REPORT OF

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING ANALYSIS

NORTH HILL PROPERTY MHP
ALEXANDRIA, FAIRFAX COUNTY, VIRGINIA

FOR

GREENHORNE & O'MARA, INC.

JANUARY 27, 2010

ECS LLC MID-ATLANTIC
ECS MID-ATLANTIC, LLC
"Setting the Standard for Service"
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January 27, 2010

Mr. Cody Smith, P.E.
Greenhorne & O'Mara, Inc.
3635 Concorde Parkway, Suite 300
Chantilly, Virginia 20151

ECS Job No. 14444

Reference: Report of Subsurface Exploration and Geotechnical Engineering Analysis
North Hill Property MHP
Alexandria, Fairfax County, Virginia

Dear Mr. Smith:

ECS Mid-Atlantic, LLC, is pleased to present this report for the above-referenced project. Our services were provided in accordance with our proposal (No. 29409, dated April 8, 2008 and revised April 14, 2008), which was authorized by Mr. Gatusso of G&O on April 28, 2009. Additional services were performed in accordance with a supplement request (No. 29409-Supp, dated June 16, 2009 and revised on July 7, 2009), which was authorized by Mr. Armstrong of FCH&RA via email on July 21, 2009.

This report includes a review of the proposed site development, a review of site and subsurface conditions, and our recommendations, including the design of stability-enhancing pile walls. The appendices include a boring location plan, pile wall profiles, test boring records, and the results of laboratory tests conducted.

Development of detailed project-specific specifications for construction of stability-enhancing pile walls is not included in our scope of services. We have included basic specifications to be considered by the G&O's or the County's construction engineers and contract managers.

It is noted that Fairfax County requires that all earthwork, grading, and pile and foundation installations be observed by the Geotechnical Engineer of Record on a full-time basis for sites having problem soils, such as this site. Based on our familiarity with the site and the intent of the design, we recommend that ECS be retained to provide these services.

If you have any questions with regard to the information and recommendations contained in this report, or if we may be of further service to you during the planning and/or construction phases of this project, please do not hesitate to contact the undersigned.

Respectfully,
ECS MID-ATLANTIC, LLC

Margaret E. Tomeo, E.I.T.
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REPORT

PROJECT

Subsurface Exploration and
Geotechnical Engineering Analysis
North Hill Property MHP
Alexandria, Fairfax County, Virginia

CLIENT

Greenhorne & O'Mara, Inc.
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PROJECT OVERVIEW

Introduction

This report presents the results of our subsurface explorations and geotechnical engineering analysis for the proposed North Hill Property Mobile Home Park in Fairfax County, Virginia.

In preparing this report, we have utilized information from our current and previous subsurface explorations. We have reviewed the proposed site plans, existing topographic information, and the previous preliminary report of subsurface exploration prepared by Law Engineering Associates of Virginia, dated September 9, 1981. We have previously transmitted a preliminary review of our initial exploration findings in the letter dated May 6, 2009.

The project will consist of the development of the 34-acre North Hill Property located in Hybla Valley along U.S. Route 1 in Fairfax County, Virginia. The Fairfax County Redevelopment and Housing Authority plans to develop the site with an approximately 11-acre mobile home park (R-MHP) that will be located in the southeast quadrant of the site. The remainder of the site will be converted to a park.

Based upon our review of the site plans, it appears that varying amounts of cutting and filling will be required to establish the design elevations shown on the grading plans for the final design option chosen. In general, the cuts and fills will be nominal, about 6.0 feet ±, throughout the proposed development, except in the north area of the site. In this area 4(H) to 1(V) continuous cut slope will extend up to match existing grades.

Concrete pads will be constructed at finished grade levels for the mobile homes. Site development will include 24-foot wide roadways, utilities, and stormwater drainage systems.

In the park preserve area only minor structures, such as benches and picnic tables, are planned. No grading is planned but some brush removal will be required for foot trails.

This description of the proposed project is based on information provided to us by members of the design team. If any of this information is inaccurate or the design concept has changed, we recommend that we be contacted in order to provide additional or alternate recommendations that might be warranted.

We reviewed the aforementioned Law Engineering Associates of Virginia (LEA) information, and based on that review we advised G&O, in June of 2008, that the best area from a stability and earthwork standpoint to expand the mobile home park would be the southeast corner of the site. Further use of the LEA report was not relied upon for developing our recommendations as the borings were too shallow, and we were not able to develop any consistent subsurface profiles.

Site Location and Description

The North Hill Property is located along the east side of Richmond Highway (Route 1) in Alexandria, Fairfax County, Virginia. The 34-acre tract consists of the portions of the property directly to the north of Dart Drive and includes Poinsettia and Mums Drives. A Vicinity Map, which is presented on the Boring Location Diagram included in Appendix A of this report, shows the general location of this project.

The North Hill Property is bordered by residential housing developments to the east, west, and south, and the St. Louis School to the north. The southern area of the site is presently accessible by Dart Drive that connects to Richmond Highway.

The southeastern 11 acres of the North Hill property is currently zoned R-MHP for development as a mobile home park. The remainder of the site is lightly wooded with mostly deciduous trees of varying maturity and light underbrush. The northern 23 acres of the site was previously occupied by mobile homes. The homes were removed at a date not known to us. Since that time, the site has begun to revegetate naturally. The locations of the previous streets still remain discernable.

The property slopes significantly downward from the north to the south. Current site grades range from a high of approximately EL. +186 feet along the northernmost boundary, to a low of approximately EL. +80 feet throughout the southern portion of the proposed development where the mobile home pads are planned.

Evidence of on-going landslide activity was not observed at the time of our site visits. However, it is believed that the steep area located to the north of the planned expansion area represents an old scarp. See the Regional Geology review for additional details.

Purpose and Scope of Work

The purpose of this exploration was to explore the subsurface conditions at the site and to develop engineering recommendations to guide the design and construction of the project. We accomplished these purposes by performing the following scope of services:

1. Reviewing the geologic data and geotechnical reports prepared for nearby project sites by ECS, in addition to the preliminary report of subsurface exploration prepared by LEA (dated September 9, 1981)

2. Drilling additional borings

3. Performing laboratory tests on selected representative soil samples from the borings to evaluate pertinent engineering properties

4. Analyzing the field and laboratory data, from the subsurface exploration, to develop appropriate engineering recommendations

5. Preparing this geotechnical report of our findings and recommendations.

The conclusions and recommendations presented in this report are based on a total of sixty-two soil borings conducted at the site. Borings PB-1 through PB-5 were performed by LEA and were extended to a depth of 4.5 feet. Borings A-1 to A-11 and A-13 to A-40 were additionally performed by LEA in 1981 and were extended to depths ranging from 16 feet to 36.5 feet, or an elevation range of EL. +146.5 feet to EL. +40 feet. As noted previously, the recommendations and pile wall design are based on the borings performed by ECS.

The initial subsurface exploration conducted by ECS consisted of Borings ECS-1 through ECS-12. These borings were extended to depths of approximately 30 feet, 45 feet, and 60 feet, or elevations ranging from EL. +123 feet to EL. +55 feet. The supplemental subsurface exploration conducted by ECS in July 2009 consisted of Borings C-1 through C-4. These borings were extended to depths of approximately 60 feet, or elevations ranging from EL. +94 feet to EL. +41 feet. Additional supplemental borings D-1 and D-2 were conducted by ECS in September 2009. These borings were extended to depths of approximately 60 feet, or elevations of EL. +70 feet and EL. +82 feet, respectively. The subsurface explorations included split-spoon soil sampling, performing standard penetration tests (SPT) and groundwater level observations in the boreholes. Observation wells were established in seven borings.

A Boring Location Diagram and the test boring records are included in Appendix A. The Boring Location Diagram was developed from the site plan provided by your office. The elevations noted on the boring logs were interpolated from the site plan, which provided gradient contours at 2-foot intervals.

The number and general locations of the borings performed for the subsurface explorations were selected by ECS and located in the field for drilling purposes by representatives of ECS with the use of our Global Positioning System (GPS). The GPS layout was based on the boundary and topographic survey included on the site plans provided by the design team. The GPS unit for the boring layout is certified to sub-meter accuracy. Therefore, the boring locations in the field are considered to be accurate within approximately 3 feet of the locations shown on the Boring Location Diagram.

The assessment of the site for the presence of contaminants or other pollutants in the soil, groundwater, or bedrock is beyond the scope of our services.

Specifications for installation of pile walls have been prepared and have been submitted under separate cover. The specifications are to be used as a guide for preparing the contract documents.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

A total of six soil borings, referenced as C-1 through C-4, and D-1 and D-2, were drilled by ECS at the project site for the most recent explorations performed in July 2009 and September 2009. These borings were extended to depths on the order of 60 feet below the existing ground surface. A total of twelve soil borings, referenced as ECS-1 through ECS-12, were drilled by ECS at the project site for the previous exploration performed in March 2009. These borings were extended to depths on the order of 30 feet to 60 feet below the existing ground surface. After completion, each boring was backfilled with the auger spoils from each location.

Representative soil samples were obtained by means of the split-barrel sampling procedure in general accordance with ASTM Specification D-1586. Relatively undisturbed samples of the underlying cretaceous clays were obtained by pushing 3-inch (nominal) diameter Shelby tubes in general accordance with ASTM Specification D-1587. The undisturbed samples were obtained from Borings ECS-1 and ECS-5 for laboratory testing and use in the slope stability evaluation.

Field logs of the soils encountered in the borings were maintained by the drill crew. After recovery, each sample was removed from the sampler and visually. Representative portions of each sample were then sealed and brought to our laboratory in Chantilly, Virginia for further visual examination by a geotechnical engineer and laboratory testing.

Laboratory Testing Program

The laboratory testing program included visual classifications, moisture content, grain size analyses, direct shear tests, Proctor tests, California Bearing Ratio (CBR) testing, and Atterberg Limits tests. The laboratory test reports are included in Appendix C of this report.

To address long-term slope stability concerns, two drained, direct-shear tests were conducted in general accordance with EM 1110-2-1906 specifications on samples of over-consolidated cretaceous clay. The engineering strength parameters measured by the direct shear tests include both peak and residual strengths. The samples were pre-cut prior to testing. Utilizing residual strength parameters for cretaceous clays is the typical approach to long-term slope stability evaluations in the vicinity of the project site and the Washington Metro Area. However, it is also common to consider the strength of deep, intact cretaceous clay to be in the fully softened state, which is an intermediate strength. It is noted that our analyses only considered the residual strength values.

A geotechnical engineer classified each soil sample on the basis of texture and plasticity in accordance with the Unified Soil Classification System. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. A brief explanation of the Unified Soil Classification System is included in Appendix B with this report. The stratification lines designating the interfaces between earth materials on the boring logs and profiles are approximate as the transitions may be gradual rather than distinct.

EXPLORATION RESULTS

Regional Geology

The proposed project site is geologically located within the Atlantic Coastal Plain Physiographic Province of Northern Virginia. This Coastal Plain Province is characterized by a series of south-easterly dipping layers of relatively consolidated sandy clay deposits, with lesser amounts of gravel. These Coastal Plain deposits are estimated to be approximately 250 feet thick and are underlain by the eastward continuation of the crystalline rock of the Piedmont Physiographic Province.

In general, the higher elevations of the site area have few remnants of the Quaternary Age River Terrace deposits. The Quaternary Age Deposits are typically underlain by the Potomac Group sediments of the older Cretaceous Age. The Cretaceous Age Potomac Group deposits generally consist of interbedded, discontinuous sand and clay layers that generally slope to the southeast at roughly 50 to 80 feet per mile or approximately 0.5 to 0.8 degrees. The sand layers generally consist of fine to medium sand with variable amounts of clay and silt. In isolated areas, gravel can also be encountered. The occurrences of the sand layers are discontinuous, both laterally and vertically.

The clay layers of the Potomac Group are commonly referred to as “marine clay”, although it is generally believed that they were deposited in a deltaic environment. These very stiff to hard clays are often moderately to highly over-consolidated and have a blocky structure. The clays vary in their composition and shear strength parameters. Fissures and slickensided surfaces can be present within these clays although they were not observed in the samples collected. In their natural state, these clays exhibit considerable strength, but after removal of overburden by erosion or grading, a significant reduction in shear strength occurs. This strength loss is attributed to creep and opening of fissures, allowing water movement along the openings which leads to a lower effective strength. The residual shear strength of the clays is generally used in stability analyses to model conditions of reduced shear strength due to large, long-term movements of slopes. These "marine clays" are highly plastic and have a high shrink/swell potential, due to the presence of montmorillonite as their predominant clay mineral. "Marine clays" are typically located in continuous layers in a lateral direction of considerable distance, although, in some cases, they may form isolated clay pockets, grade into sand, or pinch out.

There is enough evidence to suggest that the steep areas of the site represent scarps that are the result of previous landslide activity. On old map notes that a former street located at the base on one of the scarps is referred to as “Slide Lane”. The soils in the lower part of the site do not have distinct, continuous strata. We believe that is because the upper soils in the lower part of the site represent old colluvium.

Soil Conditions

The description of the soil conditions encountered at the site is based on the test borings performed by ECS, designated as ECS-1 through ECS-12, C-1 through C-4, D-1 and D-2.

Beneath the surficial layers of topsoil, asphalt, and gravel, interbedded sands and clays were encountered down to the boring termination depths. These strata are described in the subsequent text. In general, the subsurface conditions encountered within our maximum boring depths consisted of loose to very dense silty, clayey, and clean SAND (SM, SC, SP) and stiff to very hard CLAYS (CL, CH). The terrace deposits overlie the clays of the Cretaceous-Aged

Potomac Formation, except where they have been eroded away. For detailed information at specific boring locations, please refer to the boring logs provided in Appendix B of this report.

Stratum I-Terrace Soils (SC, SM, SP)

Beneath the surficial layers, Coastal Plain soils were encountered in the majority of the borings and generally can be described as clayey, silty, or poorly-graded clean SAND (SC, SM, SP) with scattered quartz gravels. SPT resistances ranged from 7 to 78 blows per foot (bpf), which corresponds to a relative density of loose to very dense.

Stratum II- Potomac Group (CL, CH)

Below the topsoil and/or the surficial SAND strata, the Potomac Group soils generally consisted of CLAY (CL, CH) with varying sand content. SPT resistances ranged from 13 to 50 blows per 5 inches of sampler penetration, which corresponds to a consistency of stiff to very hard. CLAY (CH), which is highly plastic and also referred to as marine clay, was encountered in the majority of the borings performed for past and current explorations. A distinct layer of marine clay, about 15 feet thick, parallels the ground surface in the section located just above the proposed MHP expansion. Marine clay is also interbedded in distinct layers at lower depths within Stratum III sands.

Although significant amounts of marine clay were not encountered in the borings located within the general area of the planned area of MHP expansion, the LEA borings indicate the presence of scattered colluvival remnants of such clays.

Laboratory tests on selected clay samples from this stratum indicated liquid limits (LL) between 28 and 65 percent and plastic limits (PL) ranging from 14 to 24, indicating low to highly plastic material. Marine clays were encountered and confirmed in the most recent supplemental borings performed at the site (borings D-1 and D-2 located along the western half of the proposed upper retaining wall).

Stratum III-Potomac Group Sands (SC, SM)

The natural soils encountered below Stratum II to the boring termination depths generally consisted of clayey or silty SAND (SC, SM). SPT resistances ranged from 44 to 50 blows per 5 inches of sampler penetration, which corresponds to dense to very dense relative densities. Auger refusal was not encountered within the depths of exploration in any of the borings.

Groundwater Observations

Observations for groundwater were made by the drilling crews during sampling and upon completion of drilling operations at each ECS boring location. The groundwater elevations appeared to follow the sloping topography across the site. The groundwater surface appears to represent a perched water table that exists in the Stratum III sand situated between the upper and lower marine clay layers. In the lower elevations of the site, the groundwater levels vary from shallow to not encountered.

The table shown below indicates the approximate depths at which the groundwater was observed at each boring location throughout our current and previous explorations.

Table 1: Summary of Current Groundwater Conditions Encountered

Boring Number	**Depth of Groundwater Below Ground Surface, feet (Elevation)**			
	[1]WD	**[2]BCR**	**[3]CI**	**Stabilized Reading (Observation Well)**
ECS-1	Dry	---	48.3 (EL. 132.7)	---
ECS-2	41.0 (EL. 141.0)	---	43.1 (EL. 138.9)	21.8 (EL. 160.2)
ECS-3	35.2 (EL. 147.8)	---	32.8 (EL. 150.2)	---
ECS-4	33.0 (EL. 127.0)	---	---	---
ECS-5	---	---	---	---
ECS-6	18.0 (EL. 108.0)	17.5 (EL. 108.5)	20.4 (EL. 105.6)	---
ECS-7	18.0 (EL. 103.0)	14.6 (EL. 106.4)	19.3 (EL. 101.7)	---
ECS-8	8.9 (EL. 112.1)	---	14.2 (EL. 106.8)	---
ECS-9	20.0 (EL. 68.0)	23.6 (EL. 64.4)	26.0 (EL. 62.0)	---
ECS-10	Dry	---	26.5 (EL. 63.5)	---
ECS-11	11.0 (EL. 74.0)	9.8 (EL. 75.2)	13.7 (EL. 71.3)	---
ECS-12	Dry	---	27.8 (EL. 73.2)	---
C-1	28.5 (EL. 72.5)	22.8 (EL. 78.2)	---	---
C-2	23.5 (EL. 118.5)	22.6 (EL. 119.4)	---	---
C-3	41.5 (EL. 112.5)	39.0 (EL. 115.0)	---	41.5 (EL. 112.5)
C-4	6.5 (EL. 135.5)	19.0 (EL. 123.0)	---	17.4 (EL. 124.6)
D-1	19.0 (EL.111.0)	31.5 (EL. 98.5)	37.5 (EL. 92.5)	---
D-2	15.0 (El. 127.0)	27.0 (EL. 115.0)	30.4 (111.6)	---

[1]WD – While Drilling [2]BCR – Before Casing (or Auger) Removal [3]CI – Cave In Depth

The highest groundwater observations are normally encountered in late winter and early spring and our current groundwater observations are not expected to be at the seasonal maximum water table. Variations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration.

ANALYSIS AND RECOMMENDATIONS

The planned development, consisting of the proposed mobile home park redevelopment and single-family housing, is technically feasible from a geotechnical perspective. The conclusions and recommendations presented in this report should be incorporated in the design and construction of the project to minimize possible soil and/or foundation related problems. The primary factor from a geotechnical perspective that will affect the proposed development will be slope stability issues typically associated with the underlying marine clays that exist at the site.

The marine clay soils found in the majority of the borings during the previous and current subsurface explorations are known to be a major concern with regard to slope stability. Upon review of the site plans for the proposed development, it appears that there are planned 4(H) to 1(V) cut slopes in the north part of the MHP expansion area. Also, there are local slightly steeper existing slopes in the same area. The slope stability analyses performed for the current exploration are discussed in the following sections.

It is noted that there are several large trees located throughout the proposed area to be developed. It is suggested that if the cut or fill grading requirements in the vicinity of the trees is nominal, grading changes be considered such that these trees can be saved.

Slope Stability Analyses and Considerations

Due to the planned modification of the existing site grades, including cuts, and because of the problematic nature and stability of the underlying clay soils, evaluation of the proposed grading plan is essential. For this purpose, we performed analyses of the most critical slope configurations at the site, Sections C-C, D-D, and F-F as noted on the Boring Location diagram. Due to the direction of the ground contours, landslide activity outside the area considered by the section lines noted above should not affect the areas of the proposed MHP expansion. Therefore, this report does not address these areas.

It is noted that limited development is planned for the site outside the expanded mobile home park area. The limited development will include the construction or placement of foot trails, picnic tables, etc. If construction of large structures or grading is planned, it could affect the stability of the entire park area. Therefore, if such development is planned, a project-specific geotechnical investigation and evaluation is required to develop appropriate recommendations. To the extent possible the remainder of the site should be left in its vegetated state. Ponding of water or altering the natural surface water flow is to be avoided.

Procedure and Design

The analysis of the representative subsurface profiles selected is based on assigning appropriate engineering parameters to the subsurface strata identified. Marine clay unit weights and residual strengths were assigned based on the results of direct shear testing. The strength values and unit weights of other strata were assigned on the basis of VDOT's Geotechnical Design Criteria for Coastal Plain soils. Substrata values were determined on the basis of N_{60} values. These values are known to be more conservative than other correlations to N_{60} values. Table D-1 in the Appendix D summarizes the strength values used in our analyses.

The results of the direct shear tests can be found in Appendix C and in table 2 on the following page.

Table 2: Summary of Direct Shear Test Results

Boring	Depth, feet	Liquid Limit LL, %	Plasticity Index PI	$\Phi_{residual}$, degrees
ECS-1	11.0 to 13.0	60	32	10.0
ECS-5	15.0 to 17.0	66	38	9.4

Slope Stability Analysis

The slope stability analyses were performed using a two-dimensional computerized slope stability method based on a limit equilibrium analysis. The GSTABL7 computer program was utilized to perform these computations. The factor of safety against slope instability computed by the program is defined as the ratio of the sum of the moments (or forces) resisting failure divided by the sum of the moments (or forces) causing failure along a specified potential failure surface. Because of the margin of uncertainty regarding soil parameters in-situ, and the lower-limit values assumed for the soil parameters, a factor of safety of 1.3 is considered to be the minimum adequate factor of safety for planned slope design, not considering seismic loading conditions. When considering seismic loading conditions, the minimum suggested factor of safety is 1.1.

The GSTABL7 program utilized the Simplified Bishop Method of slices to compute the factors of safety for circular and block potential failure surfaces. During this analysis, numerous conditions and potential failure surfaces were analyzed.

Slope cross sections (C-C through F-F), which are shown on the Boring Location Diagram, were analyzed. These cross-sections were identified by ECS as representative, post-construction design slopes. Estimated subsurface profiles representing these cross sections are included in Appendix A. A review of the analyses performed is presented in Table 3 on the following page.

Regardless of the thoroughness of a geotechnical investigation, there is a risk that subsurface conditions might be different at locations between borings. There is also the possibility that extreme rainfall or future site development could affect the stability of the site. Recognizing this, our recommendations and analyses have been conservative.

