Nos. 97-108G-00 and 97-108G-01 dated September 12, 1997 and January 28, 1998 respectively. The study included conducting field reconnaissance and reviewing available published and unpublished literature.

The project area is located in an area subject to geologic faulting. Based on previous geologic fault delineation work conducted by HVJ Associates in the general project area, several echelon northeast to southwest trending linear features possibly indicative of geologic faulting seen on historical aerial photographs are located approximately 8000 ft. northwest of the project area.

We recommend a Phase I Geologic Fault Study following the guidelines for Phase I fault studies as recommended by the Houston Geological Society (HGS Bulletin, March 1985). The purpose of this study is to determine, based on a review of available geologic records and a site reconnaissance, whether geologic faults may be present on the surface in the general area and specifically with the confines of the project area and whether adverse impacts to the areas have occurred. While this type of study is widely recognized as an initial step in determining if faults are present, faults may escape detection due to slow movement rates and lack of identifiable fault-related features such as scarps. Information considered for this Phase I study will include maps, reports and other documents from (but not limited to) the following sources: US Geological Survey; current and historical aerial photography; Texas Bureau of Economic Geology; other professional and university geological publications/records; proprietary oil field maps of oil field development near the project area and the Natural Resource Conservation Service. The scope of work for this project will include a review of the above data specifically within or near the project area with an on-site field reconnaissance survey by a geologist trained in methods of fault identification.

5.3 Soil Stratigraphy

Our interpretation of soil and groundwater conditions along the project alignment is based on information obtained at the boring locations only. This information has been used as the basis for our conclusions and recommendations. Significant variations at areas not explored by the project borings may require reevaluation of our findings and conclusions.

Based on the field investigation, the subsurface soils generally consist of medium dense to very dense cohesionless clayey sands and silty sands at the top 2 to 4 feet, followed by firm to hard cohesive clays and sandy clays to a depth of 18 to 53 feet, followed by medium dense to very dense clayey sands, silty sands and sands to the maximum termination depth of the borings. Intermittent layers of very dense silty sands and clayey sands were found in between 23 and 30 feet in boring B-1, between 23 and 28 feet in boring B-2, between 18 and 23 feet in borings B-3, B-4 and B-8, between 18 and 33 feet in boring B-5, and between 13 and 25 feet in boring B-6. Sand seams, ferrous nodules and gravel were encountered at various depths in all the borings.

Detailed descriptions of the materials encountered in the borings are given on the boring logs presented on Plates 2 to 11. Key to the terms and symbols used for soil classification on the boring logs are also presented on Plate 12.

5.4 Groundwater

Groundwater was encountered during the drilling operations in all the borings at depths between 4 and 20 feet below the existing ground surface. However, it should be noted that groundwater levels may fluctuate seasonally and with other climate changes.

6. SLOPE STABILITY

6.1 General

We understand that the project includes construction of single family residences on top of 60-foot high fill area. The fill material will be imported from several sites. One of these sites is the Creekside Park Detention Pond. Slope stability analysis was performed for the fill area for two soil situations, situation 1 assuming the fill material as cohesionless soil, and situation 2 assuming the fill material as cohesive sandy clay material.

Global stability analyses for the mass fill area sides should meet the following minimum recommended factors of safety, which are tabulated in the following table.

Recommended Factors of Safety for Different Loading Conditions

Loading Condition	Recommended Factor of Safety
End of Construction	1.30
Long-Term	1.50
Long-Term w/high water table inside Mass Fill	1.25

The factors of safety represent the calculated ratio of resisting forces and moments to the calculated driving forces and moments for the various potential failure surfaces analyzed. These forces and moments are based on the estimated unit weights and shear strengths of the various soils in the slope profile. Accordingly, a factor of safety of 1.0 indicates impending failure. The greater than 1.0 the factor is, the lower the risk of slope failure. As a practical matter, and in consideration of the variables and uncertainties involved, the risk cannot be reduced to zero. The goal is to reduce the risk of slope failure to a reasonable and acceptable level, with due consideration of the consequences of failure.

6.2 Method of Analysis

Several methods of slope stability analysis are available. The most commonly used method is the Bishop Method. Slope stability analyses were conducted using a slope stability program WINSTABL. The program calculates the factor of safety against slope failure using a two-dimensional limiting equilibrium method. The calculation of the factor of safety against instability was performed by the Modified Bishop Method.

6.3 Soil Parameters and Water Level

Slope stability analyses were performed for the End of Construction Case, Rapid Drawdown Case and Long Term Case. The soil parameters used in each case are discussed below and were estimated based on the field and laboratory data developed for this study, and also our experience with similar soils.

End of Construction. The end of construction case models the initial undrained condition of the soil. For this analysis, unconfined compression soil parameters were used. In this analysis, the piezometric level was taken at the bottom of the fill area. The soil parameters used in the analysis of the slope stability analysis for this condition are presented below.

Long Term. The long-term design case represents steady state piezometric and stress conditions. When a slope is excavated, altered stress conditions create pore pressure changes within the slope and the undrained strength of the bank soils is mobilized. With time, the soil pore pressures adjust

to the imposed stress and piezometric conditions, and the bank soils rely on their available strength for long-term stability. In this analysis, the piezometric level was taken at as in the first design case (End of Construction).

Long Term w/ high water table inside Mass Fill. This case models the condition where the water level inside the mass fill is at a higher level than the water level outside the mass fill. For this analysis, the maximum water table level inside the mass fill was taken at 0.7 times the height of the fill area from the existing ground surface. The water level outside of the fill area was taken at the existing ground surface.

Slope stability analyses for the mass fill area was performed on slope 3(H) to 1(V) under all the above conditions. The soil parameters used in each case are discussed below.

SOIL PARAMETERS FOR SLOPE STABILITY ANALYSIS

Stratum	Depth below the existing ground surface (ft)	Description	Unit Weights		EC		LT	
			γ_t (pcf)	γ_{sat} (pcf)	c (psf)	ϕ (deg)	c' (psf)	ϕ' (deg)
Case 1 – Based on borings B-1 thru B-7, and B-10 (Fill Area – Clayey Sand)								
1	60 ft above GL	FILL (Clayey Sand)	125	125	0	32	0	32
2	0-2	Clayey Sand	125	125	0	34	0	34
3	2-16	Sandy Clay	125	125	1400	0	140	24
4	16-20	Clayey Sand	125	125	0	34	0	34
5	20-40	Sandy Clay/ Clay	125	125	2500	0	250	22
6	Below 40	Sand	0	35	0	35	0	35
Case 2 – Based on borings B-1 thru B-7, and B-10 (Fill Area – Sandy Clay)								
1	60 ft above GL	FILL (Sandy Clay)	125	125	1200	0	100	24
2	0-2	Clayey Sand	125	125	0	34	0	34
3	2-16	Sandy Clay	125	125	1400	0	140	24
4	16-20	Clayey Sand	125	125	0	34	0	34
5	20-40	Sandy Clay/ Clay	130	130	2500	0	250	22

Stratum	Depth below the existing ground surface (ft)	Description	Unit Weights		EC		LT	
			γ_t (pcf)	γ_{sat} (pcf)	c (psf)	ϕ (deg)	c' (psf)	ϕ' (deg)
6	Below 40	Sand	125	125	0	35	0	35
Case 3 – Based on borings B-8 and B-9 (Fill Area – Clayey Sand)								
1	60 ft above GL	FILL (Clayey Sand)	120	120	0	32	0	32
2	0-18	Sandy Clay	125	125	2000	0	200	24
3	Below 18	Sand	0	32	0	32	0	32
Case 4 – Based on borings B-8 and B-9 (Fill Area – Sandy Clay)								
1	60 ft above GL	FILL (Sandy Clay)	125	125	1200	0	100	24
2	0-18	Sandy Clay	125	125	2000	0	200	24
3	Below 18	Sand	0	32	0	32	0	32

Where:

EC: End of Construction

RD: Rapid Drawdown

LT: Long Term Condition

γ_t : Moist Unit Weight of Soil

γ_{sat} : Saturated Unit Weight of Soil

c: Unconsolidated Undrained Cohesion

ϕ : Unconsolidated Undrained Friction Angle

c': Consolidated Drained Cohesion

ϕ' : Consolidated Drained Friction Angle

6.4 Computed Factor of Safety of the Analyzed Slope

Based on the soil parameters and water levels discussed previously, slope stability analyses for slope 3(H):1(V) was analyzed for all the four cases described above. The results of computed factors of safety are tabulated below:

Computed Factors of Safety

Loading Condition	Computed Factors of Safety for Slope 3(H):1(V)			
	Case 1	Case 2	Case 3	Case 4
End of Construction	1.65	1.33	2.21	1.56
Long – Term	1.77	1.70	2.19	2.25
Long Term w/high water table inside the Mass Fill	0.94*	1.08*	0.90	1.53
Long Term w/high water table inside the Mass Fill (With Geogrid Reinforcement)	1.32	1.24	1.36	-

* Does not meet the required safety factor.

Based on the computed factors of safety for the proposed depth, the mass fill slope does not have acceptable factors of safety for global stability for long term with high water table inside the mass fill. Therefore, we recommend the use of geogrids along the slope of the fill material.

6.5 Slope Recommendation

Based on the computed factors of safety for the proposed depth, the earthen slope of the 3(H) to 1(V) for the mass fill do not have acceptable factors of safety for global stability for long term with high water table inside the mass fill. Hence, we recommend using geogrid reinforcement of 120 feet long at every 2 foot intervals along the slope of the fill material. Stability calculations for the above slope conditions are presented in Appendix A. We also recommend a setback of about 30 feet for the construction of the houses from the edge of the slope in order to have acceptable factors of safety. Furthermore, we recommend a proper drainage plan for the development after completion of mass fill construction to minimize infiltration that may cause a high water table inside the mass fill.

6.6 Erosion Protection

Erosion control measures will be needed wherever cohesionless soils (sand or silt) are exposed on the slope. Since cohesionless soils may be used as fill material for the mass fill site, we recommend that the mass fill plans include provisions for treatment of erodible soils. Several alternative erosion protection measures are discussed below.

Geocomposites. Specialty geocomposites have been developed by many manufacturers for erosion control applications. The goal of such systems is to prevent sheet, gully or roll erosion either indefinitely or until vegetation can establish itself. These materials are installed by pinning or stapling them to the soil on a prepared subgrade. Typical failure mechanisms are water flow between the fabric and the soil or undermining at roll edges. Manufacturer's installation recommendations should be followed.

Temporary erosion control materials are designed to remain in place until vegetation is established. They are partially or completely biodegradable after a period of time. We recommend a permanent erosion control system, in which the geocomposite material is placed and becomes enmeshed with the vegetation root system. Such materials are placed as above, and then soil backfill is placed within

and above the material. The fill is seeded or the soil subgrade is seeded prior to geocomposite and backfill placement. The fill soil partially protects the geocomposite material from ultraviolet degradation, and forms the medium for root growth.

Many products are suitable for erosion control. One such product is Tensar Erosion Mat available from Industrial Fabrics (800) 848-4500, and others. Another such products are Landlok Erosion Control Mats from SI Geosolutions (800)-FIX-SOIL. We would be pleased to assist you in identifying other options.

7. MASS FILL AREA SETTLEMENT ANALYSIS

7.1 General

Settlement analyses were performed for the foundation soils of the proposed mass fill area. The settlement at the project site will include the settlement of the fill material used for the construction of the fill area and settlement of existing foundation soils below the existing ground surface. The following sections discuss the fill and foundation settlement that will have an impact on the final constructed facilities.

7.2 Fill Settlement

We believe that fill settlement will be substantially complete within a few months for granular fill and for low plasticity clay fill if properly compacted. For high plasticity clay fill settlement may occur within the fill for longer periods. We expect that clay fill with a liquid limit higher than about 45 placed with moisture content higher than about one percent above optimum moisture may continue to settle for as long as several years after filling is complete. Where water is allowed to flow through the fill material, erosion of the fill may occur, this can lead to settlement of the structures. Also, where poor compaction of the fill is performed unusually large settlements may occur, and that settlement may continue for a long time.

For high plasticity fill placed several percent wet of optimum moisture content the total settlement that may occur after six months from the end of filling may be up to 0.5% of the fill height that is up to 3.6 inches. If high plasticity fill is placed several percent dry of optimum the amount of settlement that may occur after six months will be negligible; however, high plasticity fill placed in this condition may swell causing heave.

Our experience shows that clay fill placed in the Houston area often achieves acceptable density at moisture contents one percent above optimum, and in the winter months such fill is often accepted since drying the fill is practically impossible at that time of the year. In the summer months clay fill often achieves acceptable densities at moisture contents lower than 3% below optimum moisture content, and this fill is often accepted since wetting the clay is time consuming in the summer months. Both conditions can cause fill movement and may result in unacceptable levels of differential movement.

For the purposes of the settlement analysis we have assumed that fill settlement will be complete within a few months of filling. If clay fill with a liquid limit higher than 45 is used in the mass fill very careful moisture control during compaction will be needed to satisfy this assumption. We recommend that the moisture condition of fill with a liquid limit greater than 45 be controlled during compaction such that it is within the range of 2% below to 1% above optimum moisture content. Furthermore, we recommend the use of wick drains if cohesive soils (clays or sandy clays) are used as fill material for the mass fill to expedite the fill settlement. If a combination of cohesive and cohesionless soils will be used for the mass fill, we recommend placing the cohesive soils and

using wick drains to expedite the settlement of the cohesive soils first, and then placing the cohesionless soils on the top of cohesive soils.

7.3 Foundation Soil Settlement

Existing soils will undergo immediate elastic settlements and long-term consolidation settlements. Elastic settlement of the on-site soils should occur within a few months after mass fill site construction, and should have little impact on the final constructed facilities. As part of the study, we performed consolidation settlement analysis for the subsurface soils underneath the existing ground surface. Consolidation settlement is estimated based on our laboratory tests and soil conditions encountered in the borings. We have estimated the settlement of the ground underneath the fill material along the edge of the project area based on borings B-1, B-4, B-8 and B-10, and at the center of the site based on borings B-5, B-6 and B-7. A summary of the estimated consolidation is presented in the table below.

Location	Mass Fill Area Height (ft)	Settlement of ground underneath the Fill material (inches)
Along the Edge of the Project area	60	2.4
At the Center of the Project area	60	6.0

In the table the "Edge" settlement is the settlement estimated along the periphery of the mass fill area and the "Center" settlement is the settlement estimated at the center of the mass fill. The "Center" settlement should be considered the maximum settlement that will occur at the center of the fill.

7.4 Foundation Soil Settlement with Time

Consolidation is a slow process and takes a number of years to complete. Based on our experience with Houston soils, generally more than 50% of consolidation is achieved within the first six months of placement of fill. The consolidation settlement with time is important when evaluating the remaining settlement that may occur. We understand that fill placement may take approximately 5 years. We have assumed that 12 feet of fill will be placed each year, with a total of 60 feet in 5 years. Since the structures are not constructed immediately after the fill placement, we have calculated the settlement at different times after the fill placement. The remaining settlement at different times is summarized in the table below.

Time Since Beginning of Construction (yrs)	Total Fill Height (ft)	Remaining Foundation Soil Settlement at Center (in)	Remaining Foundation Soil Settlement Along Edge (in)
1	12	1.92	0.73
2	24	2.77	1.05
3	36	3.34	1.26

Time Since Beginning of Construction	Total Fill Height	Remaining Foundation Soil Settlement at Center	Remaining Foundation Soil Settlement Along Edge
(yrs)	(ft)	(in)	(in)
4	48	3.71	1.40
5	60	3.96	1.51
6	60	3.43	1.25
8	60	2.74	0.88
10	60	2.21	0.72
14	60	1.46	0.50
20	60	0.81	0.28

Plates 13 and 14 present the settlement and the remaining settlement at the center of the mass fill site, respectively. Plates 15 and 16 present the settlement and the remaining settlement along the edge of the mass fill site, respectively.

7.5 Foundation Soil Settlement Reduction Measures

In this section we present several approaches to reducing the foundation soil settlement and/or reducing the time required for the settlement to occur.

Summary. The table below summarizes the potential settlement reduction methods discussed in this section.

Summary of Ground Improvement Approaches

Method	Along the Edge	At the Center
Preloading	Not a good solution	Not a good solution
Drains	Valid Solution	Valid Solution
Foundation Replacement	Not a good solution	Not a good solution
Wait Longer	May be a good solution	May be a good solution

Preloading. We investigated preloading as an alternative to accelerate the progress of fill settlement. Settlement due to an applied pressure occurs over a period of time. A proportion of the final settlement can be achieved prior to construction by pre-loading the soil. The larger the pre-load, the less time it will take to achieve the final settlement. The heavier fill causes the settlement to occur quicker. When the desired amount of settlement has occurred, the fill is then reduced to the final height. This reduction of the fill height halts further settlement. There are various reasons that this approach is not appropriate for this project as listed below.

1. Preloading will require substantial amounts of additional fill that will be placed and then removed at a substantial cost.

2. The global stability of the fill will be below the acceptable level. Any raising of the fill for preloading purposes would reduce global stability to unacceptably low levels.

Drains. Sand drains or wick drains are inserted into the ground vertically at close horizontal spacing, and reduce the time needed for full consolidation by decreasing the drainage path length. Accelerating settlement by installing drains prior to filling over an area equal to five feet outside the fill area would reduce the differential settlement to tolerable levels. The drains should be about 55 feet deep (throughout the clay layers).

As an alternative to sand or wick drains, stone columns can also be used underneath the fill material. The elements are constructed by drilling out a volume of compressible soil to create a cavity and then ramming aggregate into the cavity. The ramming action causes the aggregate to compact vertically and to push laterally against the soil matrix, thereby increasing the horizontal stress in the soil. Stone columns serve as vertical drains thereby enhancing drainage and expediting settlement. Stone columns will also improve the composite shear strength and increase the factor of safety against global instability and sliding.

Foundation Replacement. Removing the compressible foundation and replacing it with an incompressible material will result in reducing the overall magnitude of the settlement at the abutment fill. Through the removal and replacement process, the foundation soils are also strengthened which will result in an increased factor of safety for global stability than under the existing condition. However, this option is not applicable on this project.

Wait for a Longer Time for Settlement to Occur. Based on the soil conditions encountered for this project the time required to wait for settlement to occur would be many years, this approach maybe practical depending on project schedule. Plates 13 and 14 present the settlement and the remaining settlement at the center of the mass fill site, respectively, and plates 15 and 16 present the settlement and the remaining settlement along the edge of the mass fill site, respectively.

7.6 Fill Soil Settlement Reduction Measures

In this section we present several approaches to reducing the fill soil settlement and/or reducing the time required for the settlement to occur. No matter what approach is selected, we recommend monitoring the settlement, and waiting until the settlement reaches a steady state. A graph plotting the monitored settlement with time can be used to determine when the steady state has been reached.

Summary. The table below summarizes the potential settlement reduction methods discussed in this section.

Summary of Ground Improvement Approaches

Method	Along the Edge	At the Center
Preloading	Not a good solution	Not a good solution
Drains	Valid solution for cohesive fill	Valid solution for cohesive fill
Wait Longer	May be a good solution	May be a good solution

Preloading. This approach is not appropriate for this project due to the same reasons discussed previously.

Drains. Sand drains or wick drains will be a good solution if cohesive fill is used.

Wait for a Longer Time for Settlement to Occur. This approach maybe practical depending on project schedule.

8. SITE PREPARATION AND FILLING

Before the mass fill takes place the site should be cleared, grubbed and stripped of all organic material, soft soils and foreign material within the proposed development area. Stripped areas should be appropriately graded and shaped to prevent ponding of water. Pumping may occur if the site becomes wet. Stump holes or other small excavations in the limits of the mass fill shall be backfilled with suitable material and thoroughly compacted by approved methods before commencing mass fill construction. All subgrade soils should be proof rolled prior to placement of fill material.

The surface of the existing ground shall be loosened by scarifying or plowing to a depth of not less than 4-inches. The loosened material shall be recompacted with the new mass fill as hereinafter specified, and shall not exceed 8-inches in total depth. The mass fill shall then be placed in layers, not to exceed 8-inches, beginning at the low side in part width layers and increasing the widths as the mass fill is raised. The material which has been loosened shall be recompacted simultaneously with the mass fill material placed at the same elevation.

Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in the mass fill. All mass fill shall be constructed in horizontal layers.

Prior to compaction, the layers shall not exceed 6 inches in depth where pneumatic tire rolling is to be used and shall not exceed 8-inches in depth for rolling with other types of rollers. Layers of mass fill may be formed by utilizing equipment which will spread the material as it is dumped, or they may be formed by being spread by blading or other acceptable methods, from piles or windrows dumped from excavating or hauling equipment in such amounts that the material is evenly distributed.

Each layer of mass fill shall be uniform as to material and moisture content before compaction. Where layers of unlike materials abut each other, the material shall be mixed so as to prevent abrupt changes in the soil. No material placed in the mass fill by dumping in a pile or windrow shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken and the mass fill material mixed by blading, harrowing, discing, or similar methods to the end that a uniform material is secured in each layer. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied.

Each layer shall be compacted to a minimum of 95% of standard proctor density (ASTM Method D698), at a moisture content of one percent below optimum and three percent above optimum. After each layer of fill is complete, we recommend tests to be performed by the testing lab. If the material fails to meet the density specified, the course shall be reworked, as necessary, to obtain the specified compaction.

As a preliminary recommendation, we recommend the use of wick drains if cohesive soils (clays or sandy clays) are used as fill material for the mass fill to expedite the fill settlement. If a combination of cohesive and cohesionless soils will be used for the mass fill, we recommend placing the cohesive soils and using wick drains to expedite the settlement of the cohesive soils first, and then placing the cohesionless soils on the top of cohesive soils. Plates 17, 18 and 19 show suggested diagrams for fill placement for different types of soils.

We also recommend regular monitoring of the fill placement and drilling additional borings after the placement of fill material to evaluate the settlement and determine the soil properties of the fill material after placement.

9. DESIGN REVIEW

HVJ Associates, Inc. should review the design and construction plans and specifications prior to release to make certain that the geotechnical recommendations and design criteria presented herein have been properly interpreted.

10. CONSTRUCTION MATERIALS TESTING

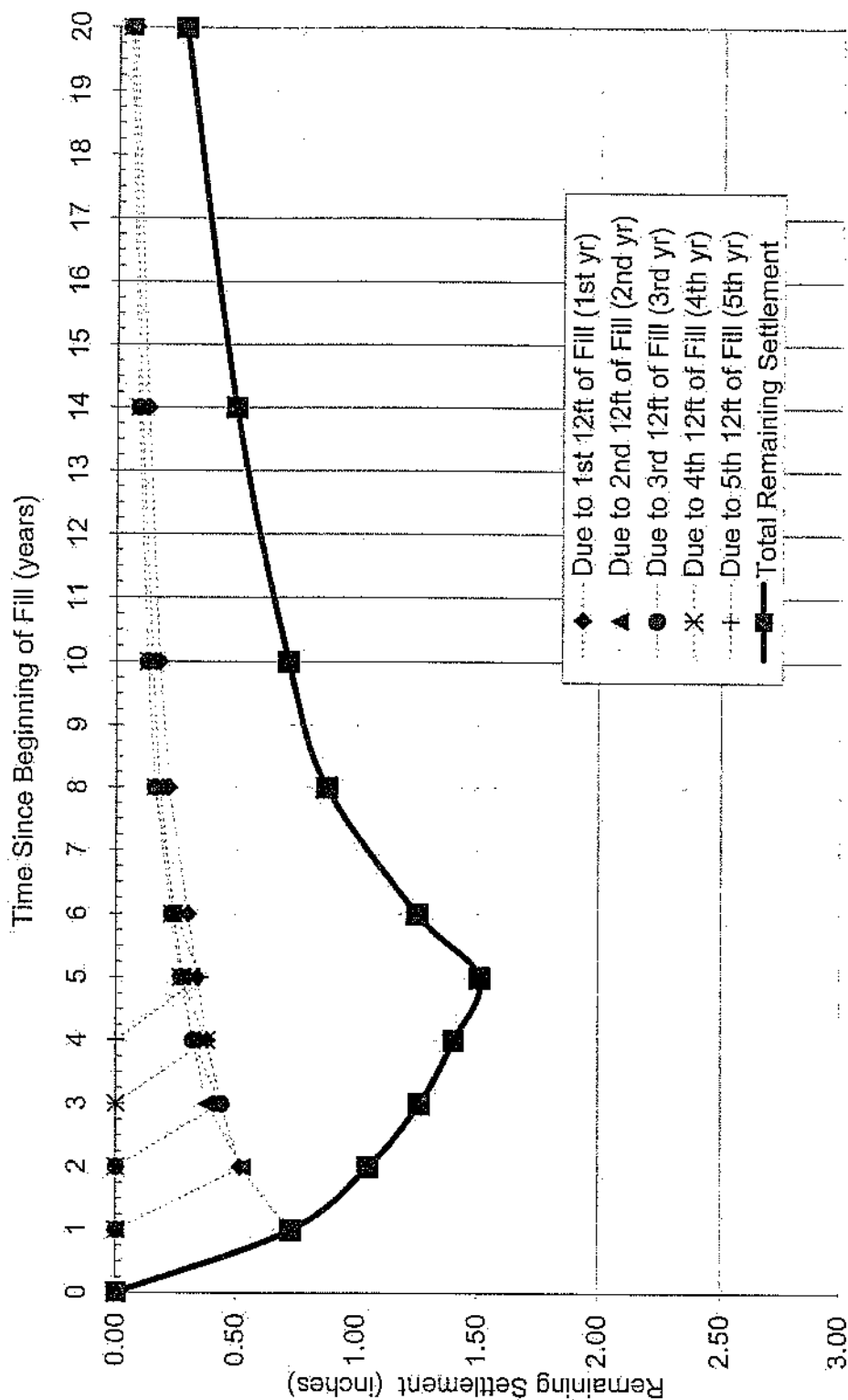
We recommend that the placement and compaction of the fill material be monitored by HVJ Associates during the construction phase to ensure that construction is performed in conformance with the project specifications. Our involvement in monitoring the fill placement and monitoring the settlement is highly recommended in order to evaluate the site conditions and provide any future recommendations based on better knowledge of the existing fill conditions.

11. LIMITATIONS

This investigation was performed for the exclusive use of The Woodlands Operating Company, L.P. for the preliminary design and construction of the proposed Creekside Park Mass Fill Site in The Woodlands, Texas. HVJ Associates, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common in the local area. HVJ Associates, Inc. makes no warranty, express or implied. The analyses and recommendations contained in this report are based on data obtained from subsurface exploration, laboratory testing, the project information provided to us and our experience with similar soils and site conditions. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any subsurface conditions other than those described in our boring logs be encountered, HVJ Associates, Inc. should be immediately notified so that further investigation and supplemental recommendations can be provided.

PLATES

Remaining Foundation Soil Settlement Along Edge of Mass Fill



6120 S. Dairy Ashford Road
Houston, Texas 77072-1010
281.933.7388 Ph
281.933.7293 Fax

DATE: 04/24/06

APPROVED BY:
FF

PREPARED BY:
FF

REMAINING FOUNDATION SOIL SETTLEMENT
ALONG EDGE OF MASS FILL

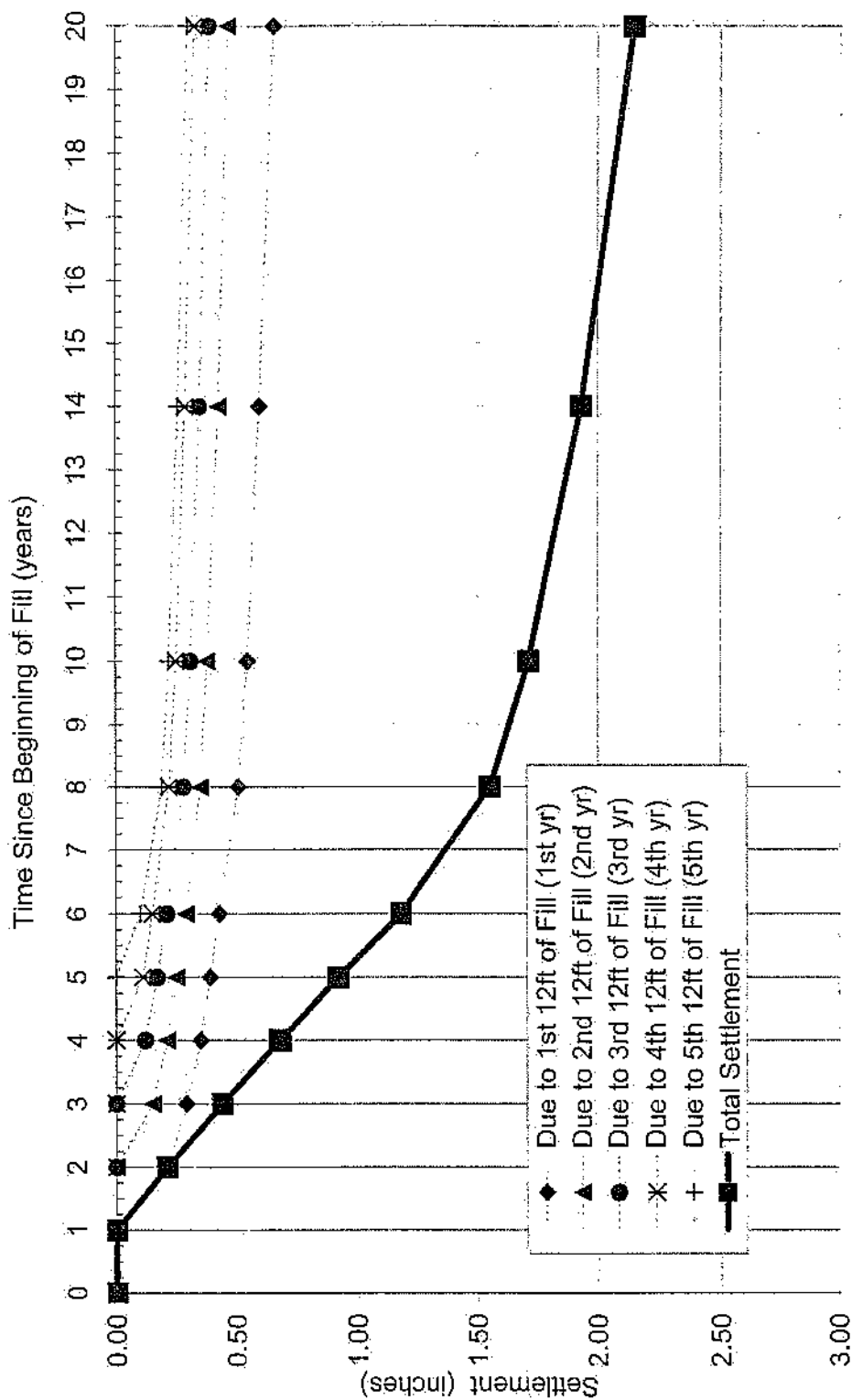
PROJECT NO.:

HG-05-20940 (BG-2)

DRAWING NO.:

PLATE 16

Foundation Soil Settlement Along Edge of Mass Fill



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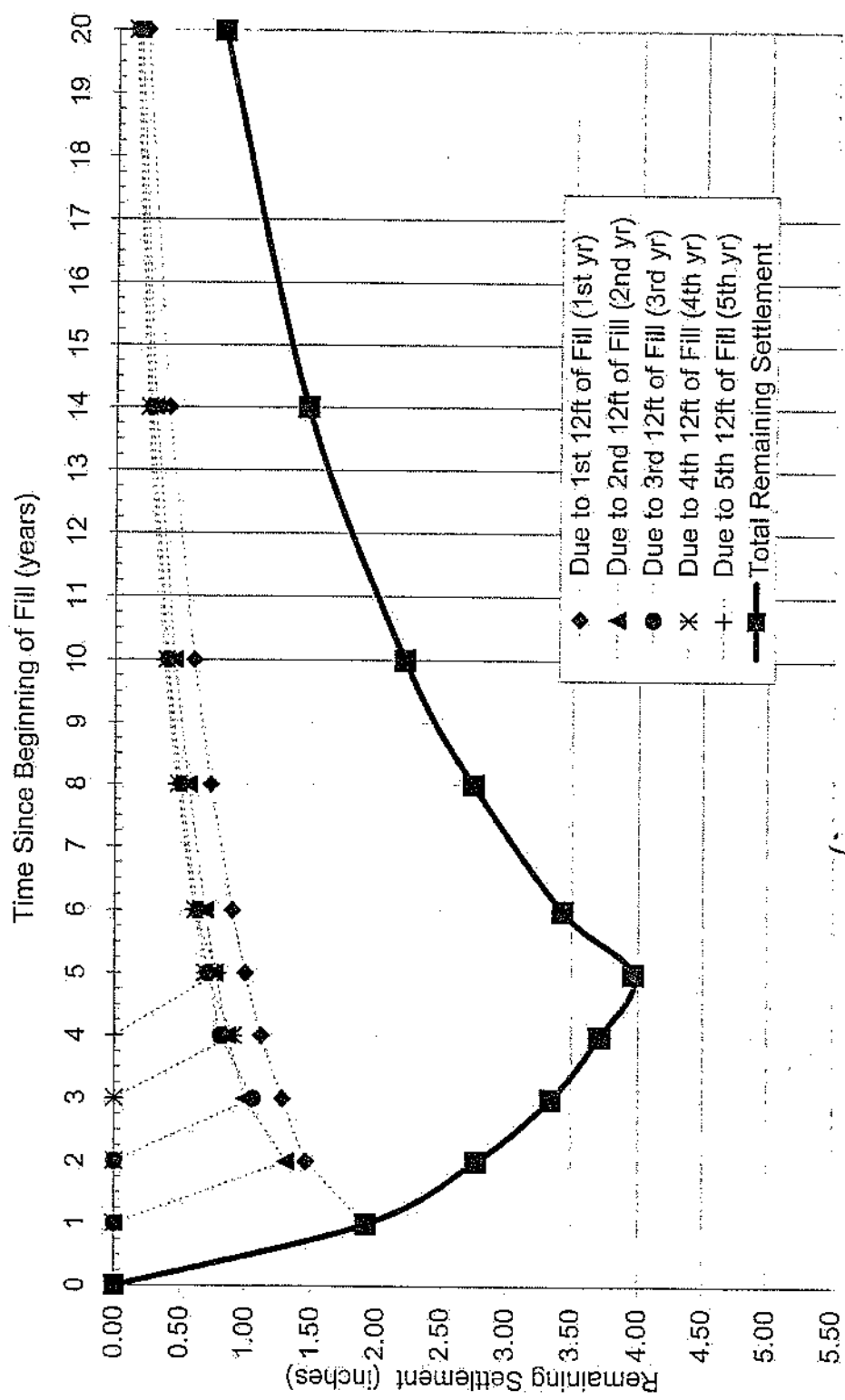