Table 3: Slope Stability Analysis Results

Analysis No.	Slope Section	Pile Wall	Analysis Location	Analysis Type	Factor of Safety
1	Section C-C’	No Pile Wall	Lower Slope	Circular	3.22
2	Section C-C’	No Pile Wall	Oveall Slope	Circular	2.45
3	Section C-C’	No Pile Wall	Upper Slope	Block	1.75
4	Section D-D’	No Pile Walls	Middle to Upper Slope	Circular	3.62
5	Section D-D’	No Pile Walls	Overall Slope	Block	3.17
6	Section D-D’	No Pile Walls	Overall Slope	Circular	3.67
7	Section D-D’	No Pile Walls	Lower to Middle Slope	Circular	2.94
8	Section D-D’	No Pile Walls	Lower Slope	Block	3.12
9	Section D-D’	No Pile Wall	Lower Slope High WT	Block	2.27
10	Section D-D’	No longer used.			
11	Section F-F′	No Pile Walls	Overall Slope	Circular	2.02
12	Section F-F′	No Pile Walls	Upper Slope	Block	1.89
13	Section F-F′	No Pile Walls	Middle Slope	Block	1.26
14	Section F-F′	No Pile Walls	Lower to Middle Slope	Circular	1.12
15	Section F-F′	No Pile Walls	Lower Slope	Block	1.01
16	Section F-F′	With Upper Pile Wall	Below Pile Wall	Circular	1.92
17	Section F-F′	With Upper Pile Wall	Above Pile Wall	Block	1.44
18	Section F-F′	With Upper Pile Wall	Through Pile Wall	Circular	1.30
19	Section F-F′	With Upper Pile Wall	Below Pile Wall	Block	1.03
20	Section F-F′	With Lower Pile Wall	Through Pile Wall	Block	1.29
21	Section F-F′	With Lower Pile Wall	Through Pile Wall	Circular	1.33

It is noted that the final wall locations have changed very slightly since the above analyses have been performed. The wall locations were changed to accommodate a few of the larger existing trees. Since the changes in wall locations were minor, no further reanalysis is considered to be necessary. The wall plan and profile locations included in the Appendix represent the final wall locations.

Pile Wall Recommendations

Section F-F’ requires a pile wall to be placed near the +138-foot contour. This will reduce the potential of failure of the upper slope. If the pile wall is placed at a lower elevation, there is potential for the upper slope to fail and slide over the wall. Due to the relatively thick stratum of marine clay that appears to be present at this section, a second lower wall is required to stabilize the slope below the upper pile wall.

Based on the initial borings, it appears that a thin stratum of marine clay is present in the planned cut slope in Section D-D'. However, subsequent drilling of Borings D-2 indicates no marine clay in the vicinity of this boring. Since the stratum is thin, analyses of several areas within this section indicate that it is stable. If we were to consider that seasonal wet weather could cause a perched water table to develop above our originally estimated marine clay layer, the stability in the cut area is indicated to be marginal. Therefore, we previously recommended continuing the upper pile wall through this section. Based on our final analyses, the stability of the slope represented by cross section D-D appears to have adequate factors of safety. Nevertheless, the removal of the toe for the grading plan causes us some concern as marine clay layers could be intermittent and it is believed that this area might be an old scarp remnant. Therefore, we recommend that the wall continue west to Line C-C.

The profile for Section C-C' indicates that the marine clay stratum pinches out just above the top of the cut slope. The analyses performed of various sections along this section indicate that it is stable. Based on the boring information, the upper wall can end at this point.

The design of the upper pile wall was based on the analysis of Section F-F', which is considered to be the most critical case as the marine clay is about 19.0 feet thick in this section. Based on GSTABL analyses, the piles spaced on 6-foot centers require a force of 15 kips to improve the factor of safety to 1.3 or better. To determine the maximum bending moment on the piles, two methods of analysis were employed. First, we considered that all ground above the slide plane was 'removed' and the 15-kip load was applied as distributed load above the slide plane. The pile was then analyzed for maximum moment using LPILE. The corresponding required section modulus would be 42 in^3. Second, the pile was analyzed using Rankine earth pressures assuming that half of the material above the slide plane could be 'removed' by slumping below the pile wall. The corresponding required section modulus would be 135 in^3. Both cases are a bit conservative. The first one requires a low section modulus for bending, but does require a higher modulus (≈135 in^3) to limit deflection. We selected an HP 14 x 89 pile (S_x = 131 in^3). Based on working stress design, this pile will have a FS of about 1.5. It is our experience that sufficient soil arching will prevent squeeze through the pile if the spacing is limited to 6.0-foot centers. The above analyses also indicate that the recommended embedment depths exceed the depths required for pile fixity. A similar approach was used for the lower pile wall and an HP 14 x 73 pile is required. It is noted that a section modulus considerably less than that of an HP 14 x 73 is required, but this pile was selected because of its flange width.

The Boring Location Diagram in Appendix A includes the location of the pile walls. All geometric data required for layout is presented on this drawing. A separate drawing included in Appendix A includes the pile wall profiles. The results of our stability analyses and pile wall calculations are presented in Appendix D.

The piles may be driven or installed in pre-bored holes. Driving piles will be quicker and require less equipment than pre-boring, although there will be the noise nuisance factor. Also, it is not necessary to terminate piles in 'refusal' materials, so driving will be relatively easy. If the piles are pre-bored, they must be centered and held in place until the grout sets. Grout should have a compressive strength of 2,500 psi. The grout should completely fill the annular spaces.

The piles should be installed and the site restored prior to cutting the slope for the planned MHP expansion. It is recognized that it will be necessary to cut benches across the hillside to install the pile walls. The benches should be as small as practical. Deep cuts or placement of large fills must be avoided. Localized sheeting and shoring should be employed if cuts are greater than 6 feet. Immediately after the piles are installed, the site should be restored to its natural grade, seeded, and covered with erosion protection mats.

It is recommended that cutting benches should only occur after and during a period of dry weather conditions. Constructing temporary excavations with saturated ground conditions increases the risk of ground instability.

Site Drainage

To help promote slope stability, surface water run-off should not be concentrated or directed to cut and fill slope faces. All slopes should be seeded and covered with erosion protection mats, such as VDOT Type EC-2, immediately after grading. Roof downspouts should be connected to the site stormwater collection system.

Underdrains, VDOT Type UD-1, should be placed along the high side of upper loop roadway. Additionally, underdrains, VDOT Type UD-7, should be placed along the low side of this roadway and the other roadways to be constructed.

Sidewalks should be provided with underdrains, FCPFM Type UD-3, when the sidewalk grade exceeds 3 percent.

Foundations

It is expected that concrete pads, rather than footings, will be used to support the mobile homes. The loads will be distributed over a large area and the applied bearing pressures will be low. It is recognized that the pads will be constructed over old colluvial soils. Consequently, the soil types at the foundation levels will vary in density and soil types. Marine clay will be present at scattered locations.

In order to improve soil density and to provide a non-frost susceptible foundation it is recommended that the soils within the pad footprint be undercut to a depth of 2.5 feet, or deeper if rootmat is present, and replaced with a non-frost susceptible soil. Acceptable soils would include silty or clayey sands (SC, SC) with less than 30 percent fines and a PI < 10. Other acceptable non-frost-susceptible soils include VDOT 21 aggregate. Clean sands or aggregates should not be used as they can fill with water that could freeze and heave.

After excavation, the subgrade should be examined. If soft soils are present, they should be excavated and replaced or densified to a condition that will permit placement of compacted fill above.

Water should be diverted from the excavations. If water seeps into the excavations, it should be removed expeditiously with small sump pits and pumping. The excavations should be backfilled up to the slab level the same day they are dug. Open excavations should not be permitted to stand overnight.

The design of the concrete pads should be based on an allowable bearing pressure of 3,000 psf and a modulus of subgrade reaction of 150 pci. The edges of the slab should be turned down and bear 2.5 feet below exterior grade.

Roadways

Based on the results of the laboratory tests, we recommend that the pavement design utilize a CBR value of 5.3, which is two-thirds of the average test value. All pavement materials and construction methods should be in compliance with the latest VDOT Road and Bridge Specifications.

During grading, occasional highly plastic soils will be encountered at the subgrade level. These soils should be undercut entirely or at least 2 feet and replaced with acceptable compacted fill. There is also the possibility that highly plastic soils might be present just below the graded surface. To delineate these zones, it is recommended that the Geotechnical Engineer perform hand auger probes at 25-foot intervals per roadway lane. If highly plastic soils are encountered they should be undercut and replaced as required above. The recommendations in this paragraph include roadways, curbs and gutters, and sidewalks.

The roadways pavement and base course aggregate should be graded with a minimum slope of one-quarter inch per foot (2%) to promote drainage. The base course aggregate must communicate directly with the underdrains.

It is common practice in residential construction to install only the base aggregate and the base course asphalt during initial construction, and then the final topping surface asphalt much later in the construction process. Often, depending upon the sequence and timing of construction, the final pavement surface may not be placed until several months after the initial base asphalt is placed. Often, the most critical load conditions for most residential developments occur during the construction phase when the pavement system is subjected to loading that includes construction equipment and other heavy trucks when the pavement section is not at its full strength. There are other recommendations that the designers should consider such as using thicker-than-required aggregate bases, or the use of geogrids and/or geotextiles.

Depending upon the time in which the temporary construction is used as a service road, some failures should be expected. If the construction pavement system fails, it will be necessary to remove this failed section and subgrade soils and replace them with the initial design section or an equivalent repaired section.

Large, front loading trash dumpsters frequently impose concentrated front-wheel loads on pavements during loading. In a similar manner, truck loading docks can also experience very high turning wheel loads. This type of loading typically results in rutting of the pavement and ultimately pavement failures. Therefore, we recommend that the pavement in trash pickup areas and at loading docks, if any, consist of a 6-inch thick, mesh reinforced concrete slab, with a minimum unconfined compressive strength of 4,000 psi, resting on 6 inches of VDOT 21A aggregate.

CONSTRUCTION RECOMMENDATIONS

Subgrade Preparation and Earthwork Operations

The subgrade preparation should consist of stripping all vegetation, rootmat, topsoil, and any other soft or unsuitable material from the proposed mobile home pads and pavement areas. We recommend the earthwork clearing be extended 2 feet beyond pad and pavement limits.

After stripping to the desired grade, and prior to fill placement, the stripped surface should be observed by an experienced geotechnical engineer or their authorized representative. Proofrolling pavement areas using a loaded dump truck, having an axle weight of at least 10 tons, should be performed to identify localized soft or unsuitable material that should be removed. Proofrolling of roadways should also be performed once the final grade is achieved and prior to placing the base course aggregate.

Special efforts should also be made to identify unsuitable soils. Any soft or unsuitable materials encountered during this proofrolling should be removed and replaced with an approved backfill compacted to the criteria given in the section below.

Fill Placement

All fills should consist of approved materials, free of organic matter, debris, and cobbles greater than 4 inches. They should have a liquid limit and plasticity Index less than 40 and 20, respectively. Non-frost susceptible materials should meet the requirements previously indicated. Most of the site’s SAND soils (SC, SM, SP) will likely meet the plasticity requirements for re-use as engineered fill. It is possible that some of the low plasticity CLAY (CL) and SILT (ML) soils will also meet the plasticity requirements for re-use as fill; however, these soils will be more difficult to place and compact when compared to the sandier soils. Unacceptable fill materials include topsoil and organic materials (OH, OL), and high plasticity clays and silts (CH, MH). Under no circumstances should high plasticity soils be used as fill material in proposed structural areas or close to site slopes.

The on-site SAND (SC, SM, SP) and low plasticity CLAY (CL) and SILT (ML) soils may require moisture content adjustments, such as the application of discing or other drying techniques or spraying of water to the soils prior to their use as controlled fill materials (termed manipulation). Some of the on-site CLAY (CL) and SILT (ML) soils may not meet the plasticity requirements for reuse as engineered fill. The planning of earthwork operations should recognize and account for increased costs associated with manipulation of the on-site materials considered for re-use as compacted fill.

Fill materials should be placed in lifts not exceeding 8 inches in loose thickness and moisture conditioned to within ±2% of the optimum moisture content. Soil bridging lifts should not be used. Controlled fill soils should be compacted to a minimum of 95% of the maximum dry density obtained in accordance with ASTM Specification D-698, Standard Proctor Method. Additionally, the upper 1.0 foot of soil supporting mobile home pads, pavements, sidewalks, or curbs and gutters should be compacted to a minimum of 98% of the maximum dry density.

Grade control should be maintained throughout the fill placement operations. All fill operations should be observed on a full-time basis by a qualified soil technician to determine that the specified compaction requirements are being met. A minimum of one compaction test per

2,500-square foot area should be tested in each lift placed. The elevation and location of the tests should be clearly identified at the time of fill placement.

Compaction equipment suitable to the soil type used as fill should be used to compact the fill material. Theoretically, any equipment type can be used as long as the required density if achieved. Ideally, a steel drum roller would be most efficient for compacting and sealing the surface soils. All areas receiving fill should be graded to facilitate positive drainage.

It should be noted that prior to the commencement of fill operations and/or utilization of any off-site borrow materials, the Geotechnical Engineer of Record should be provided with representative samples to determine the material's suitability for use in a controlled compacted fill and to develop moisture-density relationships.

Fill materials should not be placed on frozen soils or frost-heaved soils and/or soils that have been recently subjected to precipitation. All frozen soils should be removed prior to continuation of fill operations. Borrow fill materials, if required, should not contain frozen materials at the time of placement. All frost-heaved soils should be removed prior to placement of compacted fill, granular subbase materials, foundation or slab concrete, and asphalt pavement materials.

Construction Dewatering

Excavations performed at this site might encounter perched groundwater conditions, surface water flowing from the higher elevations of the site, or seasonally high groundwater levels. We anticipate that some localized areas within the excavations may not be completely dry and could require the use of trenches and pits with pumps to dewater the excavations.

Additionally, the surface of the site should be kept properly graded in order to enhance drainage of the surface water away from the proposed working areas during the construction phase.

Temporary and Permanent Slopes

For temporary cuts or excavations, side slopes as steep as 3H:1V are possible in the natural soils observed at this site. For long-term stability, side slopes should be constructed no steeper than 4.5H:1V in natural soils. All temporary and permanent slopes should be immediately protected, such as by seeding and mulching as soon as possible after placement, to prevent from sloughing and erosion. Maintenance should be anticipated for temporary slopes which remain in place for more than about thirty days.

The contractor should avoid stockpiling excavated materials or equipment immediately adjacent to any slopes.

Closing

We recommend that if there are any changes to the project information as outlined in this report, ECS be retained to review the plans and determine if modifications to the recommendations are necessary or if additional geotechnical recommendations are necessary for the proposed development.

APPENDICES

Appendix A – Drawings

Boring Location Diagram with:
  Site Location Plan
  Pile Wall Plan Locations

Boring Cross-Sections (C-C' through F-F')

Pile Wall Profiles

Appendix B – Soil Test Borings

Unified Soil Classification System

Reference Notes for Boring Logs

ECS Boring Logs D-1 and D-2

ECS Boring Logs C-1 through C-4

ECS Boring Logs ECS-1 through ECS-12

Appendix C – Laboratory Test Results

Laboratory Testing Summaries

Grain Size Analyses

Plasticity Chart

CBR Tests

Residual Direct Shear Test Results (2 tests)

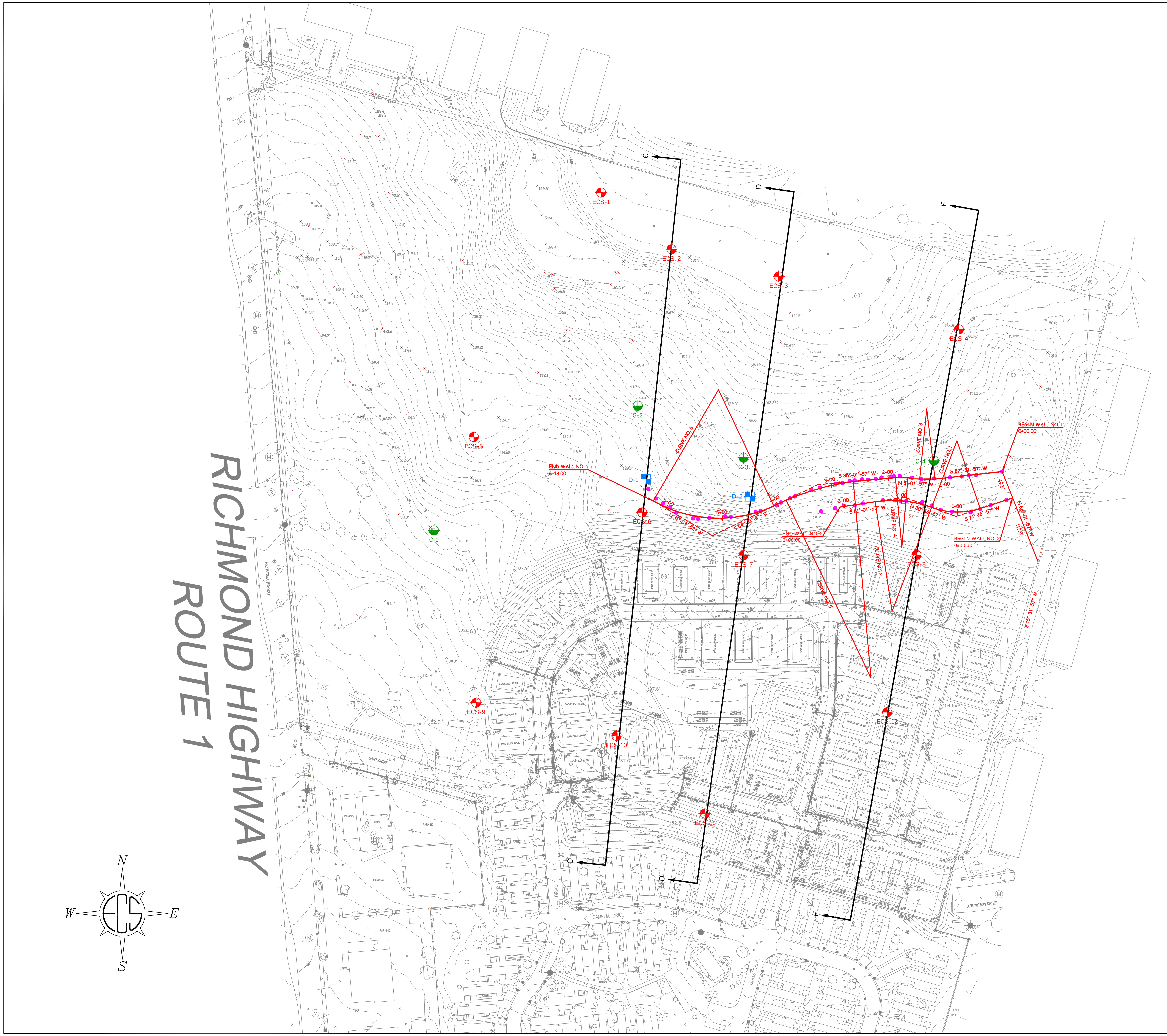
Appendix D – Calculations

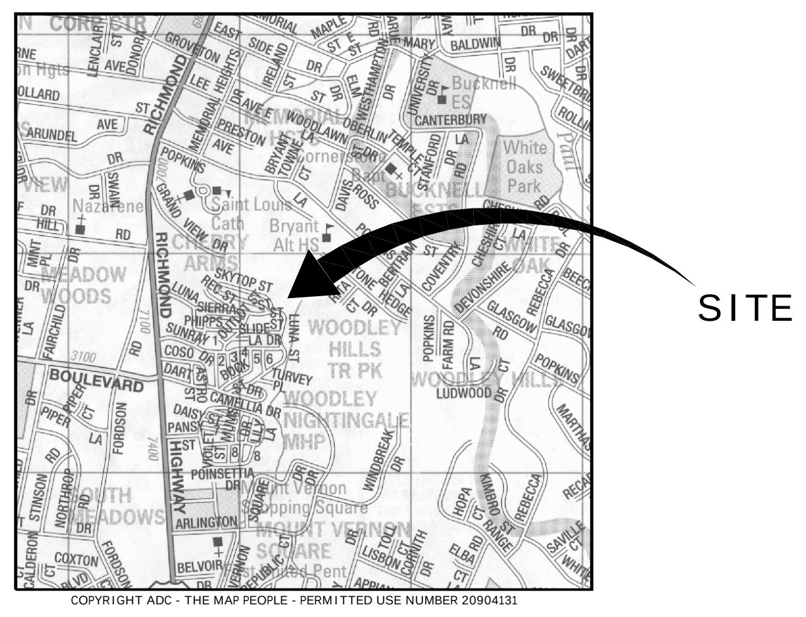
Soil Parameter Sheets

Slope Stability Analyses Outputs

Pile Wall Calculations

Appendix A – Drawings





VICINITY MAP
NTS

CURVE DATA

CURVE NO. 1

PC = 0+60.00
△ = 39°-00'-00"
R = 125.50
L = 85.08
T = 44.44
PT = 1+45.08

CURVE DATA

CURVE NO. 4

PC = 1+65.27
△ = 10°-00'-00"
R = 125.00
L = 21.82
T = 10.94
PT = 1+87.00

CURVE DATA

CURVE NO. 2

PC = 1+45.08
△ = 29°-15'-00"
R = 195.00
L = 50.88
T = 99.55
PT = 2+44.63

CURVE DATA

CURVE NO. 5

PC = 2+48.59
△ = 20°-30'-00"
R = 345.00
L = 62.39
T = 123.44
PT = 3+72.02

CURVE DATA

CURVE NO. 3

PC = 1+17.50
△ = 12°-30'-00"
R = 125.00
L = 27.27
T = 13.69
PT = 1+44.77

CURVE DATA

CURVE NO. 6

PC = 3+96.00
△ = 56°-31'-55"
R = 225.00
L = 222.00
T = 120.98
PT = 6+18.00

LEGEND

- APPROX. BORING LOCATION (ECS MARCH 2009)
- APPROX. BORING LOCATION (ECS JULY 2009)
- APPROX. BORING LOCATION (ECS SEPT 2009)
- ● FLAGGED FIELD LOCATIONS (HOT PINK RIBBON) NOTING APPROXIMATE WALL LOCATIONS.

NOTES:

1) WALL NO. 1 PILES SHALL BE HP 14 x 89, GRADE 50, SPACED ON 6-FOOT CENTERS.