DATE: 04/24/06
APPROVED BY: FF
PREPARED BY: FF

FOUNDATION SOIL SETTLEMENT
ALONG EDGE OF MASS FILL

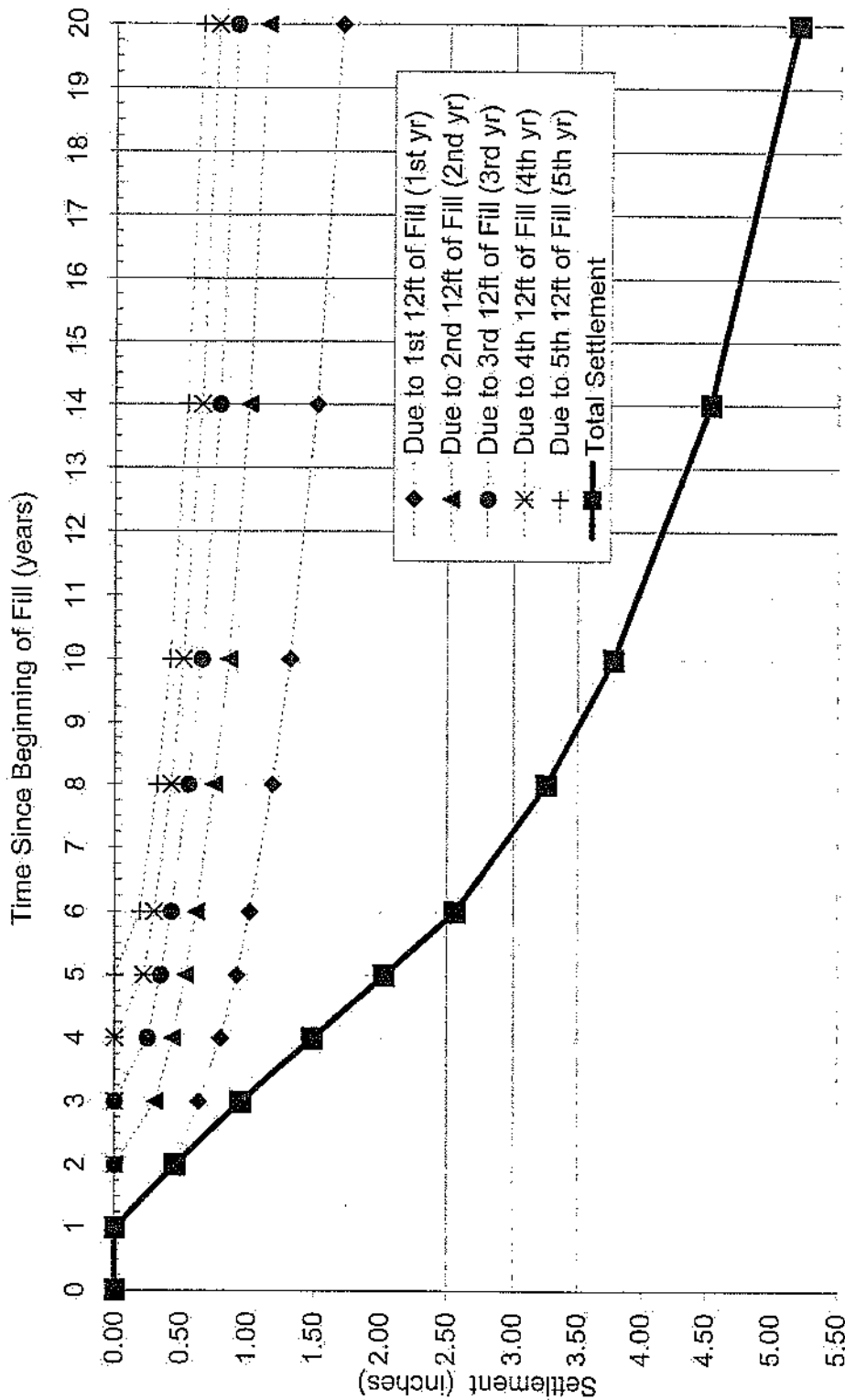
PROJECT NO.: HG-05-20940 (BG-2)
DRAWING NO.: PLATE 15

Remaining Foundation Soil Settlement At Center of Mass Fill



		6120 S. Dairy Ashford Road Houston, Texas 77072-1010 281.933.7388 Ph 281.933.7293 Fax	
DATE: 04/24/06	APPROVED BY: FF	PREPARED BY: FF	
REMAINING FOUNDATION SOIL SETTLEMENT AT CENTER OF MASS FILL			
PROJECT NO.: HG-05-20940 (BG-2)	DRAWING NO.: PLATE 14		

Foundation Soil Settlement At Center of Mass Fill



settlement from 1953
to 1960

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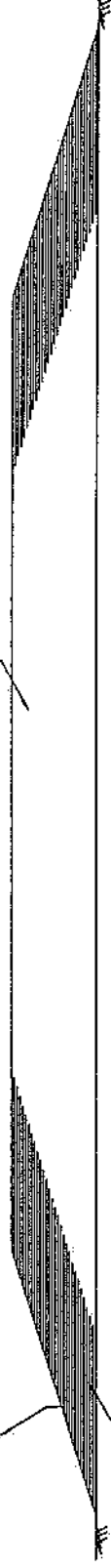
DATE: 04/24/06
APPROVED BY: PF
PREPARED BY: PF

FOUNDATION SOIL SETTLEMENT
AT CENTER OF MASS FILL

PROJECT NO.:
DRAWING NO.:
HG-05-20940 (BG-2) PLATE 13

Slope 3(H):1(V) with
Geocomposite to protect
Vegetation for Erosion Control

Cohesive Fill (Use Drains to enhance Settlement)



Geogrids 120" long @ 2' Intervals

FOUNDATION SOIL



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281.933.7293 Fax

DATE: 04/06/06

APPROVED BY:
FF

PREPARED BY:
SV

PROPOSED MASS FILL DIAGRAM
FOR COHESIVE FILL

PROJECT NO.:

HG-05-20940 (BG-2)

DRAWING NO.:

PLATE 17

Slope 3(H):1(V) with
Geocomposite to protect
Vegetation for Erosion Control

Geogrids 120' long @ 2' Intervals

Cohesionless Fill

FOUNDATION SOIL



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281-933-7388 Ph.
281-933-7293 Fax

DATE: 04/06/06

APPROVED BY:
FF

PREPARED BY:
SV

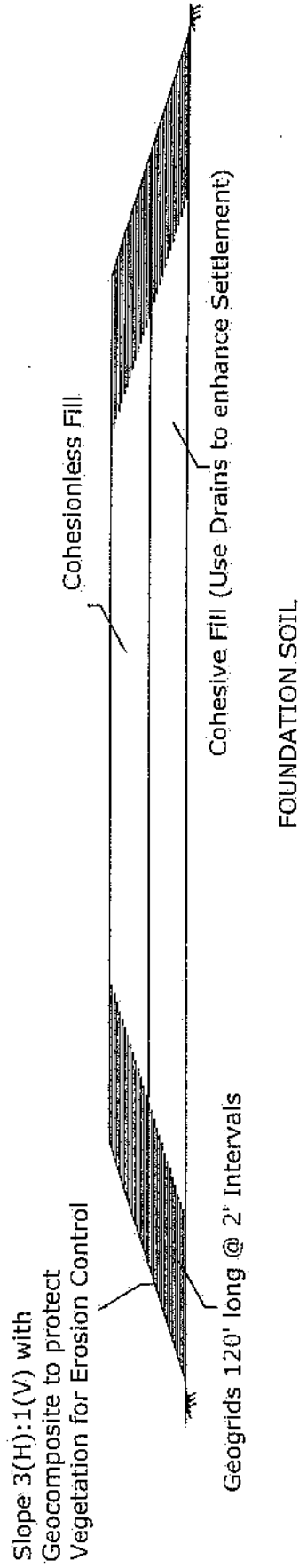
PROPOSED MASS FILL DIAGRAM
FOR COHESIONLESS FILL

PROJECT NO.:

HG-05-20940 (BG-2)

DRAWING NO.:

PLATE 18



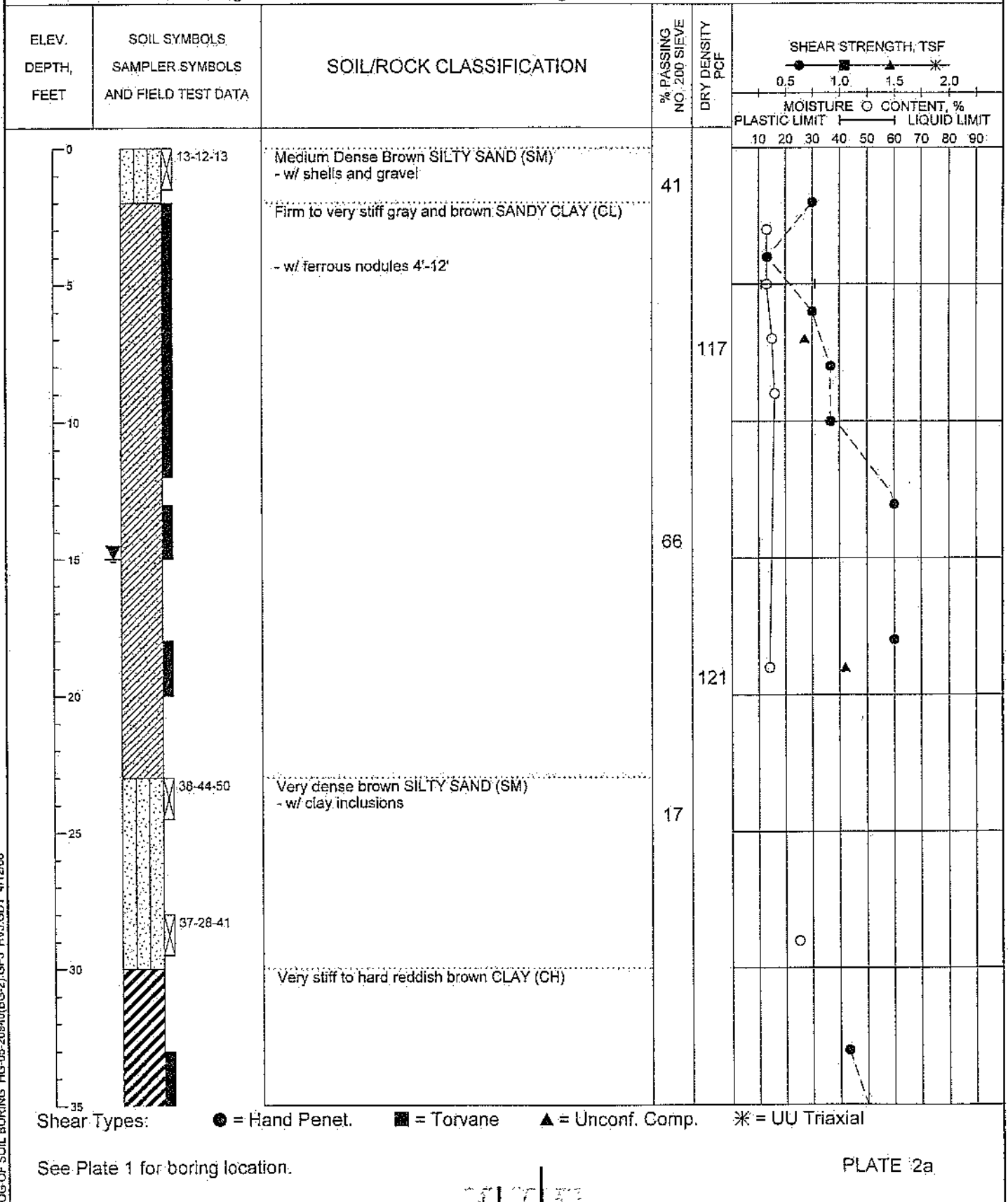
 6120 S. Dairy Ashford Road Houston, Texas 77072-1010 281.933.7388 Pk 281.933.7293 Fax	DATE: 04/06/06 APPROVED BY: FF PREPARED BY: SV	PROPOSED MASS FILL DIAGRAM FOR COHESIVE & COHESIONLESS FILL	
PROJECT NO.: HG-05-20940 (BG-2)		DRAWING NO.: PLATE 19	

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-1
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/10/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



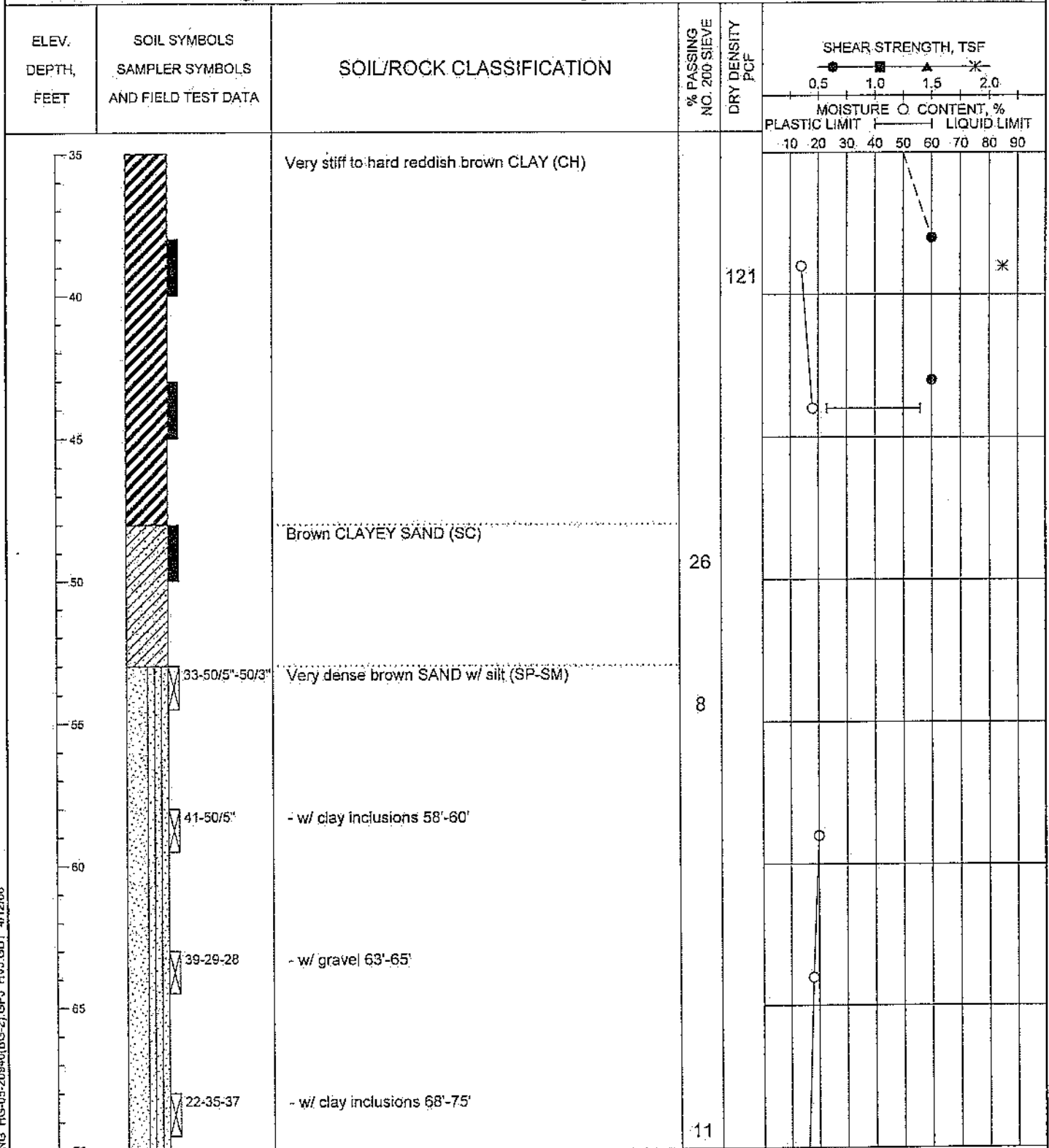
LOG OF SOIL BORING HG-05-20940(BG-2) GPJ HVJ GDT 4/12/06

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-1
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/10/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

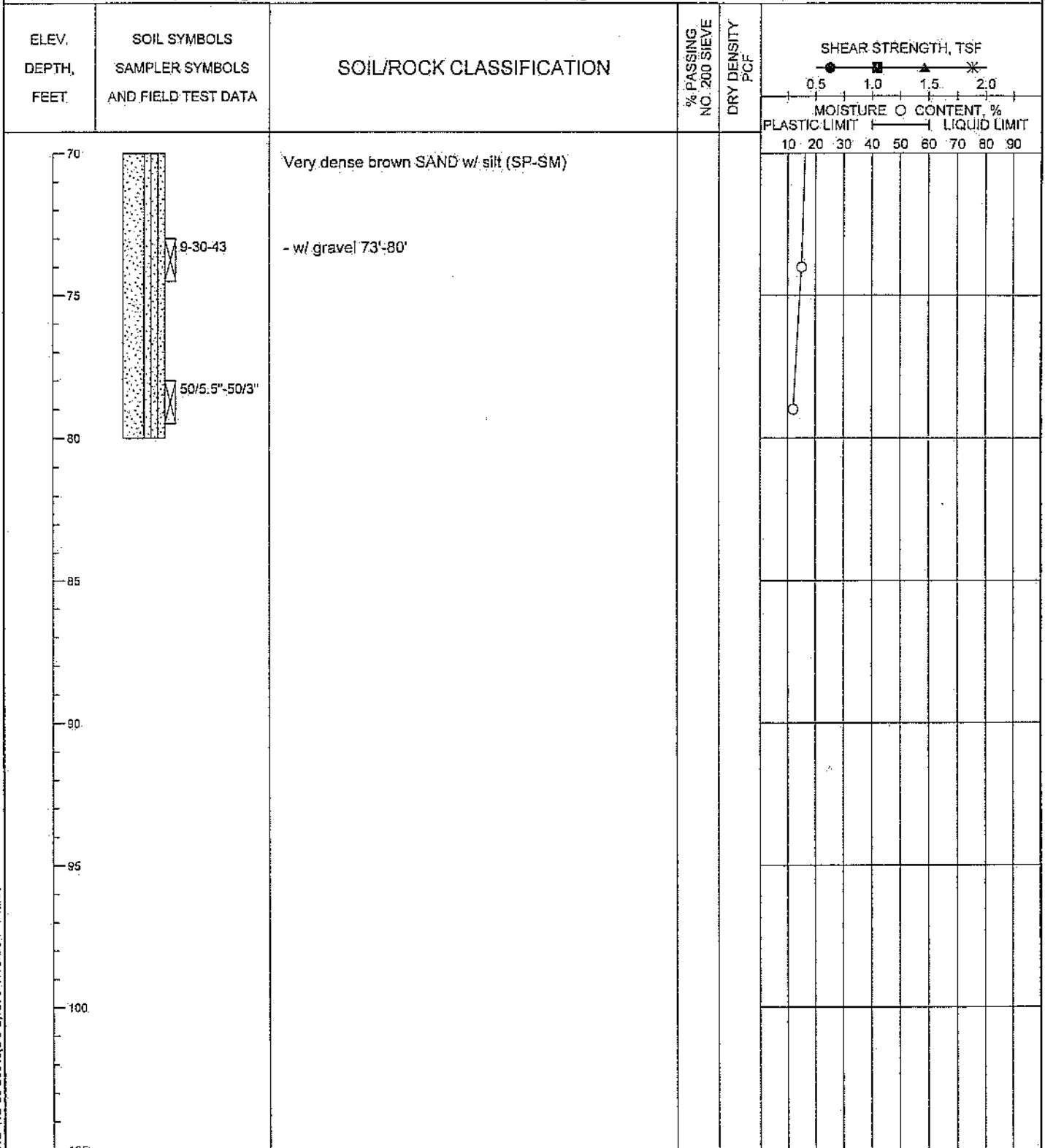
PLATE 2b

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-1
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/10/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

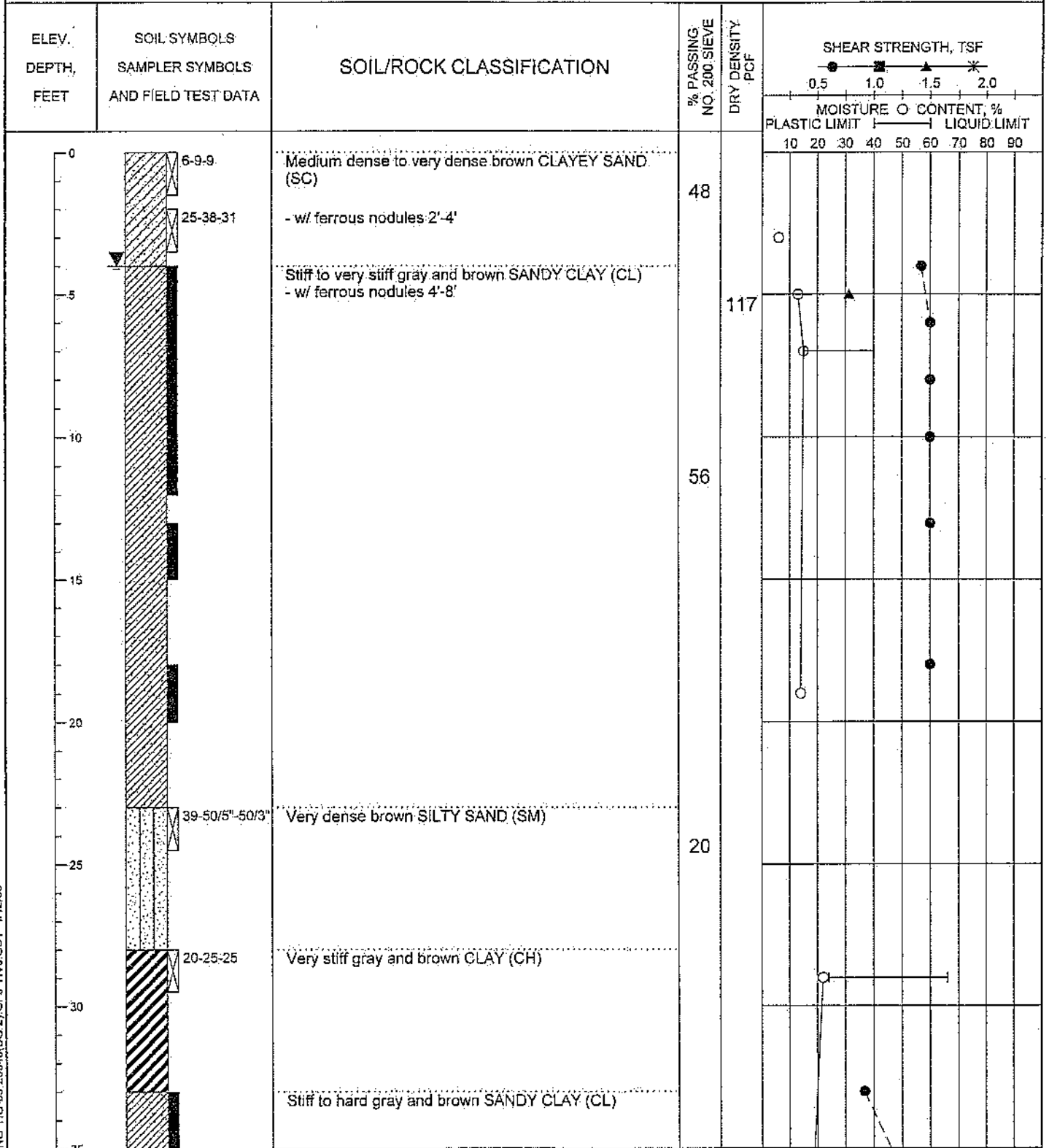
PLATE 2c

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-2
 Groundwater during drilling: 4 feet
 Groundwater after drilling: ---

Date: 12/10/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ※ = UU Triaxial

See Plate 1 for boring location.

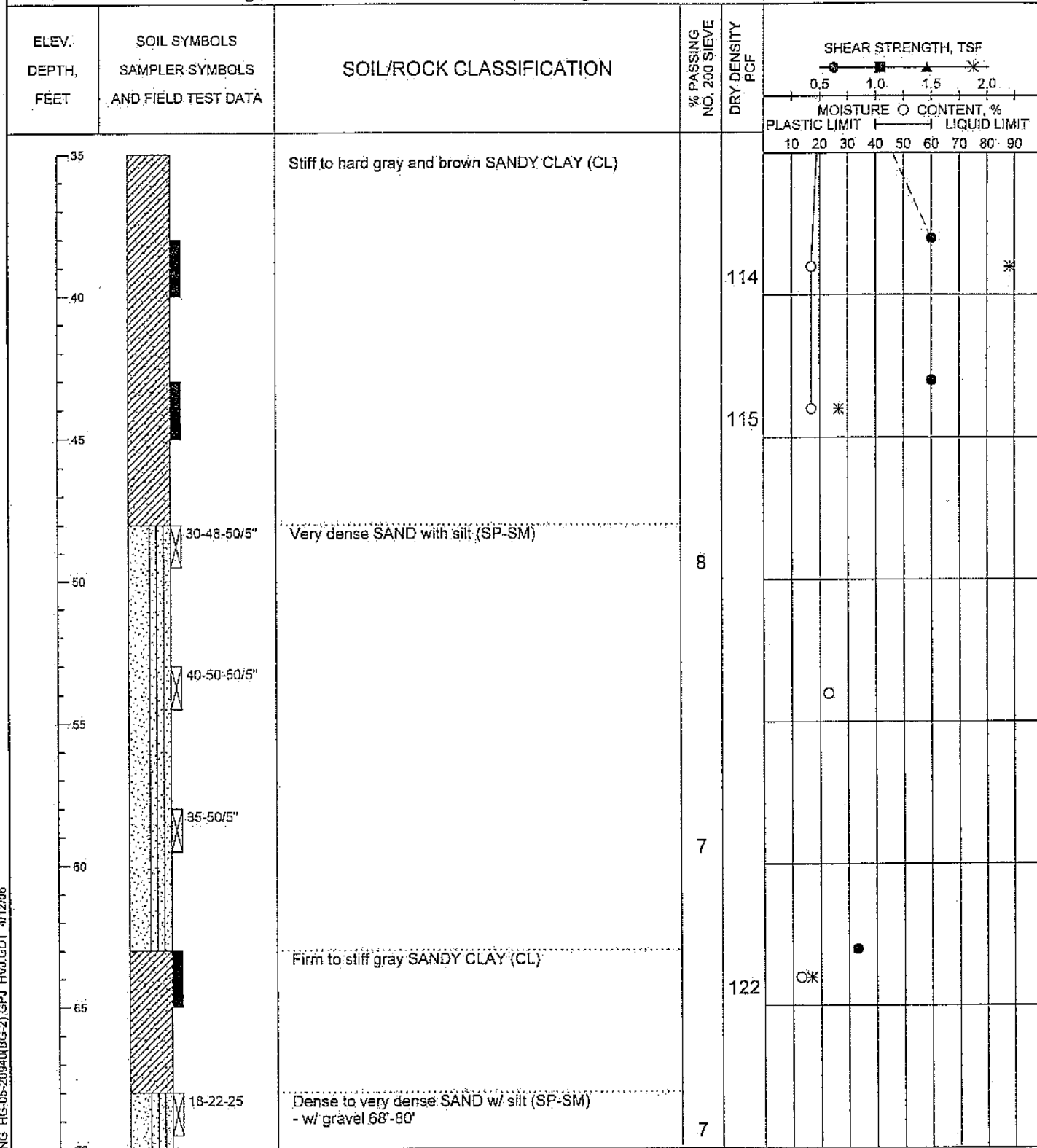
PLATE 3a

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-2
 Groundwater during drilling: 4 feet
 Groundwater after drilling: ---

Date: 12/10/2005
 Northing: --
 Easting: --

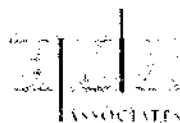
Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 3b



LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-2
 Groundwater during drilling: 4 feet
 Groundwater after drilling: ---

Date: 12/10/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF ● ■ ▲ ✱ 0.5 1.0 1.5 2.0 MOISTURE CONTENT, % ○ PLASTIC LIMIT LIQUID LIMIT 10 20 30 40 50 60 70 80 90
70		Dense to very dense SAND w/ silt (SP-SM) - w/ gravel 68'-80'			
75		- w/ clay inclusions 73'-75'			
80					
85					
90					
95					
100					
105					

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

PLATE 3c

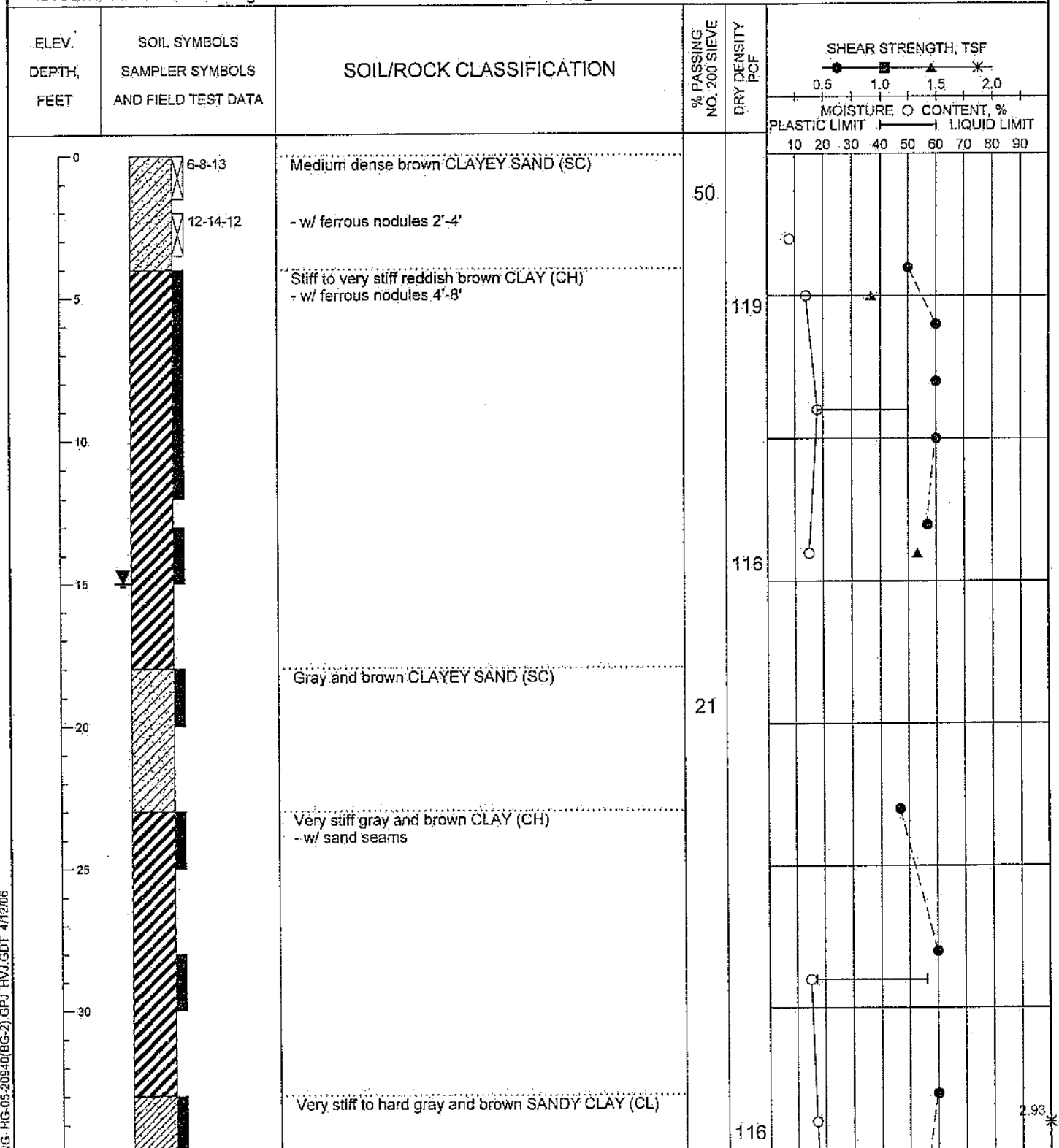


LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-3
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/10/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

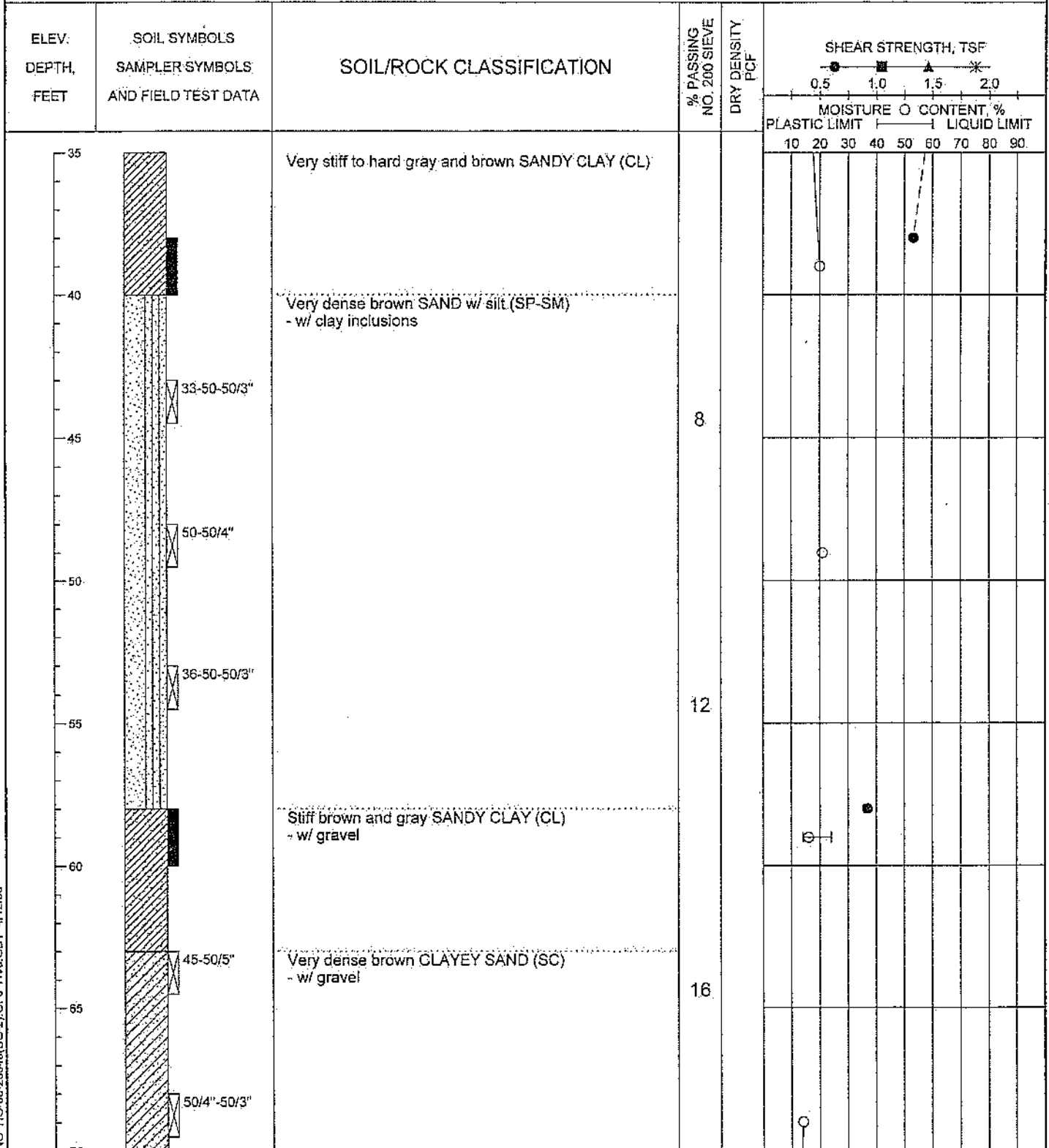
PLATE 4a

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-3
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/10/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ※ = UU Triaxial

See Plate 1 for boring location.