2) WALL NO. 2 PILES SHALL BE HP 14 x 73, GRADE 50, SPACED ON 6-FOOT CENTERS.

3) PLACE ALL PILES WITH WEBS PERPINDICULAR TO THE GROUND CONTOURS.

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(FAX) 703-834-5527

NORTH HILL MHP
FAIRFAX COUNTY, VA.

BORING LOCATION DIAGRAM & STABILITY ENHANCING WALL PLAN

ECS REVISIONS	
09-10-09	
10-14-09	
ENGINEER JCG	DRAFTING RAC
SCALE	1"=80'
PROJECT NO.	14444
SHEET	1 OF 3
DATE	03-17-09

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SOIL CLASSIFICATION LEGEND

ST - SHELBY TUBE
RC - ROCK CORE
PM - PRESSURE METER

- FILL - FILL (POSS/PROB) OF ALL TYPES.
- GW - WELL GRADED GRAVEL
- GM - SILTY GRAVEL
- GP - POORLY GRADED GRAVEL
- GC - CLAYEY GRAVEL
- SW - WELL GRADED SAND
- ML - LOW PLASTICITY SILT
- CL - LOW PLASTICITY CLAY
- MH - HIGH PLASTICITY SILT
- SM - SILTY SAND
- SP - POORLY GRADED SAND
- SC - CLAYEY SAND
- CH - HIGH PLASTICITY CLAY
- OH - HIGH PLASTICITY ORGANIC SILTS AND CLAYS
- OL - LOW PLASTICITY ORGANIC SILTS AND CLAY
- PT - PEAT

SURFACE MATERIALS

- TOPSOIL
- ASPHALT
- GRAVEL
- CONCRETE
- VOID

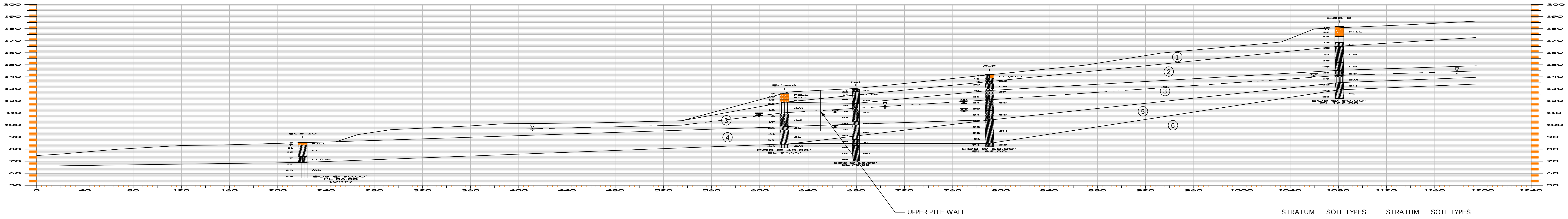
ROCK TYPES

- IGNEOUS
- METAMORPHIC
- SEDIMENTARY

SYMBOL LEGEND

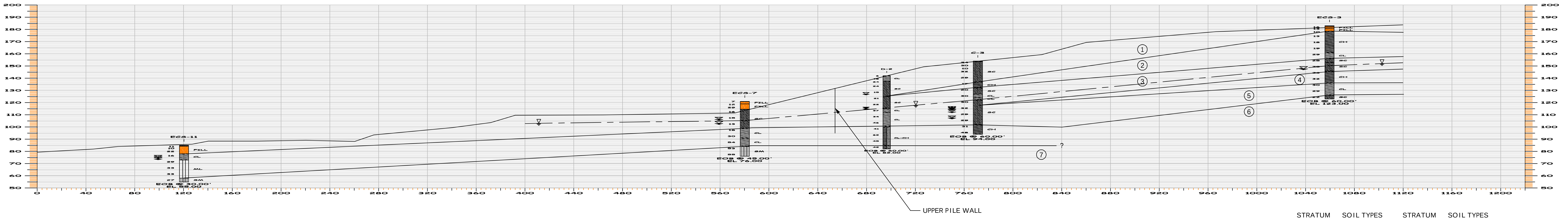
- ▽ WATER LEVEL SYMBOL
- ▽ WATER LEVEL - BEFORE CASING REMOVAL
- ▼ WATER LEVEL - AFTER CASING REMOVAL
- ▽ WATER LEVEL - AFTER 24 HOURS

CROSS SECTION C-C



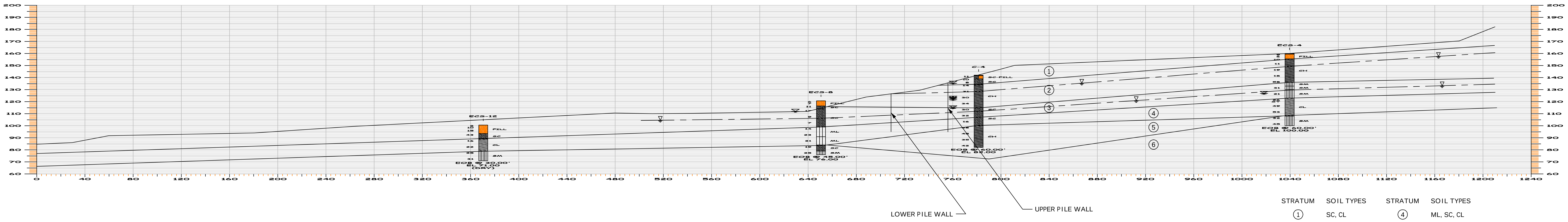
STRATUM	SOIL TYPES	STRATUM	SOIL TYPES
①	CL, SC	④	CL, SC, ML
②	CH	⑤	CH
③	SC, SM	⑥	SM

CROSS SECTION D-D



STRATUM	SOIL TYPES	STRATUM	SOIL TYPES
①	SC, SM, CL	④	CH
②	CH	⑤	SC, CL
③	SC	⑥	CL, CH
		⑦	SM, SC

CROSS SECTION F-F



STRATUM	SOIL TYPES	STRATUM	SOIL TYPES
①	SC, CL	④	ML, SC, CL
②	CH	⑤	CH
③	SC, SM	⑥	SM

SCALE
VERTICAL SCALE 1"=10'
HORIZONTAL SCALE 1"=40'

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CROSS SECTIONS
C-C, D-D & F-F

ECS REVISIONS
10-13-09

ENGINEER	DRAFTING
MET	RAC

SCALE AS NOTED
PROJECT NO. 14444
SHEET 2 OF 3
DATE 04-27-09

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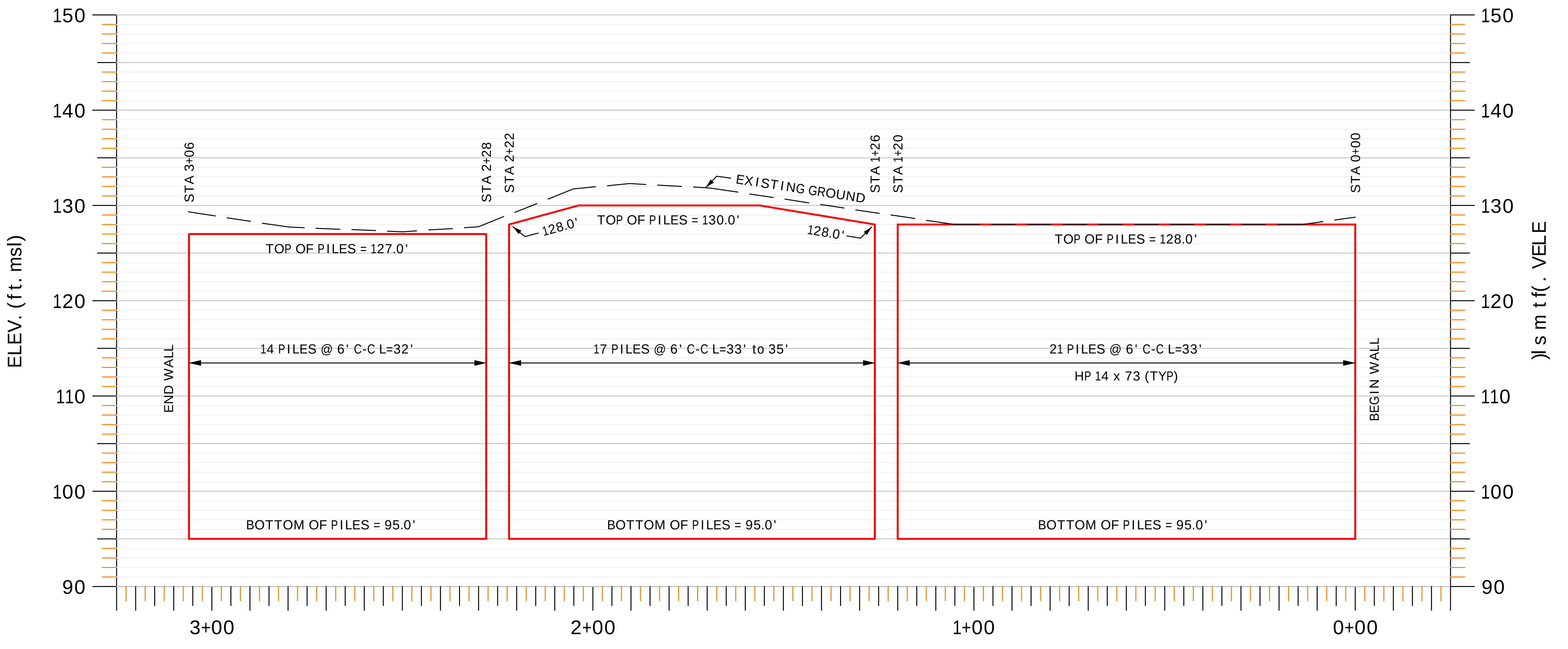
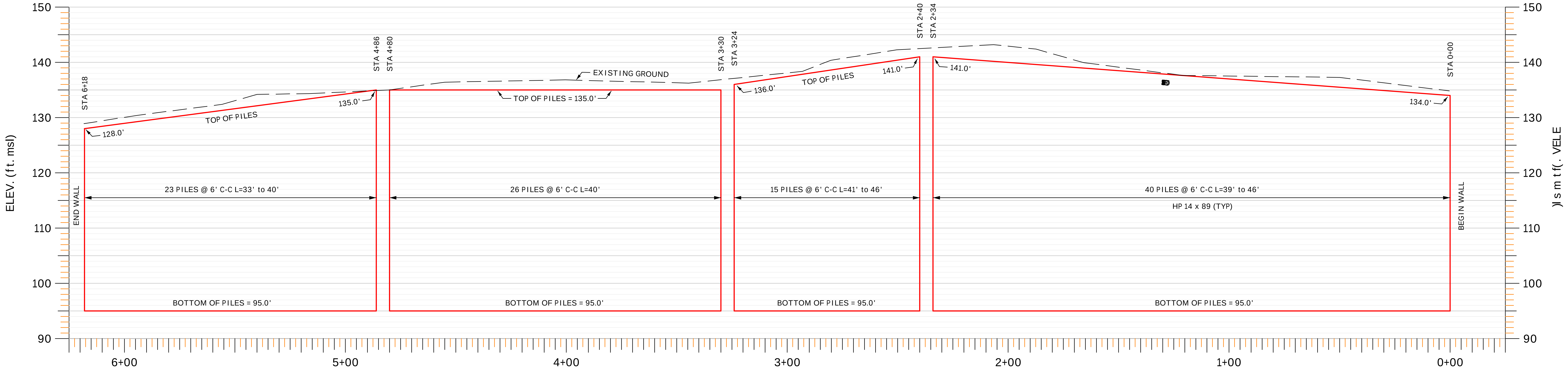
LOWER PILE WALL PROFILE



UPPER PILE WALL PROFILE



SCALE
VERTICAL SCALE 1"=10'
HORIZONTAL SCALE 1"=25'

NOTE: TOPS OF PILES MAY BE CUT OFF AT HIGHER ELEVATIONS
TO ACCOMODATE ACTUAL SITE GRADES.

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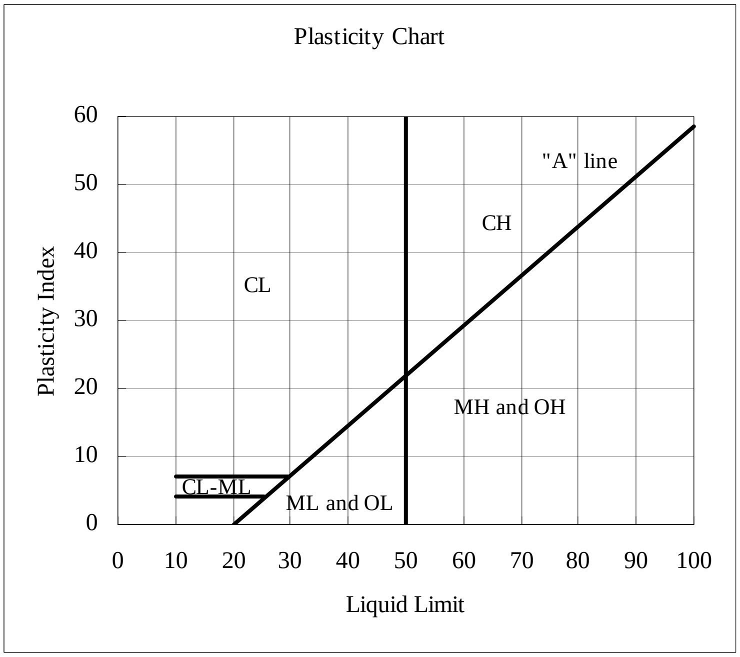
UPEER & LOWER
PILE WALL PROFILE

ECS REVISIONS

ENGINEER JCG	DRAFTING RAC
SCALE	NTS
PROJECT NO.	14444
SHEET	3 OF 3
DATE	10-13-09

Appendix B – Soil Test Borings

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

Major Divisions			Group Symbols		Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is larger than No. 200 Sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols [b]	$C_u = D_{60}/D_{10}$ greater than 4 $C_c = (D_{30})^2/(D_{10}xD_{60})$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u				
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line or P.I. less than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ greater than 6 $C_c = (D_{30})^2/(D_{10}xD_{60})$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or P.I. less than 4	Limits plotting in CL-ML zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 Sieve)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly Organic soils		Pt		Peat and other highly organic soils			

[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder. (From Table 2.16 - Winterkorn and Fang, 1975)

REFERENCE NOTES FOR BORING LOGS

I. Drilling Sampling Symbols

SS	Split Spoon Sampler	ST	Shelby Tube Sampler
RC	Rock Core, NX, BX, AX	PM	Pressuremeter
DC	Dutch Cone Penetrometer	RD	Rock Bit Drilling
BS	Bulk Sample of Cuttings	PA	Power Auger (no sample)
HSA	Hollow Stem Auger	WS	Wash sample
REC	Rock Sample Recovery %	RQD	Rock Quality Designation %

II. Correlation of Penetration Resistances to Soil Properties

Standard Penetration (blows/ft) refers to the blows per foot of a 140 lb. hammer falling 30 inches on a 2-inch OD split-spoon sampler, as specified in ASTM D 1586. The blow count is commonly referred to as the N-value.

A. Non-Cohesive Soils (Silt, Sand, Gravel and Combinations)

Density		*Relative Properties*	
Under 4 blows/ft	Very Loose	Adjective Form	12% to 49%
5 to 10 blows/ft	Loose	With	5% to 12%
11 to 30 blows/ft	Medium Dense		
31 to 50 blows/ft	Dense		
Over 51 blows/ft	Very Dense		

Particle Size Identification		
Boulders		8 inches or larger
Cobbles		3 to 8 inches
Gravel	Coarse	1 to 3 inches
	Medium	½ to 1 inch
	Fine	¼ to ½ inch
Sand	Coarse	2.00 mm to ¼ inch (dia. of lead pencil)
	Medium	0.42 to 2.00 mm (dia. of broom straw)
	Fine	0.074 to 0.42 mm (dia. of human hair)
Silt and Clay		0.0 to 0.074 mm (particles cannot be seen)

B. Cohesive Soils (Clay, Silt, and Combinations)

Blows/ft	*Consistency*	*Unconfined Comp. Strength Q_p (tsf)*	*Degree of Plasticity*	*Plasticity Index*
Under 2	Very Soft	Under 0.25	None to slight	0 – 4
3 to 4	Soft	0.25-0.49	Slight	5 – 7
5 to 8	Medium Stiff	0.50-0.99	Medium	8 – 22
9 to 15	Stiff	1.00-1.99	High to Very High	Over 22
16 to 30	Very Stiff	2.00-3.00		
31 to 50	Hard	4.00–8.00		
Over 51	Very Hard	Over 8.00		

III. Water Level Measurement Symbols

WL	Water Level	BCR	Before Casing Removal	DCI	Dry Cave-In
WS	While Sampling	ACR	After Casing Removal	WCI	Wet Cave-In
WD	While Drilling	▽	Est. Groundwater Level	▼	Est. Seasonal High GWT

The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clay and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.

CLIENT
GREENHORNE & O'MARA

JOB #
14444

BORING #
D-1

SHEET
1 OF 2

ECS LLC
MID-ATLANTIC

PROJECT NAME
NORTH HILL MHP

ARCHITECT-ENGINEER
GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, FAIRFAX COUNTY, VA.

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 130

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)
1	SS	18	1
2	SS	18	6
3	SS	18	14
4	SS	18	18
5	SS	18	18
6	SS	18	18
7	SS	18	18
8	SS	18	18

DEPTH (FT): 0, 5, 10, 15, 20, 25, 30

ELEVATION (FT): 125, 120, 115, 110, 105

Asphalt Depth 2"

Gravel Depth 4"

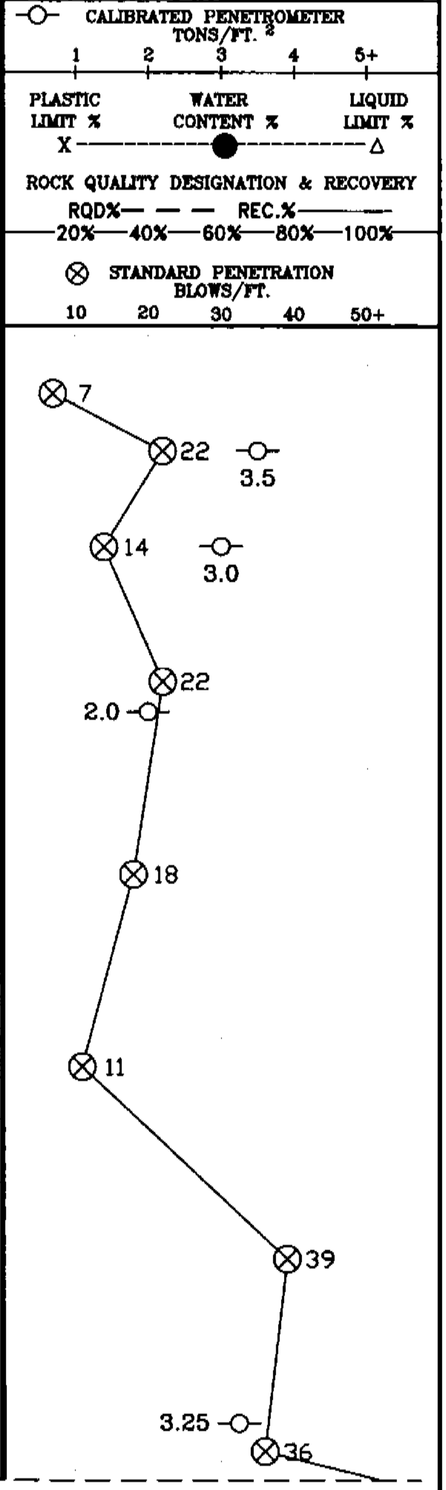
Clayey SAND, Trace Gravel, Brown, Moist, Loose, (SC)

CLAY, Trace Sand, Trace Quartz, Red, Moist, Stiff to Very Stiff, (CL-CH)

CLAY, Light Tannish Brown, Moist, Very Stiff, (CH)

Clayey SAND, Gray to Light Brown, Moist, Medium Dense to Dense, (SC)

CLAY, Trace Sand, Brown and Dark Gray, Moist, Hard to Very Hard, (CL)



CONTINUED ON NEXT PAGE.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 19.0' WS OR (D)	BORING STARTED 09-12-09	
▼WL(BCR) ▼WL(ACR) 31.5'	BORING COMPLETED 09-12-09	CAVE IN DEPTH ● 37.5'
▽WL	RIG FOREMAN STEVENS	DRILLING METHOD HOLLOW STEM AUGER

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RC (07-28-08) RC (08-18-08) RC (08-18-08) RC (09-21-08) RC (10-14-09)

(07/27/2009)

MTomeo

CLIENT	JOB #	BORING #	SHEET
GREENHORNE & O'MARA	14444	D-1	2 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME: NORTH HILL MHP

ARCHITECT-ENGINEER: GREENHORNE & O'MARA

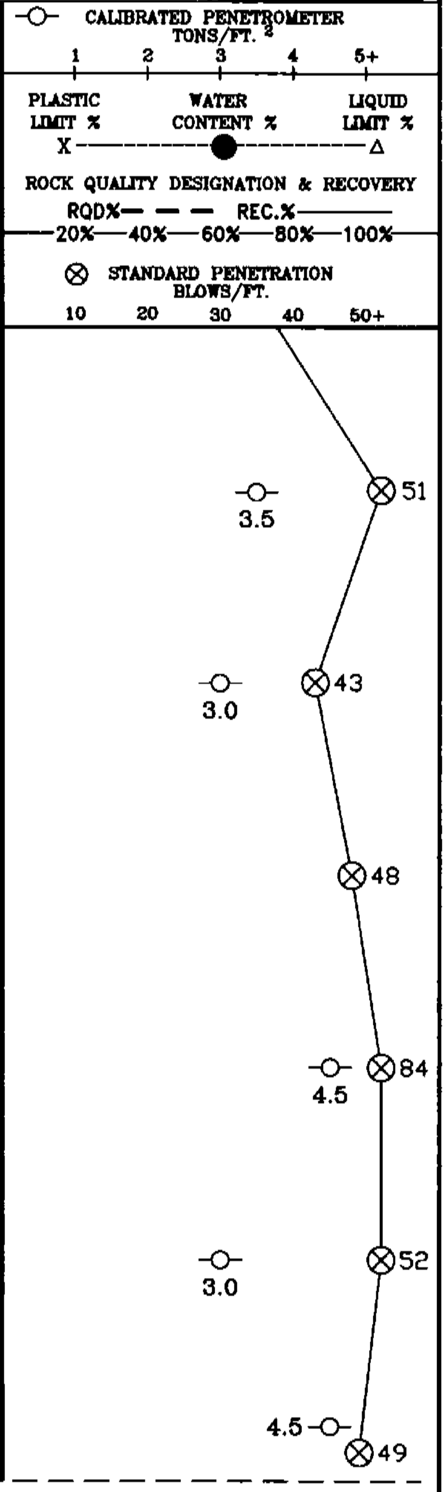
SITE LOCATION: ALEXANDRIA, FAIRFAX COUNTY, VA.