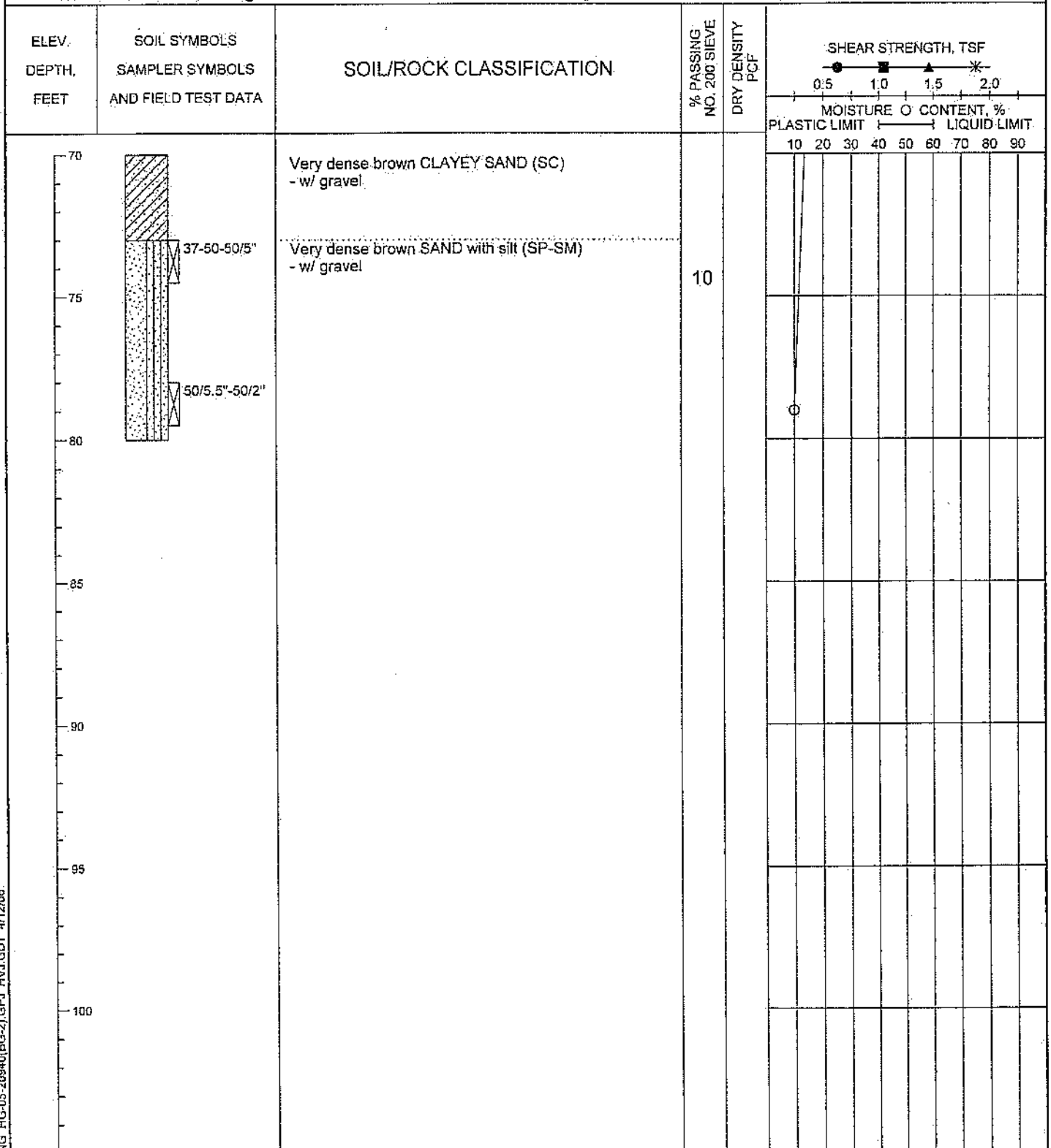
PLATE 4b

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-3
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/10/2005
 Northing: --
 Easting: --

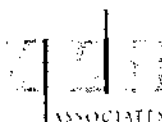
Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --

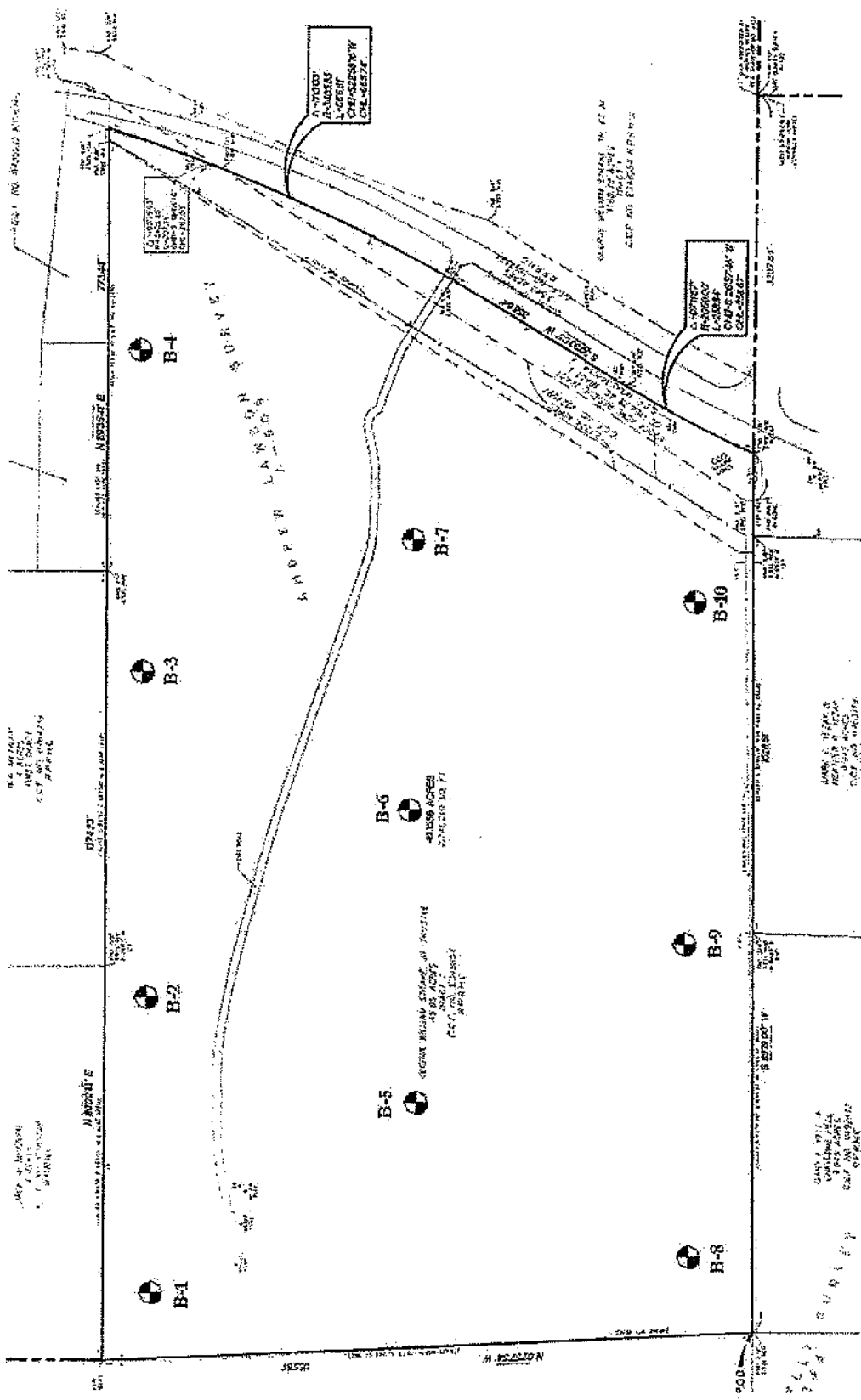


Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 4c





 6120 S. Dairy Ashford Road Houston, Texas 77072-1010 281.933.7388 Ph 281.933.7293 Fax		PREPARED BY: SV
DATE: 03/20/05	APPROVED BY: EF	PROJECT NO.: HG-05-20940 (BG-2)
PLAN OF BORINGS CREEKSIDE PARK MASS FILL		DRAWING NO.: PLATE 1

SOIL SYMBOLS

Soil Types



Clay



Silt



Sand



Gravel

Modifiers



Clayey



Silty



Sandy



Cemented

Construction Materials



Asphaltic
Concrete



Stabilized
Base



Fill or
Debris



Portland
Cement
Concrete

SAMPLER TYPES



Thin Walled
Shelby Tube



No Recovery



Split Barrel



Core



Liner Tube



Jar Sample

WATER LEVEL SYMBOLS



Groundwater level after drilling in
open borehole or piezometer



Groundwater level determined during
drilling operations

SOIL GRAIN SIZE

Classification

Clay
Silt
Sand
Gravel
Cobble
Boulder

Particle Size

< 0.002 mm
0.002 - 0.075 mm
0.075 - 4.75 mm
4.75 - 75 mm
75 - 200 mm
> 200 mm

Particle Size or Sieve No. (U.S. Standard)

< 0.002 mm
0.002 mm - #200 sieve
#200 sieve - #4 sieve
#4 sieve - 3 in.
3 in. - 8 in.
> 8 in.

DENSITY OF COHESIONLESS SOILS

Descriptive Term	Penetration Resistance "N" * Blows/Foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

CONSISTENCY OF COHESIVE SOILS

Consistency	Undrained Shear Strength (tsf)	Penetration Resistance "N" * Blows/Foot
Very Soft	0 - 0.125	0 - 2
Soft	0.125 - 0.25	2 - 4
Firm	0.25 - 0.5	4 - 8
Stiff	0.5 - 1.0	8 - 16
Very Stiff	1.0 - 2.0	16 - 32
Hard	> 2.0	> 32

PENETRATION RESISTANCE

3/6
50/4"
0/18"

Blows required to penetrate each of three consecutive 6-inch increments per ASTM D-1586 *
If more than 50 blows are required, driving is discontinued and penetration at 50 blows is noted
Sampler penetrated full depth under weight of drill rods and hammer

* The N value is taken as the blows required to penetrate the final 12 inches

TERMS DESCRIBING SOIL STRUCTURE

<i>Slickensided</i>	Fracture planes appear polished or glossy, sometimes striated
<i>Fissured</i>	Breaks along definite planes of fracture with little resistance to fracturing
<i>Inclusion</i>	Small pockets of different soils, such as small lenses of sand scattered through a mass of clay
<i>Parting</i>	Inclusion less than 1/4 inch thick extending through the sample
<i>Seam</i>	Inclusion 1/4 inch to 3 inches thick extending through the sample
<i>Layer</i>	Inclusion greater than 3 inches thick extending through the sample
<i>Laminated</i>	Soil sample composed of alternating partings of different soil type
<i>Stratified</i>	Soil sample composed of alternating seams or layers of different soil type

<i>Intermixed</i>	Soil sample composed of pockets of different soil type and laminated or stratified structure is not evident
<i>Calcareous</i>	Having appreciable quantities of calcium carbonate
<i>Ferrous</i>	Having appreciable quantities of iron
<i>Nodule</i>	A small mass of irregular shape



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281.933.7293 Fax

KEY TO TERMS AND SYMBOLS USED ON BORING LOGS

PROJECT NO.:
HG-05-20940 (BG-2)

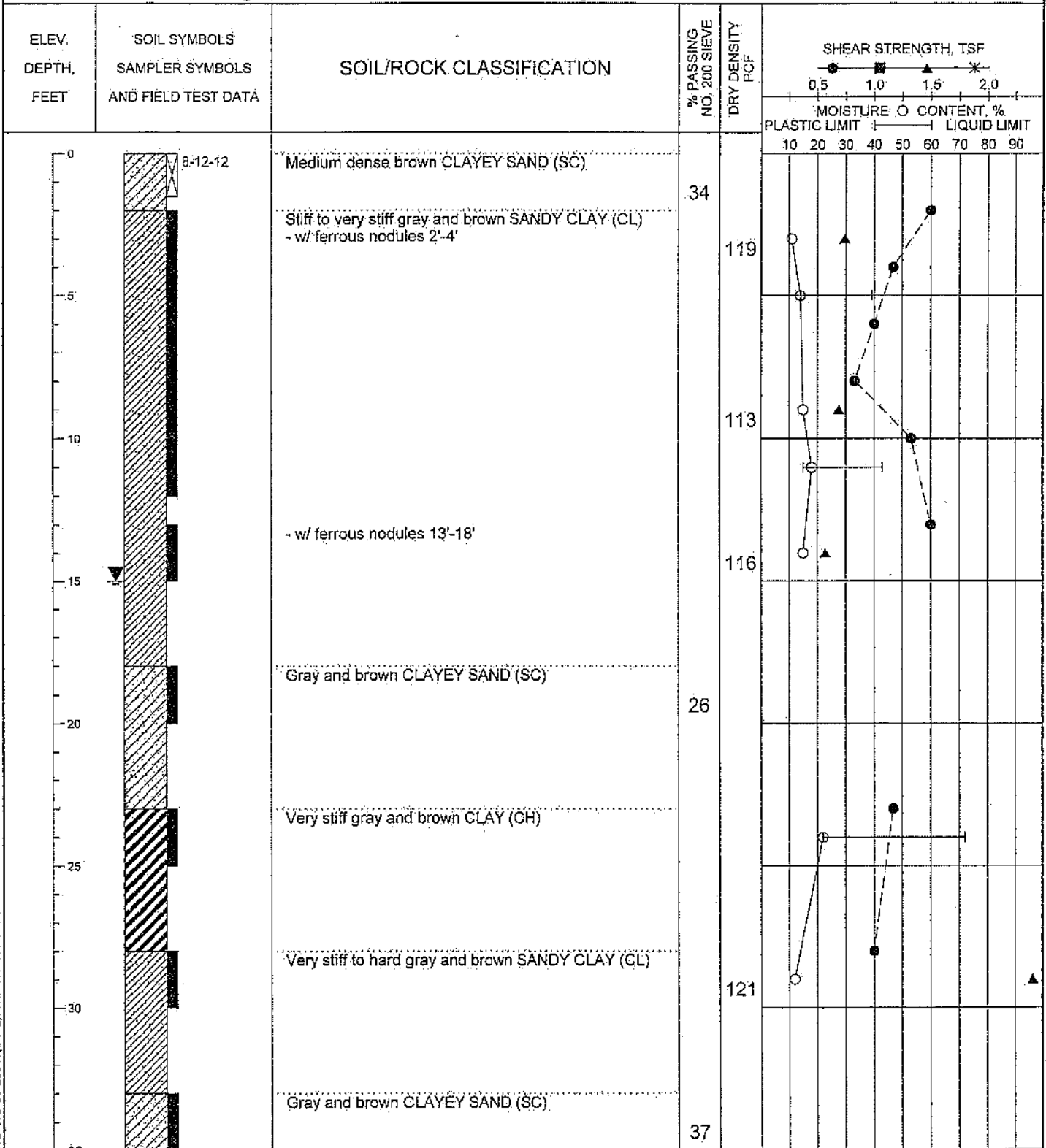
DRAWING NO.:
PLATE 12

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-4
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/11/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

PLATE 5a

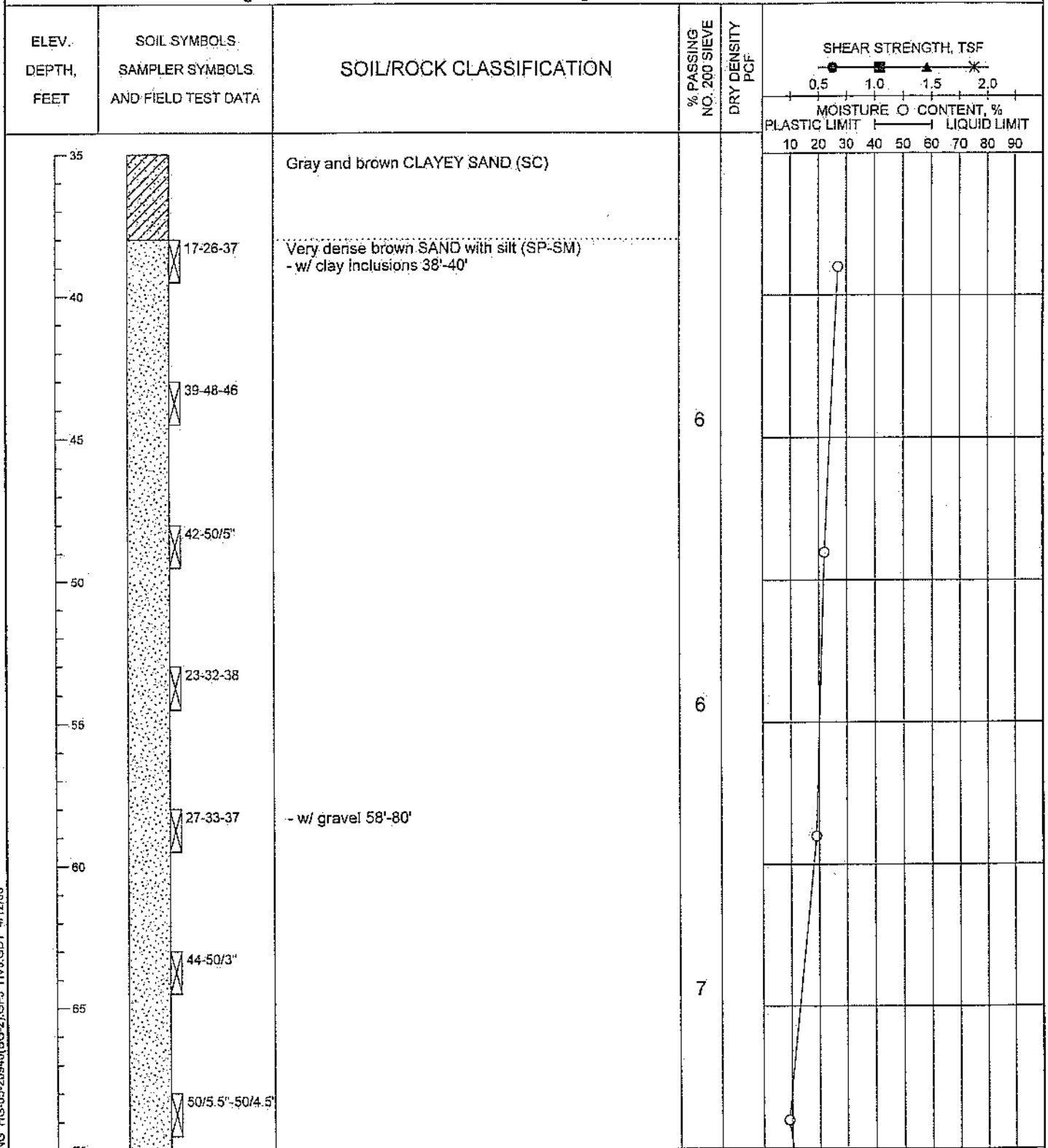


LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-4
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/11/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ※ = UU Triaxial

See Plate 1 for boring location.

PLATE 5b



LOG OF BORING

Project: Creekside Park Mass Fill

Boring No.: B-4

Groundwater during drilling: 15 feet

Groundwater after drilling: --

Date: 12/11/2005

Northing: --

Easting: --

Project No.: HG05-20940 (BG-2)

Elevation:

Station: --

Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF 0.5 1.0 1.5 2.0 MOISTURE CONTENT, % PLASTIC LIMIT LIQUID LIMIT 10 20 30 40 50 60 70 80 90
70		Very dense brown SAND with silt (SP-SM) - w/ clay inclusions 38'-40'	10		
75					
80					
85					
90					
95					
100					
105					

Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

* = UU Triaxial

See Plate 1 for boring location:

PLATE 5c

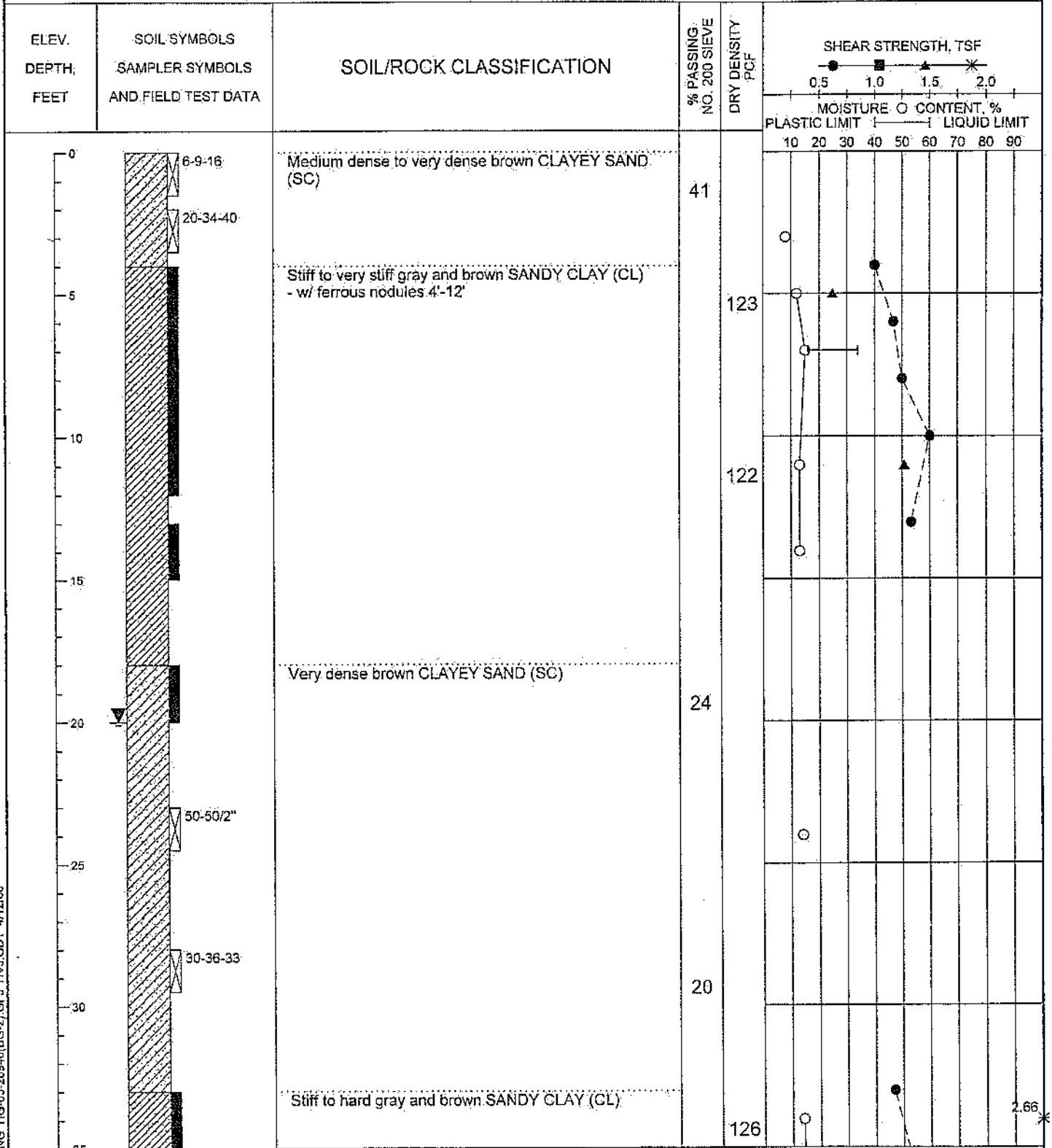
LOG OF SOIL BORING HG-05-20940(BG-2) GPJ HVJ/GDT 4/12/06

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-5
 Groundwater during drilling: 20 feet
 Groundwater after drilling: ---

Date: 12/9/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 6a

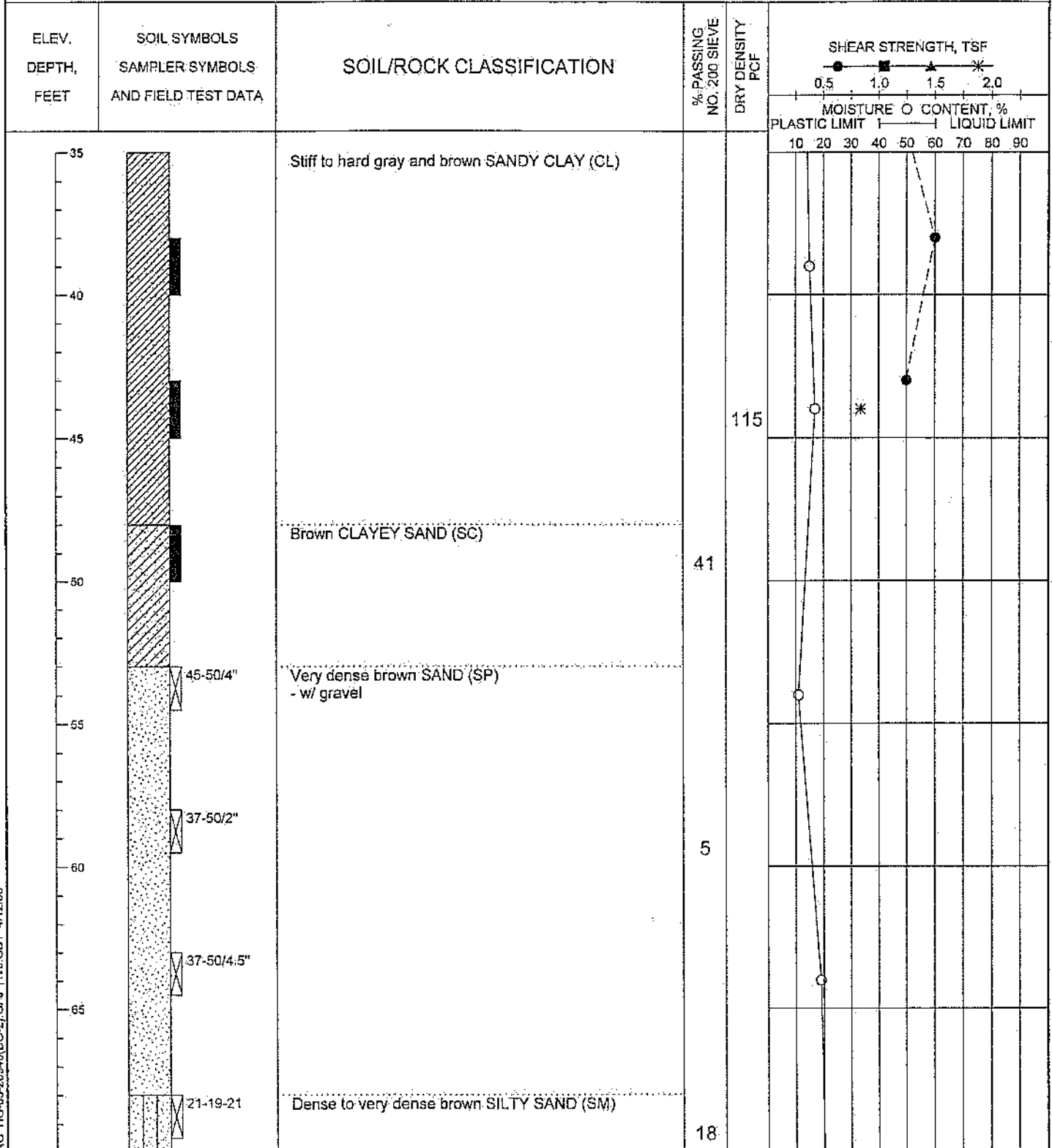
LOG OF SOIL BORING HG-05-20940(BG-2).GPJ HVJ:GDT 4/12/08

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-5
 Groundwater during drilling: 20 feet
 Groundwater after drilling: ---

Date: 12/9/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 6b

LOG OF SOIL BORING HG-05-20940(BG-2) GPFJ HVJ/GDT 4/12/06

LOG OF BORING

Project: Creekside Park Mass-Fill
 Boring No.: B-5
 Groundwater during drilling: 20 feet
 Groundwater after drilling: ---

Date: 12/9/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF 0.5 1.0 1.5 2.0 MOISTURE CONTENT, % PLASTIC LIMIT LIQUID LIMIT 10 20 30 40 50 60 70 80 90
70		Dense to very dense brown SILTY SAND (SM)	6		
75		Very dense brown SAND with silt (SP-SM)			
80					
85					
90					
95					
100					
105					

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

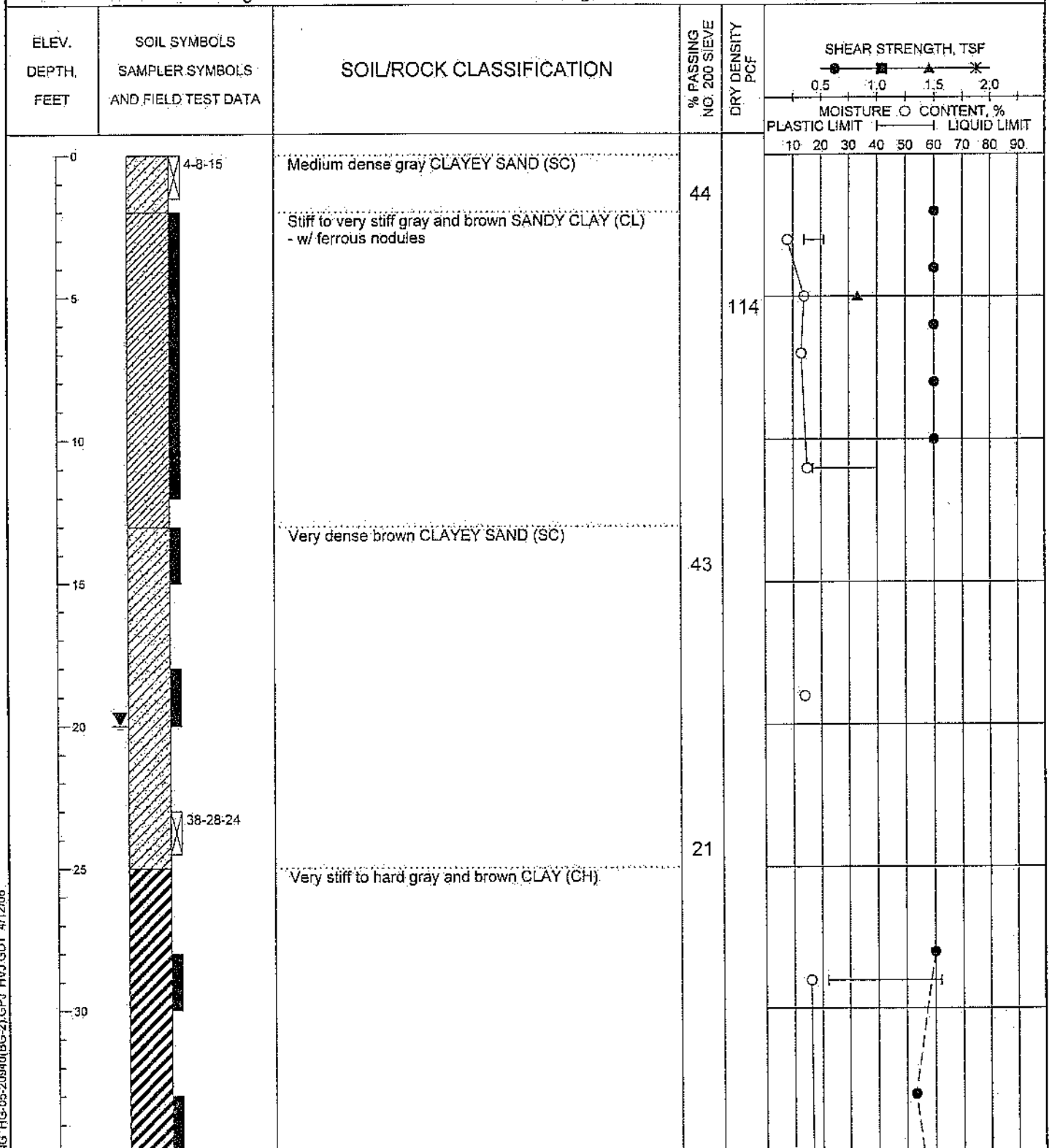
PLATE 6c

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-6
 Groundwater during drilling: 20 feet
 Groundwater after drilling: ---

Date: 12/9/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

PLATE 7a

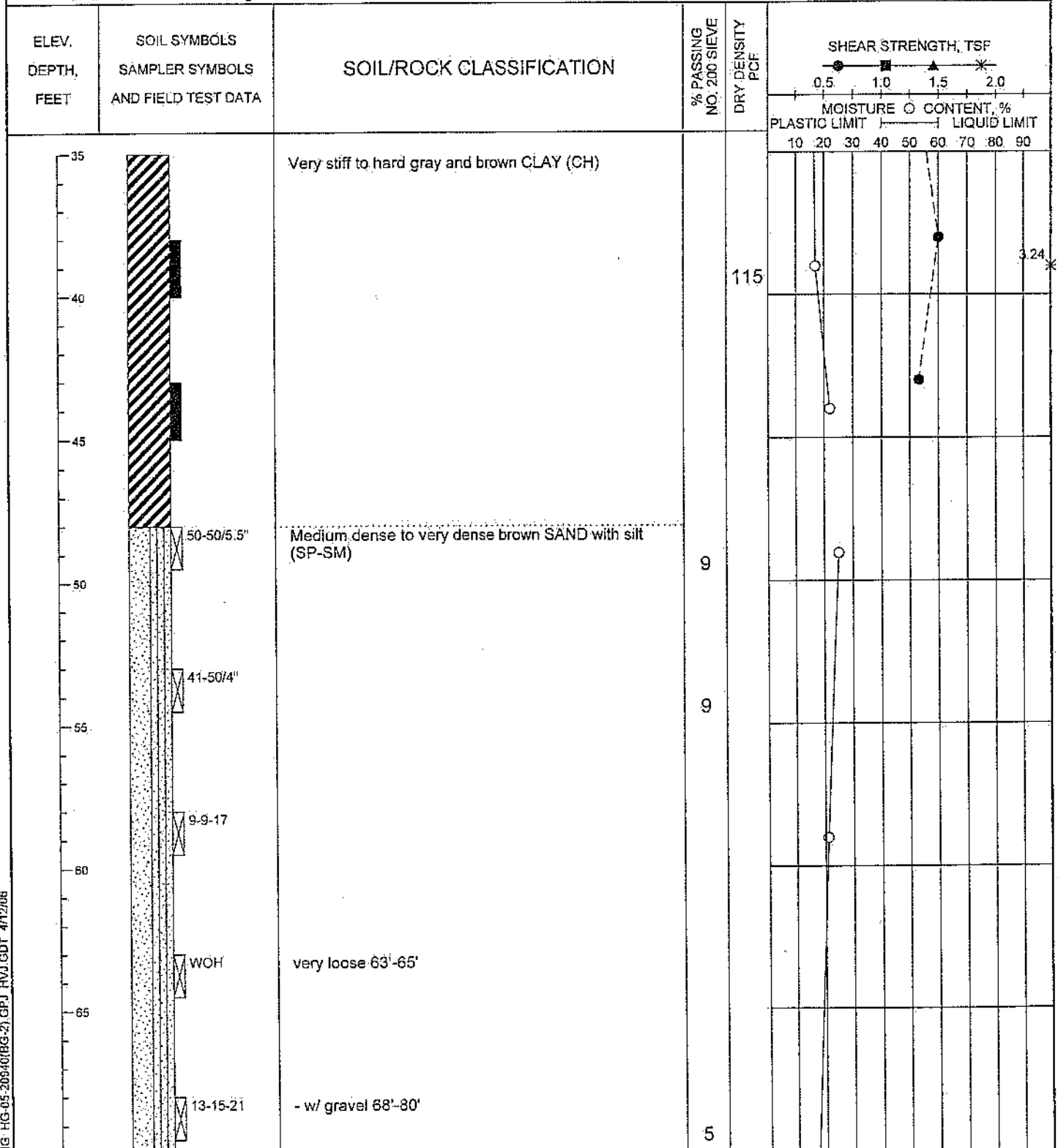
LOG OF SOIL BORING HG-05-20940(BG-2).GPJ HVJ/GDT 4/12/06

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-6
 Groundwater during drilling: 20 feet
 Groundwater after drilling: ---

Date: 12/9/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 7b

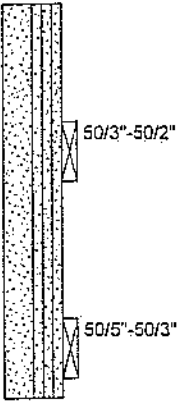
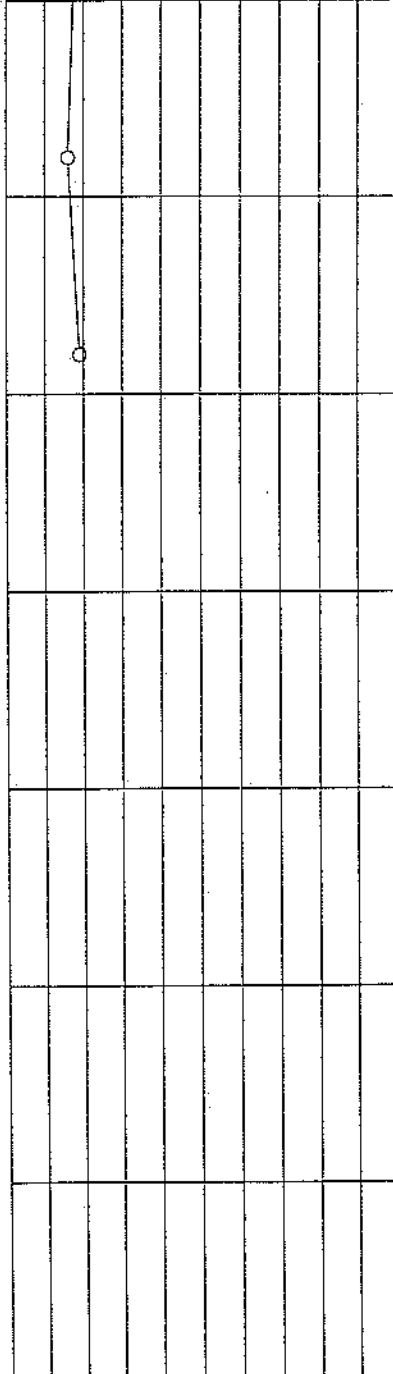


LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-6
 Groundwater during drilling: 20 feet
 Groundwater after drilling: ---

Date: 12/9/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF 0.5 1.0 1.5 2.0 MOISTURE CONTENT, % PLASTIC LIMIT LIQUID LIMIT
70		Medium dense to very dense brown SAND with silt (SP-SM)			
75					
80					
85					
90					
95					
100					
105					

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ※ = UU Triaxial

See Plate 1 for boring location.