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 130

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
30					CLAY, Trace Sand, Brown and Dark Gray, Moist, Hard to Very Hard, (CL)	▼	
	9	SS	18	18			
35							95
	10	SS	18	18			
40							90
					Clayey SAND, Dark Gray and Brown, Moist, Dense, (SC)		
	11	SS	18	18			
45							85
					CLAY, Dark Gray and Red, Moist, Hard to Very Hard, (CH)		
	12	SS	18	18			
50							80
	13	SS	18	18			
55							75
	14	SS	18	18			
60							



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 19.0'	WS OR BD	BORING STARTED 09-12-09	
▼WL(BCR)	▼WL(ACR) 31.5'	BORING COMPLETED 09-12-09	CAVE IN DEPTH ● 37.5'
▽WL		RIG FOREMAN STEVENS	DRILLING METHOD HOLLOW STEM AUGER

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RC (07-29-08) RC (08-16-08) RC (08-18-08) RC (08-21-08) RC (10-14-08)

(07/27/2009)

MTomeo

CLIENT	JOB #	BORING #	SHEET	
GREENHORNE & O'MARA	14444	D-2	1 OF 2	**ECS LLC** MID-ATLANTIC

PROJECT NAME: NORTH HILL MHP

ARCHITECT–ENGINEER: GREENHORNE & O'MARA

SITE LOCATION: ALEXANDRIA, FAIRFAX COUNTY, VA.

-O- CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY: RQD% — — — REC.% ——— 20% 40% 60% 80% 100%

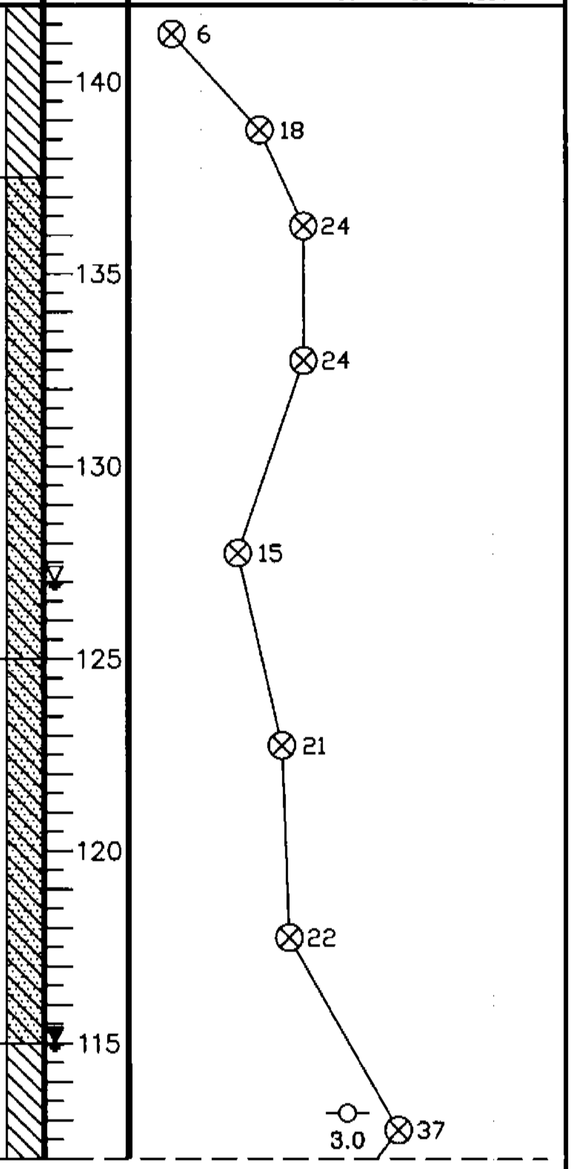
⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 142

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	STANDARD PENETRATION BLOWS/FT.
0	1	SS	18	12	CLAY, With Sand, Trace Gravel, Reddish Brown, Moist, Loose to Medium Dense, (CL)	6
	2	SS	18	12		18
5	3	SS	18	18	Clayey SAND, Reddish Brown and Gray, Moist, Medium Dense, (SC)	24
10	4	SS	18	18		24
15	5	SS	18	18		15
20	6	SS	18	18	Clayey SAND, Light Brown and Brown, Moist to Wet, Medium Dense, (SC)	21
25	7	SS	18	18		22
30	8	SS	18	18	CLAY, With Sand, Dark Gray and Brown, Moist, Hard, (CL)	37 (-O- 3.0)



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 15.0' WS OR (WD)	BORING STARTED 09-12-09	
▼WL(BCR) ▼WL(ACR) 27.0'	BORING COMPLETED 09-12-09	CAVE IN DEPTH ● 30.4'
▽WL	RIG FOREMAN STEVENS	DRILLING METHOD HOLLOW STEM AUGER

CLIENT GREENHORNE & O'MARA	JOB # 14444	BORING # D-2	SHEET 2 OF 2
PROJECT NAME NORTH HILL MHP	ARCHITECT-ENGINEER GREENHORNE & O'MARA		
SITE LOCATION ALEXANDRIA, FAIRFAX COUNTY, VA.			

ECS LLC MID-ATLANTIC

-○- CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC.% ——— 20% 40% 60% 80% 100%

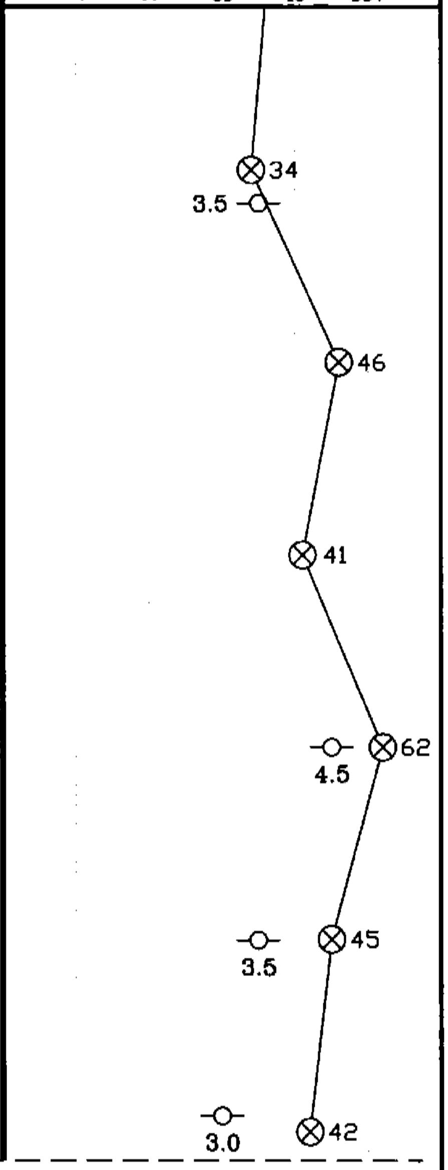
⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 142

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)
30					CLAY, With Sand, Dark Gray and Brown, Moist, Hard, (CL)	110
35	9	SS	18	18		
						105
40	10	SS	18	18		
					CLAY, With Sand, Dark Gray, Greenish Gray and Brownish Red, Moist, Hard to Very Hard, (CL-CH)	100
45	11	SS	18	17		
						95
50	12	SS	18	18		
						90
55	13	SS	18	18		
						85
60	14	SS	18	18		



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 15.0' WS OR WD	BORING STARTED 09-12-09	
▼WL(BCR) ▼WL(ACR) 27.0'	BORING COMPLETED 09-12-09	CAVE IN DEPTH ● 30.4'
▽WL	RIG FOREMAN STEVENS	DRILLING METHOD HOLLOW STEM AUGER

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RC (07-29-08) RC (08-16-08) RC (08-18-08) RC (08-21-08) RC (10-14-08)

(08/15/2009)

CLIENT GREENHORNE & O'MARA	JOB # 14444	BORING # C-1	SHEET 1 OF 2
PROJECT NAME NORTH HILL MHP	ARCHITECT–ENGINEER GREENHORNE & O'MARA		
SITE LOCATION ALEXANDRIA, FAIRFAX COUNTY, VA.			

ECS LLC MID-ATLANTIC

–○– CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X ——— WATER CONTENT % ● ——— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC.% ——— 20% 40% 60% 80% 100%

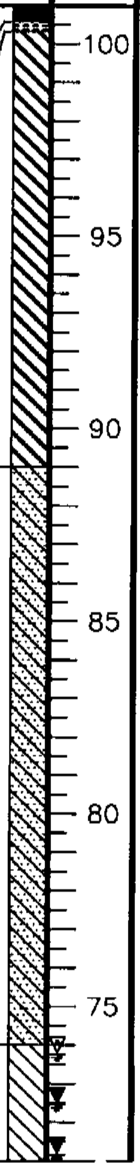
⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

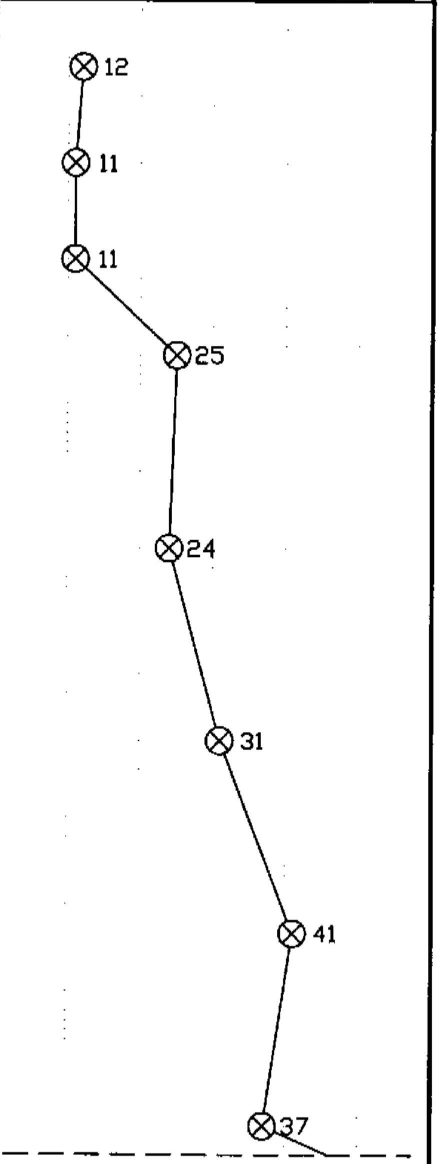
DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 101

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL
0					Asphalt Depth 5"
	1	SS	18	6	Gravel Depth 3"
	2	SS	18	8	CLAY, Orangish Brown and Gray, Moist, Stiff to Very Stiff, (CH)
5					
	3	SS	18	16	
	4	SS	18	18	
10					
					Clayey SAND, Gray to Brown, Moist, Medium Dense to Dense, (SC)
	5	SS	18	18	
15					
	6	SS	18	18	
20					
	7	SS	18	18	
25					
					CLAY, With Sand, Dark Gray to Brown, Moist, Hard, (CL)
	8	SS	18	18	
30					





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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 28.5' WS OR BD	BORING STARTED 07-22-09	
▼WL(BCR) 29.8' ▼WL(ACR) 28.5'	BORING COMPLETED 07-22-09	CAVE IN DEPTH ●
▽WL 27.2' @ 24HRS	RIG CME550 FOREMAN RECON	DRILLING METHOD HOLLOW STEM AUGER

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RC (07-29-08)

(04/15/2008)

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CLIENT GREENHORNE & O'MARA	JOB # 14444	BORING # C-1	SHEET 2 OF 2
PROJECT NAME NORTH HILL MHP	ARCHITECT-ENGINEER GREENHORNE & O'MARA		
SITE LOCATION ALEXANDRIA, FAIRFAX COUNTY, VA.			

ECS LLC MID-ATLANTIC

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ———
20% 40% 60% 80% 100%

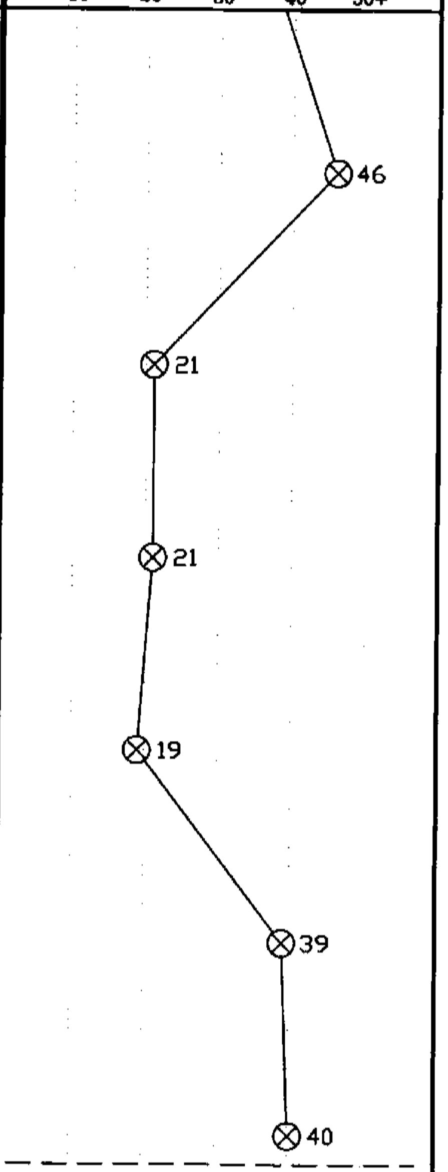
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 101

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
30					CLAY, With Sand, Dark Gray to Brown, Moist, Hard, (CL)		70	
35	9	SS	18	18				46
							65	
					Medium SAND, Trace Silt, Light Gray, Wet, Medium Dense, (SP)			
40	10	SS	18	18				21
							60	
45	11	SS	18	18				21
							55	
50	12	SS	18	18				19
							50	
					CLAY, Reddish Brown and Gray, Moist, Hard, (CH)			
55	13	SS	18	18				39
							45	
60	14	SS	18	18				40



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 28.5' WS OR (BD)	BORING STARTED 07-22-09	
▼WL(BCR) 29.8' ▼WL(ACR) 28.5'	BORING COMPLETED 07-22-09	CAVE IN DEPTH ●
▽WL 27.2' @ 24HRS	RIG CME550 FOREMAN RECON	DRILLING METHOD HOLLOW STEM AUGER

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RC (07-28-09)

(04/15/2009)

CLIENT GREENHORNE & O'MARA
JOB # 14444
BORING # C-2
SHEET 1 OF 2
PROJECT NAME NORTH HILL MHP
ARCHITECT-ENGINEER GREENHORNE & O'MARA
SITE LOCATION ALEXANDRIA, FAIRFAX COUNTY, VA.

ECS LLC MID-ATLANTIC

DESCRIPTION OF MATERIAL ENGLISH UNITS
BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%
SURFACE ELEVATION 142

Sample No.	Sample Type	Sample Dist. (in)	Recovery (in)
1	SS	18	2
2	SS	18	3
3	SS	18	5
4	SS	18	10
5	SS	18	18
6	SS	18	18
7	SS	18	18
8	SS	18	18

Asphalt Depth 2"

Gravel Depth 4"

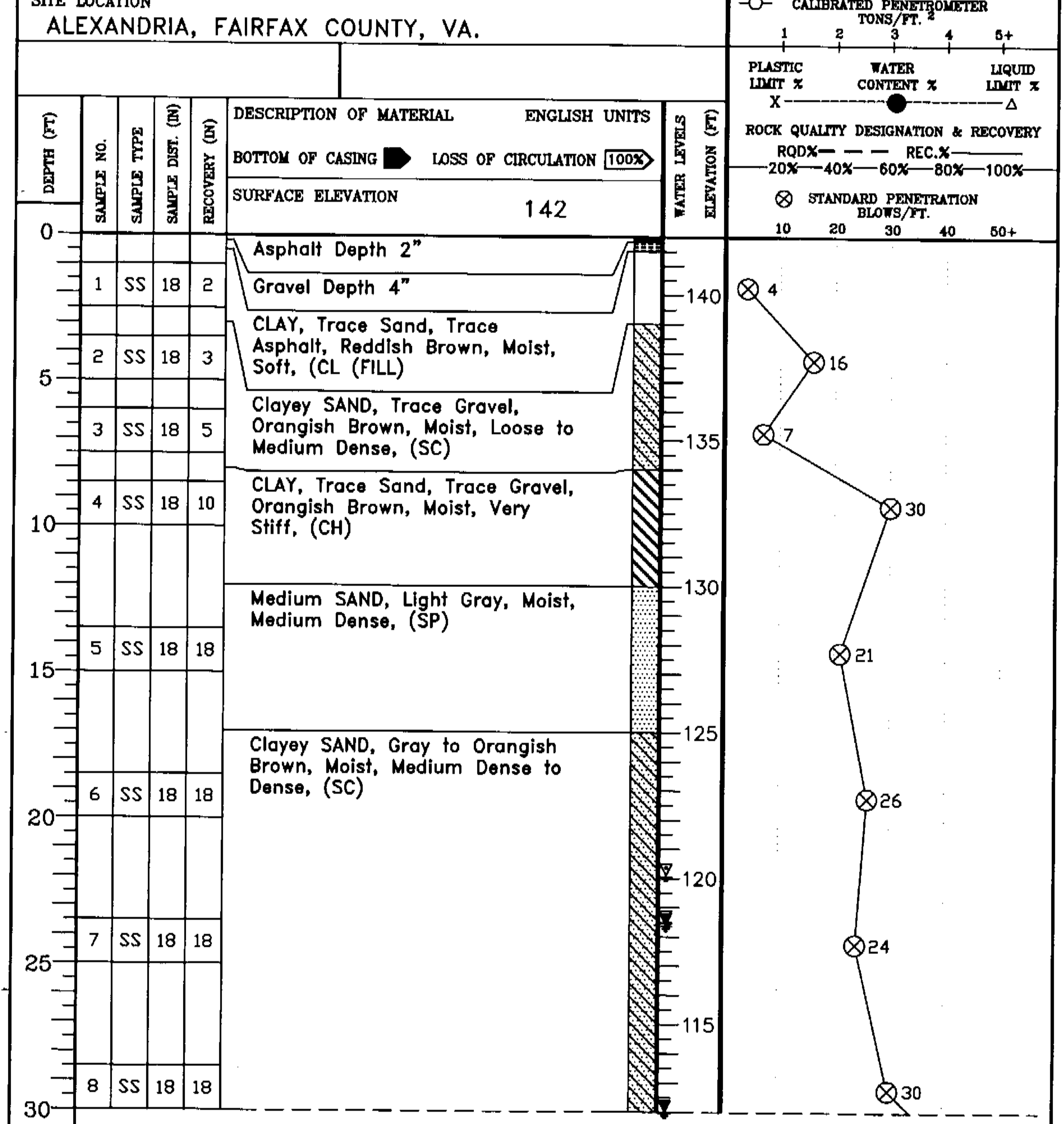
CLAY, Trace Sand, Trace Asphalt, Reddish Brown, Moist, Soft, (CL (FILL)

Clayey SAND, Trace Gravel, Orangish Brown, Moist, Loose to Medium Dense, (SC)

CLAY, Trace Sand, Trace Gravel, Orangish Brown, Moist, Very Stiff, (CH)

Medium SAND, Light Gray, Moist, Medium Dense, (SP)

Clayey SAND, Gray to Orangish Brown, Moist, Medium Dense to Dense, (SC)



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 23.5' WS OR ⓓ
BORING STARTED 07-23-09
▼WL(BCR) 30.0' ▼WL(ACR) 23.6'
BORING COMPLETED 07-23-09
CAVE IN DEPTH ●
▽WL 21.9' @ 24HRS
RIG CME550 FOREMAN RECON
DRILLING METHOD HOLLOW STEM AUGER

CLIENT	JOB #	BORING #	SHEET
GREENHORNE & O'MARA	14444	C-2	2 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME
NORTH HILL MHP

ARCHITECT-ENGINEER
GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, FAIRFAX COUNTY, VA.

-○- CALIBRATED PENETROMETER TONS/FT.²
1 2 3 4 5+

PLASTIC LIMIT % X———— WATER CONTENT % ●———— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD%— — — REC.%————
20%—40%—60%—80%—100%

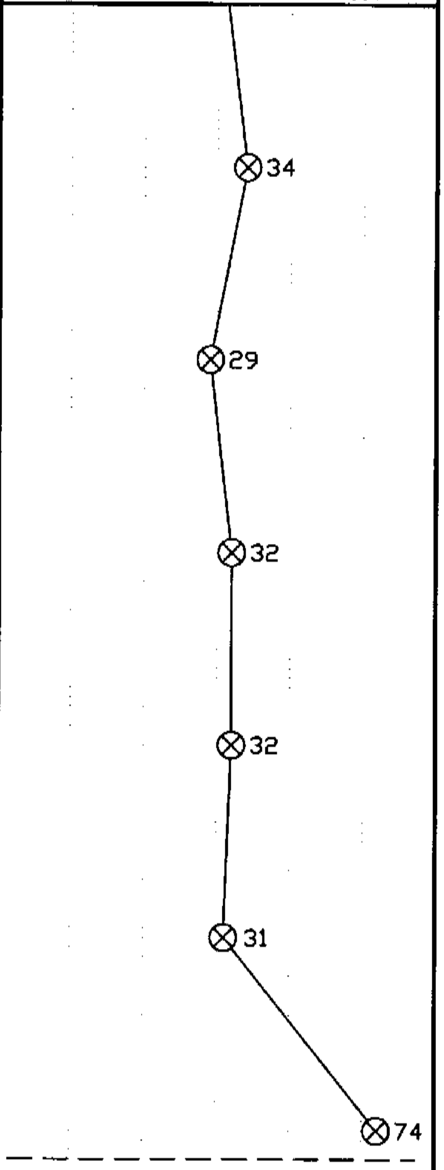
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ➡ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 142

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)
30					Clayey SAND, Gray to Orangish Brown, Moist, Medium Dense to Dense, (SC)	110
35	9	SS	18	18		
					CLAY, Trace Sand, Dark Gray, Moist, Very Stiff to Hard, (CH)	105
40	10	SS	18	18		100
45	11	SS	18	18		95
50	12	SS	18	18		90
55	13	SS	18	18		85
					Clayey SAND, Greenish Gray, Moist, Very Dense, (SC)	
60	14	SS	18	18		



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 23.5' WS OR (WD)	BORING STARTED 07-23-09	
▼WL(BCR) 30.0' ▼WL(ACR) 23.6'	BORING COMPLETED 07-23-09	CAVE IN DEPTH ●
▽WL 21.9' @ 24HRS	RIG CME550 FOREMAN RECON	DRILLING METHOD HOLLOW STEM AUGER

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RC (07-29-09)

(07/27/2009)
MTomeo

CLIENT
GREENHORNE & O'MARA

JOB # 14444

BORING # C-3

SHEET 1 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME
NORTH HILL MHP

ARCHITECT-ENGINEER
GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, FAIRFAX COUNTY, VA.