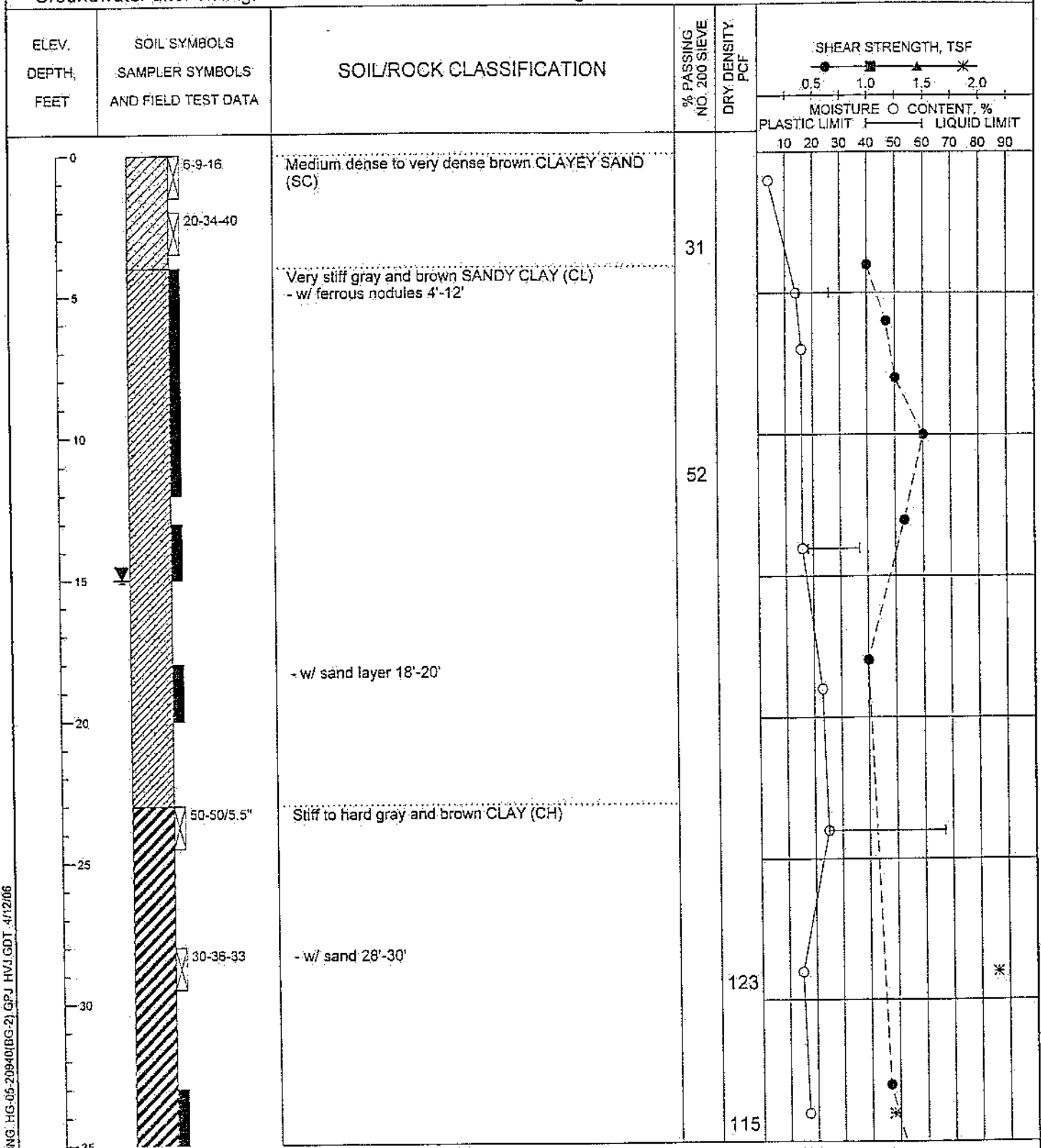
PLATE 7c

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-7
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/7/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 8a

LOG OF BORING

Project: Creekside Park Mass Fill

Boring No.: B-7

Groundwater during drilling: 15 feet

Groundwater after drilling: —

Date: 12/7/2005

Northing: —

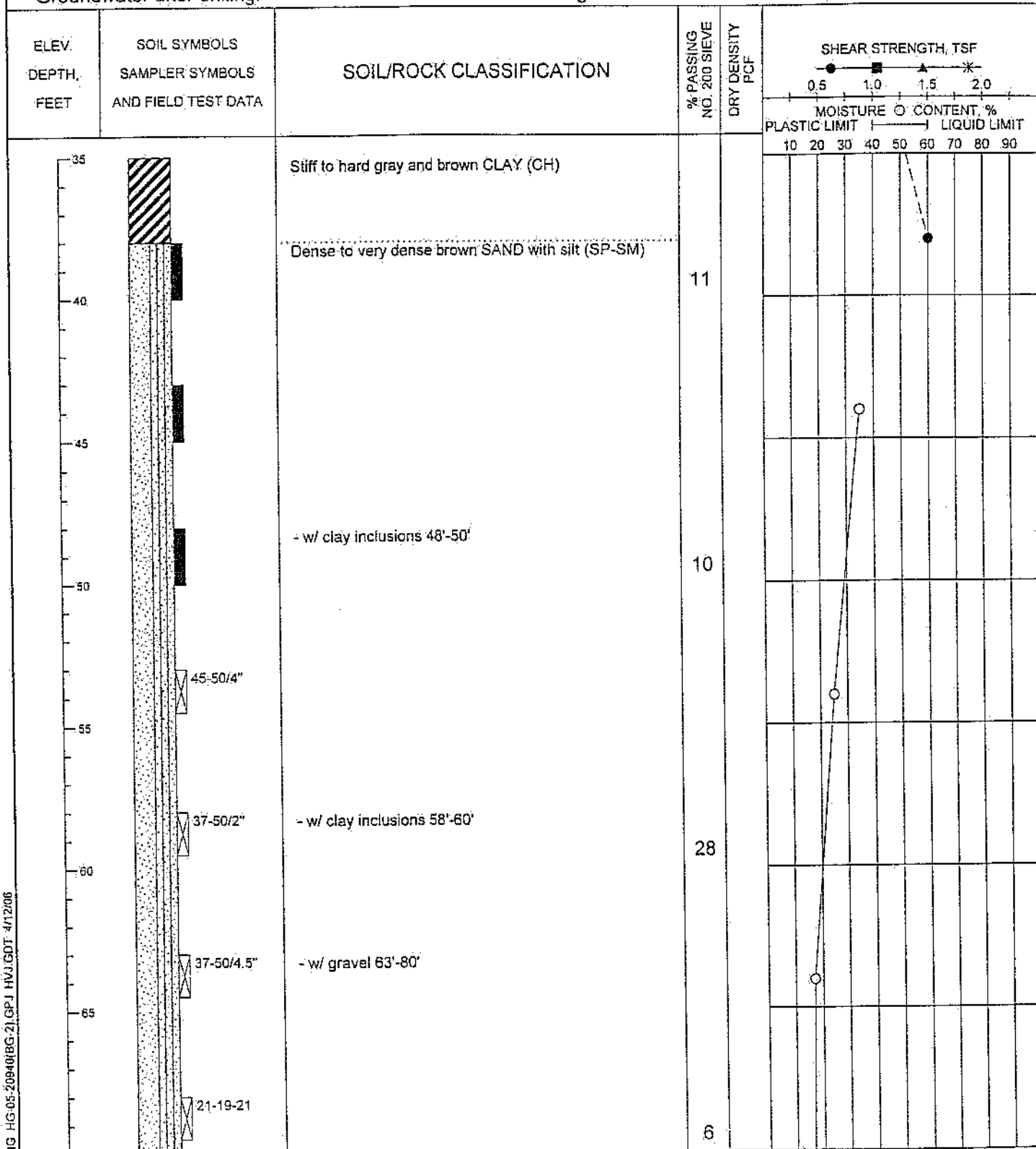
Easting: —

Project No.: HG05-20940 (BG-2)

Elevation: —

Station: —

Offset: —



Shear Types:

● = Hand Penet.

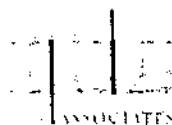
■ = Torvane

▲ = Unconf. Comp.

* = UU Triaxial

See Plate 1 for boring location.

PLATE 8b



LOG OF SOIL BORING HG-05-20940(BG-2) GPJ HVJ GDT 4/12/06

LOG OF BORING

Project: Creekside Park Mass Fill

Boring No.: B-7

Groundwater during drilling: 15 feet.

Groundwater after drilling: ---

Date: 12/7/2005

Northing: —

Easting: —

Project No.: HG05-20940 (BG-2)

Elevation:

Station: —

Offset: --

ELEV. DEPTH, FEET		SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF 0.5 1.0 1.5 2.0 MOISTURE CONTENT, % PLASTIC LIMIT LIQUID LIMIT 10 20 30 40 50 60 70 80 90	
70			Dense to very dense brown SAND with silt (SP-SM)				
75			Dense to very dense SAND (SP) - w/ clay inclusions 73'-75'				
80				4			
85							
90							
95							
100							

Shear Types:

● = Hand Penet.

 = Torvane

▲ = Unconf. Comp.

* = UU Triaxial

See Plate 1 for boring location.

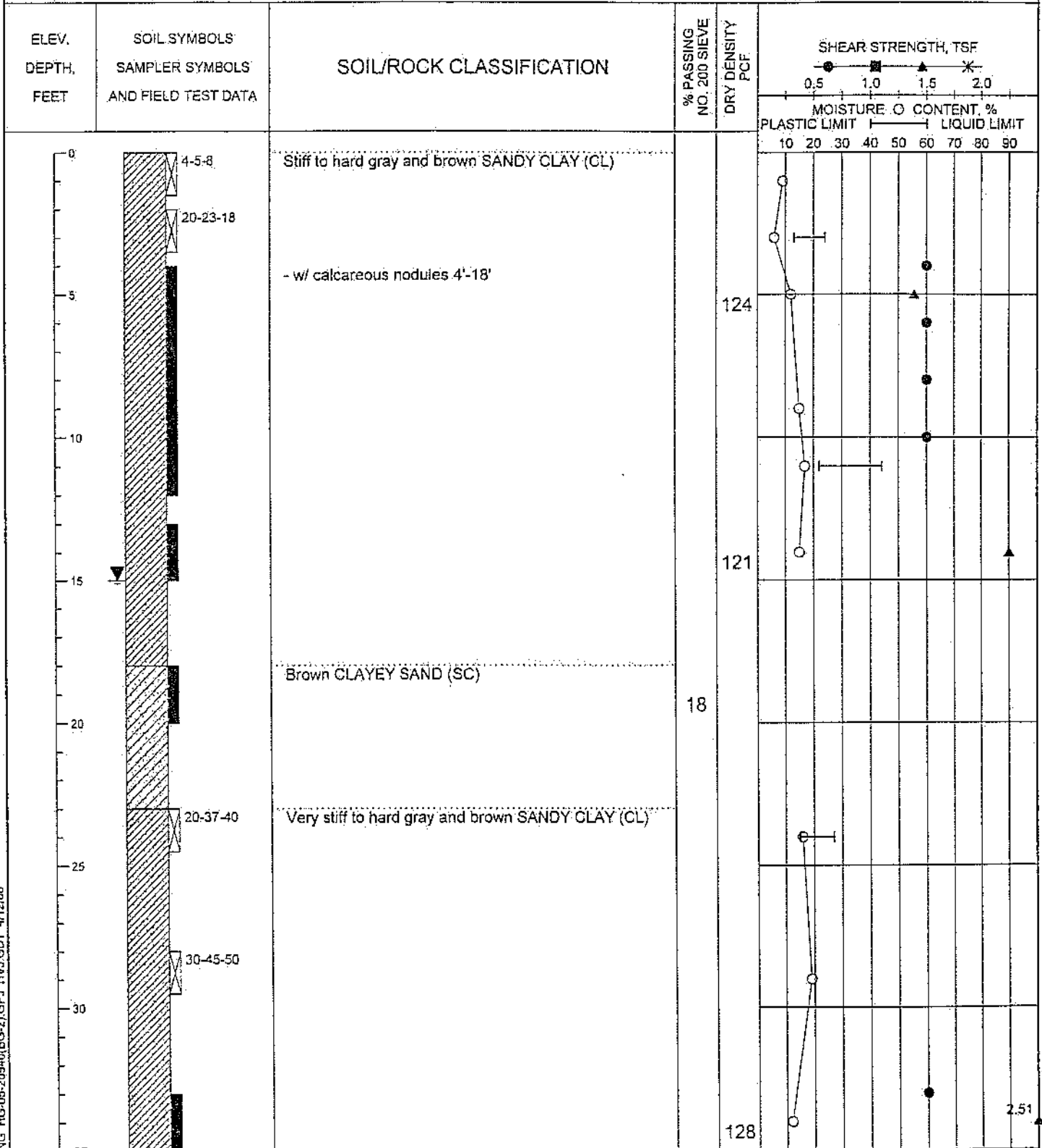
PLATE 8c

LOG OF BORING

Project: Creekside Park Mass Fill.
 Boring No.: B-8
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/8/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

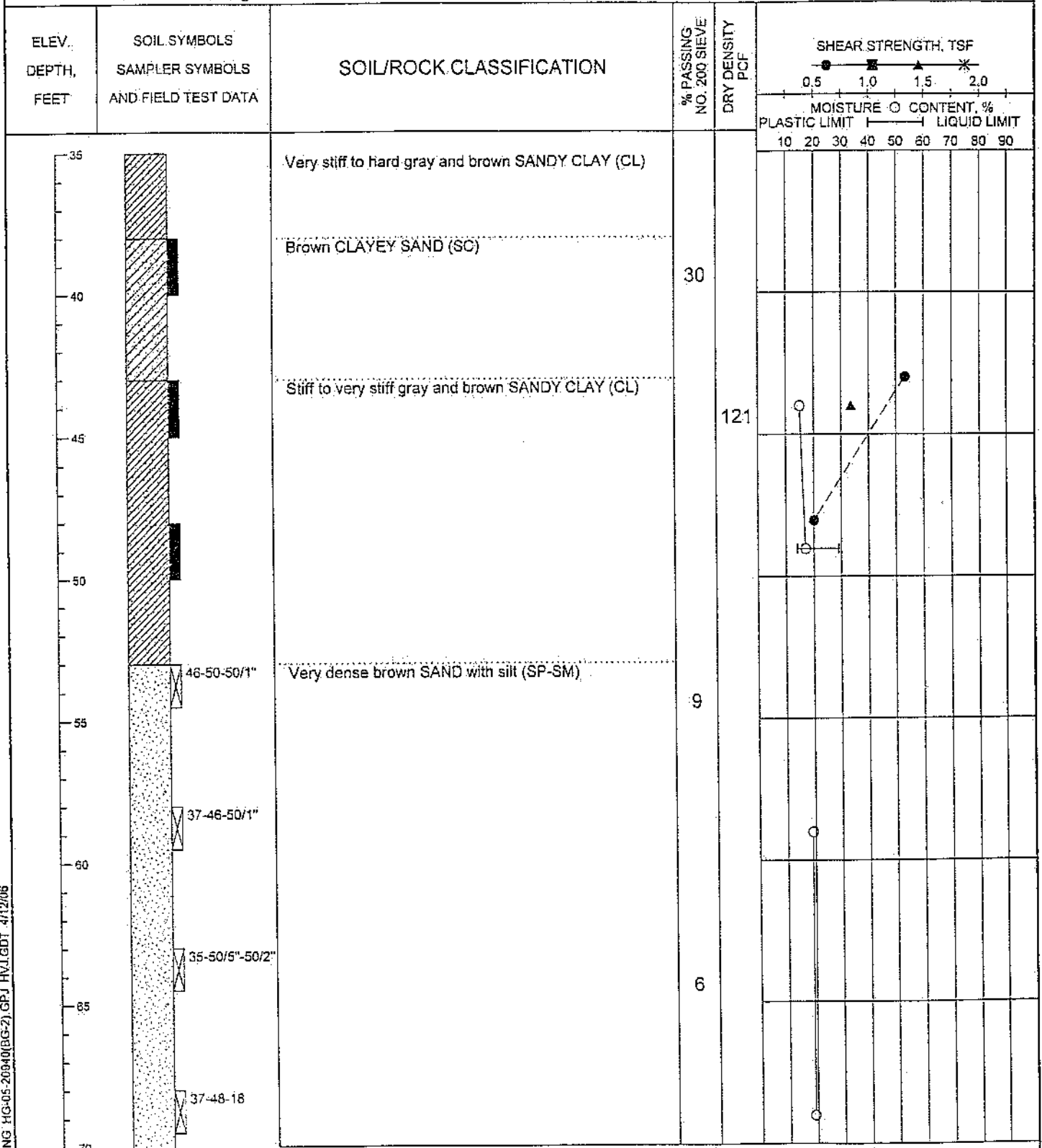
PLATE 9a

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-8
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/8/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

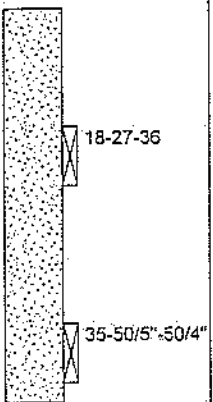
PLATE 9b

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-8
 Groundwater during drilling: 15 feet
 Groundwater after drilling: ---

Date: 12/8/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --

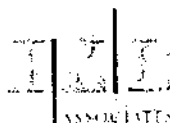
ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF ● 0.5 ■ 1.0 ▲ 1.5 ✱ 2.0 MOISTURE CONTENT, % PLASTIC LIMIT LIQUID LIMIT
70		Very dense brown SAND with silt (SP-SM)	6		
75					
80					
85					
90					
95					
100					
105					

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

PLATE 9c

LOG OF SOIL BORING HG-05-20940(BG-2) GPJ HVJ GDT 4/12/06

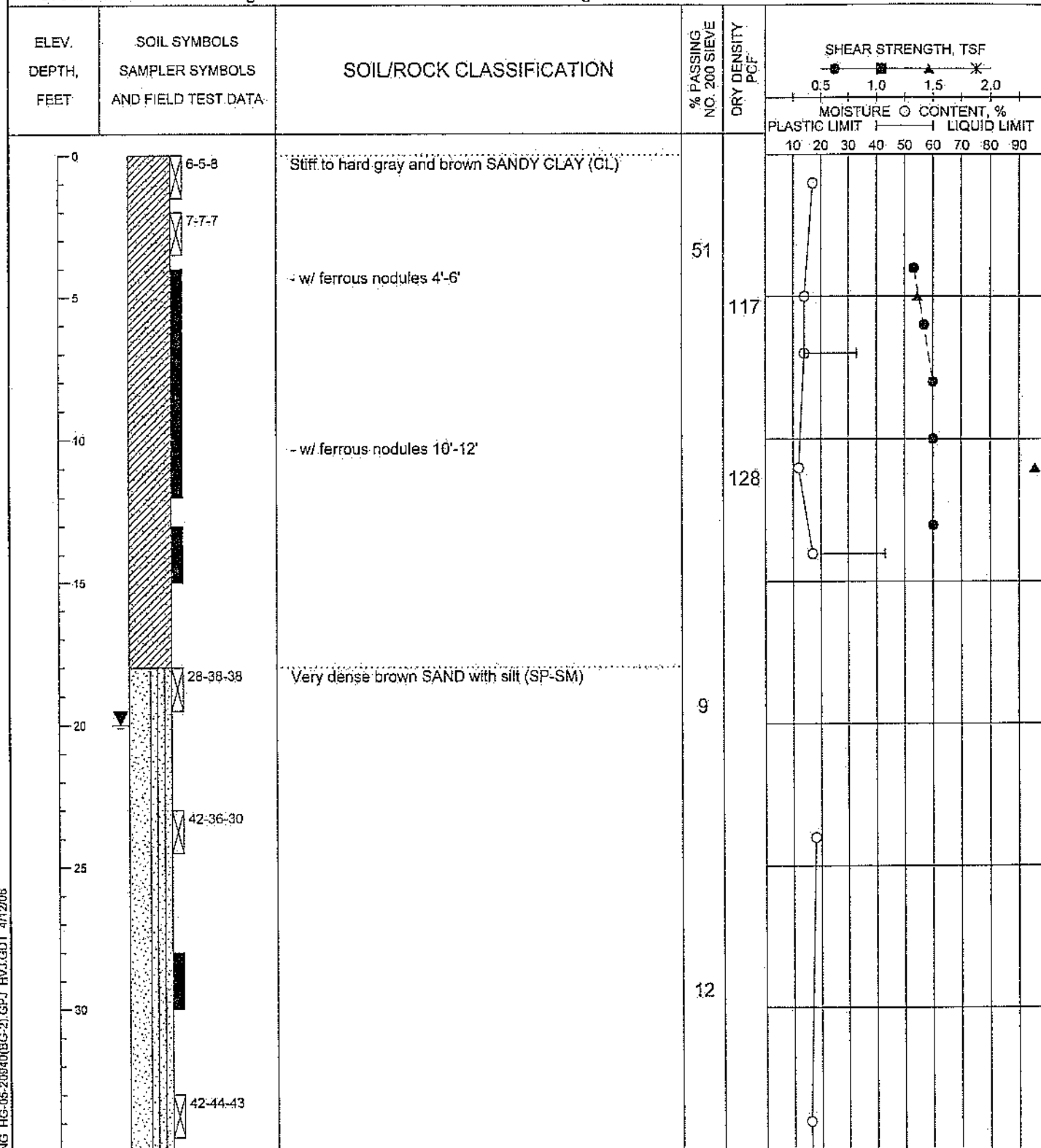


LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-9
 Groundwater during drilling: 20 feet
 Groundwater after drilling: ---

Date: 12/8/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ※ = UU Triaxial

See Plate 1 for boring location.

PLATE 10a

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-9
 Groundwater during drilling: 20 feet
 Groundwater after drilling: ---

Date: 12/8/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF 0.5 1.0 1.5 2.0 MOISTURE CONTENT, % PLASTIC LIMIT LIQUID LIMIT 10 20 30 40 50 60 70 80 90
35		Very dense brown SAND with silt (SP-SM)			
38	22-23-31	Very dense brown CLAYEY SAND (SC)		27	
42		Very dense brown SAND (SP)			
45					
48	35-35-43			4	
52					
55	50-50/2"-50/3"	- w/ gravel 53'-55'			
58					
62	33-46-50/4"			4	
65	20-30-50				
68					
70	26-50/5.5"	- w/ rock 68'-70'		5	

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 10b

LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-9
 Groundwater during drilling: 20 feet
 Groundwater after drilling: —

Date: 12/8/2005
 Northing: —
 Easting: —

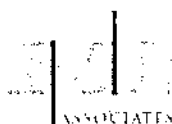
Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: —
 Offset: —

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF 0.5 1.0 1.5 2.0 MOISTURE CONTENT, % PLASTIC LIMIT LIQUID LIMIT 10 20 30 40 50 60 70 80 90
70	50/5.5"-50/2"-50/5.5" - w/ gravel 73'-75' 50/4"-50/2"	Very dense brown SAND (SP)			SHEAR STRENGTH, TSF 0.5 1.0 1.5 2.0 MOISTURE CONTENT, % PLASTIC LIMIT LIQUID LIMIT 10 20 30 40 50 60 70 80 90
75					
80					
85					
90					
95					
100					
105					

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ※ = UU Triaxial

See Plate 1 for boring location.

PLATE 10c

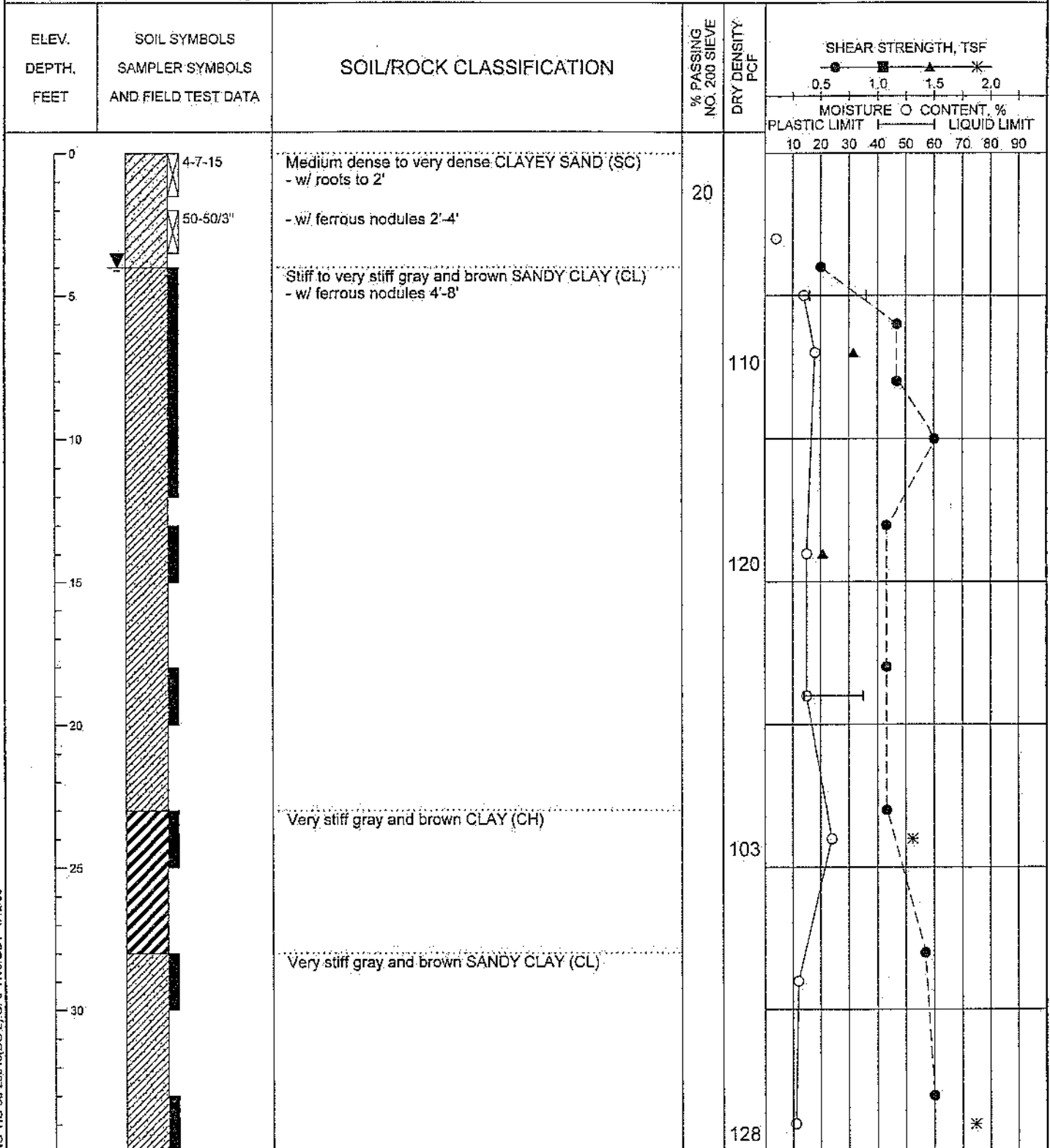


LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-10
 Groundwater during drilling: 4 feet
 Groundwater after drilling: —

Date: 12/7/2005
 Northing: —
 Easting: —

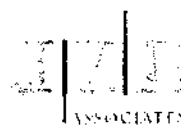
Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: —
 Offset: —



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 11a

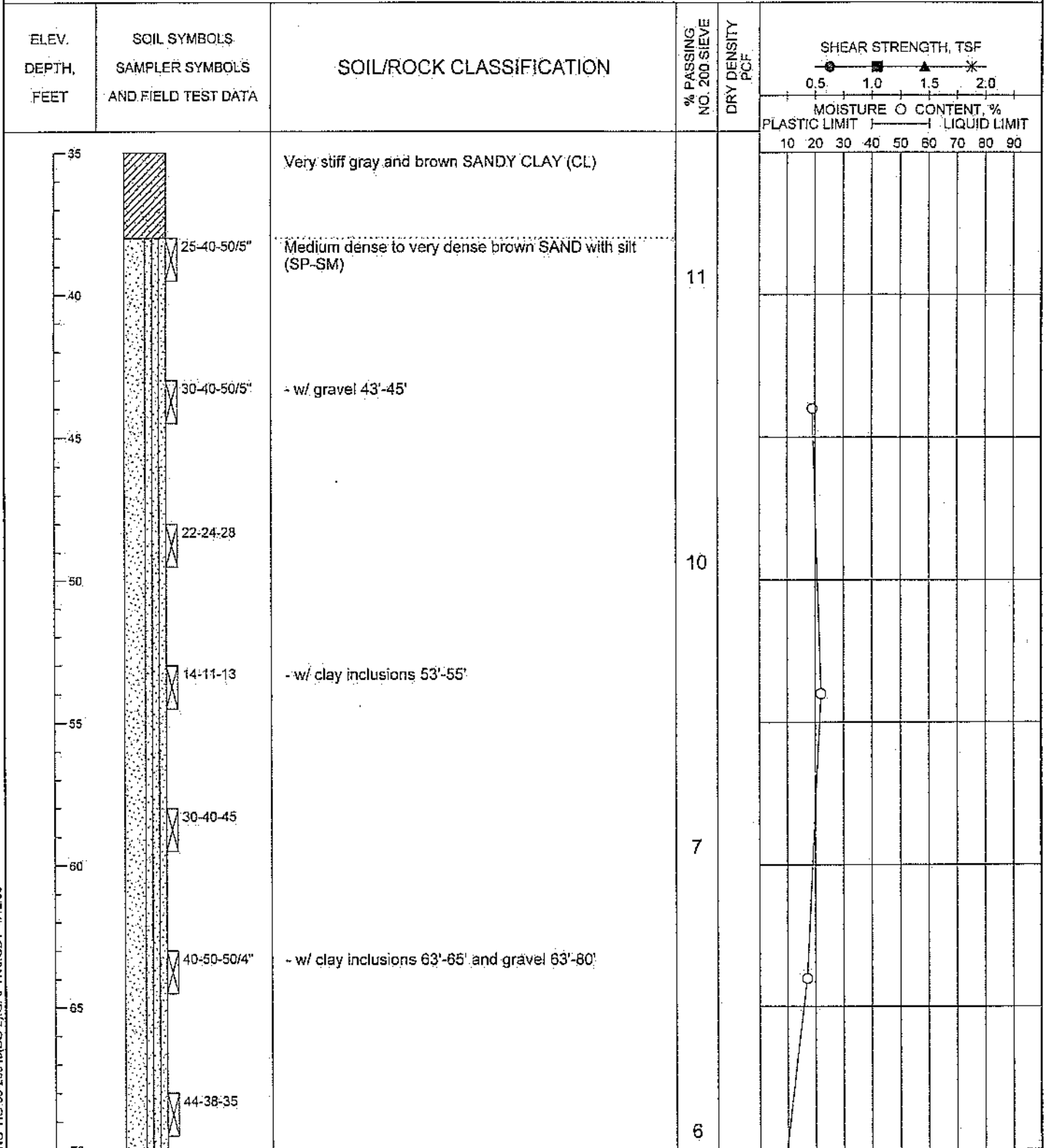


LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-10
 Groundwater during drilling: 4 feet
 Groundwater after drilling: ---

Date: 12/7/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 11b



LOG OF BORING

Project: Creekside Park Mass Fill
 Boring No.: B-10
 Groundwater during drilling: 4 feet
 Groundwater after drilling: ---

Date: 12/7/2005
 Northing: --
 Easting: --

Project No.: HG05-20940 (BG-2)
 Elevation:
 Station: --
 Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF MOISTURE CONTENT, % PLASTIC LIMIT LIQUID LIMIT
70		Medium dense to very dense brown SAND with silt (SP-SM)			
75		- w/ rock 73'-75'			
80					
85					
90					
95					
100					
105					

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

PLATE 11c

APPENDIX A

SLOPE STABILITY ANALYSIS

CASE 1

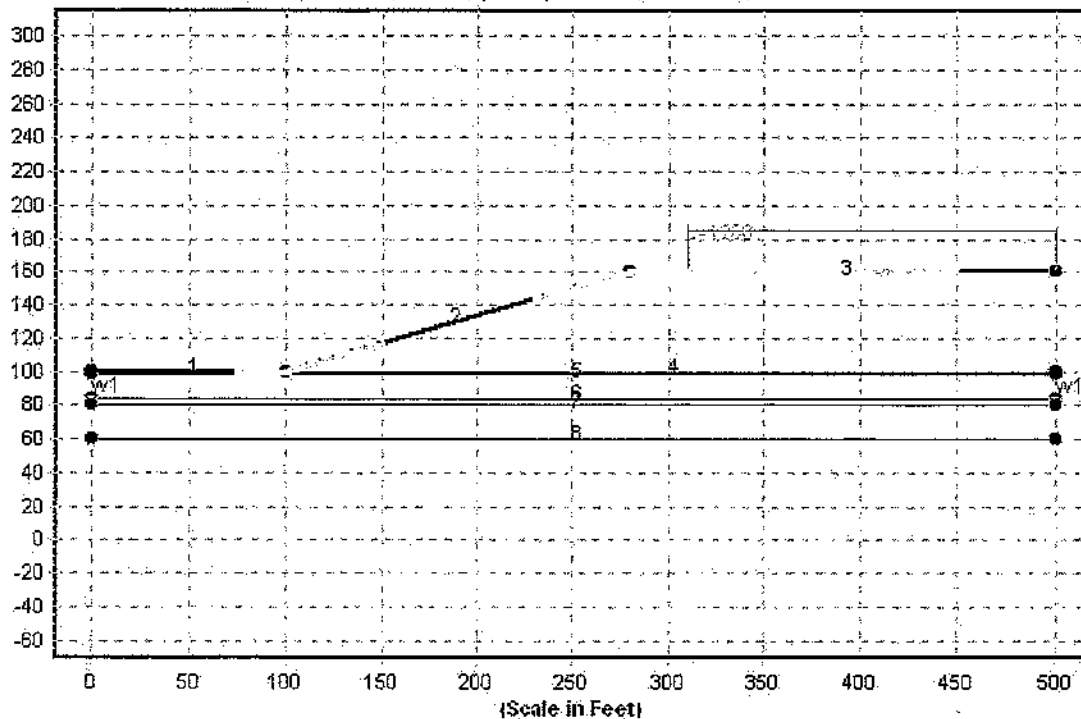
STABL for Windows Report

Date = 4/24/06

Time = 3:52:09 PM

Input Data

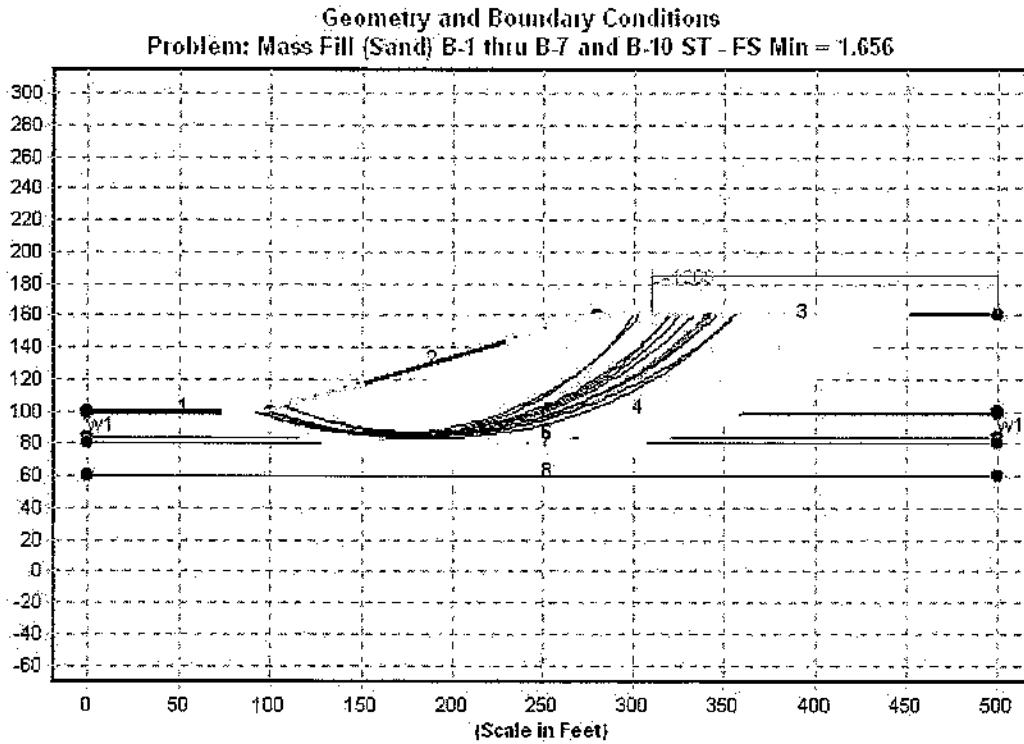
Geometry and Boundary Conditions
Problem: Mass Fill (Sand) B-1 thru B-7 and B-10 ST



Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	98	500	98	3
Segment # 6	0	84	500	84	4
Segment # 7	0	80	500	80	5
Segment # 8	0	60	500	60	6

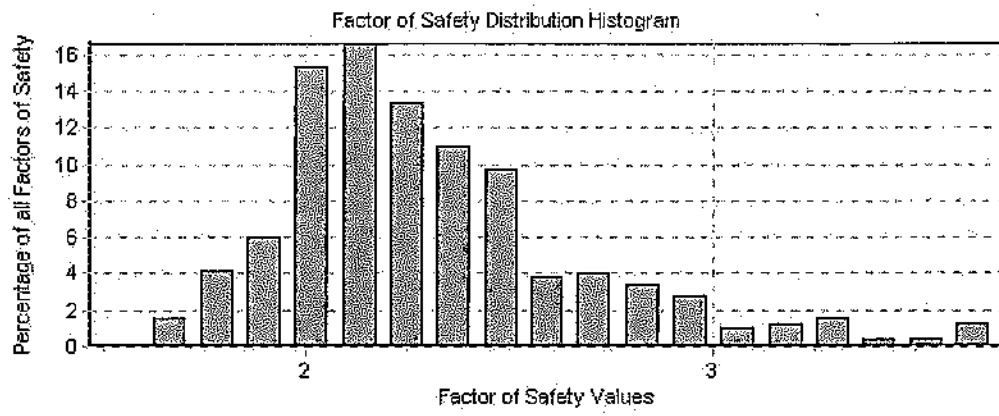
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	125	125	0	32	0	0	1
Soil # 2	125	125	0	34	0	0	1
Soil # 3	125	125	1400	0	0	0	1
Soil # 4	125	125	0	34	0	0	1
Soil # 5	130	130	2500	0	0	0	1
Soil # 6	125	125	0	35	0	0	1

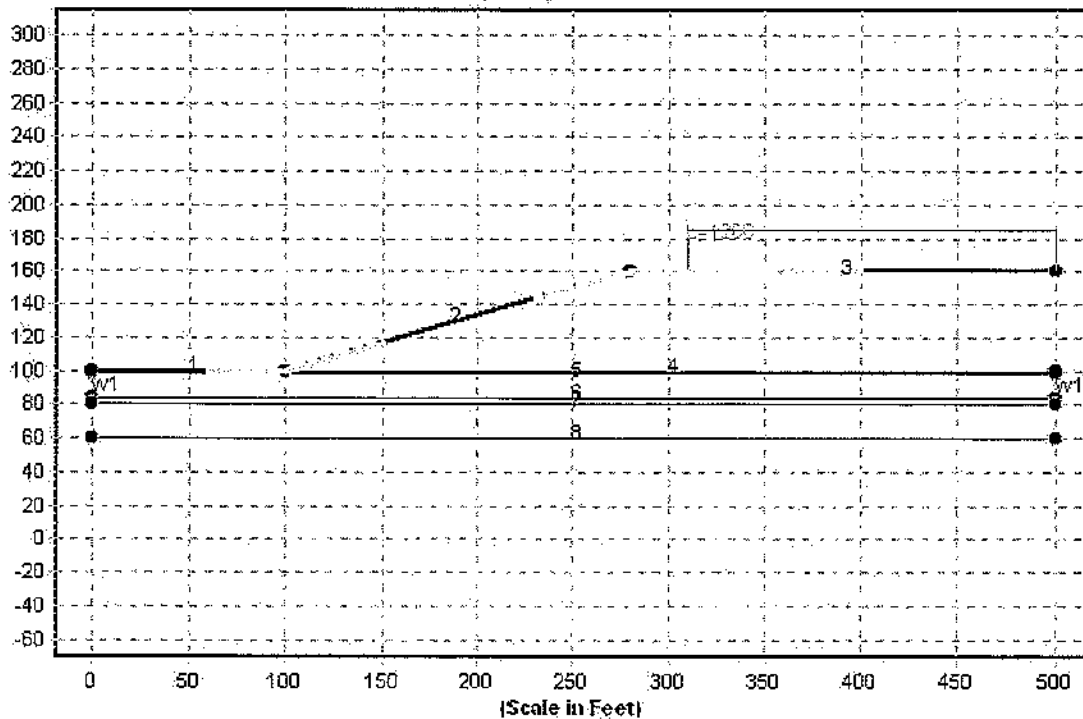
RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	1.656
Surface # 2	1.666
Surface # 3	1.676
Surface # 4	1.695
Surface # 5	1.707
Surface # 6	1.715
Surface # 7	1.718
Surface # 8	1.721
Surface # 9	1.734
Surface # 10	1.741

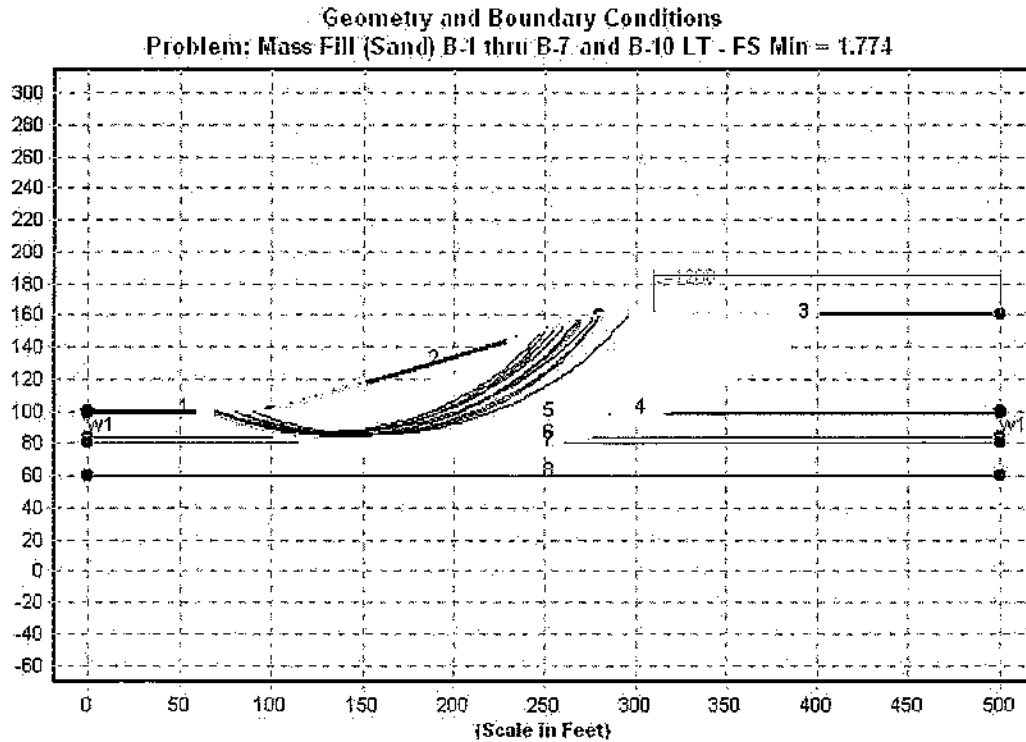




Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	98	500	98	3
Segment # 6	0	84	500	84	4
Segment # 7	0	80	500	80	5
Segment # 8	0	60	500	60	6

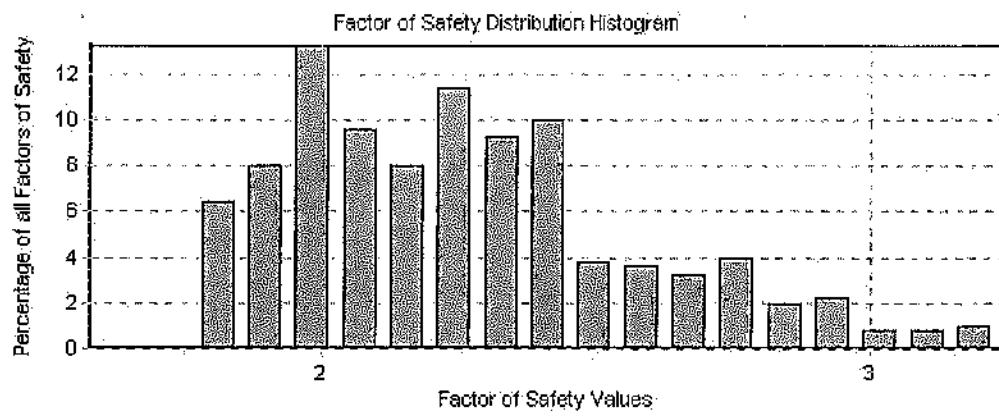
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	125	125	0	32	0	0	1
Soil # 2	125	125	0	34	0	0	1
Soil # 3	125	125	140	24	0	0	1
Soil # 4	125	125	0	34	0	0	1
Soil # 5	130	130	250	22	0	0	1
Soil # 6	125	125	0	35	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	1.774
Surface # 2	1.774
Surface # 3	1.778
Surface # 4	1.789
Surface # 5	1.791
Surface # 6	1.793
Surface # 7	1.794
Surface # 8	1.802
Surface # 9	1.804
Surface # 10	1.805

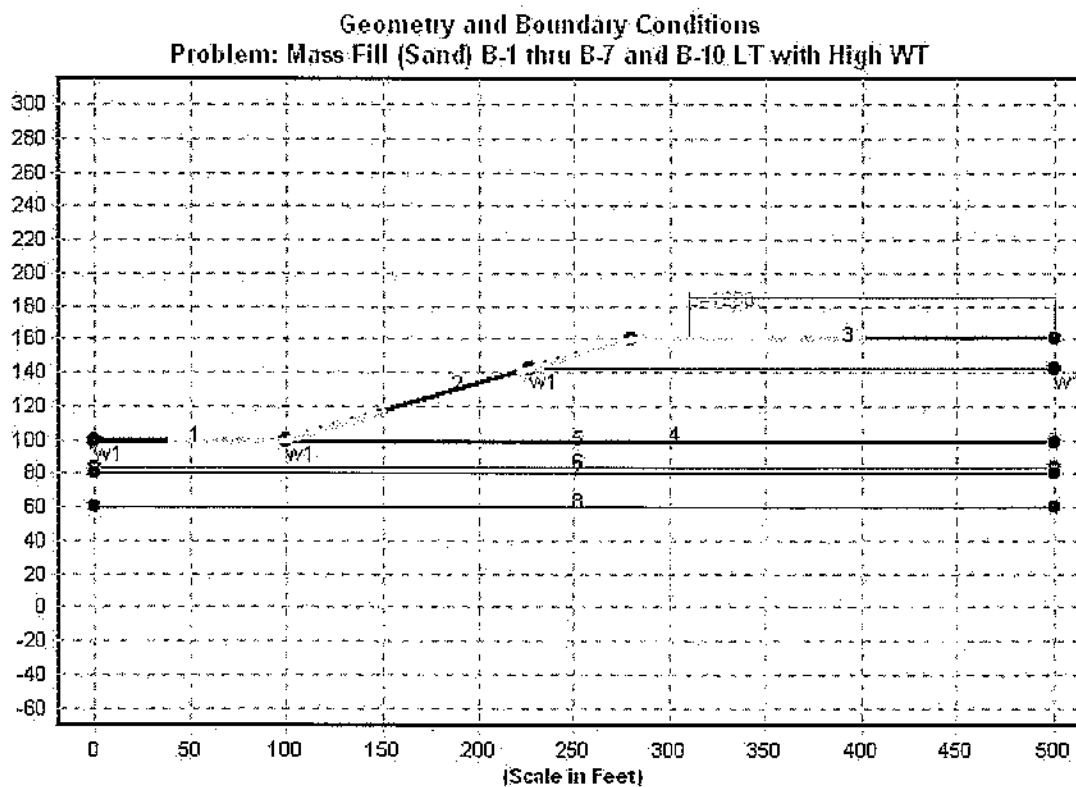


STABL for Windows Report

Date = 4/24/06

Time = 4:19:18 PM

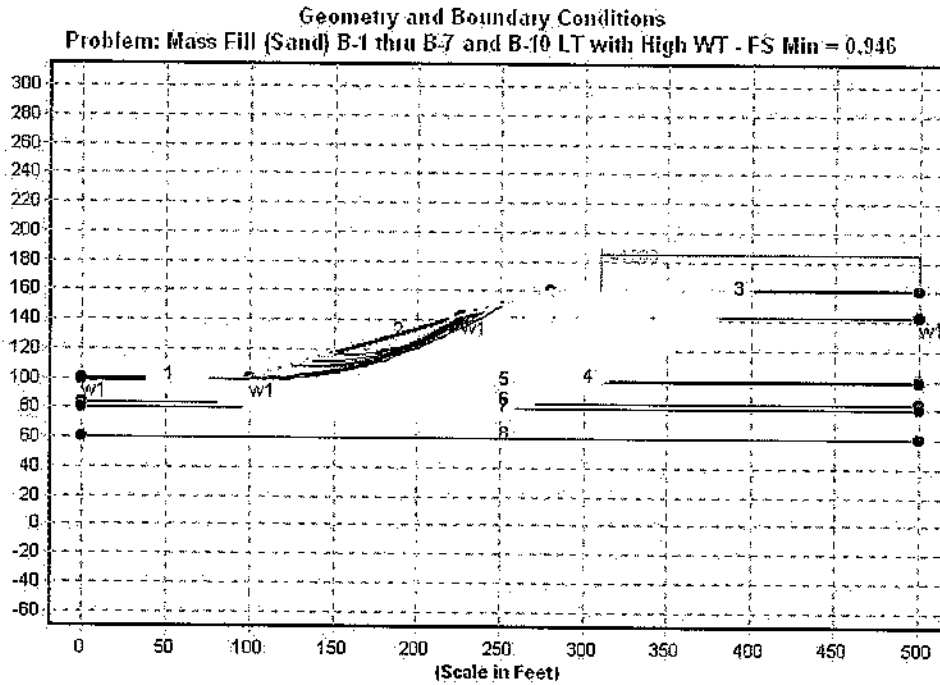
Input Data



Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	98	500	98	3
Segment # 6	0	84	500	84	4
Segment # 7	0	80	500	80	5
Segment # 8	0	60	500	60	6

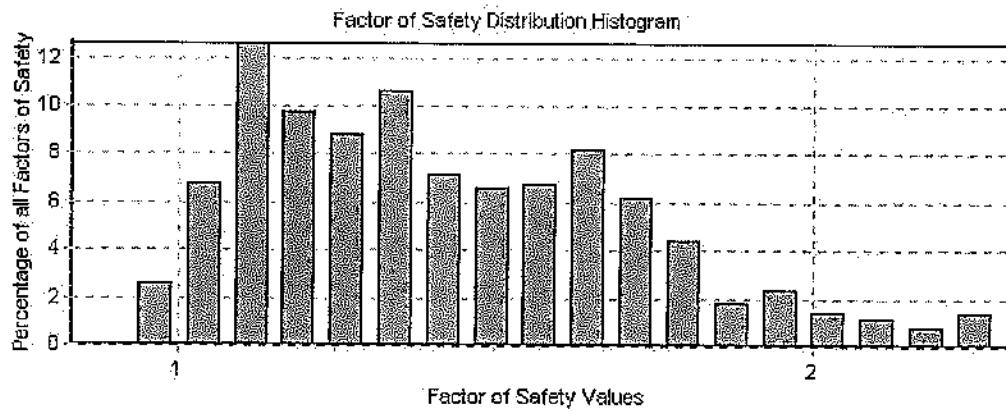
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	125	125	0	32	0	0	1
Soil # 2	125	125	0	34	0	0	1
Soil # 3	125	125	140	24	0	0	1
Soil # 4	125	125	0	34	0	0	1
Soil # 5	130	130	250	22	0	0	1
Soil # 6	125	125	0	35	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	0.946
Surface # 2	0.964
Surface # 3	0.966
Surface # 4	0.967
Surface # 5	0.967
Surface # 6	0.968
Surface # 7	0.971
Surface # 8	0.978
Surface # 9	0.978
Surface # 10	0.985

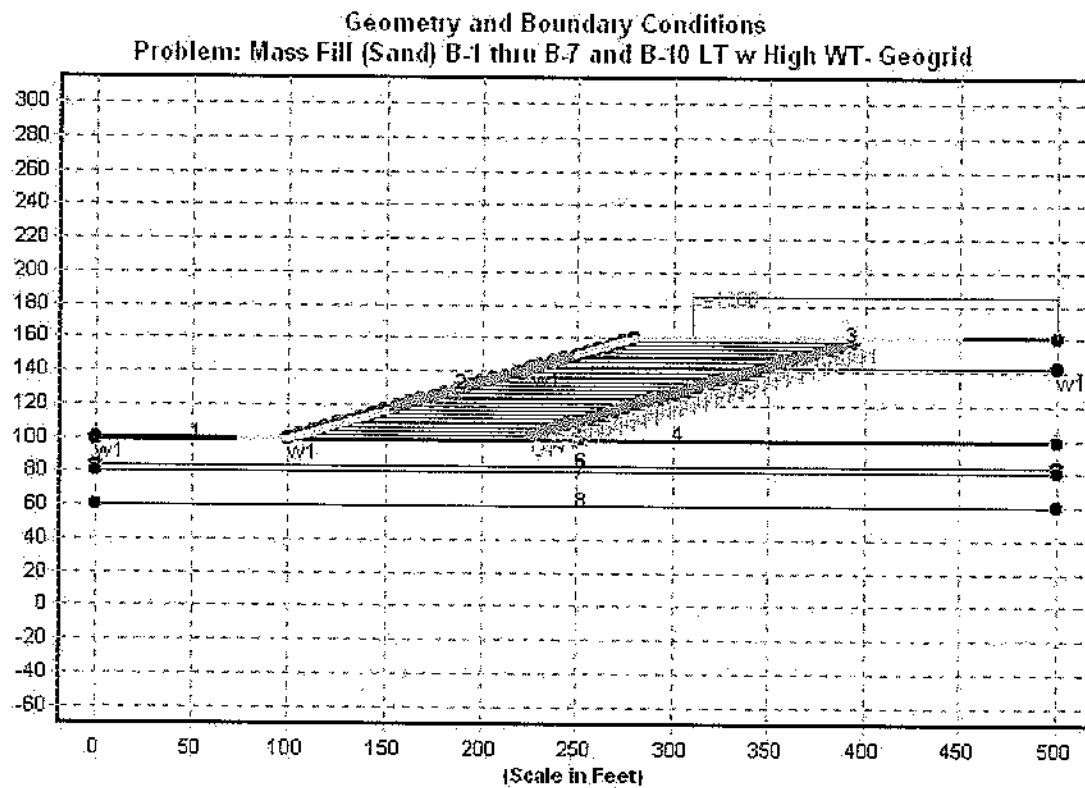


STABL for Windows Report

Date = 4/24/06

Time = 4:28:15 PM

Input Data



Profile Defining Segment Coordinates

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	98	500	98	3
Segment # 6	0	84	500	84	4
Segment # 7	0	80	500	80	5
Segment # 8	0	60	500	60	6

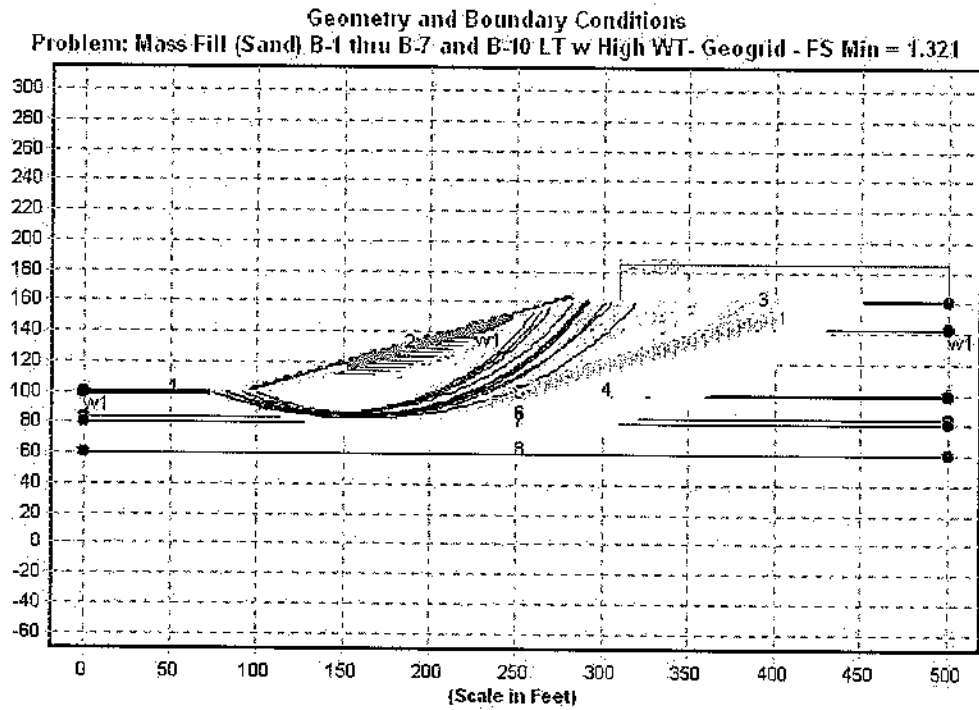
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	125	125	0	32	0	0	1
Soil # 2	125	125	0	34	0	0	1
Soil # 3	125	125	140	24	0	0	1
Soil # 4	125	125	0	34	0	0	1
Soil # 5	130	130	250	22	0	0	1
Soil # 6	125	125	0	35	0	0	1

Geosynthetics Properties

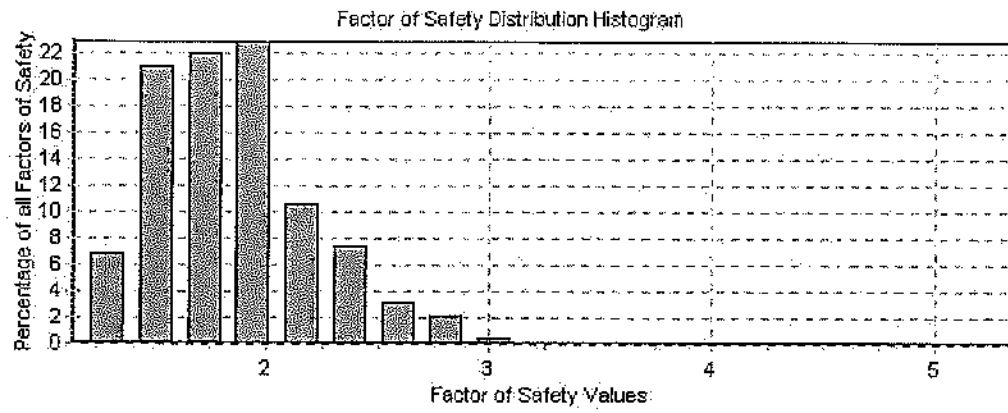
Group Number	Boundary Number for Application	Y Coordinate of Top Layer Intersection with Slope	Y Coordinate of Bottom Layer Intersection with Slope	Number of Geosynthetic Groups between Top and Bottom	Length of Geosynthetics in the Group	Allowable Geosynthetics Tensile Strength per Unit of Length	Soil-Geosynthetic Coefficient of Interaction
group # 1	2	158	102	28	120	1200	0.8

RESULTS

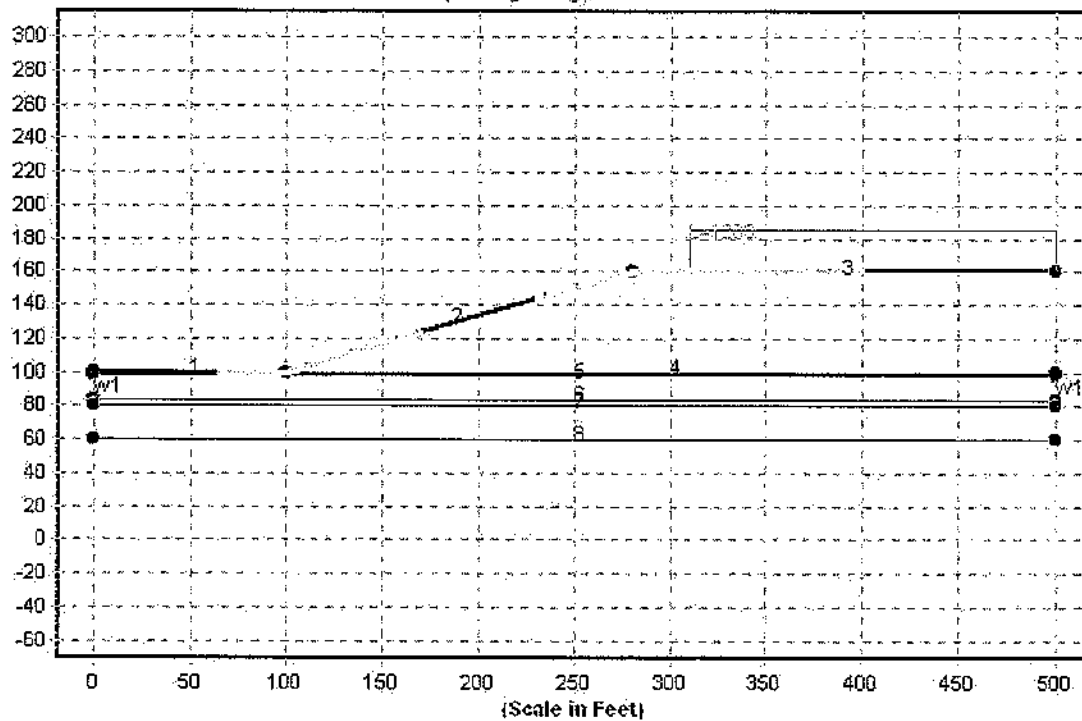


Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	1.321
Surface # 2	1.328
Surface # 3	1.329
Surface # 4	1.33
Surface # 5	1.333
Surface # 6	1.335
Surface # 7	1.337
Surface # 8	1.338
Surface # 9	1.338
Surface # 10	1.339



CASE 2



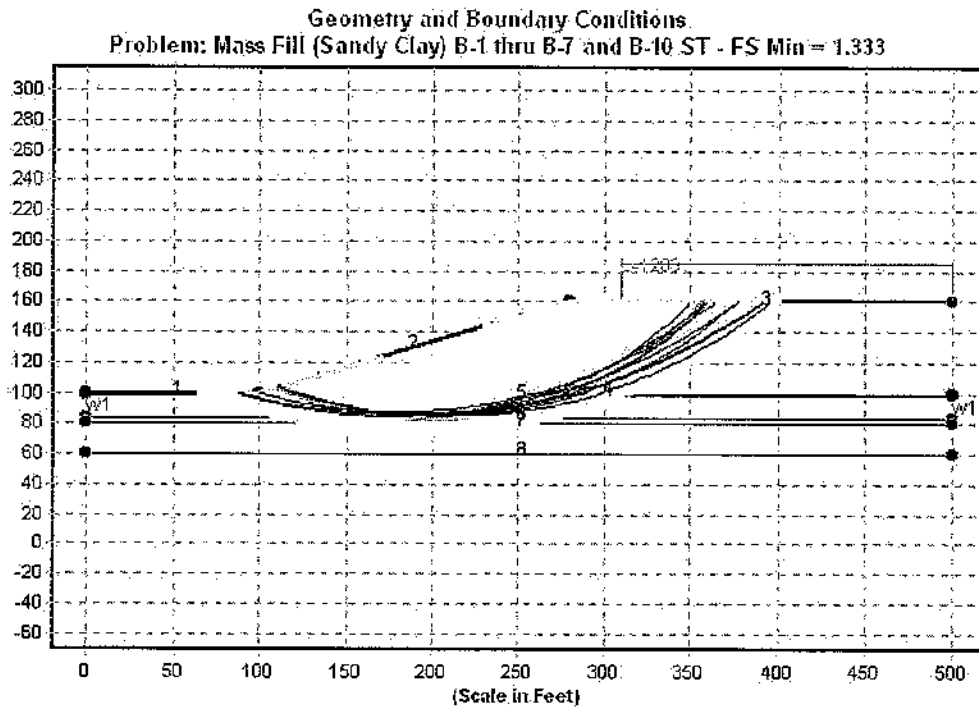
Profile Defining Segment Coordinates

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	98	500	98	3
Segment # 6	0	84	500	84	4
Segment # 7	0	80	500	80	5
Segment # 8	0	60	500	60	6

Soil Properties

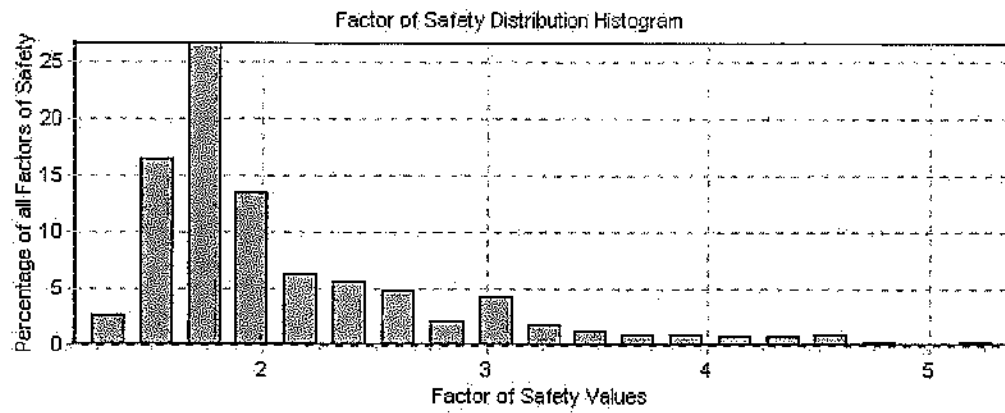
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	125	125	1200	0	0	0	1
Soil # 2	125	125	0	34	0	0	1
Soil # 3	125	125	1400	0	0	0	1
Soil # 4	125	125	0	34	0	0	1
Soil # 5	130	130	2500	0	0	0	1
Soil # 6	125	125	0	35	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	1.333
Surface # 2	1.342
Surface # 3	1.348
Surface # 4	1.356
Surface # 5	1.356
Surface # 6	1.361
Surface # 7	1.368
Surface # 8	1.372
Surface # 9	1.382
Surface # 10	1.383



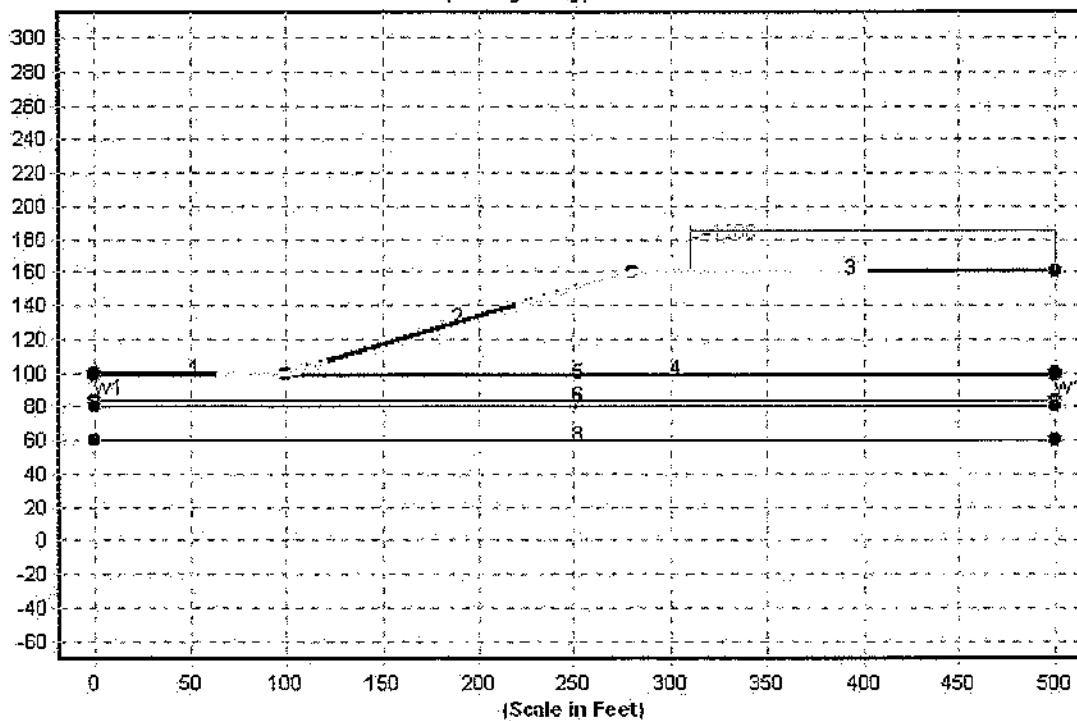
STABL for Windows Report

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Time = 4:57:18 PM

Input Data

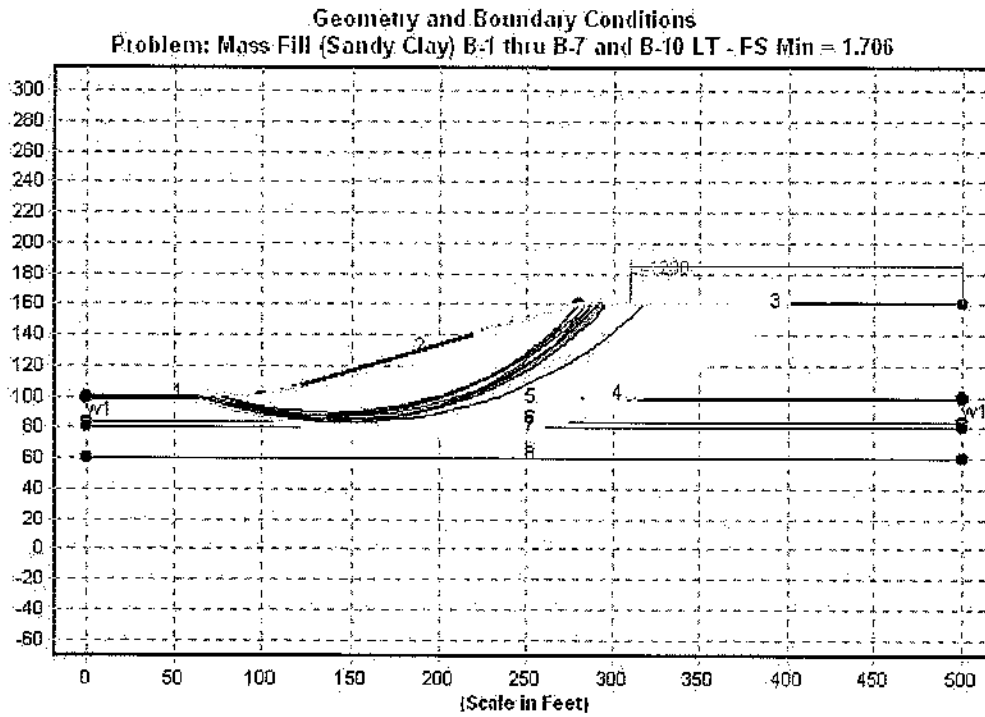
Geometry and Boundary Conditions
Problem: Mass Fill (Sandy Clay) B-1 thru B-7 and B-10 LT



Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	98	500	98	3
Segment # 6	0	84	500	84	4
Segment # 7	0	80	500	80	5
Segment # 8	0	60	500	60	6

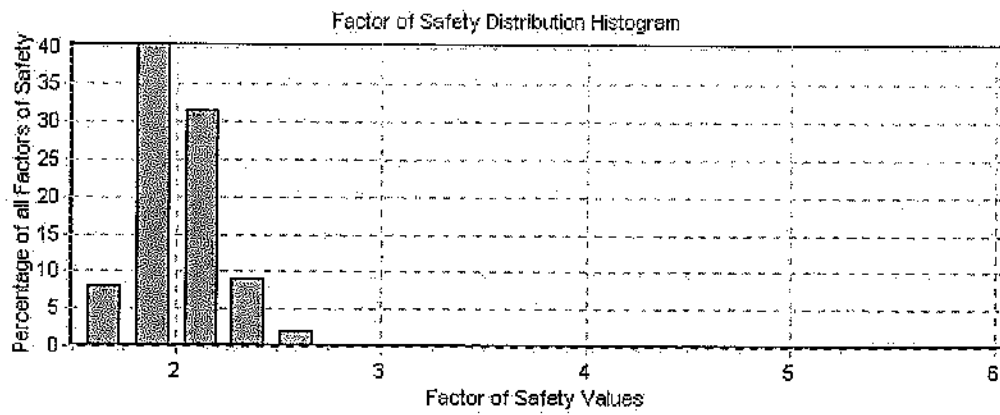
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	125	125	100	24	0	0	1
Soil # 2	125	125	0	34	0	0	1
Soil # 3	125	125	140	24	0	0	1
Soil # 4	125	125	0	34	0	0	1
Soil # 5	130	130	250	22	0	0	1
Soil # 6	125	125	0	35	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	1.706
Surface # 2	1.712
Surface # 3	1.714
Surface # 4	1.718
Surface # 5	1.724
Surface # 6	1.725
Surface # 7	1.73
Surface # 8	1.733
Surface # 9	1.734
Surface # 10	1.735