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X ——— WATER CONTENT % ● ——— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD%— — — REC.%———
20%—40%—60%—80%—100%

⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ **LOSS OF CIRCULATION** 100%

SURFACE ELEVATION 154

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	ELEVATION (FT)
0					
	1	SS	18	8	
	2	SS	18	18	150
5					
	3	SS	18	1	
	4	SS	18	16	145
10					
	5	SS	18	3	140
15					
	6	SS	18	18	135
20					
	7	SS	18	18	130
25					
	8	SS	18	18	125
30					

Asphalt Depth 3"

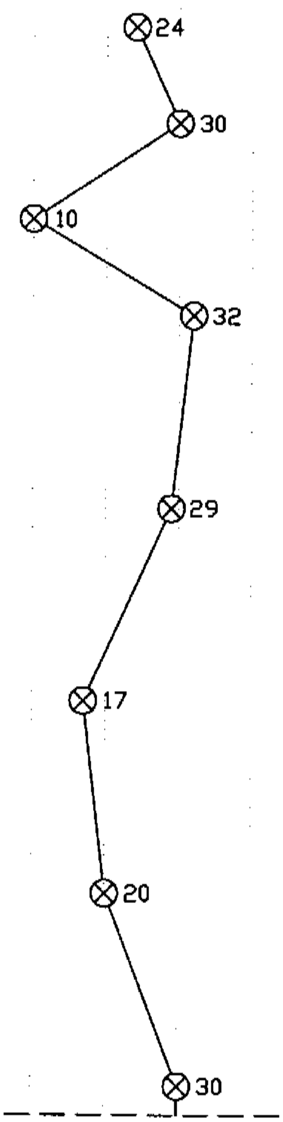
Gravel Depth 2"

Clayey Fine to Medium SAND, Trace Gravel, Orangish Brown, Moist, Loose to Dense, (SC)

CLAY, Gray, Moist, Very Stiff, (CH)

Clayey SAND, Brown, Moist, Medium Dense, (SC)

CLAY, With Sand, Brown, Moist, Very Stiff, (CL)



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 41.5' WS OR BD	BORING STARTED 07-23-09	
▼WL(BCR) 46.5' ▼WL(ACR) 39.6'	BORING COMPLETED 07-23-09	CAVE IN DEPTH ●
▽WL 38.8' @ 24HRS	RIG CME550 FOREMAN RECON	DRILLING METHOD HOLLOW STEM AUGER

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RC (07-28-09)

(07/27/2009)

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CLIENT GREENHORNE & O'MARA	JOB # 14444	BORING # C-3	SHEET 2 OF 2
PROJECT NAME NORTH HILL MHP	ARCHITECT-ENGINEER GREENHORNE & O'MARA		
SITE LOCATION ALEXANDRIA, FAIRFAX COUNTY, VA.			

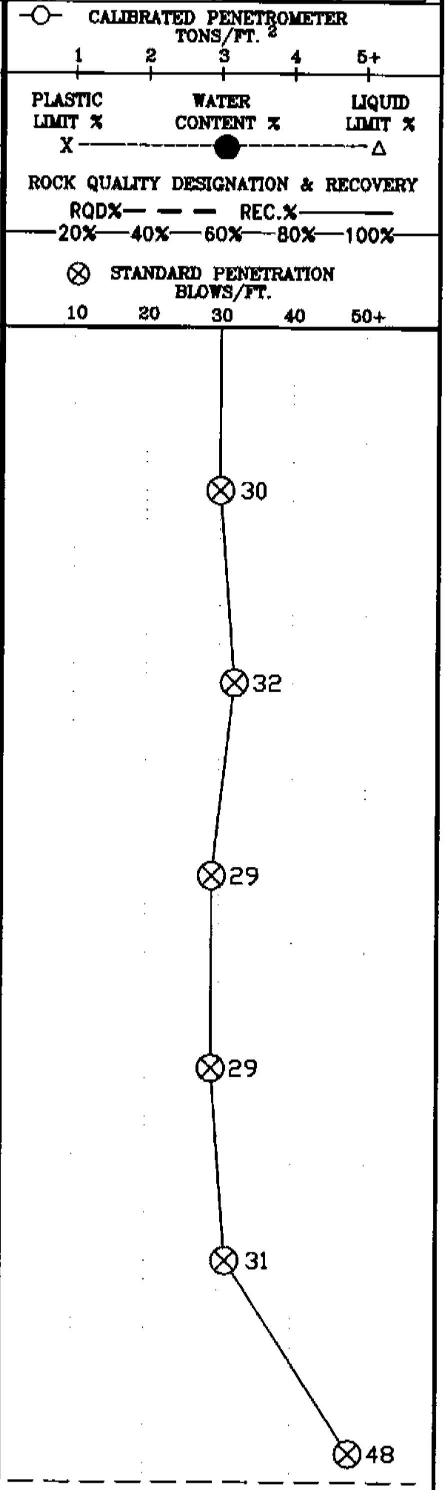
ECS LLC MID-ATLANTIC

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 154

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
30					CLAY, With Sand, Brown, Moist, Very Stiff, (CL)		
					Clayey SAND, Orangish Brown to Gray, Moist, Medium Dense to Dense, (SC)		
35	9	SS	18	18		120	30
40	10	SS	18	18		115	32
45	11	SS	18	18		110	29
50	12	SS	18	18		105	29
					CLAY, Brown and Dark Gray, Moist, Hard, (CH)		
55	13	SS	18	18		100	31
60	14	SS	18	18		95	48



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 41.5' WS OR (WD)	BORING STARTED 07-23-09	
▼WL(BCR) 46.5' ▼WL(ACR) 39.6'	BORING COMPLETED 07-23-09	CAVE IN DEPTH ●
▼WL 38.8' @ 24HRS	RIG CME550 FOREMAN RECON	DRILLING METHOD HOLLOW STEM AUGER

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RC (07-29-09)

(07/27/2009)

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CLIENT GREENHORNE & O'MARA
JOB # 14444
BORING # C-4
SHEET 1 OF 2
PROJECT NAME NORTH HILL MHP
ARCHITECT-ENGINEER GREENHORNE & O'MARA
SITE LOCATION ALEXANDRIA, FAIRFAX COUNTY, VA.

ECS LLC MID-ATLANTIC

DESCRIPTION OF MATERIAL ENGLISH UNITS
BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%
SURFACE ELEVATION 142

-○- CALIBRATED PENETROMETER TONS/FT.² 1 2 3 4 5+
PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △
ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC.% —— 20% 40% 60% 80% 100%
⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	STANDARD PENETRATION BLOWS/FT.
1	SS	18	3	11
2	SS	18	4	10
3	SS	18	5	8
4	SS	18	18	14
5	SS	18	18	31
6	SS	18	18	30
7	SS	18	18	34
8	SS	18	18	30

Asphalt Depth 3"

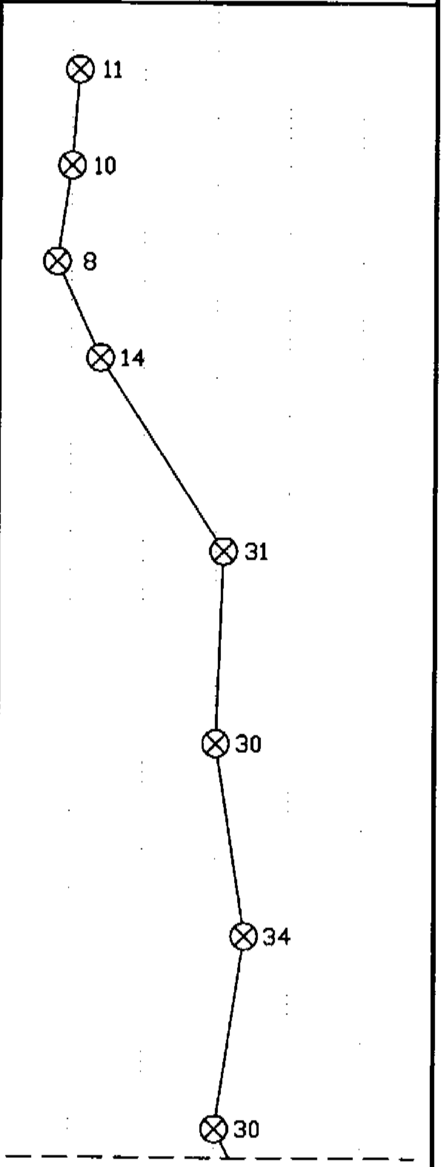
Gravel Depth 2"

Clayey SAND, Trace Gravel, Trace Asphalt, Trace Roots, Reddish Brown, Moist, Medium Dense, (SC-FILL)

Clayey SAND, Trace Silt, Orangish Brown, Moist, Loose, (SC)

CLAY, Orangish Brown, Moist, Stiff to Hard, (CH)

Clayey SAND, Dark Gray, Moist, Medium Dense to Dense, (SC)



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 6.5' WS OR BD	BORING STARTED	07-24-09	
▼WL(BCR) 27.0' ▼WL(ACR) 20.1'	BORING COMPLETED	07-24-09	CAVE IN DEPTH ●
▼WL 19.0' @ 24HRS	RIG CME550 FOREMAN RECON		DRILLING METHOD HOLLOW STEM AUGER

CLIENT
GREENHORNE & O'MARA

JOB #
14444

BORING #
C-4

SHEET
2 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME
NORTH HILL MHP

ARCHITECT-ENGINEER
GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, FAIRFAX COUNTY, VA.

-O- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD%— — — REC.%——
20%—40%—60%—80%—100%

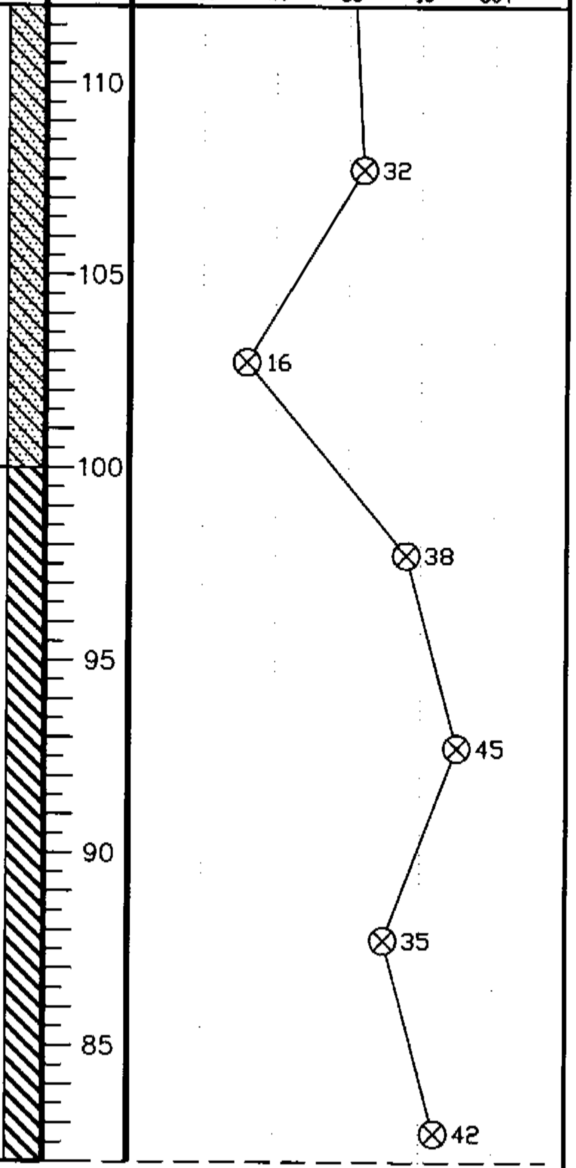
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 142

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL
30					Clayey SAND, Dark Gray, Moist, Medium Dense to Dense, (SC)
35	9	SS	18	18	
40	10	SS	18	18	
					CLAY, Dark Reddish Brown to Brown, Moist, Hard, (CH)
45	11	SS	18	18	
50	12	SS	18	18	
55	13	SS	18	18	
60	14	SS	18	18	



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 6.5' WS OR (BD)
BORING STARTED 07-24-09
▼WL(BCR) 27.0' ▼WL(ACR) 20.1'
BORING COMPLETED 07-24-09
CAVE IN DEPTH ●
▼WL 19.0' @ 24HRS
RIG CME550 FOREMAN RECON
DRILLING METHOD HOLLOW STEM AUGER

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RC (07-29-09)

(07/27/2009)

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CLIENT	JOB # 14444	BORING # ECS-1	SHEET 1 OF 2
PROJECT NAME NORTH HILL MHP	ARCHITECT-ENGINEER GREENHORNE & O'MARA		
SITE LOCATION ALEXANDRIA, VA. (FAIRFAX COUNTY)			

ECS LLC MID-ATLANTIC

-O- CALIBRATED PENETROMETER TONS/FT.²
1 2 3 4 5+

PLASTIC LIMIT % X—— WATER CONTENT % ●—— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD%— — — REC.%——
20%—40%—60%—80%—100%

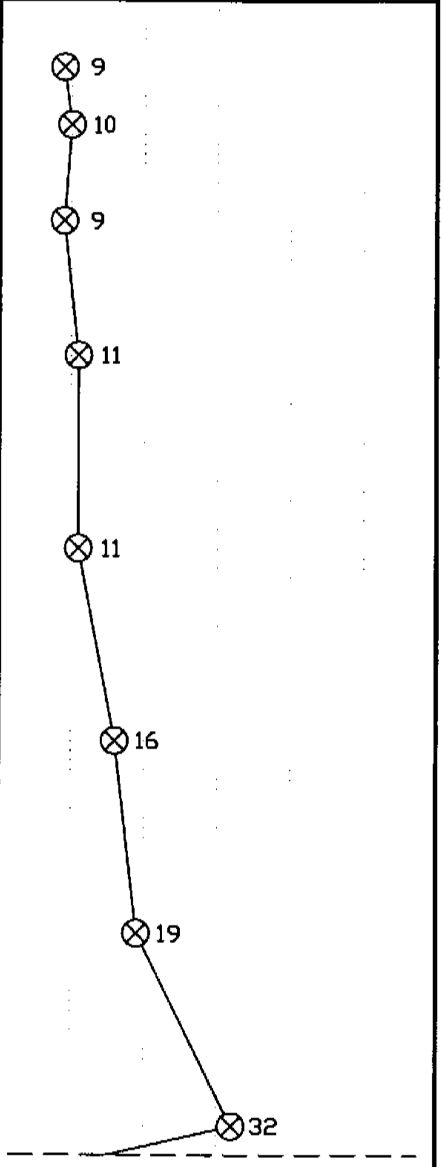
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ➡ LOSS OF CIRCULATION 100%>

SURFACE ELEVATION 183

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)
0						
	1	SS	18	10	SAND, With Gravel, Trace Clay, Brown, Moist, Loose, (FILL)	
	2	SS	18	12	Sandy CLAY, With Gravel, Orangish Brown, Moist, Medium Stiff, (FILL)	180
5	3	SS	18	16	CLAY, With Sand, Brown, Moist, Very Stiff, (CL)	
					CLAY, Brown to Reddish Brown, Moist, Very Stiff to Hard, (CH)	175
	4	SS	18	12		
10						
						170
	5	SS	18	16		
15						
						165
	6	SS	18	18		
20						
						160
	7	SS	18	18		
25						
						155
	8	SS	18	18		
30						



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL DRY WS OR (D)	BORING STARTED 03-28-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-28-09	CAVE IN DEPTH ● 48.3'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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RC (04-27-08) RC (04-27-08) RC (06-05-08) RC (07-30-08)

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CLIENT	JOB #	BORING #	SHEET
	14444	ECS-1	2 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME
NORTH HILL MHP

ARCHITECT-ENGINEER
GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, VA. (FAIRFAX COUNTY)

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 183

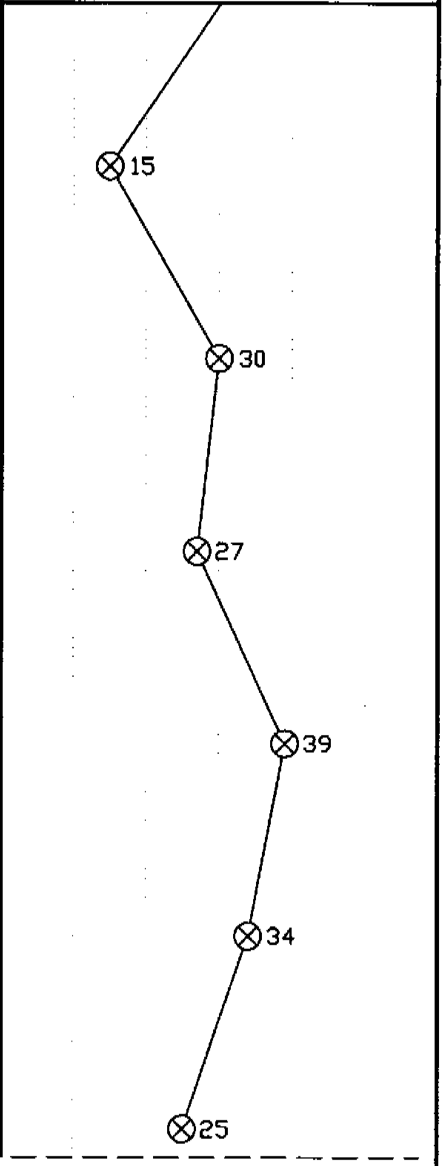
-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X ——— WATER CONTENT % ● ——— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ———
20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
30					CLAY, Brown to Reddish Brown, Moist, Very Stiff to Hard, (CH)		
					SAND, Trace Clay, Gray to Brown, Moist, Medium Dense, (SM)		150
	9	SS	18	16			
35							
	10	SS	18	10			145
40							
					CLAY, Brown, Moist, Hard, (CH)		140
	11	SS	18	16			
45							
							135
	12	SS	18	18			
50							
					Sandy CLAY, Brown and Gray, Moist, Stiff to Very Stiff, (CL)		130
	13	SS	18	16			
55							
							125
	14	SS	18	16			
60							



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL DRY WS OR BD	BORING STARTED 03-28-09		
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-28-09	CAVE IN DEPTH ● 48.3'	
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER	

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CLIENT	JOB #	BORING #	SHEET
	14444	ECS-2	1 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME: NORTH HILL MHP

ARCHITECT-ENGINEER: GREENHORNE & O'MARA

SITE LOCATION: ALEXANDRIA, VA. (FAIRFAX COUNTY)

-O- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X ——— WATER CONTENT % ● ——— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ———
20% 40% 60% 80% 100%

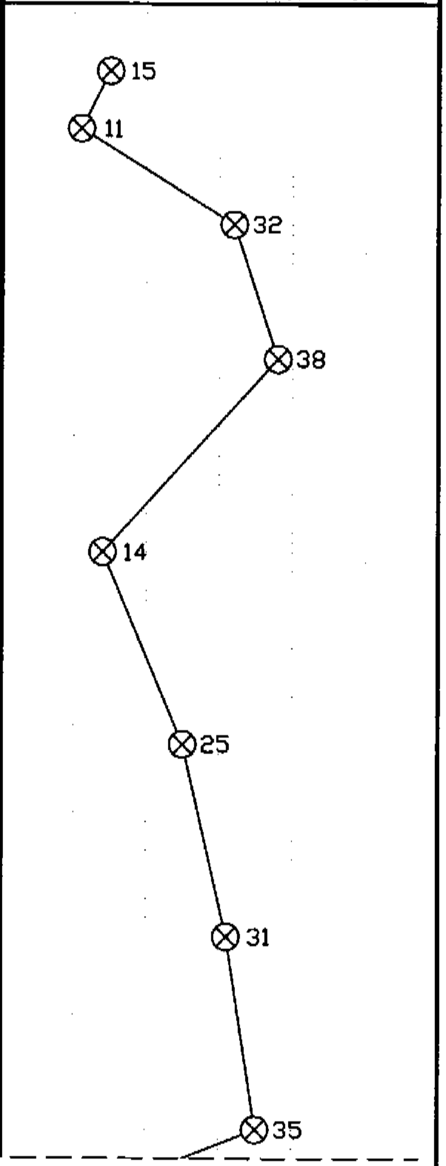
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➧ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 182

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0					Asphalt Depth 1"		
	1	SS	18	6	Gravel Depth 6"		180
	2	SS	18	8	SAND, With Gravel, Trace Clay, Brown, Moist, Medium Dense to Dense, (FILL)		
5							
	3	SS	18	5			
							175
	4	SS	18	0	No Recovery		
10							
							170
	5	SS	18	16	Sandy CLAY, Brown, Moist, Very Stiff, (CL)		
15							
					CLAY, Brown to Reddish Brown, Moist, Very Stiff to Hard, (CH)		165
	6	SS	18	18			
20							
							160
	7	SS	18	14			
25							
							155
	8	SS	18	16			
30							



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 41.0' WS OR ⓓ	BORING STARTED 03-30-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-30-09	CAVE IN DEPTH ● 43.1'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

CLIENT	JOB #	BORING #	SHEET
	14444	ECS-2	2 OF 2

ECS LLC
MID-ATLANTIC

PROJECT NAME
NORTH HILL MHP

ARCHITECT-ENGINEER
GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, VA. (FAIRFAX COUNTY)