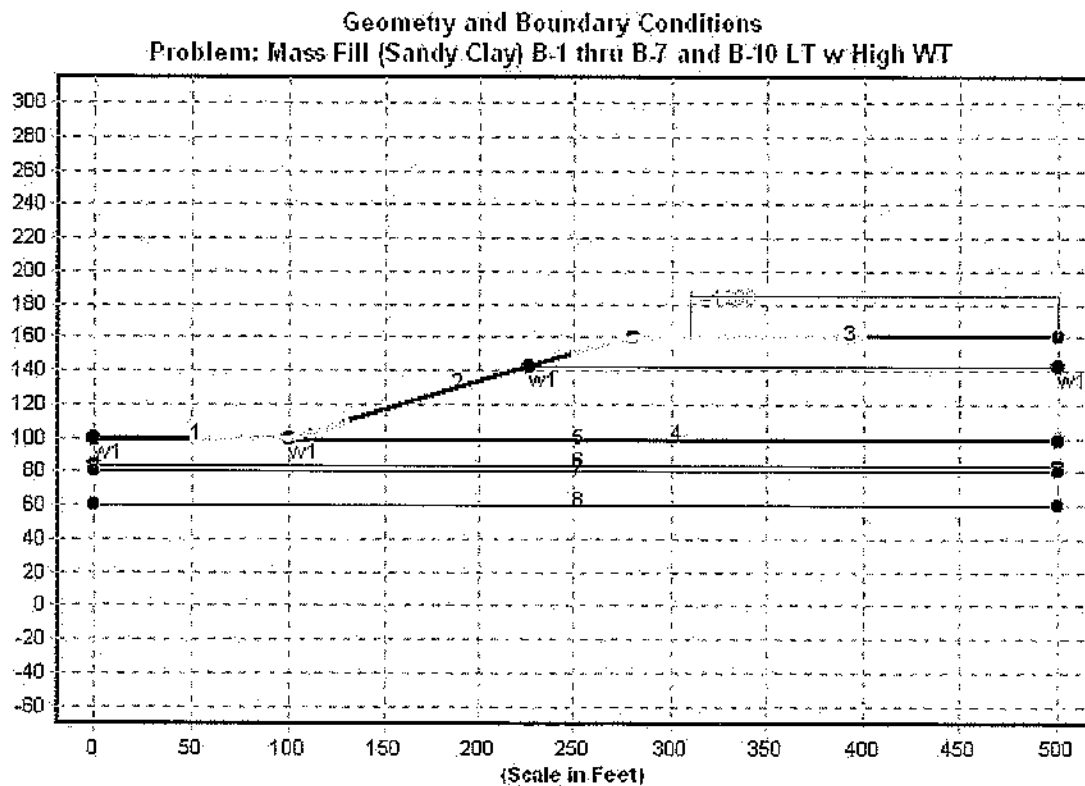


STABL for Windows Report

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Time = 5:02:19 PM

Input Data



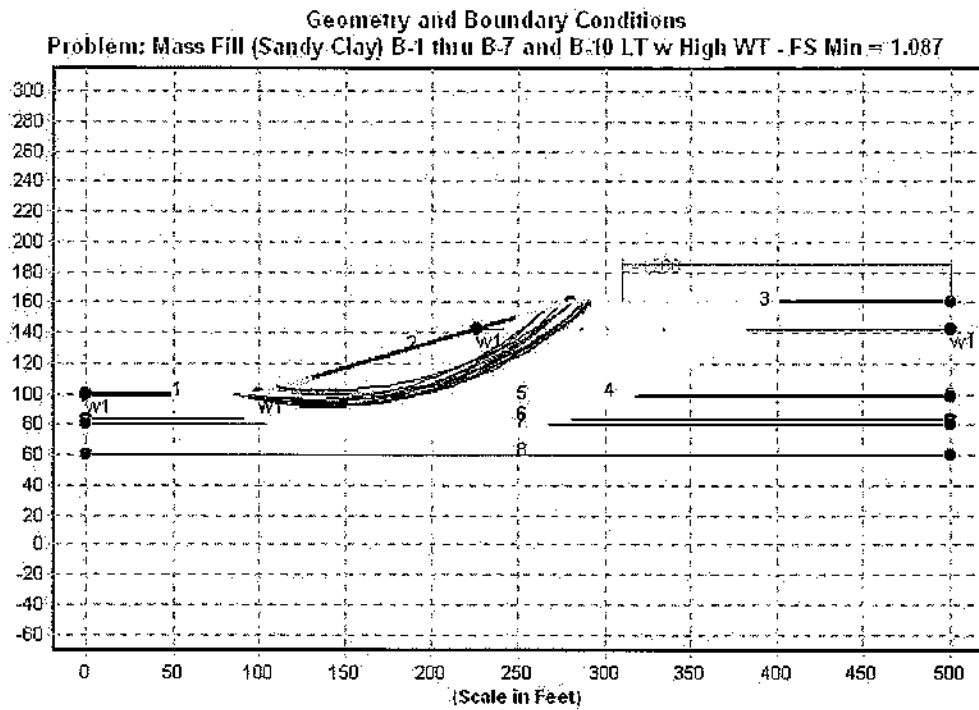
Profile Defining Segment Coordinates

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	98	500	98	3
Segment # 6	0	84	500	84	4
Segment # 7	0	80	500	80	5
Segment # 8	0	60	500	60	6

Soil Properties

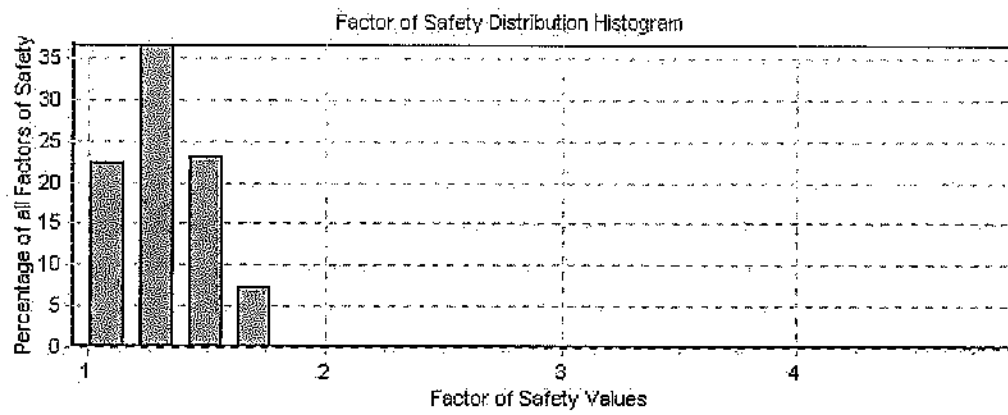
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	125	125	100	24	0	0	1
Soil # 2	125	125	0	34	0	0	1
Soil # 3	125	125	140	24	0	0	1
Soil # 4	125	125	0	34	0	0	1
Soil # 5	130	130	250	22	0	0	1
Soil # 6	125	125	0	35	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	1.087
Surface # 2	1.09
Surface # 3	1.091
Surface # 4	1.092
Surface # 5	1.092
Surface # 6	1.093
Surface # 7	1.093
Surface # 8	1.095
Surface # 9	1.096
Surface # 10	1.096

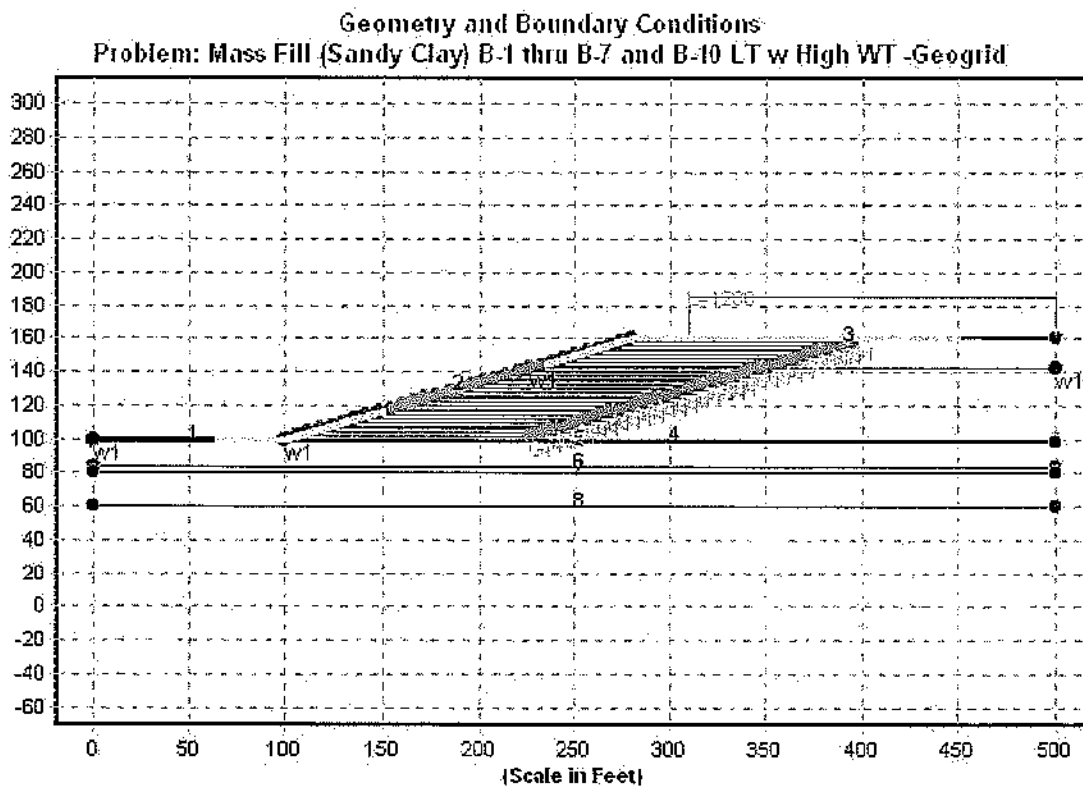


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Date = 4/24/06

Time = 5:07:26 PM

Input Data



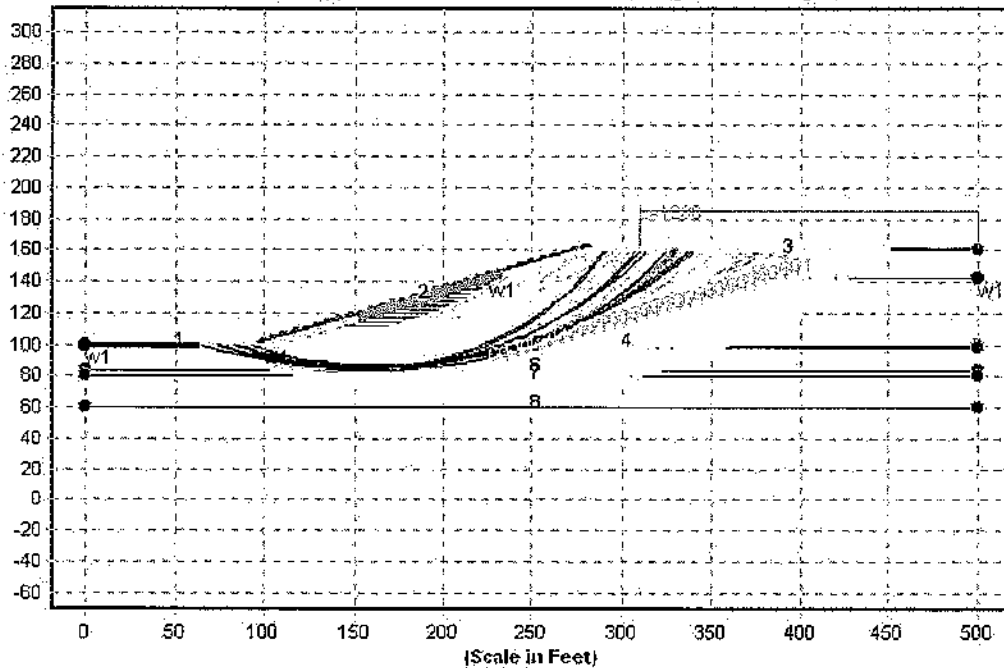
Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	98	500	98	3
Segment # 6	0	84	500	84	4
Segment # 7	0	80	500	80	5
Segment # 8	0	60	500	60	6

Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	125	125	100	24	0	0	1
Soil # 2	125	125	0	34	0	0	1
Soil # 3	125	125	140	24	0	0	1
Soil # 4	125	125	0	34	0	0	1
Soil # 5	130	130	250	22	0	0	1
Soil # 6	125	125	0	35	0	0	1

Geosynthetics Properties							
Group Number	Boundary Number for Application	Y Coordinate of Top Layer Intersection with Slope	Y Coordinate of Bottom Layer Intersection with Slope	Number of Geosynthetic Groups between Top and Bottom	Length of Geosynthetics in the Group	Allowable Geosynthetics Tensile Strength per Unit of Length	Soil-Geosynthetic Coefficient of Interaction
group # 1	2	158	102	29	120	1200	0.8

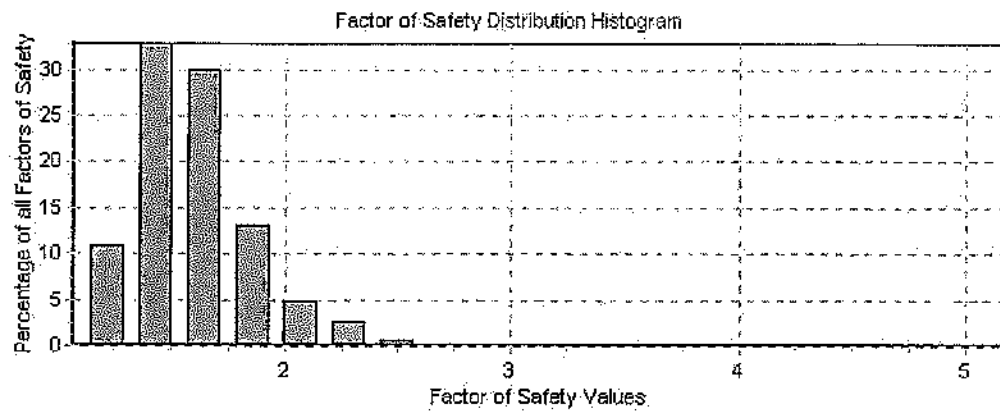
RESULTS

Geometry and Boundary Conditions
Problem: Mass Fill (Sandy Clay) B-1 thru B-7 and B-10 LT w High WT -Geogrid - FS Min = 1.241



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	1.241
Surface # 2	1.245
Surface # 3	1.246
Surface # 4	1.247
Surface # 5	1.249
Surface # 6	1.253
Surface # 7	1.253
Surface # 8	1.257
Surface # 9	1.259
Surface # 10	1.261



CASE 3

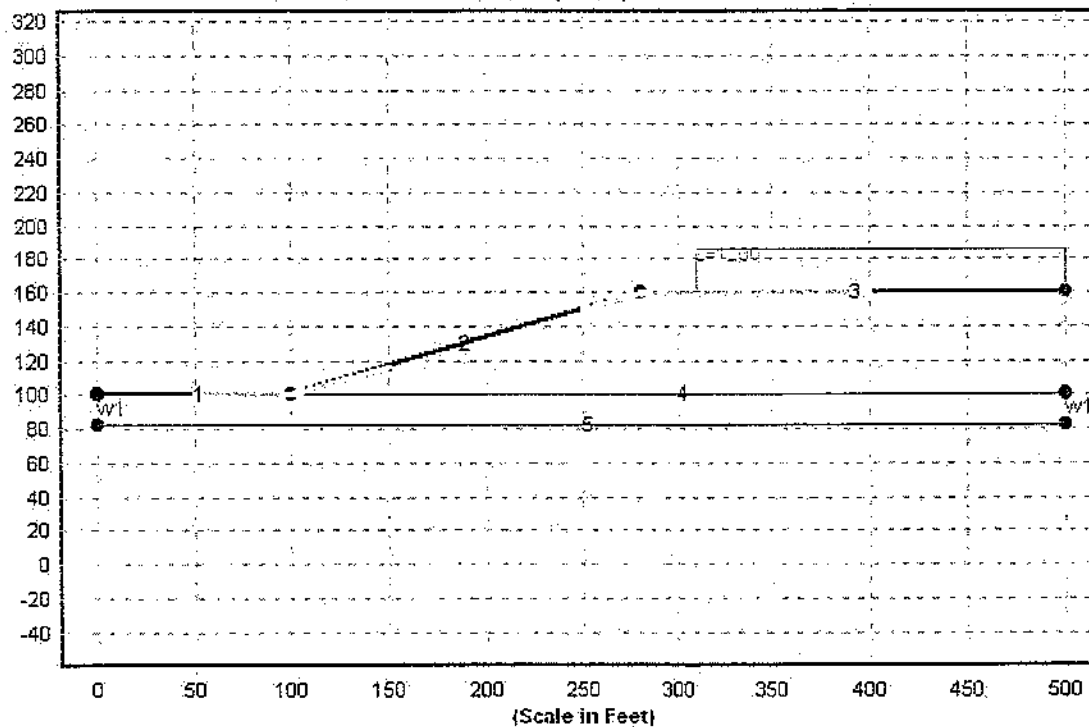
STABL for Windows Report

Date = 4/24/06

Time = 5:13:10 PM

Input Data

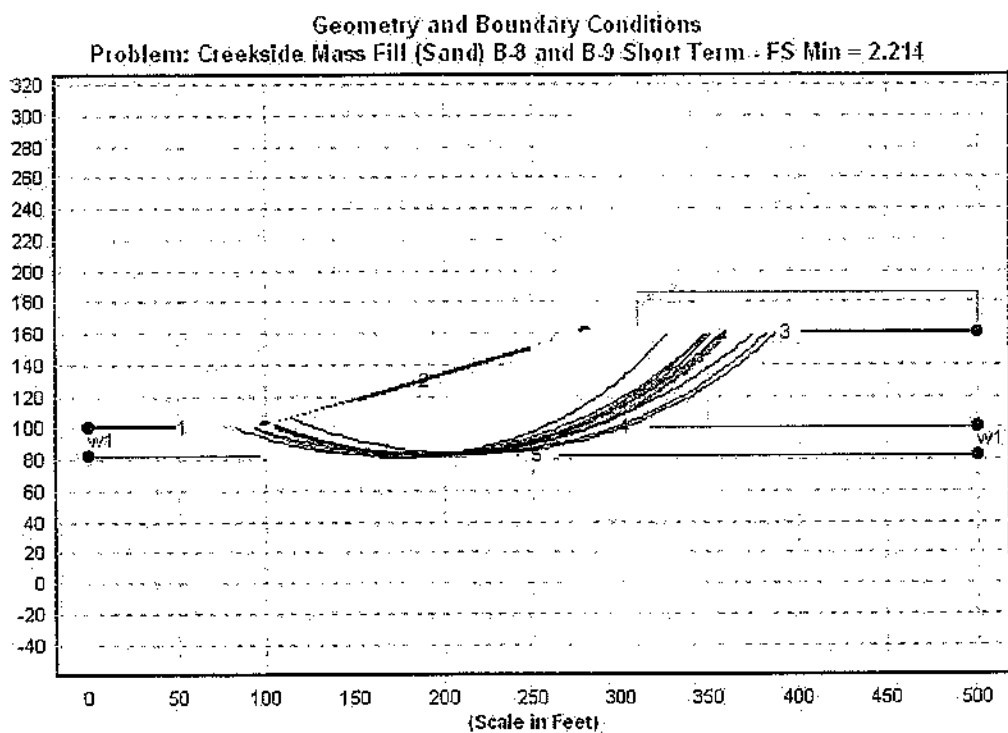
Geometry and Boundary Conditions
Problem: Creekside Mass Fill (Sand) B-8 and B-9 Short Term



Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	82	500	82	3

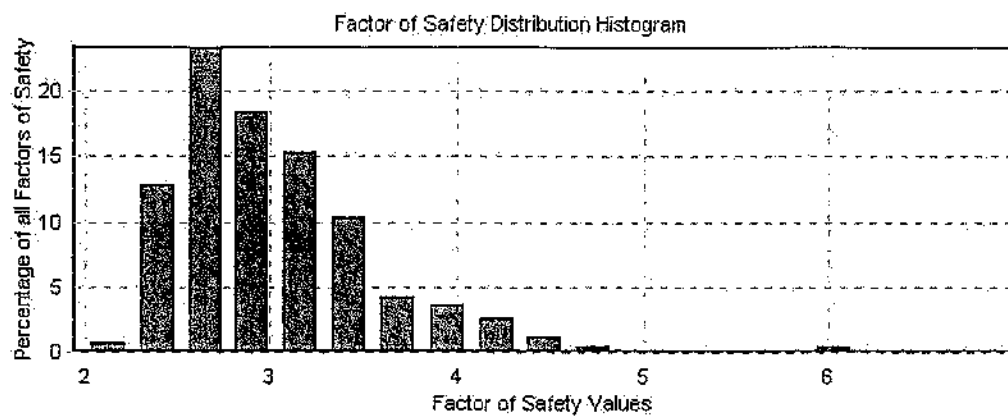
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	120	120	0	32	0	0	1
Soil # 2	125	125	2000	0	0	0	1
Soil # 3	125	125	0	32	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	2.214
Surface # 2	2.217
Surface # 3	2.222
Surface # 4	2.252
Surface # 5	2.272
Surface # 6	2.303
Surface # 7	2.31
Surface # 8	2.31
Surface # 9	2.315
Surface # 10	2.325



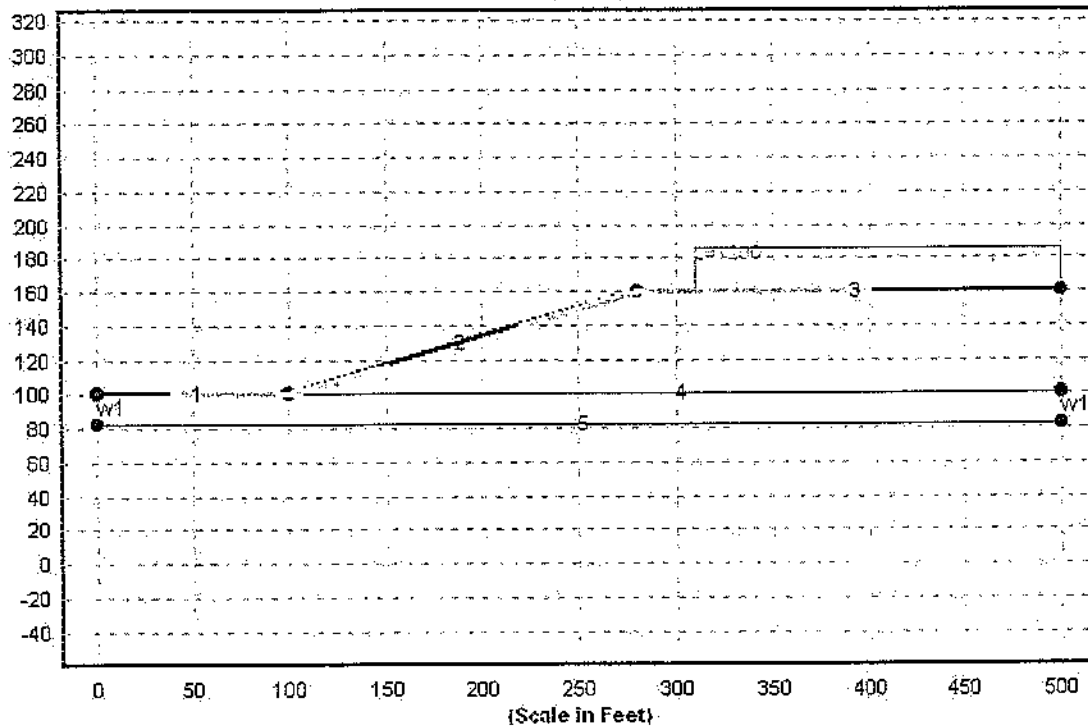
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Input Data

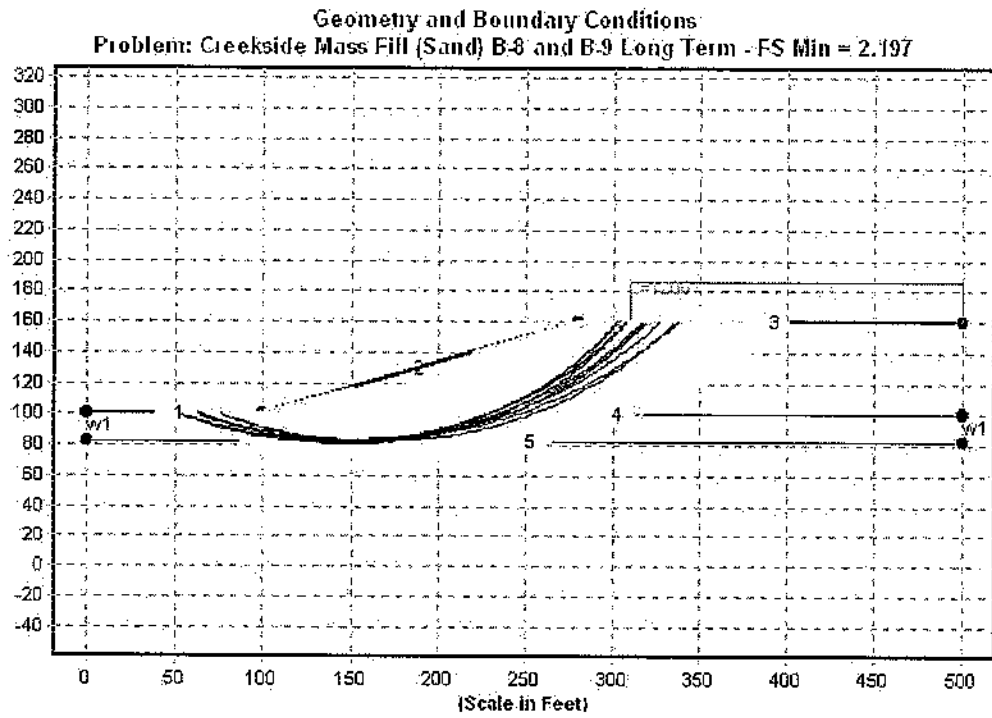
Geometry and Boundary Conditions
Problem: Creekside Mass Fill (Sand) B-8 and B-9 Long Term



Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	82	500	82	3

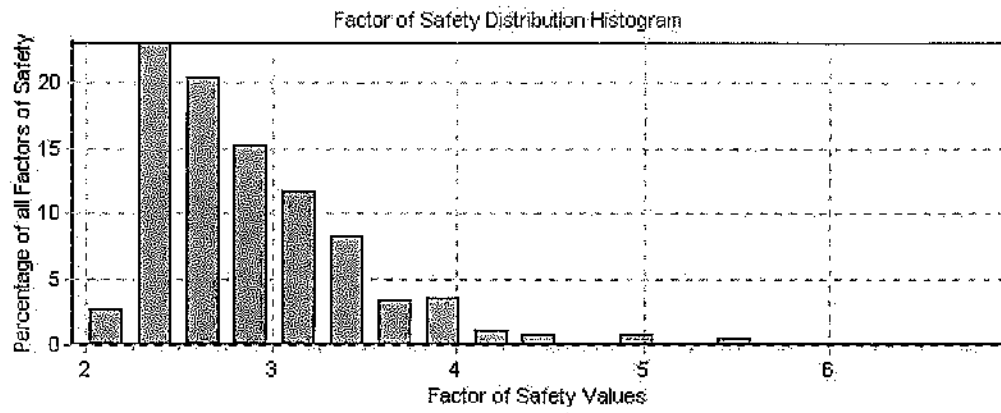
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	120	120	0	32	0	0	1
Soil # 2	125	125	200	24	0	0	1
Soil # 3	125	125	0	32	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

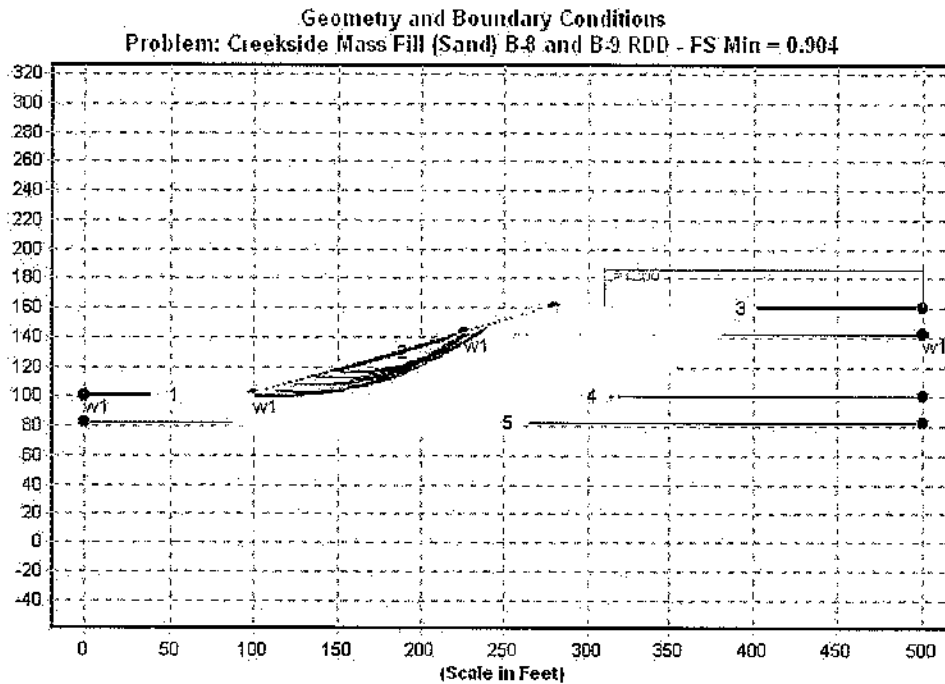
Surface Number	Factor of Safety
Surface # 1	2.197
Surface # 2	2.2
Surface # 3	2.203
Surface # 4	2.204
Surface # 5	2.212
Surface # 6	2.214
Surface # 7	2.216
Surface # 8	2.218
Surface # 9	2.222
Surface # 10	2.223



Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	82	500	82	3

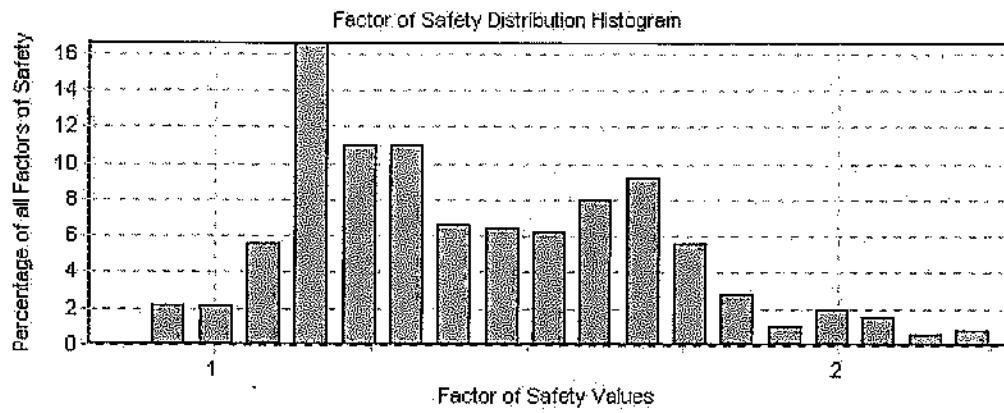
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	120	120	0	32	0	0	1
Soil # 2	125	125	200	24	0	0	1
Soil # 3	125	125	0	32	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	0.904
Surface # 2	0.922
Surface # 3	0.924
Surface # 4	0.925
Surface # 5	0.925
Surface # 6	0.929
Surface # 7	0.936
Surface # 8	0.942
Surface # 9	0.961
Surface # 10	0.963



[بازگشت به صفحه اصلی](#)

المجلة الدولية لدراسات حقوق الإنسان، المجلد 1، العدد 1، 2002، ص 10.

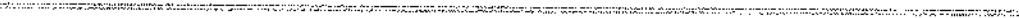
[illegible][illegible]

Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	82	500	82	3

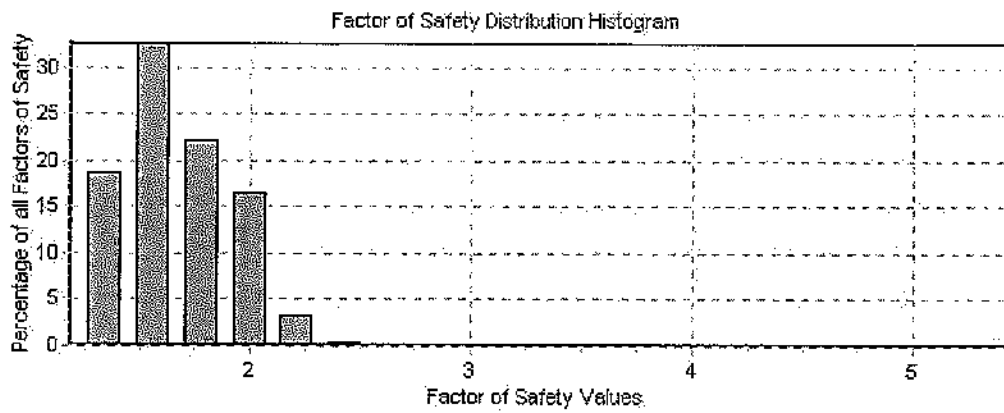
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	120	120	0	32	0	0	1
Soil # 2	125	125	200	24	0	0	1
Soil # 3	125	125	0	32	0	0	1

Geosynthetics Properties							
Group Number	Boundary Number for Application	Y Coordinate of Top Layer Intersection with Slope	Y Coordinate of Bottom Layer Intersection with Slope	Number of Geosynthetic Groups between Top and Bottom	Length of Geosynthetics in the Group	Allowable Geosynthetics Tensile Strength per Unit of Length	Soil-Geosynthetic Coefficient of Interaction
group # 1	2	158	102	29	120	1200	0.8

1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.