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ——
20% 40% 60% 80% 100%

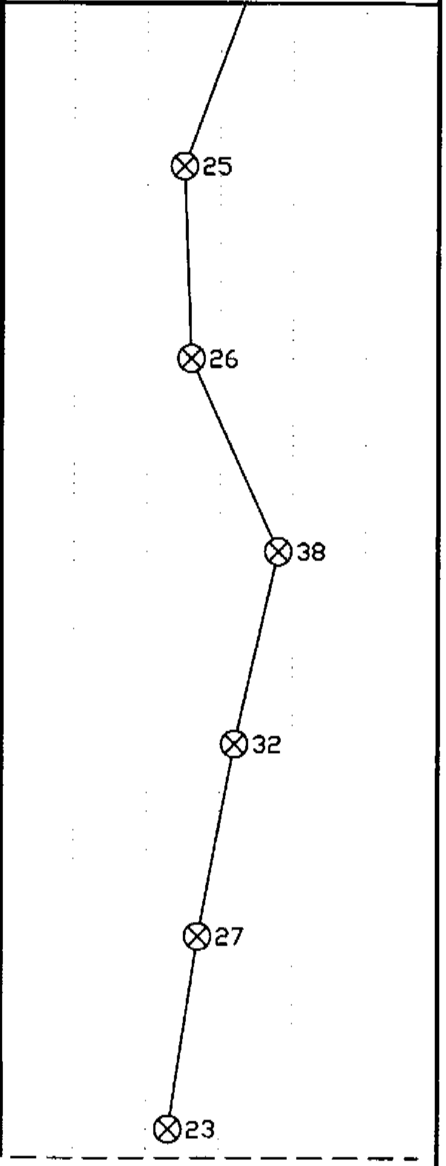
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 182

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
30					CLAY, Brown to Reddish Brown, Moist, Very Stiff to Hard, (CH)		150	
35	9	SS	18	16				25
					Clayey SAND, Grayish Brown, Moist, Medium Dense, (SC)		145	
40	10	SS	18	18		▽		26
					SAND, Gray, Moist, Dense, (SM)		140	
45	11	SS	18	14				38
					CLAY, Brown, Moist, Hard, (CH)		135	
50	12	SS	18	18				32
					Sandy CLAY, Brown and Gray, Moist, Very Stiff, (CL)		130	
55	13	SS	18	18			125	27
60	14	SS	18	16				23



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 41.0' WS OR (WD)	BORING STARTED 03-30-09		
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-30-09	CAVE IN DEPTH ● 43.1'	
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER	

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(04/14/2009)

CLIENT	JOB # 14444	BORING # ECS-3	SHEET 1 OF 2
PROJECT NAME NORTH HILL MHP	ARCHITECT-ENGINEER GREENHORNE & O'MARA		
SITE LOCATION ALEXANDRIA, VA. (FAIRFAX COUNTY)			

ECS LLC MID-ATLANTIC

-O- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % Δ

ROCK QUALITY DESIGNATION & RECOVERY
RQD%— — — REC.%——
20%—40%—60%—80%—100%

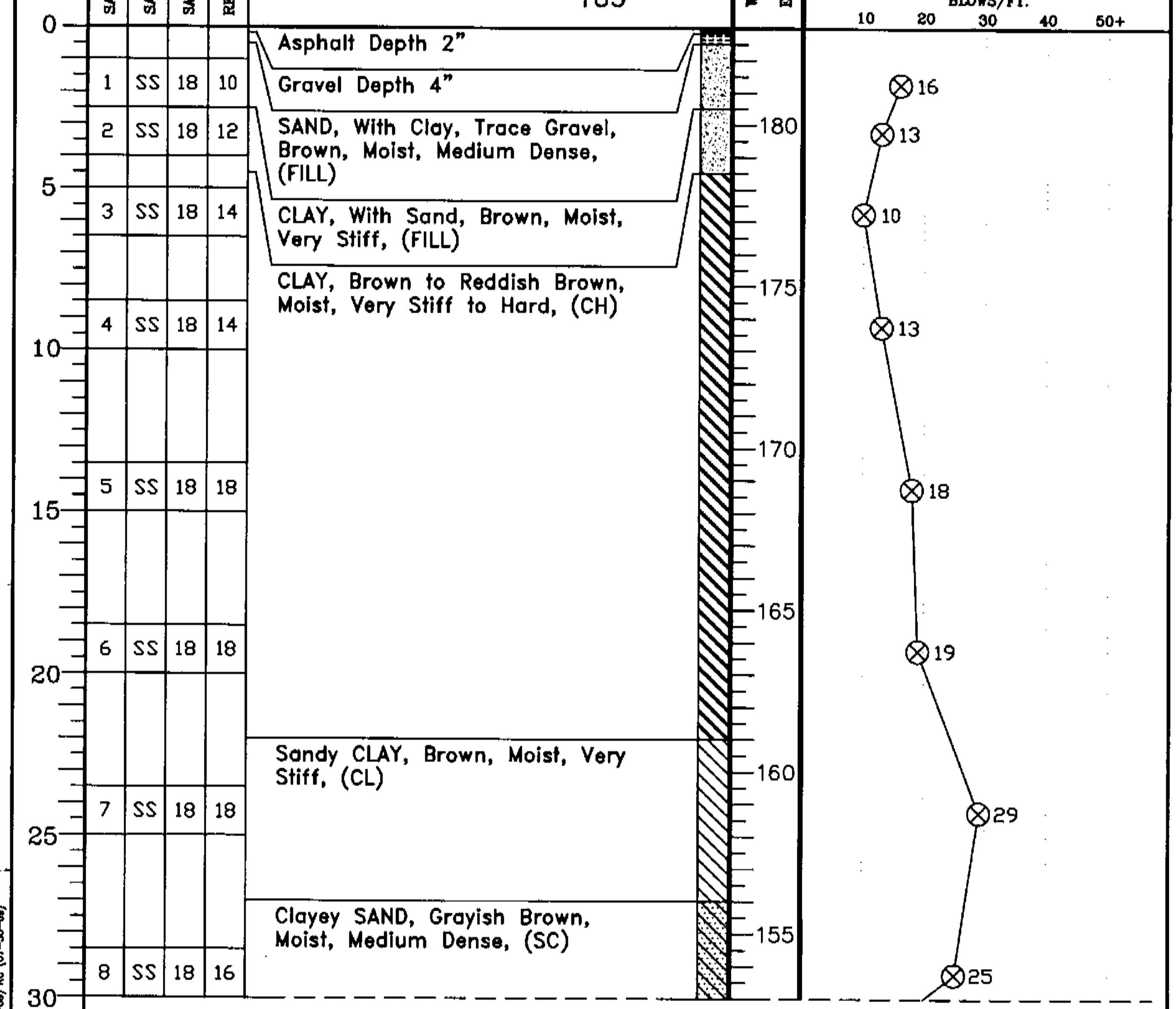
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 183

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL
				Asphalt Depth 2"
1	SS	18	10	Gravel Depth 4"
2	SS	18	12	SAND, With Clay, Trace Gravel, Brown, Moist, Medium Dense, (FILL)
3	SS	18	14	CLAY, With Sand, Brown, Moist, Very Stiff, (FILL)
4	SS	18	14	CLAY, Brown to Reddish Brown, Moist, Very Stiff to Hard, (CH)
5	SS	18	18	
6	SS	18	18	
7	SS	18	18	Sandy CLAY, Brown, Moist, Very Stiff, (CL)
8	SS	18	16	Clayey SAND, Grayish Brown, Moist, Medium Dense, (SC)



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 35.2' WS OR (BD)	BORING STARTED 03-30-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-30-09	CAVE IN DEPTH ● 32.8'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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(04/14/2009)
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CLIENT	JOB #	BORING #	SHEET
	14444	ECS-3	2 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME	ARCHITECT-ENGINEER
NORTH HILL MHP	GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, VA. (FAIRFAX COUNTY)

-O- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

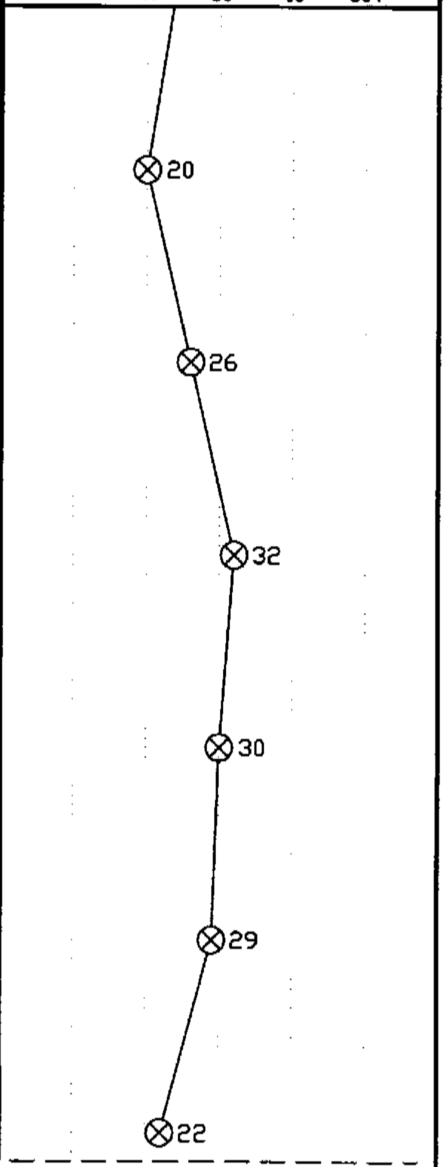
PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ——
20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING ▶ LOSS OF CIRCULATION [100%>
SURFACE ELEVATION 183

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
30					Clayey SAND, Grayish Brown, Moist, Medium Dense, (SC)			
							150	
35	9	SS	18	14		▽		20
					CLAY, Brown, Moist, Hard, (CH)		145	
40	10	SS	18	18				26
							140	
45	11	SS	18	16				32
					Sandy CLAY, Brown and Gray, Moist, Very Stiff to Hard, (CL)		135	
50	12	SS	18	18				30
							130	
55	13	SS	18	18				29
					Clayey SAND, Gray, Moist, Medium Dense, (SC)		125	
60	14	SS	18	14				22



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 35.2' WS OR (BD)	BORING STARTED 03-30-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-30-09	CAVE IN DEPTH ● 32.8'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

CLIENT	JOB #	BORING #	SHEET
	14444	ECS-4	1 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME: NORTH HILL MHP

ARCHITECT-ENGINEER: GREENHORNE & O'MARA

SITE LOCATION: ALEXANDRIA, VA. (FAIRFAX COUNTY)

-O- CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X —— WATER CONTENT % ● —— LIQUID LIMIT % Δ

ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC.% —— 20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 160

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)
1	SS	18	13
2	SS	18	14
3	SS	18	14
4	SS	18	8
5	SS	18	16
6	SS	18	18
7	SS	18	16
8	SS	18	18

Asphalt Depth 2"

Gravel Depth 4"

CLAY, With Gravel, Sand and Organics, Brown, Moist, Medium Stiff, (FILL)

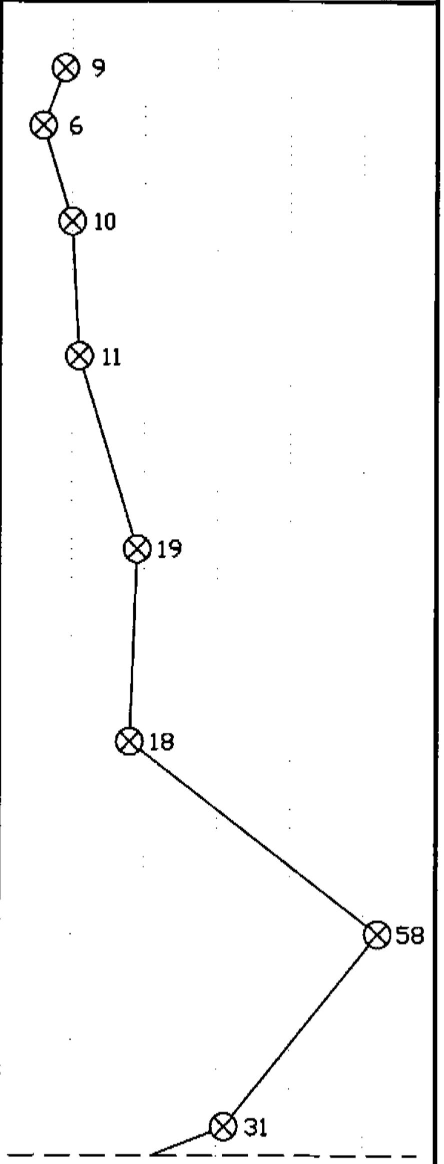
CLAY, Brown to Reddish Brown, Stiff to Hard, (CH)

SAND, With Rock Fragments, Reddish Brown, Moist, Very Dense, (SM)

SAND, Trace Gravel, Brown, Moist to Wet, Medium Dense, (SM)

DEPTH (FT): 0 5 10 15 20 25 30

ELEVATION (FT): 155 150 145 140 135



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 33.0' WS OR (D)	BORING STARTED	03-27-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED	03-27-09	CAVE IN DEPTH ●
▽WL	RIG CME75	FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

(04/14/2009)

CLIENT	JOB #	BORING #	SHEET
	14444	ECS-4	2 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME: NORTH HILL MHP

ARCHITECT-ENGINEER: GREENHORNE & O'MARA

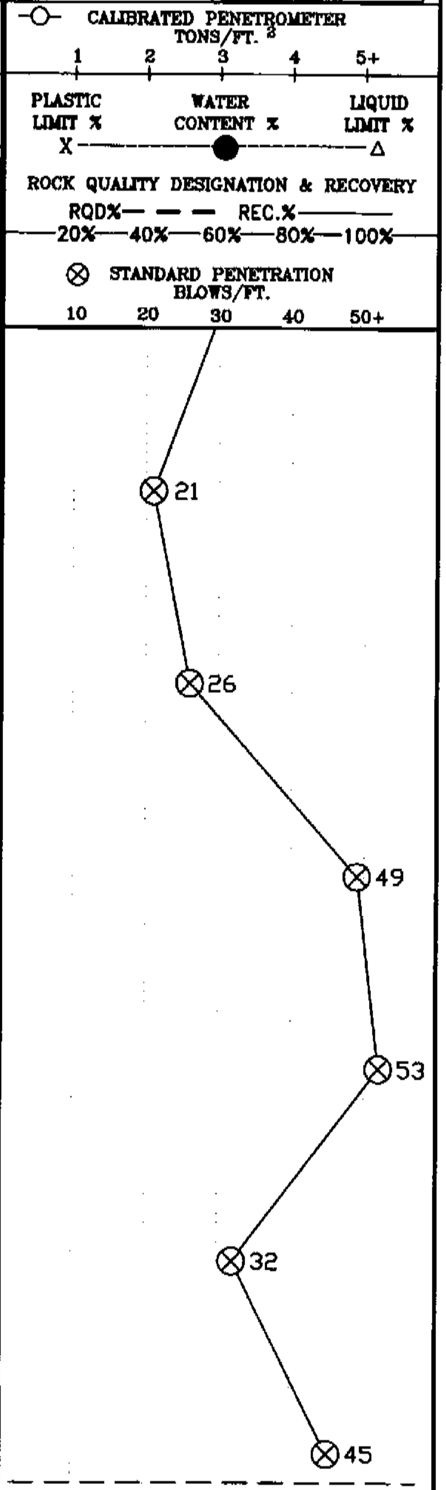
SITE LOCATION: ALEXANDRIA, VA. (FAIRFAX COUNTY)

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ◆ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 160

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
30					SAND, Trace Gravel, Brown, Moist to Wet, Medium Dense, (SM)			
						▽		
35	9	SS	18	18			125	21
					Sandy CLAY, Brown and Gray, Moist, Hard, (CL)			
40	10	SS	18	18			120	26
	11	ST	24	24				
45	12	SS	18	16			115	49
50	13	SS	18	18			110	53
					SAND, Trace Clay, Gray, Moist to Wet, Dense, (SM)			
55	14	SS	18	16			105	32
60	15	SS	18	16				45



END OF BORING @ 60.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 33.0' WS OR ⓓ	BORING STARTED 03-27-09	
▽WL(BCR) ▽WL(ACR)	BORING COMPLETED 03-27-09	CAVE IN DEPTH ●
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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RC (04-27-09) RC (04-27-09) RC (08-05-09) RC (07-30-09)

(04/14/2009)

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CLIENT	JOB #	BORING #	SHEET
	14444	ECS-5	1 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME: NORTH HILL MHP

ARCHITECT-ENGINEER: GREENHORNE & O'MARA

SITE LOCATION: ALEXANDRIA, VA. (FAIRFAX COUNTY)

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➡ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 125

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)
1	SS	18	8
2	SS	18	10
3	SS	18	14
4	SS	18	12
5	SS	18	16
6	SS	18	16
7	SS	18	18
8	SS	18	18

DEPTH (FT): 0, 5, 10, 15, 20, 25, 30

ELEVATION (FT): 120, 115, 110, 105, 100

Asphalt Depth 2"

Gravel Depth 2"

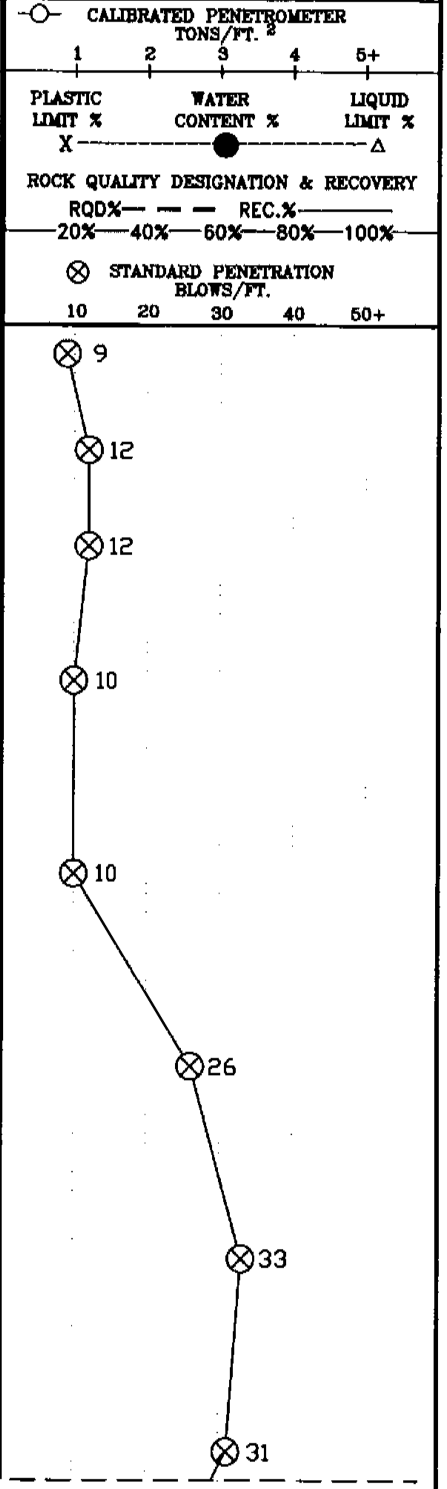
Sandy CLAY, Orangish Brown, Moist, Medium Stiff, (FILL)

SAND, Trace Clay, Orangish Brown, Moist Medium Dense, (SM)

CLAY, Trace Fine Sand, Brown, Moist, Medium Stiff, (CL/CH)

Sandy CLAY, Grayish Brown, Moist, Hard, (CL)

Silty SAND, Trace Clay, Gray and Brown, Moist, Dense, (SM)



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL WS OR (WD)	BORING STARTED 03-31-09		
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-31-09	CAVE IN DEPTH ●	
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER	

CLIENT	JOB # 14444	BORING # ECS-5	SHEET 2 OF 2
PROJECT NAME NORTH HILL MHP	ARCHITECT-ENGINEER GREENHORNE & O'MARA		
SITE LOCATION ALEXANDRIA, VA. (FAIRFAX COUNTY)			

-○- CALIBRATED PENETROMETER TONS/FT.² 1 2 3 4 5+

PLASTIC LIMIT % X —— WATER CONTENT % ● —— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ——
20% 40% 60% 80% 100%

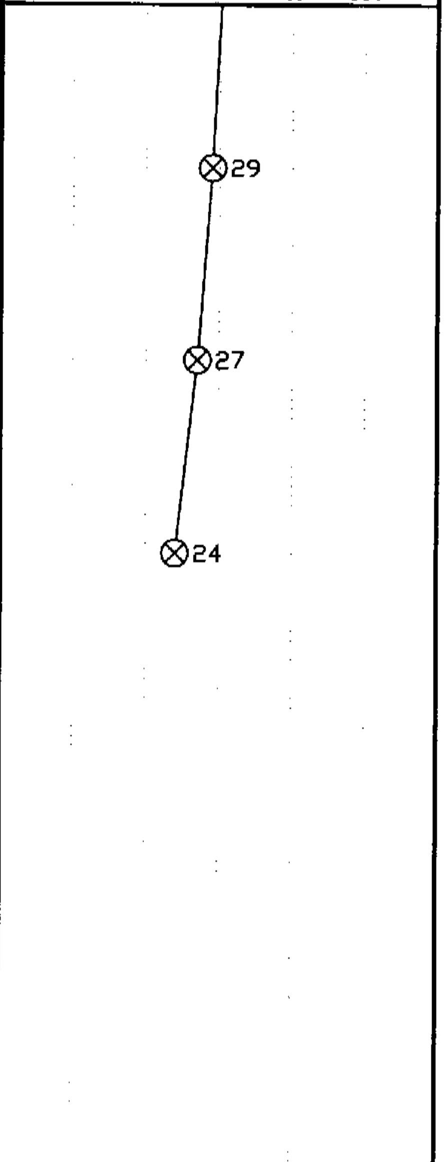
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 125

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
30					Silty SAND, Trace Clay, Gray and Brown, Moist, Dense, (SM)			
35	9	SS	18	18			90	29
					SAND, With Clay, Brown, Moist, Medium Dense, (SM)			
40	10	SS	18	16			85	27
45	11	SS	18	16			80	24
					END OF BORING @ 45.00'			
50							75	
55							70	
60								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL WS OR WD	BORING STARTED 03-31-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-31-09	CAVE IN DEPTH ●
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

(04/14/2009)

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RC (04-27-09) RC (04-27-09) RC (08-05-08) RC (07-30-08)

CLIENT	JOB # 14444	BORING # ECS-6	SHEET 1 OF 2
PROJECT NAME NORTH HILL MHP	ARCHITECT-ENGINEER GREENHORNE & O'MARA		
SITE LOCATION ALEXANDRIA, VA. (FAIRFAX COUNTY)			

ECS LLC MID-ATLANTIC

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ➡ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 126

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)
0	1	SS	18	6
	2	SS	18	8
5	3	SS	18	14
10	4	SS	18	18
15	5	SS	18	16
20	6	SS	18	18
25	7	SS	18	18
30	8	SS	18	18

Asphalt Depth 1"

CLAY, With Sand, Gravel and Asphalt, Brown, Moist, Medium Stiff, (FILL)

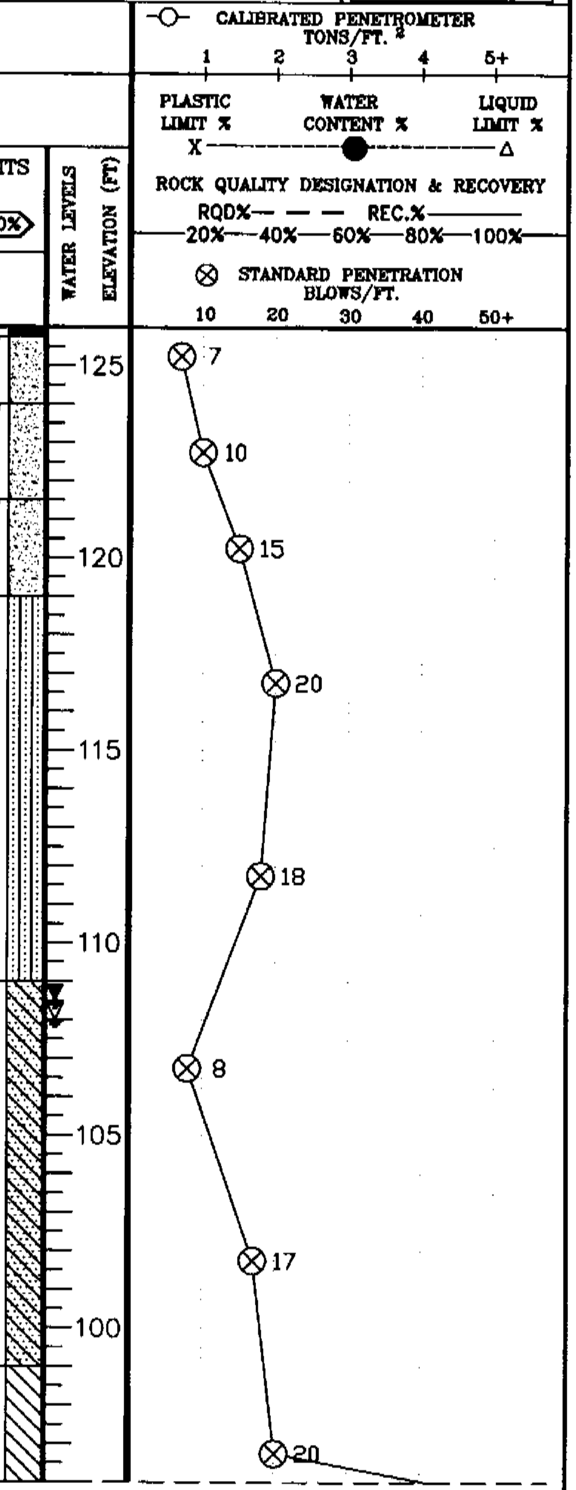
Clayey SAND, Brown, Moist, Loose, (FILL)

Sandy CLAY, Trace Roots, Brown, Moist, Medium Stiff, (FILL)

Silty SAND, Trace Rock Fragments, Brown to Gray, Moist, Medium Dense, (SM)

Clayey SAND, Grayish Brown, Moist to Wet, Loose to Medium Dense, (SC)

Sandy CLAY, Brown and Gray, Moist, Very Stiff, (CL)



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 18.0' WS OR WD	BORING STARTED 03-25-09	
▼WL(BCR) 17.5' ▼WL(ACR)	BORING COMPLETED 03-25-09	CAVE IN DEPTH ● 20.4'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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(04/14/2009)

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CLIENT	JOB #	BORING #	SHEET
	14444	ECS-6	2 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME	ARCHITECT-ENGINEER
NORTH HILL MHP	GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, VA. (FAIRFAX COUNTY)

—○— CALIBRATED PENETROMETER TONS/FT.²
1 2 3 4 5+

PLASTIC LIMIT % X———— WATER CONTENT % ●———— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD%— — — REC.%————
—20%—40%—60%—80%—100%—

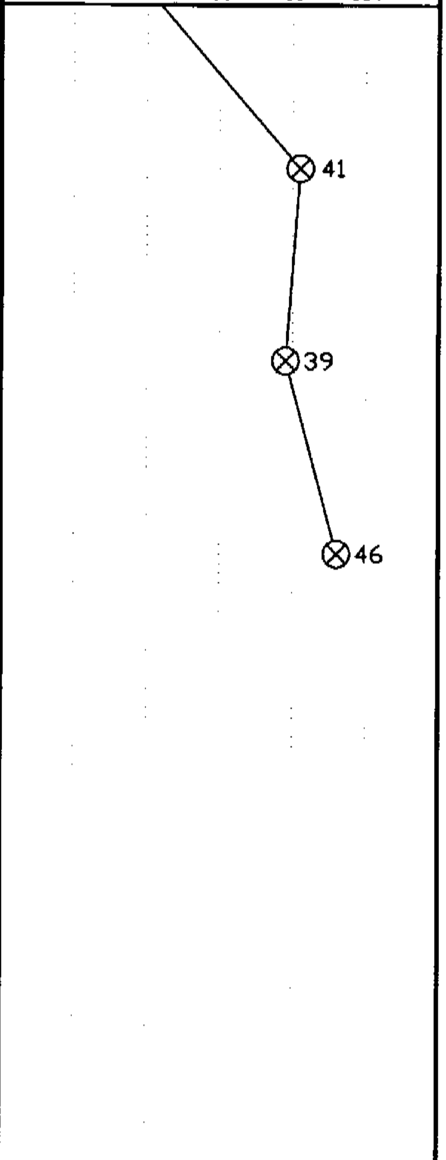
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ➡ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 126

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
30					Sandy CLAY, Brown and Gray, Moist, Very Stiff, (CL)		95
35	9	SS	18	18			90
40	10	SS	18	18			85
45	11	SS	18	0	SAND, Trace Clay, Gray, Wet, Dense, (SM)		80
50					END OF BORING @ 45.00'		75
55							70
60							



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 18.0' WS OR (D)	BORING STARTED 03-25-09	
▼WL(BCR) 17.5' ▼WL(ACR)	BORING COMPLETED 03-25-09	CAVE IN DEPTH ● 20.4'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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(04/14/2009)

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CLIENT	JOB #	BORING #	SHEET	ECS LLC MID-ATLANTIC
	14444	ECS-7	1 OF 2	

PROJECT NAME	ARCHITECT-ENGINEER
NORTH HILL MHP	GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, VA. (FAIRFAX COUNTY)

-○- CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ——
20% 40% 60% 80% 100%

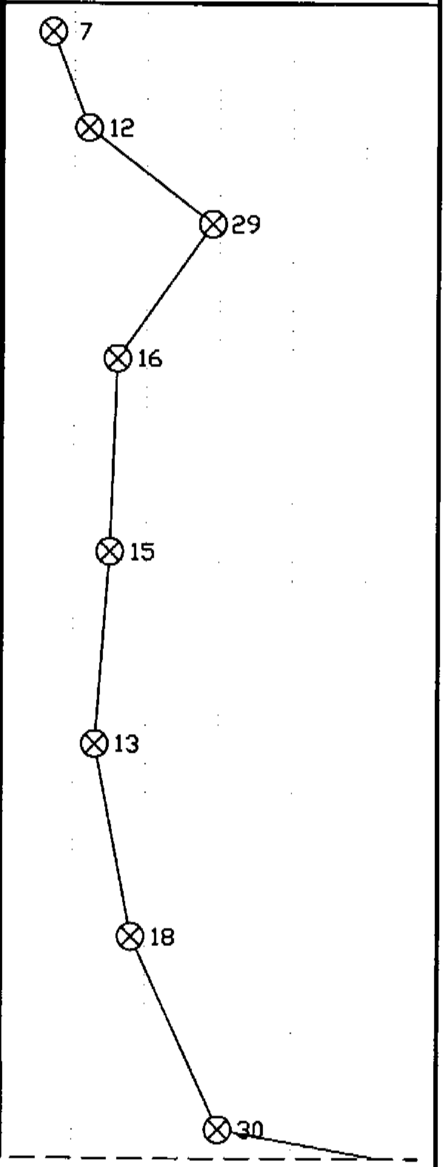
⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 121

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)
0	1	SS	18	14	Topsoil Depth 3" SAND, With Gravel and Organics, Brown, Moist, Loose, (FILL)	120
	2	SS	18	4	Sandy CLAY, With Gravel, Brown, Moist, Stiff to Very Stiff, (FILL)	
5	3	SS	18	4		115
	4	SS	18	16	SAND, With Rock Fragments and Clay, Brown to Grayish Brown, Moist, Medium Dense, (SM)	
10						110
	5	SS	18	16		
15						105
	6	SS	18	18		
20						100
	7	SS	18	16	Sandy CLAY, Brown and Gray, Moist, Very Stiff to Hard, (CL)	
25						95
	8	SS	18	18		
30						



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 18.0' WS OR (BD)	BORING STARTED 03-25-09	
▼WL(BCR) 14.6' ▼WL(ACR)	BORING COMPLETED 03-25-09	CAVE IN DEPTH ● 19.3'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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(04/14/2009)

CLIENT	JOB #	BORING #	SHEET
	14444	ECS-7	2 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME NORTH HILL MHP

ARCHITECT-ENGINEER GREENHORNE & O'MARA

SITE LOCATION ALEXANDRIA, VA. (FAIRFAX COUNTY)

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ **LOSS OF CIRCULATION** 100%

SURFACE ELEVATION 121

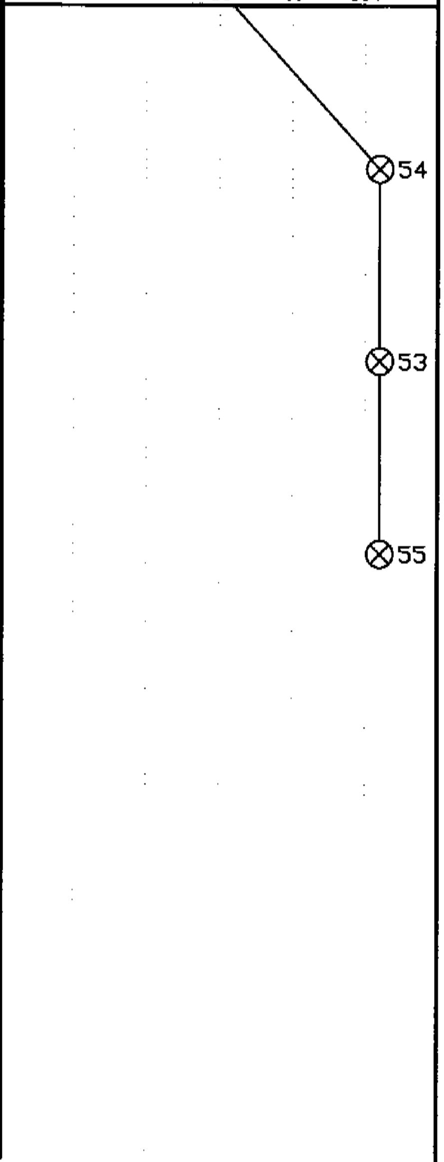
-○- CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC.% —— 20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)
30					Sandy CLAY, Brown and Gray, Moist, Very Stiff to Hard, (CL)	90
35	9	SS	18	12		85
	10	SS	18	18	Silty SAND, Trace Clay, Brown and Gray, Moist, Very Dense, (SM)	80
40						
45	11	SS	18	16		75
					END OF BORING @ 45.00'	
50						70
55						65
60						



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL 18.0' WS OR ⓓ	BORING STARTED 03-25-09	
▼ WL(BCR) 14.6' ▼ WL(ACR)	BORING COMPLETED 03-25-09	CAVE IN DEPTH ● 19.3'
▽ WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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CLIENT	JOB #	BORING #	SHEET	
	14444	ECS-8	1 OF 2	ECS LLC MID-ATLANTIC
PROJECT NAME NORTH HILL MHP	ARCHITECT-ENGINEER GREENHORNE & O'MARA			
SITE LOCATION ALEXANDRIA, VA. (FAIRFAX COUNTY)				

-○- CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X ——— WATER CONTENT % ● ——— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC.% ——— 20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

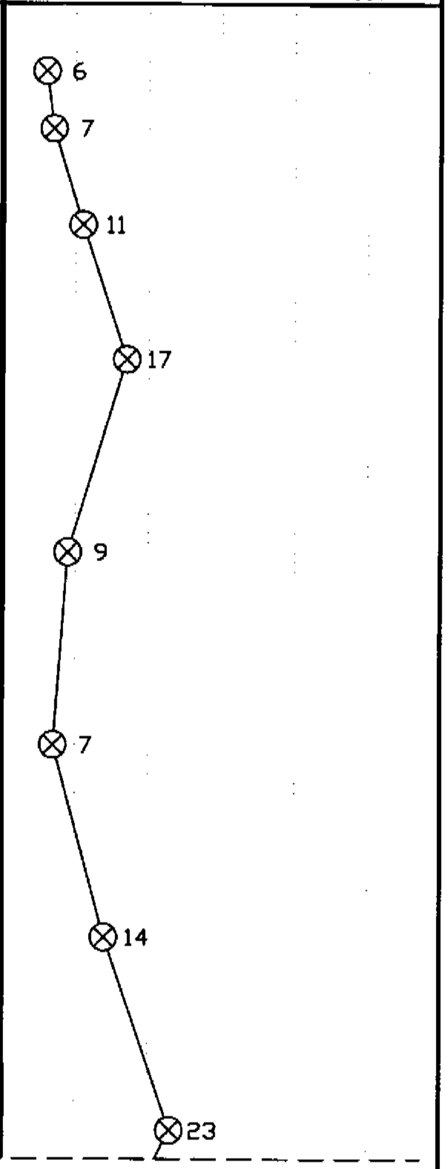
DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 121

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)
1	SS	18	16
2	SS	18	12
3	SS	18	12
4	SS	18	8
5	SS	18	16
6	SS	18	18
7	SS	18	18
8	SS	18	16

DEPTH (FT)	DESCRIPTION OF MATERIAL	ELEVATION (FT)
0	CLAY, With Gravel and Sand, Brown, Moist, Medium Stiff, (FILL)	120
5	SAND, Trace Clay, Brown, Moist, Medium Dense, (SM)	115
	Clayey SAND, Grayish Brown, Moist to Wet, Loose to Medium Dense, (SC)	
10		110
15		105
20		100
	Sandy SILT, Brown, Medium Dense, (ML)	
25		95
30		



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 8.9' WS OR (BD)	BORING STARTED 03-25-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-25-09	CAVE IN DEPTH ● 14.2'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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(04/15/2009)

ARanders

CLIENT	JOB #	BORING #	SHEET
	14444	ECS-8	2 OF 2

ECS LLC MID-ATLANTIC

PROJECT NAME
NORTH HILL MHP

ARCHITECT-ENGINEER
GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, VA. (FAIRFAX COUNTY)

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 121

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL
9	SS	18	18	Sandy SILT, Brown, Medium Dense, (ML)
10	SS	18	14	Clayey SAND, Brown and Gray, Moist, Medium Dense, (SC)
11	SS	18	16	Silty SAND, Grayish Brown, Moist, Medium Dense, (SM)

END OF BORING @ 45.00'

DEPTH (FT): 30, 35, 40, 45, 50, 55, 60

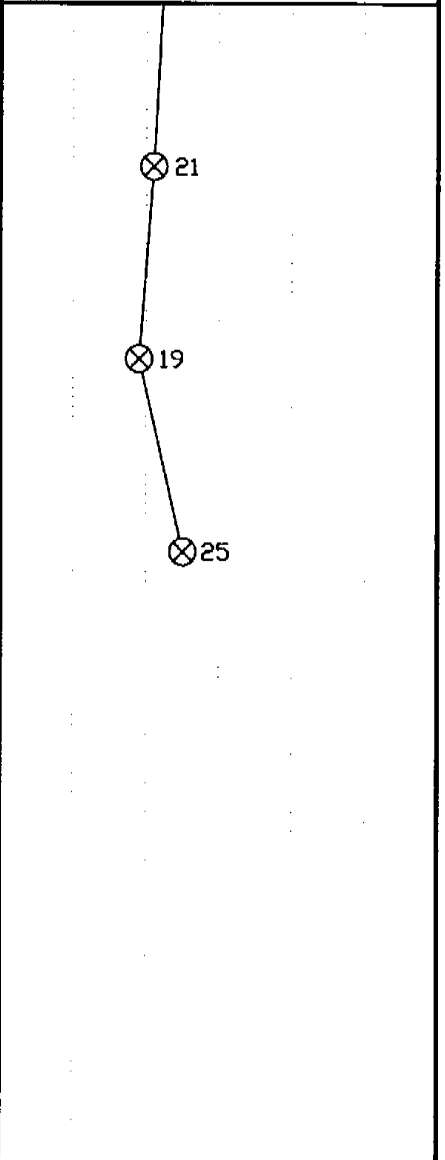
WATER LEVELS — ELEVATION (FT): 90, 85, 80, 75, 70, 65

-○- CALIBRATED PENETROMETER TONS/FT.² 1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ———
20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

∇WL 8.9' WS OR (WD)	BORING STARTED	03-25-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED	03-25-09	CAVE IN DEPTH ● 14.2'
∇WL	RIG CME75	FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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(04/15/2009)
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CLIENT	JOB #	BORING #	SHEET
	14444	ECS-9	1 OF 1

ECS LLC MID-ATLANTIC

PROJECT NAME
NORTH HILL MHP

ARCHITECT-ENGINEER
GREENHORNE & O'MARA

SITE LOCATION
ALEXANDRIA, VA. (FAIRFAX COUNTY)

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 88

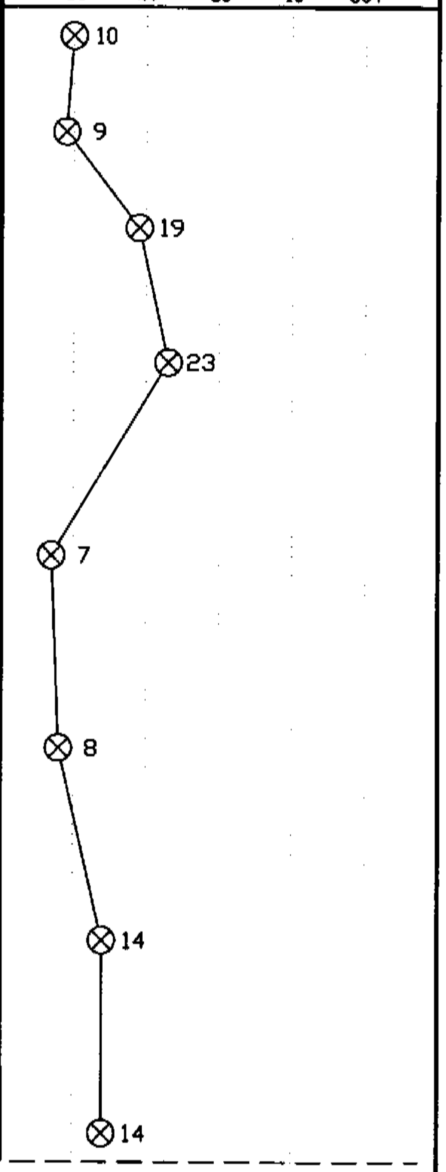
-○- CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X WATER CONTENT % ● LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC.% ——— 20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0							
	1	SS	18	14	Topsoil Depth 2"		
					SAND, With Fine Gravel, Trace Clay, Brown, Moist, Loose, (FILL)		
	2	SS	18	12			85
5					CLAY, With Gravel, Reddish Brown, Moist, Very Stiff to Hard, (CH)		
	3	SS	18	12			
					SAND, With Gravel, Trace Clay, Orangish Brown, Moist, Medium Dense, (SM)		80
	4	SS	18	14			
10							
					CLAY, Brown, Moist, Medium Stiff, (CL/CH)		75
	5	SS	18	18			
15							
					Sandy CLAY, Brown, Moist, Medium Stiff to Stiff, (CL)		70
	6	SS	18	16			
20						▽	
						▼	65
	7	SS	18	18			
25							
					CLAY, Brown, Moist, Very Stiff, (CH)		60
	8	SS	18	16			
30							



END OF BORING @ 30.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 20.0' WS OR (BD)	BORING STARTED 03-24-09	
▼WL(BCR) 23.6' ▼WL(ACR)	BORING COMPLETED 03-24-09	CAVE IN DEPTH ● 26.0'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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(04/15/2008)

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CLIENT	JOB # 14444	BORING # ECS-10	SHEET 1 OF 1	ECS LLC MID-ATLANTIC
PROJECT NAME NORTH HILL MHP	ARCHITECT-ENGINEER GREENHORNE & O'MARA			
SITE LOCATION ALEXANDRIA, VA. (FAIRFAX COUNTY)				

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X——— WATER CONTENT % ● ———△ LIQUID LIMIT %

ROCK QUALITY DESIGNATION & RECOVERY
RQD%— — — REC.%———
20%—40%—60%—80%—100%

⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 90

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)
1	SS	18	10
2	SS	18	8
3	SS	18	10
4	SS	18	12
5	SS	18	16
6	SS	18	14
7	SS	18	18
8	SS	18	16

Topsoil Depth 2"