Factors of Safety of Ten Most Critical Surfaces	
Surface Number	Factor of Safety
Surface # 1	1.367
Surface # 2	1.373
Surface # 3	1.374
Surface # 4	1.374
Surface # 5	1.375
Surface # 6	1.375
Surface # 7	1.378
Surface # 8	1.378
Surface # 9	1.378
Surface # 10	1.382



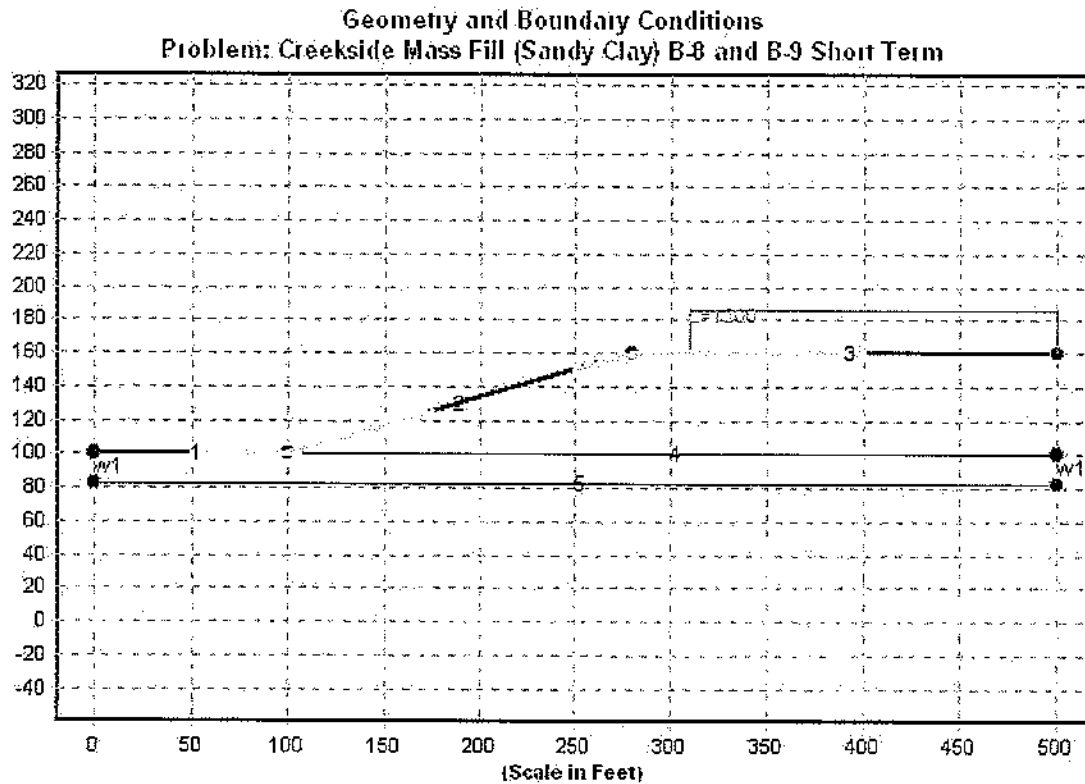
CASE 4

STABL for Windows Report

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Time = 8:39:18 AM

Input Data



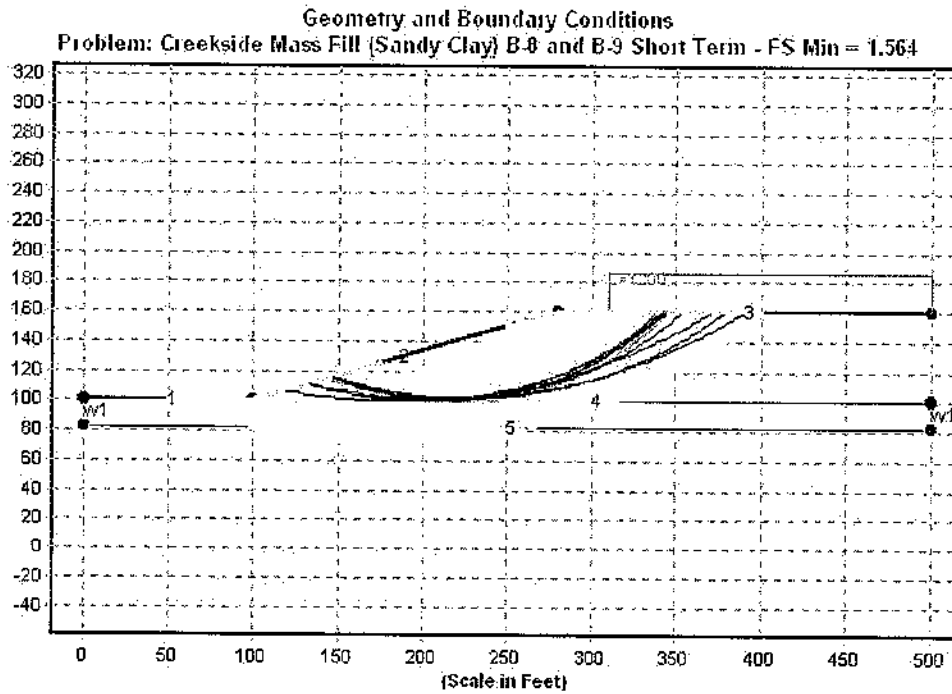
Profile Defining Segment Coordinates

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	82	500	82	3

Soil Properties

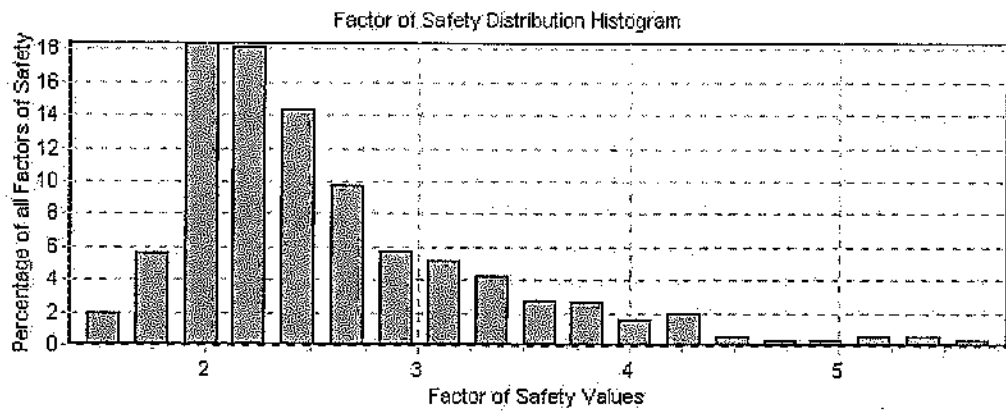
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	120	120	1000	0	0	0	1
Soil # 2	125	125	2000	0	0	0	1
Soil # 3	125	125	0	32	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	1.564
Surface # 2	1.588
Surface # 3	1.599
Surface # 4	1.603
Surface # 5	1.605
Surface # 6	1.61
Surface # 7	1.617
Surface # 8	1.618
Surface # 9	1.626
Surface # 10	1.63

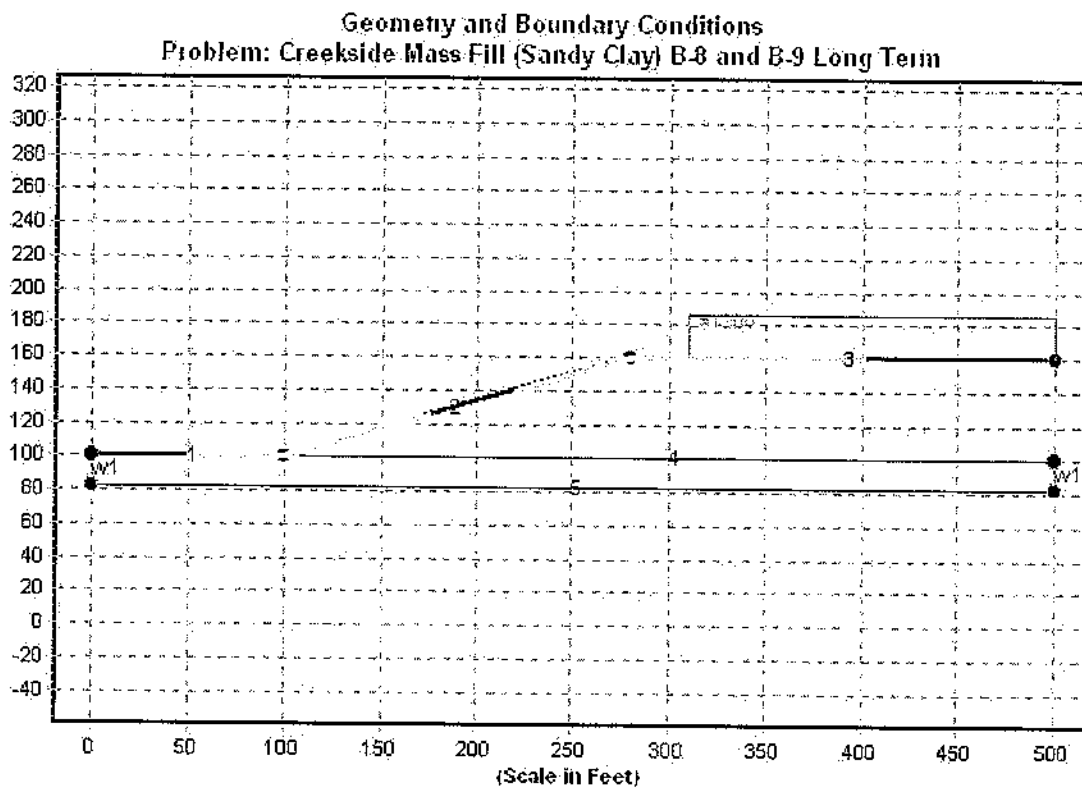


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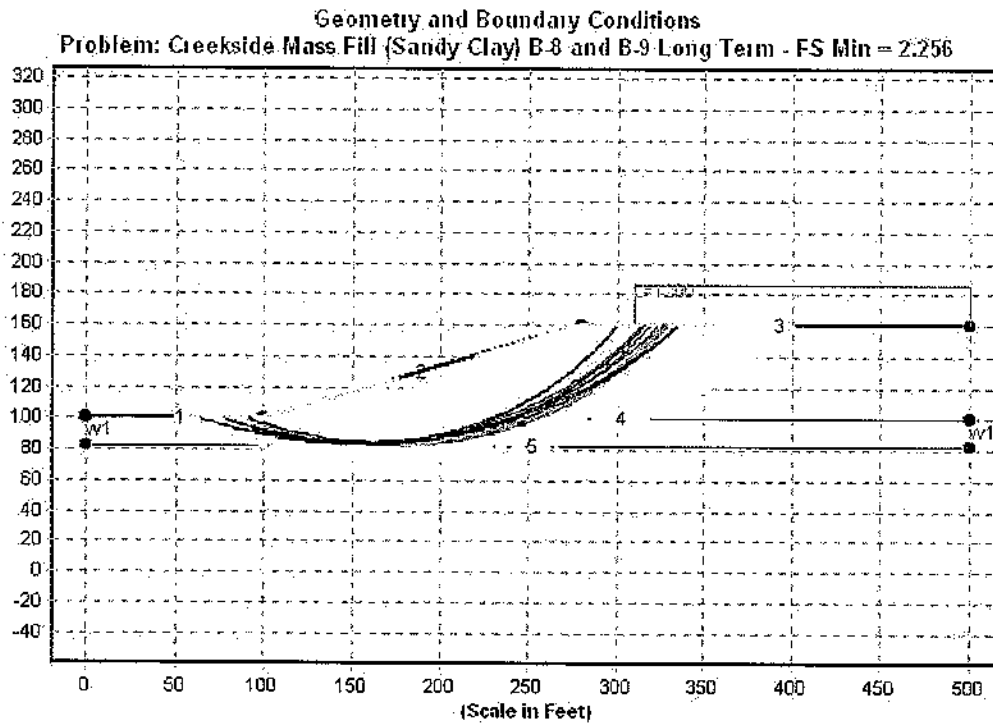
Input Data



Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	82	500	82	3

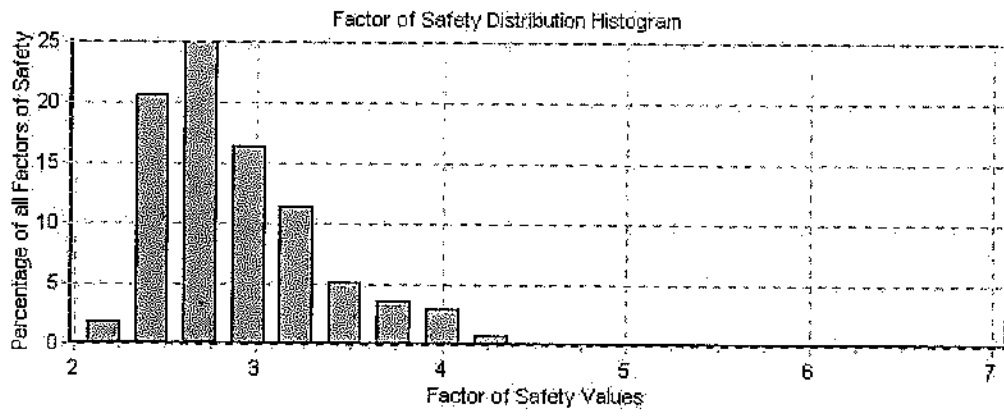
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	120	120	100	24	0	0	1
Soil # 2	125	125	200	24	0	0	1
Soil # 3	125	125	0	32	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	2.256
Surface # 2	2.266
Surface # 3	2.271
Surface # 4	2.272
Surface # 5	2.273
Surface # 6	2.287
Surface # 7	2.288
Surface # 8	2.289
Surface # 9	2.293
Surface # 10	2.294



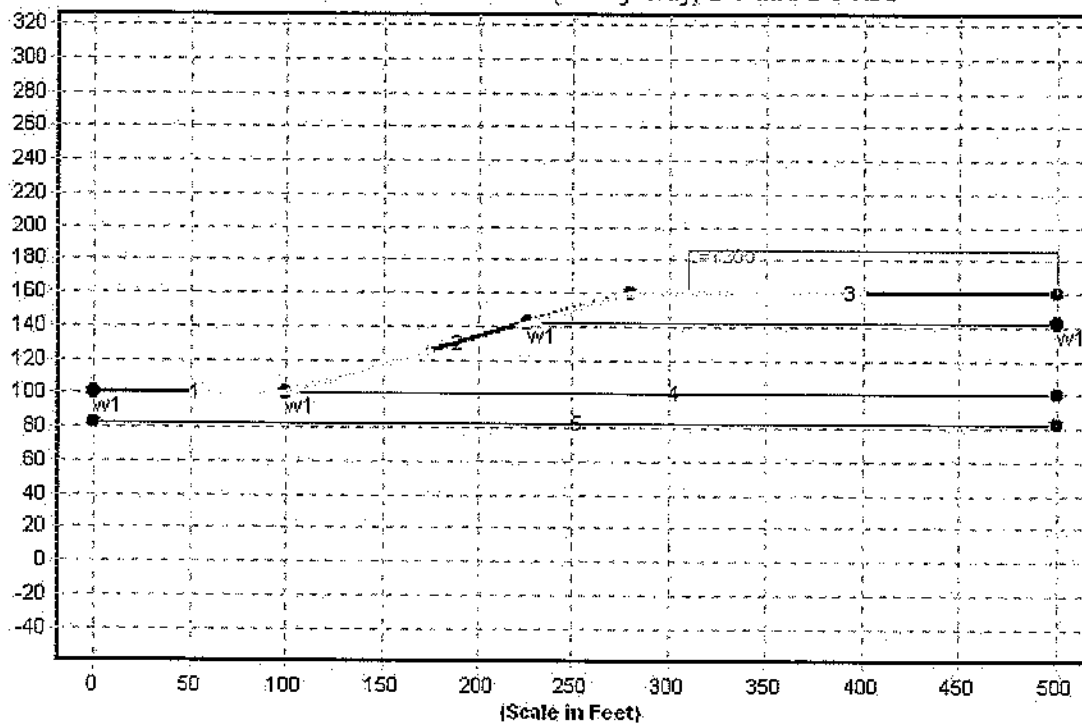
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Input Data

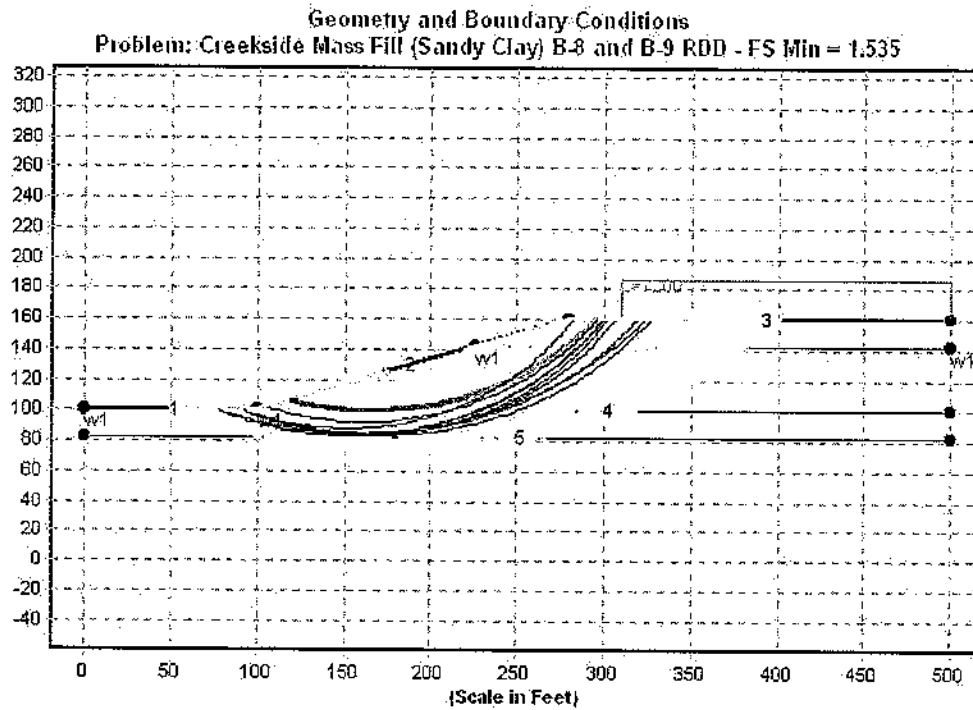
Geometry and Boundary Conditions
Problem: Creekside Mass Fill (Sandy Clay) B-8 and B-9 RDD



Profile Defining Segment Coordinates					
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
Segment # 1 (Top)	0	100	100	100	2
Segment # 2 (Top)	100	100	280	160	1
Segment # 3 (Top)	280	160	500	160	1
Segment # 4	100	100	500	100	2
Segment # 5	0	82	500	82	3

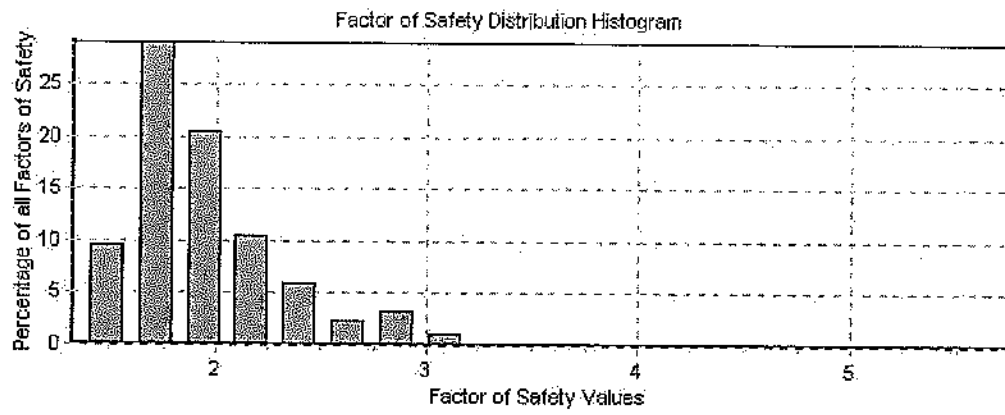
Soil Properties							
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Phi (deg)	Ru	Pressure Head	Water Table
Soil # 1	125	125	100	24	0	0	1
Soil # 2	125	125	200	24	0	0	1
Soil # 3	125	125	0	32	0	0	1

RESULTS



Factors of Safety of Ten Most Critical Surfaces

Surface Number	Factor of Safety
Surface # 1	1.535
Surface # 2	1.541
Surface # 3	1.542
Surface # 4	1.546
Surface # 5	1.547
Surface # 6	1.548
Surface # 7	1.549
Surface # 8	1.549
Surface # 9	1.55
Surface # 10	1.552



APPENDIX B

CONSOLIDATION TEST RESULTS

HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS
ASTM D 2435

Project Name:	<u>Creekside Park Mass Fill</u>	Boring No.	<u>B-1</u>
Project No.	<u>HG-05-20940 (BG-2)</u>	Sample No.	<u>S-11</u>
		Sample Depth	<u>33' - 35'</u>

Soil Properties

Initial Dry Unit Weight (pcf)	89.07
Final Dry Unit Weight (pcf)	92.11
Initial Void Ratio	0.856
Final Void Ratio	0.795
Initial Moisture Content (%)	30.82
Final Moisture Content (%)	32.83
Pre-Consolidation Pressure (tsf)	3.6
Over-Consolidation Ratio, OCR	2.4
Compression Index, Cc	0.265
Swell Index, Cs	0.066

Tested by:	<u>IG</u>	Date:	<u>1/24/2006</u>
Calculated by:	<u>SV</u>	Date:	<u>3/14/2006</u>
Checked by:	<u>FF</u>	Date:	<u>3/21/2006</u>

HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

Project Name:	Creekside Park Mass Fill	Boring No.	B-1
Project No.	HG05-20940	Sample No.	S-11
Date Tested:	1-24-06	Sample Depth	33.0' - 35.0'
Technician:	IG	Date Calculated:	2-14-06

Sample Data	Initial	Final	Test Data	Initial	Final
Sample Height (in)	1.000	0.987	Wet + Ring (g)	693.000	695.300
Diameter (in)	2.500	2.500	Dry + Ring (g)	657.600	657.600
Volume (cc)	80.440	79.394	Ring Wt. (g)	542.770	542.770
Height of Solids (in)	0.529	0.529	Moisture Data (Trimmings)		LL
Specific Gravity	2.700	2.700	Wet + Tare (g)	57.130	
Moisture Content (%)	30.828	32.831	Dry + Tare (g)	51.430	PI
Wet Density (pcf)	116.539	119.881	Tare (g)	30.180	
Dry Density (pcf)	89.078	90.251	Moisture Content (%)	26.824	
Void Ratio	0.891	0.867	Sample Description	Red Clay	
Percent Saturation	93.379	102.267			

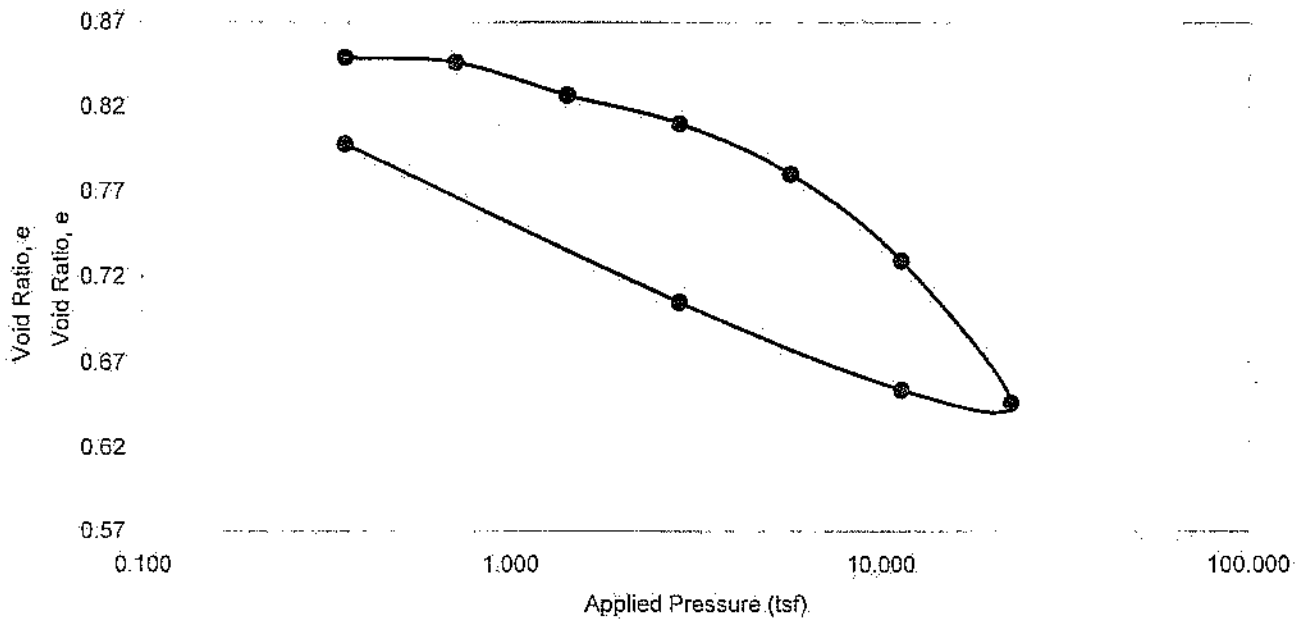
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HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

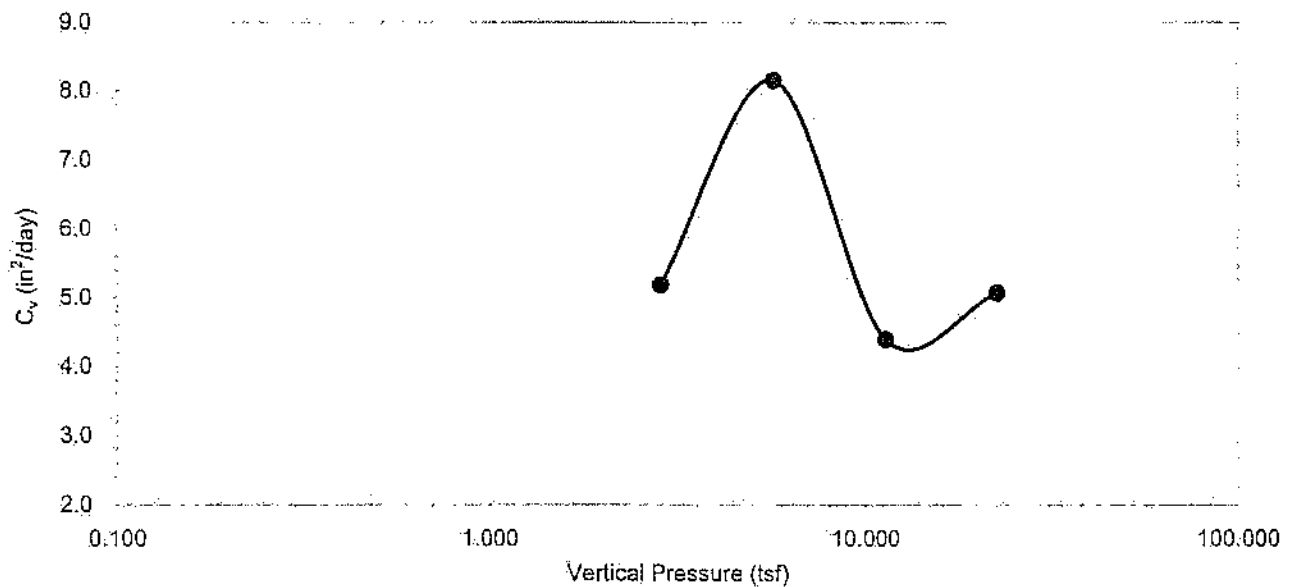
Project Name: Creekside Park Mass Fill
Project No. HG05-20940

Boring No. B-1
Sample No. S-11
Sample Depth 33-35

e - Log(p) Curve



C_v - Log(p) Curve



HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS
ASTM D 2435

Project Name:	<u>Creekside Park Mass Fill</u>	Boring No.	<u>B-2</u>
Project No.	<u>HG-05-20940 (BG-2)</u>	Sample No.	<u>S-7</u>
		Sample Depth	<u>13'-15'</u>

Soil Properties

Initial Dry Unit Weight (pcf)	112.4
Final Dry Unit Weight (pcf)	113.3
Initial Void Ratio	0.471
Final Void Ratio	0.459
Initial Moisture Content (%)	15.9
Final Moisture Content (%)	16.4
Pre-Consolidation Pressure (tsf)	2.8
Over-Consolidation Ratio, OCR	3.3
Compression Index, Cc	0.100
Swell Index, Cs	0.022

Tested by:	<u>IG</u>	Date:	<u>1/24/2006</u>
Calculated by:	<u>SV</u>	Date:	<u>3/14/2006</u>
Checked by:	<u>FF</u>	Date:	<u>3/21/2006</u>

Project Name:	Creekside Park Mass Fill	Boring No.	B-2
Project No.	HG05-20940	Sample No.	S-7
Date Tested:	12.23.05	Sample Depth	13'-15'
Technician:	IG	Date Calculated:	2-11-06

Sample Data	Initial	Final	Test Data	Initial	Final
Sample Height (in)	0.794	0.786	Wet + Ring (g)	151.750	151.920
Diameter (in)	1.950	1.950	Dry + Ring (g)	140.565	140.433
Volume (cc)	38.858	38.466	Ring Wt. (g)	70.560	70.560
Height of Solids (in)	0.540	0.539	Moisture Data (Trimmings)		LL
Specific Gravity	2.650	2.650	Wet + Tare (g)	161.180	
Moisture Content (%)	15.981	16.440	Dry + Tare (g)	143.110	PI
Wet Density (pcf)	130.379	131.982	Tare (g)	30.040	
Dry Density (pcf)	112.414	113.347	Moisture Content (%)	15.981	
Void Ratio	0.471	0.459	Sample Description	Red Sandy Clay w/sand seams and fc. nodules	
Percent Saturation	89.916	94.940			

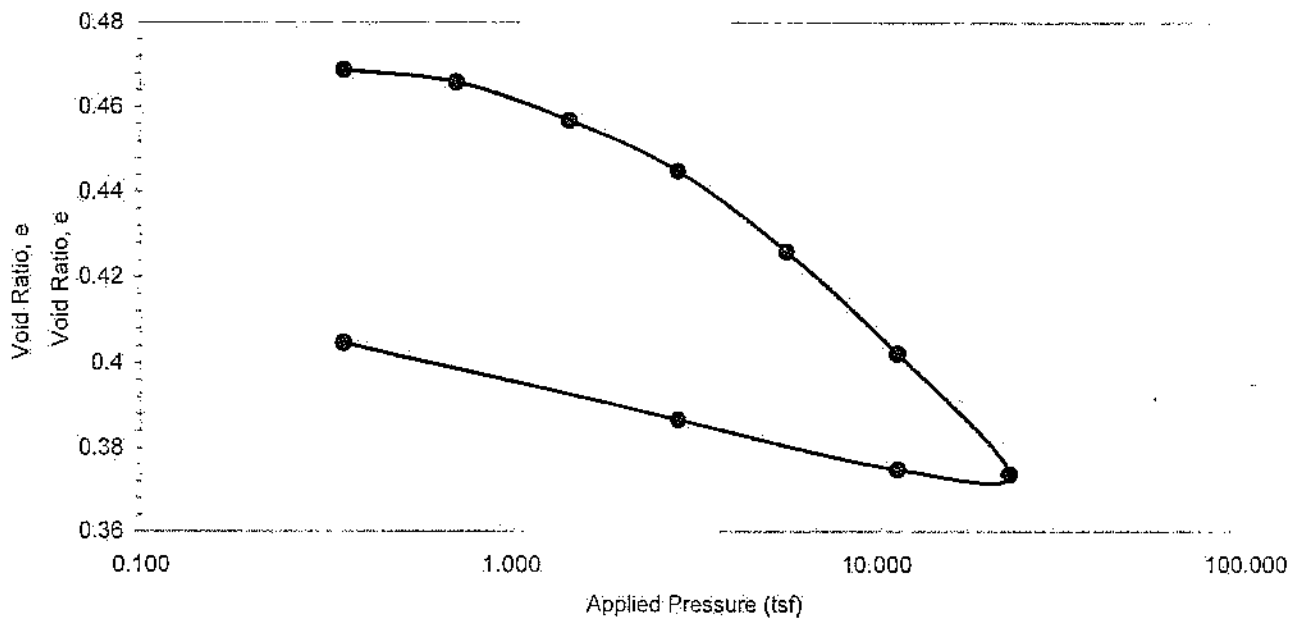
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HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

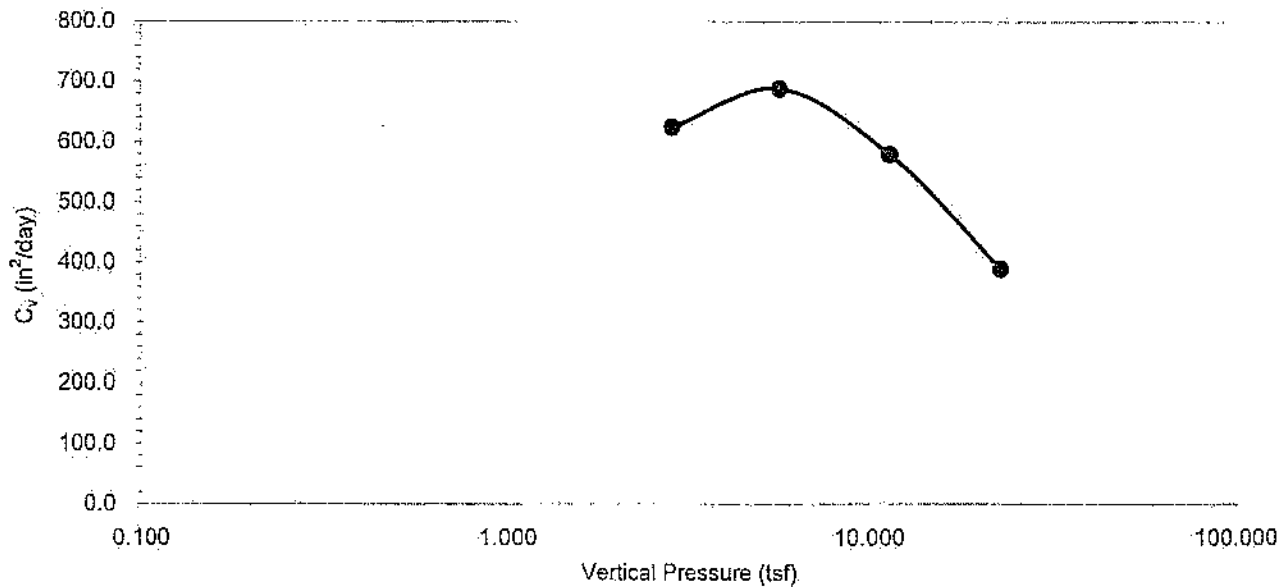
Project Name: Creekside Park Mass Fill
Project No: HG05-20940

Boring No. B-2
Sample No. S-7
Sample Depth 13'-15'

e - Log(p) Curve



C_v - Log(p) Curve



HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS
ASTM D 2435

Project Name:	<u>Creekside Park Mass Fill</u>	Boring No.	<u>B-3</u>
Project No.	<u>HG-05-20940 (BG-2)</u>	Sample No.	<u>S-9</u>
		Sample Depth	<u>23'-25'</u>

Soil Properties

Initial Dry Unit Weight (pcf)	99.9
Final Dry Unit Weight (pcf)	97.9
Initial Void Ratio	0.699
Final Void Ratio	0.688
Initial Moisture Content (%)	25.7
Final Moisture Content (%)	28.1
Pre-Consolidation Pressure (tsf)	1.9
Over-Consolidation Ratio, OCR	1.6
Compression Index, Cc	0.149
Swell Index, Cs	0.077

Tested by:	<u>IG</u>	Date:	<u>1/24/2006</u>
Calculated by:	<u>SV</u>	Date:	<u>3/14/2006</u>
Checked by:	<u>FF</u>	Date:	<u>3/21/2006</u>

HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

Project Name:	Creekside Park Mass Fill	Boring No.	B-3
Project No.	HG-05-20940(BG-2)	Sample No.	S-9
Date Tested:	12/09/2005	Sample Depth	23'0"-25'0"
Technician:	IG	Date Calculated:	03/02/2006

Sample Data	Initial	Final	Test Data	Initial	Final
Sample Height (in)	0.750	0.745	Wet + Ring (g)	177.870	180.140
Diameter (in)	2.500	2.500	Dry + Ring (g)	153.622	153.620
Volume (cc)	60.330	59.928	Ring Wt. (g)	59.520	59.520
Height of Solids (in)	0.441	0.441	Moisture Data (Trimmings)		LL
Specific Gravity	2.650	2.650	Wet + Tare (g)	140.700	
Moisture Content (%)	25.768	28.183	Dry + Tare (g)	118.230	PI
Wet Density (pcf)	122.411	125.596	Tare (g)	31.030	
Dry Density (pcf)	97.331	97.982	Moisture Content (%)	25.768	
Void Ratio	0.699	0.688	Sample Description	Red and Gray Clay w/sand and Fe. nodules	
Percent Saturation	97.697	100.000			

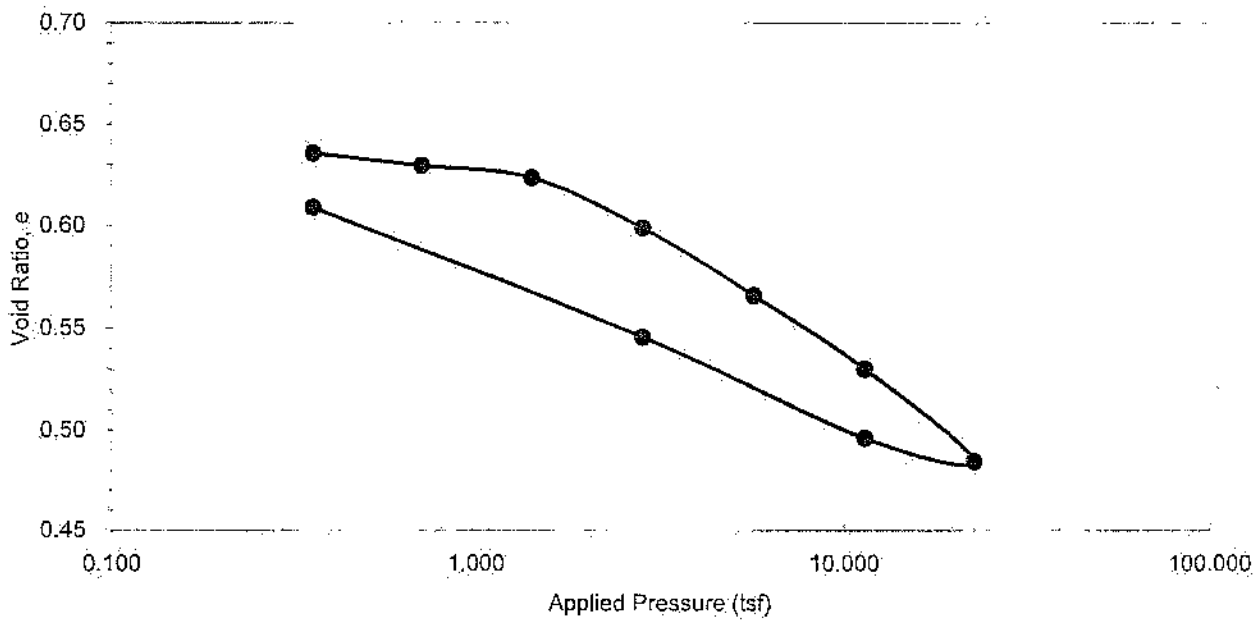
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HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

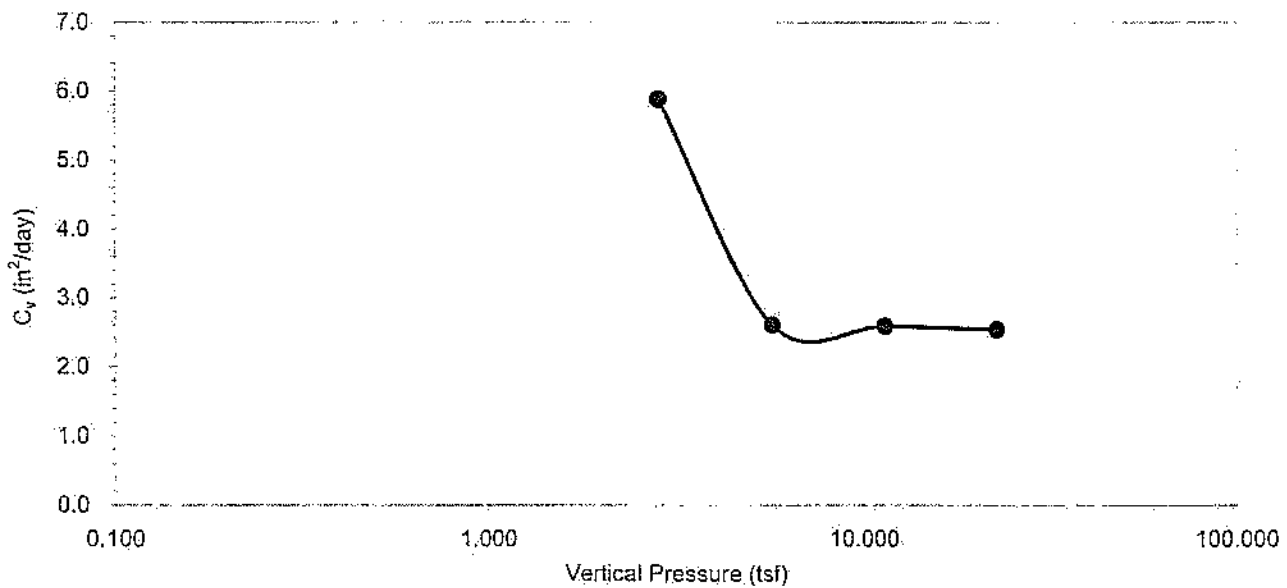
Project Name: Creekside Park Mass Fill
Project No. HG-05-20940(BG-2)

Boring No. B-3
Sample No. S-9
Sample Depth 23'0-25'0

e - Log(p) Curve



C_v - Log(p) Curve



HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS
ASTM D 2435

Project Name:	<u>Creekside Park Mass Fill</u>	Boring No.	<u>B-4</u>
Project No.	<u>HG-05-20940 (BG-2)</u>	Sample No.	<u>S-4</u>
		Sample Depth	<u>6'-8'</u>

Soil Properties

Initial Dry Unit Weight (pcf)	100.9
Final Dry Unit Weight (pcf)	105.3
Initial Void Ratio	0.637
Final Void Ratio	0.57
Initial Moisture Content (%)	18.1
Final Moisture Content (%)	21.4
Pre-Consolidation Pressure (tsf)	3
Over-Consolidation Ratio, OCR	7.1
Compression Index, C_c	0.166
Swell Index, C_s	0.011

Tested by:	<u>IG</u>	Date:	<u>1/24/2006</u>
Calculated by:	<u>SV</u>	Date:	<u>3/14/2006</u>
Checked by:	<u>EF</u>	Date:	<u>3/21/2006</u>

HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

Project Name:	Creekside Park Mass Fill	Boring No.	B-4
Project No.	HG05-20940	Sample No.	S-4
Date Tested:	12-27-05	Sample Depth	6.0'-8.0'
Technician:	IG	Date Calculated:	1-28-06

Sample Data	Initial	Final	Test Data	Initial	Final
Sample Height (in)	1.010	0.950	Wet + Ring (g)	698.240	699.470
Diameter (in)	2.500	2.500	Dry + Ring (g)	674.325	671.805
Volume (cc)	81.244	76.418	Ring Wt. (g)	542.830	542.830
Height of Solids (in)	0.617	0.605	Moisture Data (Trimmings)		LL
Specific Gravity	2.650	2.650	Wet + Tare (g)	138.910	
Moisture Content (%)	18.187	21.450	Dry + Tare (g)	122.120	PI
Wet Density (pcf)	119.363	127.907	Tare (g)	29.800	
Dry Density (pcf)	100.996	105.316	Moisture Content (%)	18.187	
Void Ratio	0.637	0.570	Sample Description	Red Sandy clay w/ lots of Ferrous nodules	
Percent Saturation	75.624	99.702			

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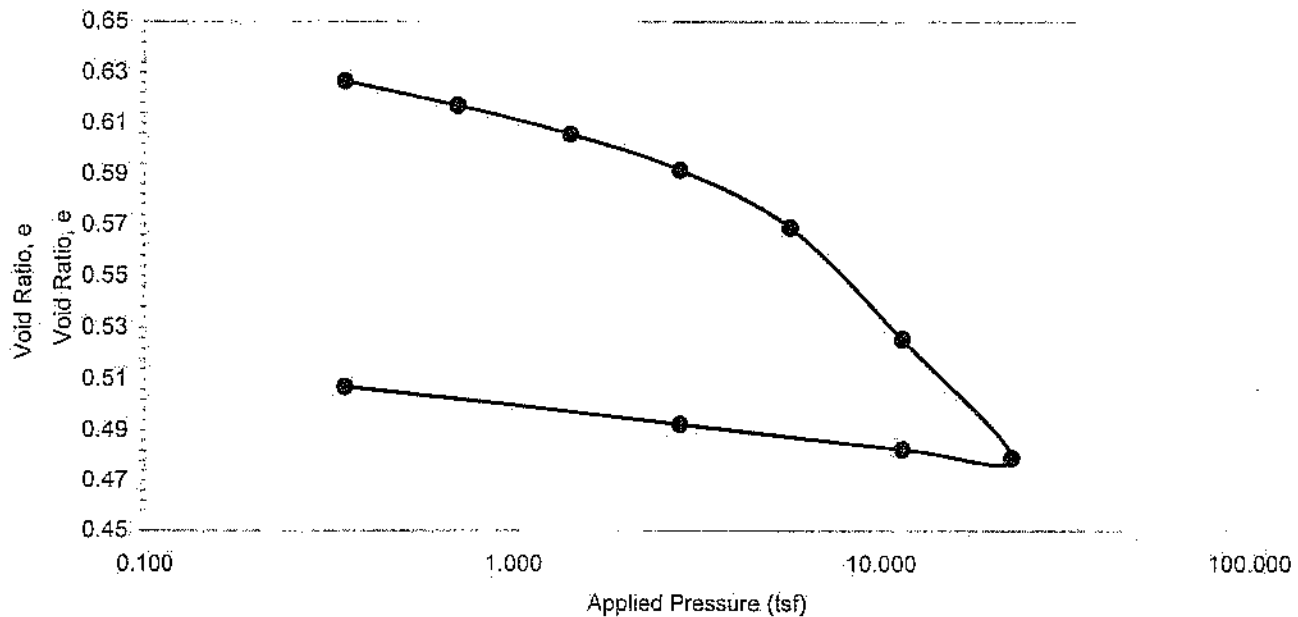
PLATE B-4-b

HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

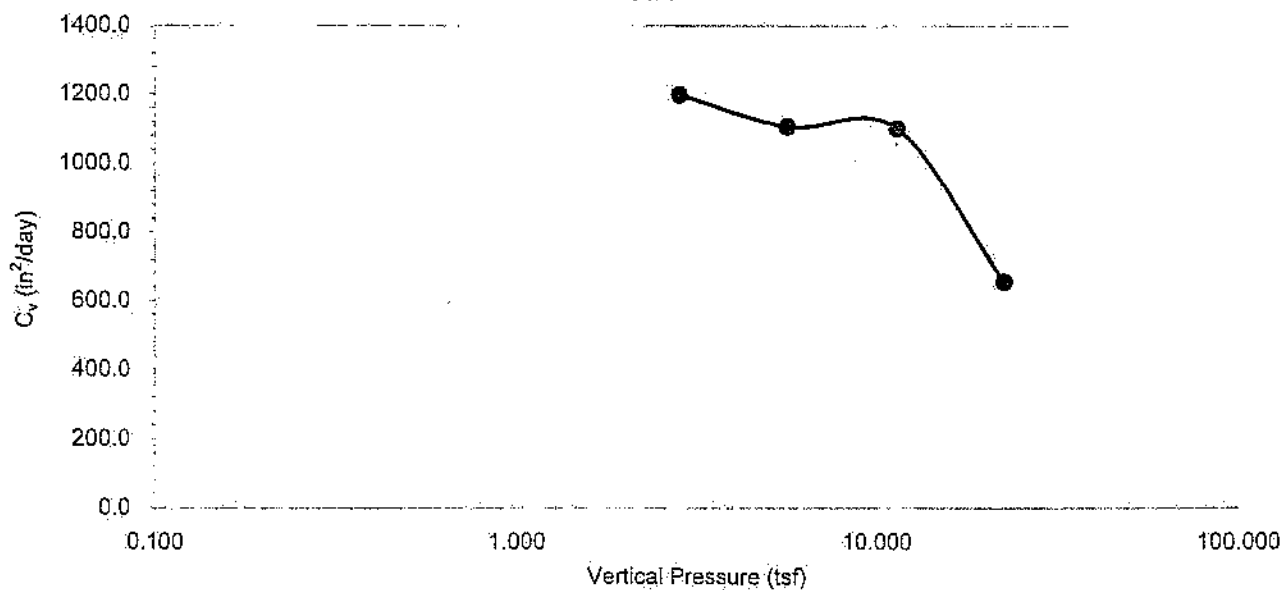
Project Name: Creekside Park Mass Fill
Project No.: HG05-20940

Boring No. B-4
Sample No. S-4
Sample Depth 6.0' - 8.0'

e - Log(p) Curve



Cv - Log(p) Curve



HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS
ASTM D 2435

Project Name:	<u>Creekside Park Mass Fill</u>	Boring No.	<u>B-6</u>
Project No.	<u>H0105-20040 (BG-2)</u>	Sample No.	<u>S-11</u>
		Sample Depth	<u>33'-35'</u>

Soil Properties

Initial Dry Unit Weight (pcf)	114.3
Final Dry Unit Weight (pcf)	114.8
Initial Void Ratio	0.446
Final Void Ratio	0.439
Initial Moisture Content (%)	15.1
Final Moisture Content (%)	16.1
Pre-Consolidation Pressure (tsf)	4.1
Over-Consolidation Ratio, OCR	2.5
Compression Index, C_c	0.099
Swell Index, C_s	0.022

Tested by:	<u>IG</u>	Date:	<u>1/24/2006</u>
Calculated by:	<u>SV</u>	Date:	<u>3/14/2006</u>
Checked by:	<u>FF</u>	Date:	<u>3/21/2006</u>

HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

Project Name:	Creekside Park Mass Fill	Boring No.	B-6
Project No.	HG05-20940	Sample No.	S-11
Date Tested:	12-28-06	Sample Depth	33-35
Technician:	IG	Date Calculated:	2-11-06

Sample Data	Initial	Final	Test Data	Initial	Final
Sample Height (in)	1.000	0.995	Wet + Ring (g)	713.440	714.860
Diameter (in)	2.500	2.500	Dry + Ring (g)	691.087	691.013
Volume (cc)	80.440	80.038	Ring Wt. (g)	543.680	543.640
Height of Solids (in)	0.692	0.691	Moisture Data (Trimmings)		LL
Specific Gravity	2.650	2.650	Wet + Tare (g)	110.790	
Moisture Content (%)	15.164	16.181	Dry + Tare (g)	100.180	PI
Wet Density (pcf)	131.689	133.489	Tare (g)	30.210	
Dry Density (pcf)	114.349	114.897	Moisture Content (%)	15.164	
Void Ratio	0.446	0.439	Sample Description		
Percent Saturation	90.080	97.632			

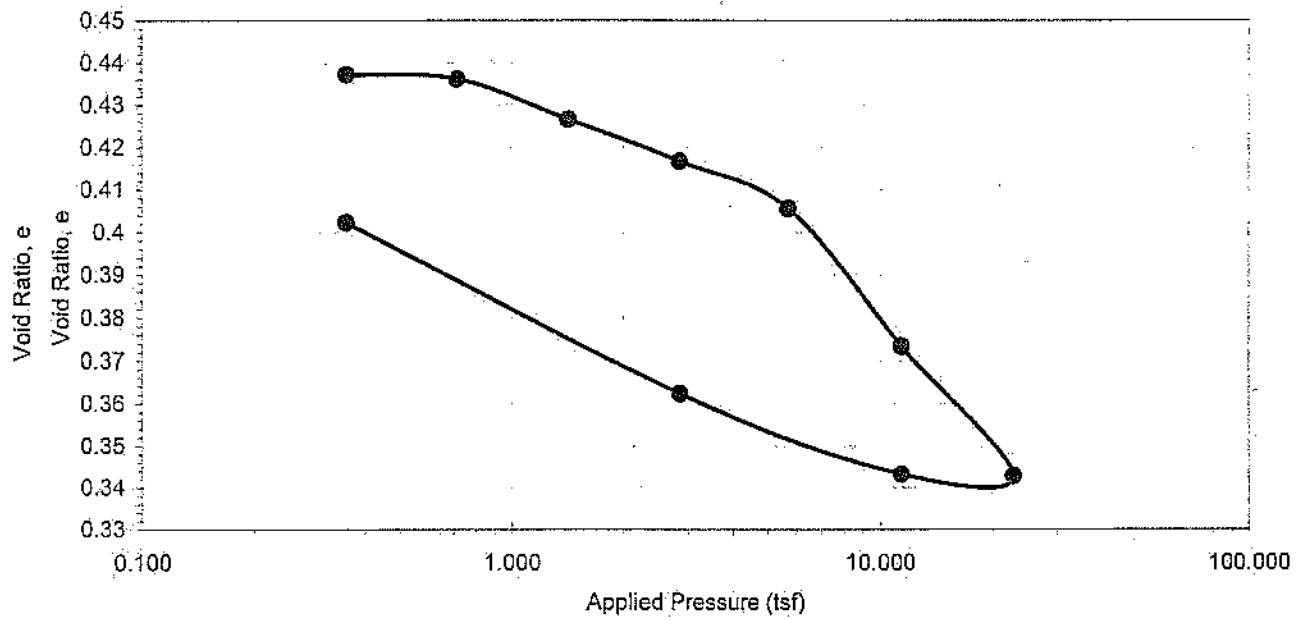
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HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

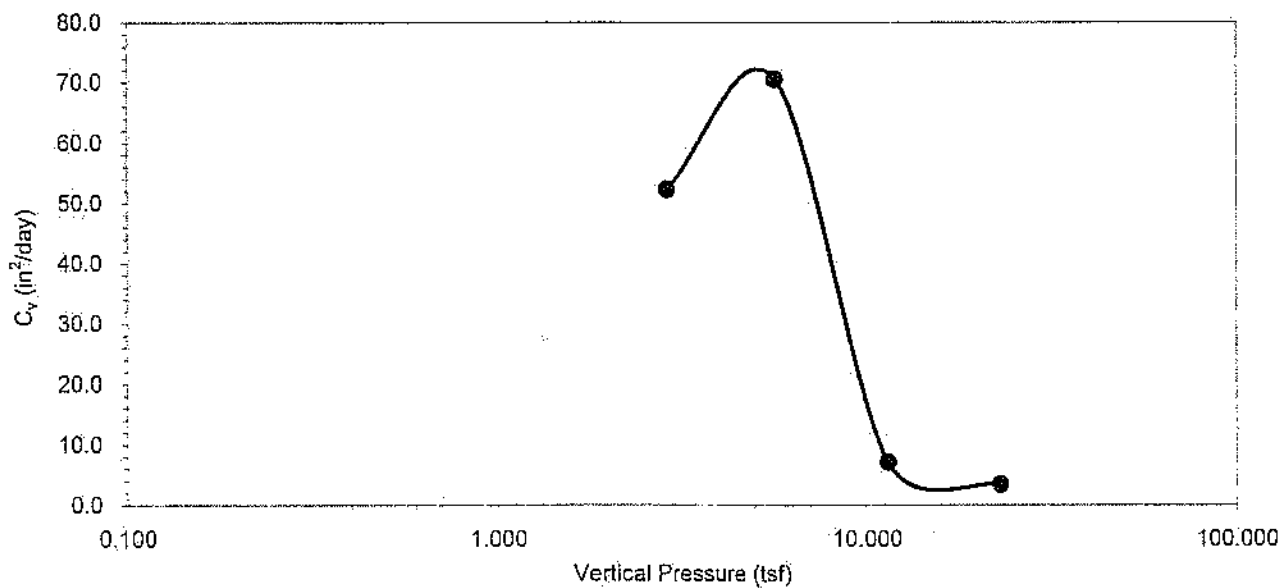
Project Name: Creekside Park Mass Fill
Project No. HG05-20940

Boring No. B-6
Sample No. S-11
Sample Depth 33-35

e - Log(p) Curve



Cv - Log(p) Curve



HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS
ASTM D 2435

Project Name:	<u>Creekside Park Mass Fill</u>	Boring No.	<u>B-7</u>
Project No.	<u>HG-05-20940 (BG-2)</u>	Sample No.	<u>S-9</u>
		Sample Depth	<u>23'-25'</u>

Soil Properties

Initial Dry Unit Weight (pcf)	97.7
Final Dry Unit Weight (pcf)	100.8
Initial Void Ratio	0.692
Final Void Ratio	0.64
Initial Moisture Content (%)	25
Final Moisture Content (%)	24.9
Pre-Consolidation Pressure (tsf)	2.6
Over-Consolidation Ratio, OCR	2.2
Compression Index, Cc	0.182
Swell Index, Cs	0.077

Tested by:	<u>IG</u>	Date:	<u>1/24/2006</u>
Calculated by:	<u>SV</u>	Date:	<u>3/14/2006</u>
Checked by:	<u>FF</u>	Date:	<u>3/21/2006</u>

Project Name:	Creekside Park Mass Fill	Boring No.	B-7
Project No.	HG-05-20940(BG-2)	Sample No.	S-9
Date Tested:	12/09/2005	Sample Depth	23'0-25'0
Technician:	IG	Date Calculated:	03-10-06

Sample Data	Initial	Final	Test Data	Initial	Final
Sample Height (in)	0.800	0.786	Wet + Ring (g)	149.030	150.020
Diameter (in)	1.972	1.972	Dry + Ring (g)	133.308	134.158
Volume (cc)	40.040	39.339	Ring Wt. (g)	70.600	70.600
Height of Solids (in)	0.473	0.479	Moisture Data (Trimmings)		LL
Specific Gravity	2.650	2.650	Wet + Tare (g)	119.870	
Moisture Content (%)	25.072	24.958	Dry + Tare (g)	101.820	PI
Wet Density (pcf)	122.228	125.976	Tare (g)	30.020	
Dry Density (pcf)	97.727	100.815	Moisture Content (%)	25.139	
Void Ratio	0.692	0.640	Sample Description	Gray & Red Clay	
Percent Saturation	96.002	100.000			

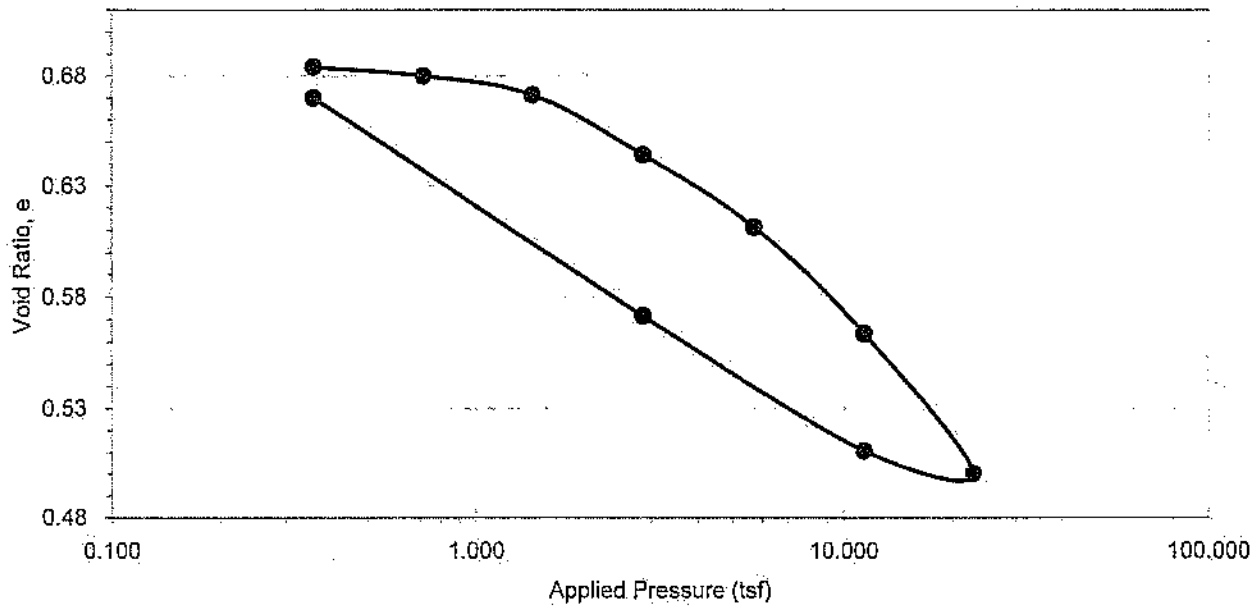
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HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

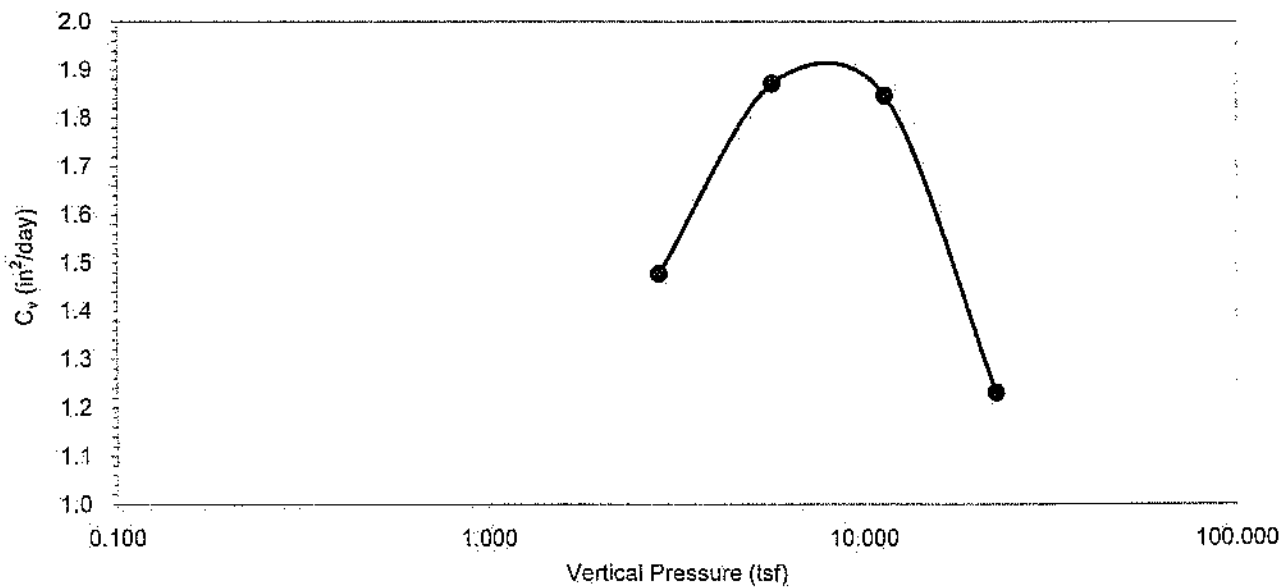
Project Name: Creekside Park Mass Fill
Project No. HG-05-20940(BG-2)

Boring No. B-7
Sample No. S-9
Sample Depth 23'0-25'0

e - Log(p) Curve



Cv - Log(p) Curve



HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS
ASTM D 2435

Project Name:	<u>Creekside Park Mass Fill</u>	Boring No.	<u>B-8</u>
Project No.	<u>HG-05-20940 (BG-2)</u>	Sample No.	<u>S-4</u>
		Sample Depth	<u>6'-8"</u>

Soil Properties

Initial Dry Unit Weight (pcf)	112.2
Final Dry Unit Weight (pcf)	114.7
Initial Void Ratio	0.474
Final Void Ratio	0.441
Initial Moisture Content (%)	14.8
Final Moisture Content (%)	16.2
Pre-Consolidation Pressure (tsf)	3.3
Over-Consolidation Ratio, OCR	6.8
Compression Index, Cc	0.099
Swell Index, Cs	0.015

Tested by:	<u>IG</u>	Date:	<u>1/24/2006</u>
Calculated by:	<u>SV</u>	Date:	<u>3/14/2006</u>
Checked by:	<u>FP</u>	Date:	<u>3/21/2006</u>

HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

Project Name:	Creekside Park Mass Fill	Boring No.:	B-8
Project No.:	HG05-20940	Sample No.:	S-4
Date Tested:	12-10-05	Sample Depth:	6.0'-8.0'
Technician:	IG	Date Calculated:	1-28-06

Sample Data	Initial	Final	Test Data	Initial	Final
Sample Height (in)	1.000	0.967	Wet + Ring (g)	708.820	708.980
Diameter (in)	2.500	2.500	Dry + Ring (g)	687.364	685.800
Volume (cc)	80.440	77.785	Ring Wt. (g)	542.720	542.720
Height of Solids (in)	0.679	0.671	Moisture Data (Trimming)		LL
Specific Gravity	2.650	2.650	Wet + Tare (g)	130.550	
Moisture Content (%)	14.834	16.201	Dry + Tare (g)	117.530	PI
Wet Density (pcf)	128.850	133.375	Tare (g)	29.760	
Dry Density (pcf)	112.205	114.780	Moisture Content (%)	14.834	
Void Ratio	0.474	0.441	Sample Description	Reddish brown Clay w/ Sand and Fe. nodules	
Percent Saturation	82.980	97.425			

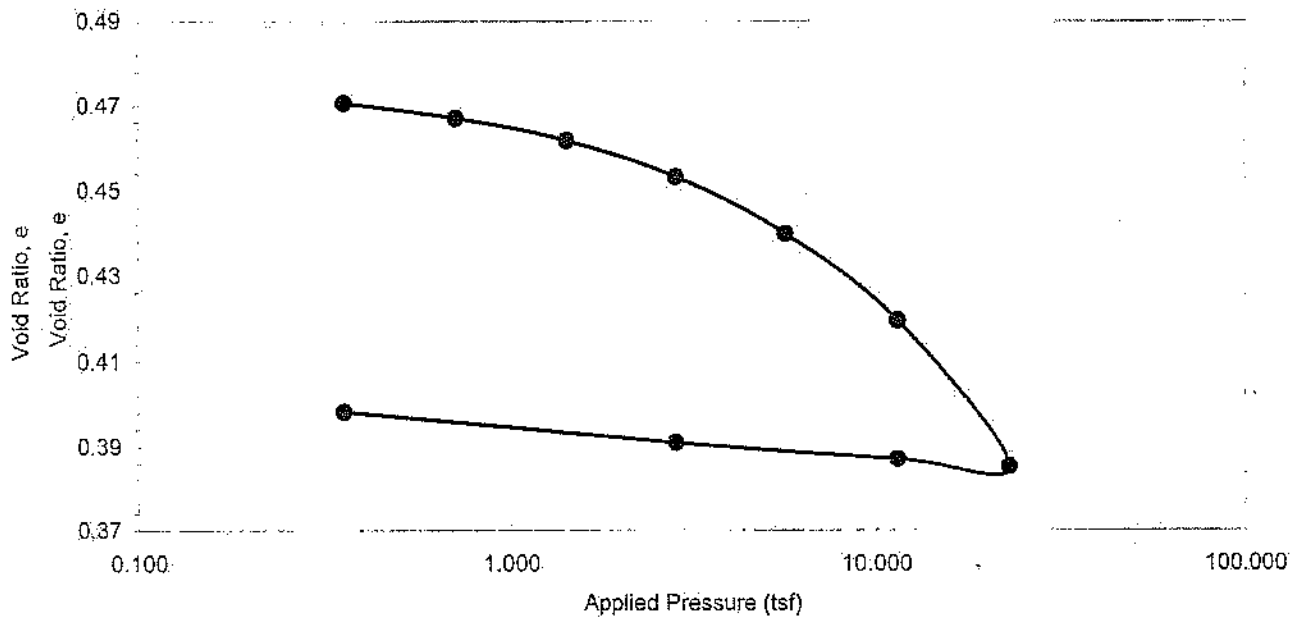
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HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

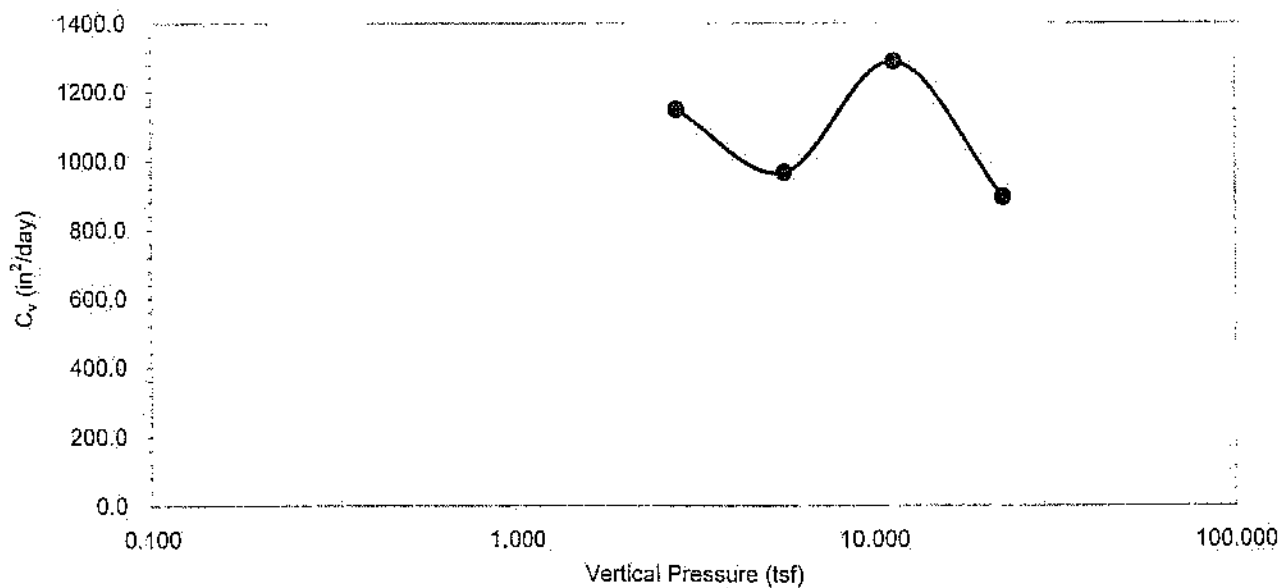
Project Name: Creekside Park Mass Fill
Project No.: HG05-20940

Boring No. B-8
Sample No. S-4
Sample Depth 6.0' - 8.0'

e - Log(p) Curve



Cv - Log(p) Curve



HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS
ASTM D 2435

Project Name:	<u>Creekside Park Mass Fill</u>	Boring No.	<u>B-10</u>
Project No.	<u>HG-05-20940 (HG-2)</u>	Sample No.	<u>S-5</u>
		Sample Depth	<u>8'-10'</u>

Soil Properties

Initial Dry Unit Weight (pcf)	102.8
Final Dry Unit Weight (pcf)	106
Initial Void Ratio	0.608
Final Void Ratio	0.559
Initial Moisture Content (%)	19.8
Final Moisture Content (%)	20.7
Pre-Consolidation Pressure (tsf)	2.6
Over-Consolidation Ratio, OCR	4.3
Compression Index, Cc	0.089
Swell Index, Cs	0.021

Tested by:	<u>IG</u>	Date:	<u>1/24/2006</u>
Calculated by:	<u>SV</u>	Date:	<u>3/14/2006</u>
Checked by:	<u>FF</u>	Date:	<u>3/21/2006</u>

HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

Project Name:	Creskide Park Mass Fill	Boring No:	B-10
Project No.	HG05-20940	Sample No.	S-5
Date Tested:	12-09-05	Sample Depth	8.0'-10.0'
Technician:	IG	Date Calculated:	1-28-06

Sample Data	Initial	Final	Test Data	Initial	Final
Sample Height (in)	0.759	0.737	Wet + Ring (g)	180.110	181.170
Diameter (in)	2.500	2.500	Dry + Ring (g)	160.164	160.300
Volume (cc)	61.054	59.284	Ring Wt. (g)	59.520	59.520
Height of Solids (in)	0.472	0.473	Moisture Data (Trimming)		LL
Specific Gravity	2.650	2.650	Wet + Tare (g)	109.120	
Moisture Content (%)	19.818	20.709	Dry + Tare (g)	96.070	PI
Wet Density (pcf)	123.249	128.044	Tare (g)	30.220	
Dry Density (pcf)	102.864	106.076	Moisture Content (%)	19.818	
Void Ratio	0.608	0.559	Sample Description	Gray & Red Clay w/ sand and ferrous nodules	
Percent Saturation	86.439	98.195			

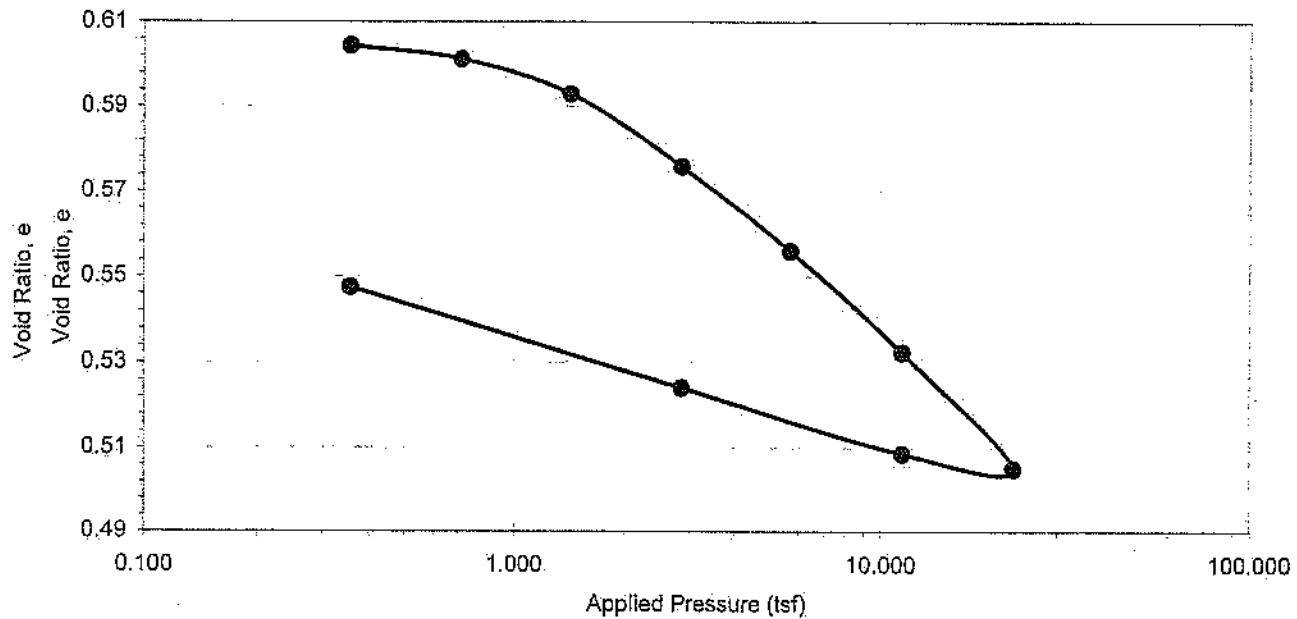
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HVJ ASSOCIATES, INC.
CONSOLIDATION TEST RESULTS

Project Name: Creekside Park Mass Fill
Project No. HG0520940

Boring No. BR10
Sample No. S-5
Sample Depth 8.0' - 10.0'

e - Log(p) Curve



Cv - Log(p) Curve