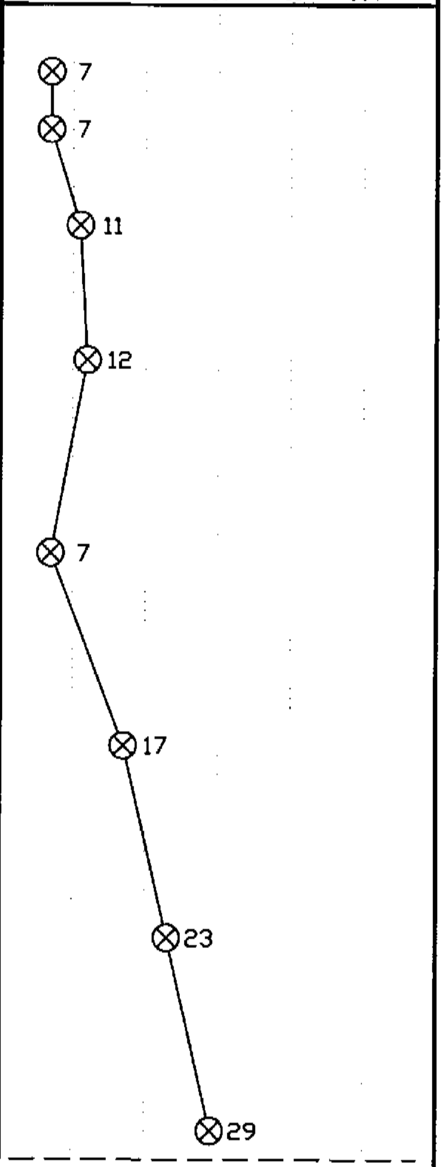
Gravel Depth 4"

SAND, Brown, Moist, Loose, (FILL)

CLAY, Trace Sand, Brown, Moist, Very Stiff, (CL)

CLAY, Brown, Moist, Very Stiff, (CL/CH)

Sandy SILT, Brown and Gray, Moist, Medium Dense, (ML)



END OF BORING @ 30.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL DRY WS OR BD	BORING STARTED 03-24-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED 03-24-09	CAVE IN DEPTH ● 26.5'
▽WL	RIG CME75 FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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RC (04-27-09) RC (04-27-09) RC (06-05-09) RC (07-30-09)

(04/15/2009)

AFlanders

CLIENT	JOB #	BORING #	SHEET
	14444	ECS-11	1 OF 1

ECS LLC MID-ATLANTIC

PROJECT NAME: NORTH HILL MHP

ARCHITECT-ENGINEER: GREENHORNE & O'MARA

SITE LOCATION: ALEXANDRIA, VA. (FAIRFAX COUNTY)

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➡ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 85

-○- CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC.% —— 20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)
1	SS	18	2
2	SS	18	2
3	SS	18	1
4	SS	18	10
5	SS	18	18
6	SS	18	18
7	SS	18	16
8	SS	18	16

Asphalt Depth 2"

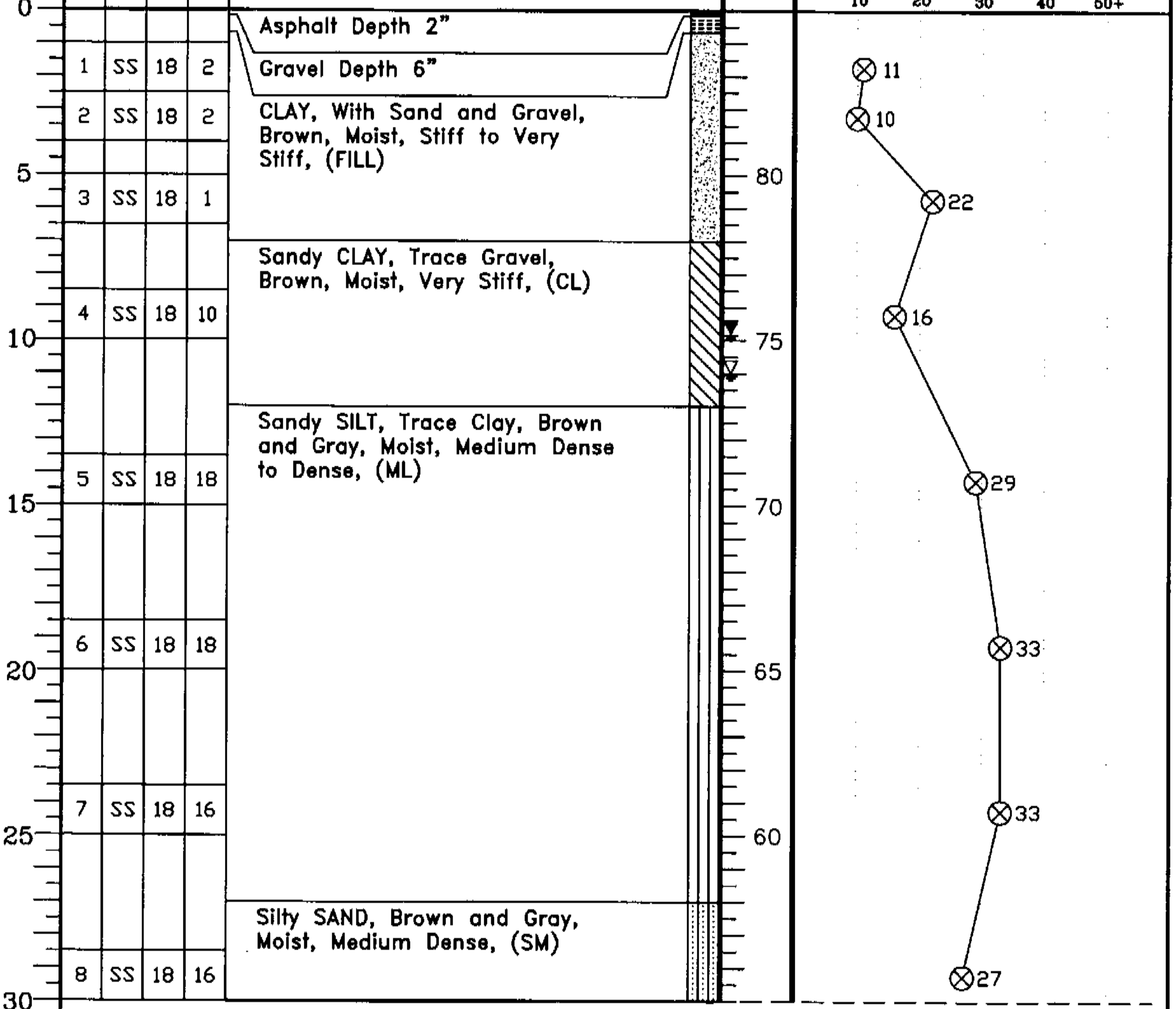
Gravel Depth 6"

CLAY, With Sand and Gravel, Brown, Moist, Stiff to Very Stiff, (FILL)

Sandy CLAY, Trace Gravel, Brown, Moist, Very Stiff, (CL)

Sandy SILT, Trace Clay, Brown and Gray, Moist, Medium Dense to Dense, (ML)

Silty SAND, Brown and Gray, Moist, Medium Dense, (SM)



END OF BORING @ 30.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL 11.0' WS OR (BCR)	BORING STARTED	03-31-09	
▼WL(BCR) 9.8' ▼WL(ACR)	BORING COMPLETED	03-31-09	CAVE IN DEPTH ● 13.7'
▽WL	RIG CME75	FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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RC (04-27-09) RC (04-27-09) RC (06-05-09) RC (07-30-09)

(04/15/2009)

CLIENT	JOB #	BORING #	SHEET
	14444	ECS-12	1 OF 1

ECS LLC MID-ATLANTIC

PROJECT NAME: NORTH HILL MHP

ARCHITECT-ENGINEER: GREENHORNE & O'MARA

SITE LOCATION: ALEXANDRIA, VA. (FAIRFAX COUNTY)

-○- CALIBRATED PENETROMETER TONS/FT.^{2} 1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY: RQD% — — — REC.% —— 20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 101

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)
1	SS	18	12
2	SS	18	10
3	SS	18	12
4	SS	18	4
5	SS	18	14
6	SS	18	18
7	SS	18	18
8	SS	18	18

CLAY, With Sand, Roots and Gravel, Brown, Moist, Medium Stiff to Stiff, (FILL)

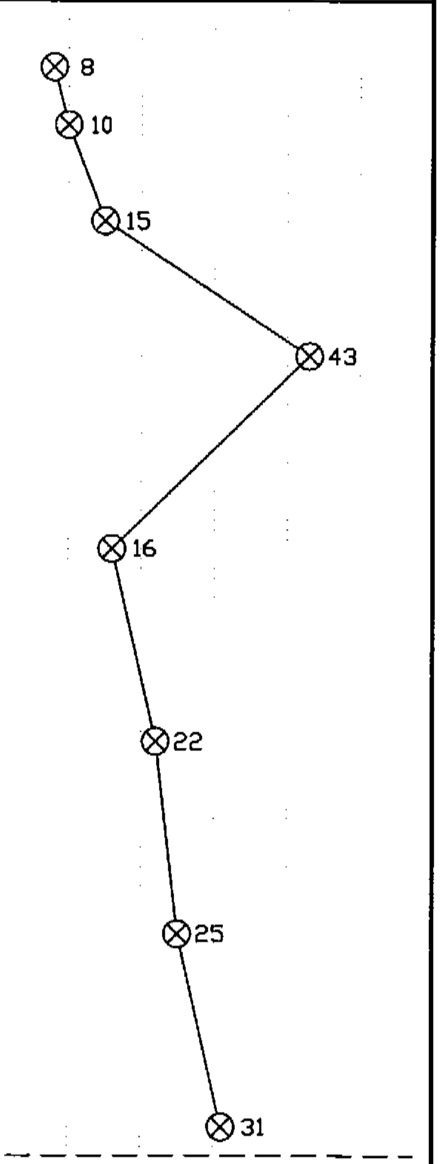
SAND, With Gravel, Trace Clay, Orangish Brown, Moist, Dense, (SM)

Sandy CLAY, Brown, Moist, Stiff to Very Stiff, (CL)

Silty SAND, Trace Clay, Brown and Gray, Moist, Medium Dense to Dense, (SM)

DEPTH (FT): 0, 5, 10, 15, 20, 25, 30

WATER LEVELS — ELEVATION (FT): 100, 95, 90, 85, 80, 75



END OF BORING @ 30.00'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL DRY — WS OR (BD)	BORING STARTED	03-24-09	
▼WL(BCR) ▼WL(ACR)	BORING COMPLETED	03-24-09	CAVE IN DEPTH ● 27.8'
▽WL	RIG CME75	FOREMAN D&S	DRILLING METHOD HOLLOW STEM AUGER

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RC (04-27-09) RC (04-27-09) RC (06-05-09) RC (07-30-09)

(04/15/2009)

AFanders

Appendix C – Laboratory Test Results

Engineering Consulting Services Mid-Atlantic, LLC

Chantilly, Virginia

Laboratory Testing Summary

Date: 4/27/09

Project Number: 14444

Project Name: North Hill Property MHP

Project Engineer: MET

Principal Engineer: JCG

Summary By: HNT1

Boring Number	Sample Number	Depth (feet)	Moisture Content (%)	USCS	Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing No. 200 Sieve	Compaction		CBR Value	Other
									Maximum Density (pcf)	Optimum Moisture (%)		
ECS-1	Tube	11.0 - 13.0		CH	60	28	32	92.8				
ECS-2	S-7	23.5 - 25.0	25.6	CH	68	24	44	96.4				
ECS-3	S-4	8.5 - 10.0	26.8	CH	66	21	45	86.1				
ECS-5	Tube	15.0 - 17.0		CH	66	28	38	92.0				
ECS-7	S-8	28.5 - 30.0	32.0	MH	55	32	23	89.7				
ECS-8	S-7	23.5 - 25.0	31.5	SM	44	28	16	39.4				
ECS-9	S-8	28.5 - 30.0	24.6	CL	46	23	23	58.4				
ECS-10	S-5	13.5 - 15.0	26.6	CH	58	22	36	64.6				
ECS-12	S-6	18.5 - 20.0	29.1	MH	55	32	23	95.6				
ECS-1	Bag	0.0 - 10.0	12.5	CH	50	17	33	64.1	114.3	14.3	7.3	
ECS-5	Bag	0.0 - 10.0	11.4	SC	47	20	27	46.1	106.2	17.1	8.7	
C-1	S-3	6.0 - 8.0		SM	76	41	35	26.0				
C-4	Bag	8.0 - 10.0		SM	52	28	24	19.5				

Summary Key:

SA = See Attached
S = Standard Proctor
M= Modified Proctor
V = Virginia Test Method
OC = Organic Content

Hyd = Hydrometer
Con = Consolidation
DS = Direct Shear
GS = Specific Gravity

UCS = Unconfined Compression Soil
UCR = Unconfined Compression Rock
LS = Lime Stabilization
CS = Cement Stabilization

NP = Non Plastic

Engineering Consulting Services Mid-Atlantic, LLC

Chantilly, Virginia

Laboratory Testing Summary

Date: **7/30/09**

Project Number: **14444** **Project Name:** **North Hill Property MHP**

Project Engineer: **MET** **Principal Engineer:** **JCG** **Summary By:** **HNT1**

Boring Number	Sample Number	Depth (feet)	Moisture Content (%)	USCS	Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing No. 200 Sieve	Compaction		CBR Value	Other
									Maximum Density (pcf)	Optimum Moisture (%)		
C-1	S-8	28.5 - 30.0	23.1									
C-2	S-4	8.5 - 10.0	8.8									
C-2	S-11	43.5 - 45.0	30.1	SC	36	22	14	48.4				
C-3	S-8	28.5 - 30.0	30.0	CH	64	29	35	93.7				
C-3	S-13	53.5 - 55.0	34.2									
C-4	S-7	23.5 - 25.0	25.1									

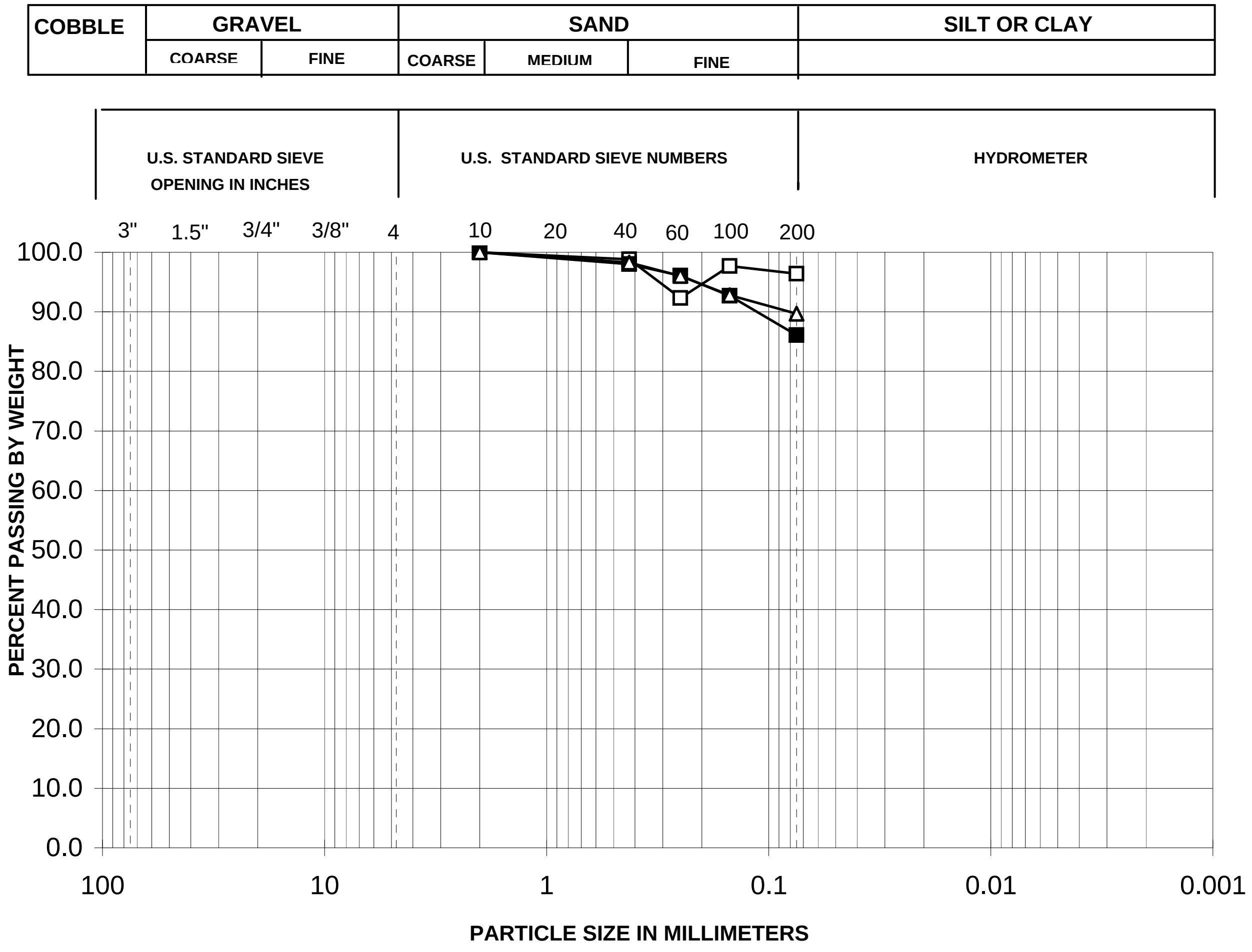
Summary Key:

SA = See Attached
S = Standard Proctor
M= Modified Proctor
V = Virginia Test Method
OC = Organic Content

Hyd = Hydrometer
Con = Consolidation
DS = Direct Shear
GS = Specific Gravity

UCS = Unconfined Compression Soil
UCR = Unconfined Compression Rock
LS = Lime Stabilization
CS = Cement Stabilization

NP = Non Plastic



Boring/ Sample No.	Depth (feet)	Symbol	LL	PI	Description
ECS-2 S-7	23.5-25.0	□	68	44	Fat Clay Yellowish Brown (CH)
ECS-3 S-4	8.5-10.0	■	66	45	Fat Clay Reddish Brown (CH)
ECS-7 S-8	28.5-30.0	△	55	33	Elastic Silt Yellowish Olive (MH)

Applicable ASTM: D-422

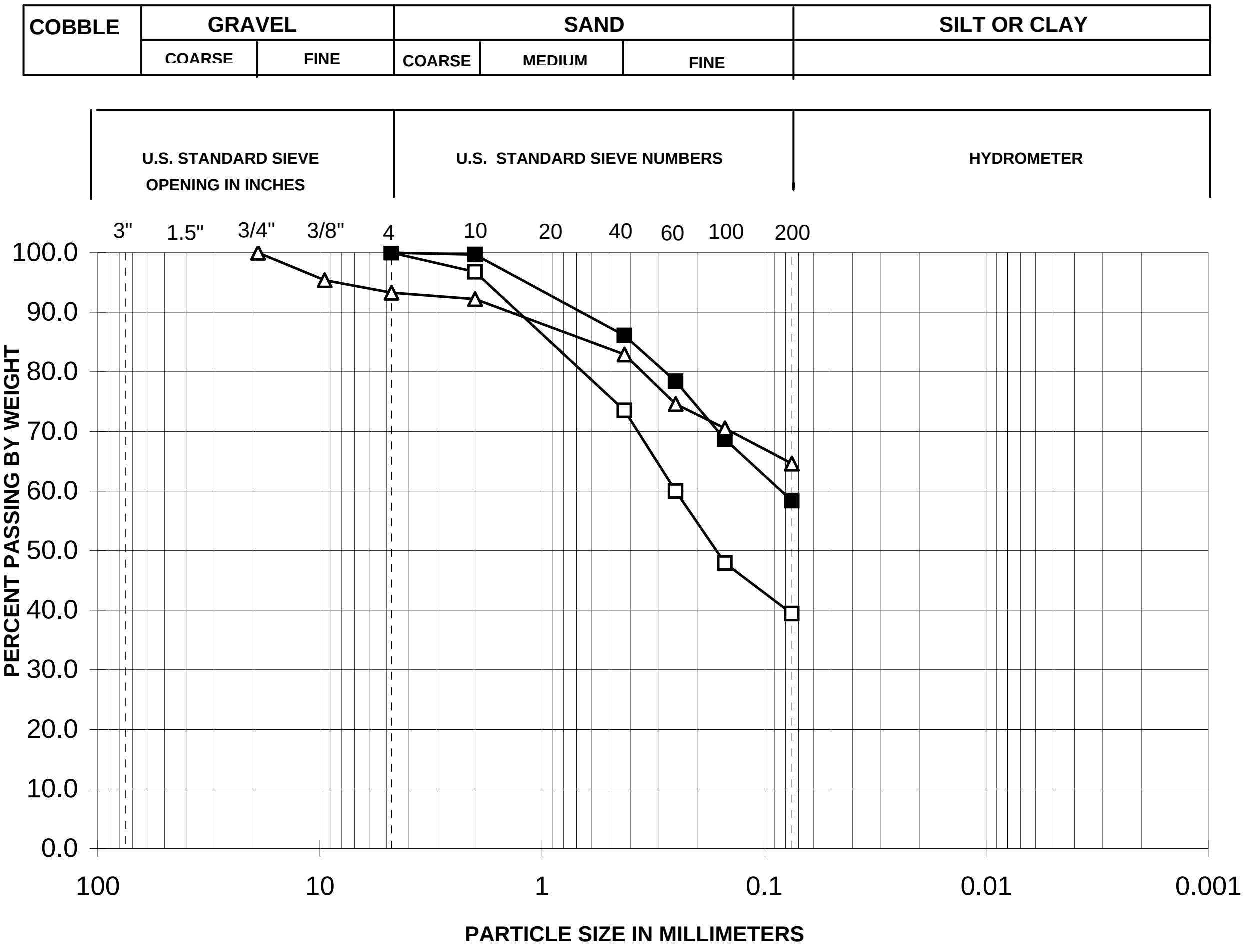
Project: North Hill Property MHP

Project No: 14444

Performed Date: 4/21/09

ECS MID-ATLANTIC, LLC
Chantilly, Virginia

Grain Size Analysis



Boring/ Sample No.	Depth (feet)	Symbol	LL	PI	Description
ECS-8 S-7	23.5-25.0	□	44	16	Silty Sand Grayish Brown (SM)
ECS-9 S-8	28.5-30.0	■	46	23	Sandy Lean Clay Yellow (CL)
ECS-10 S-5	13.5-15.0	△	58	36	Sandy Fat Clay Yellow (CH)

Applicable ASTM: D-422

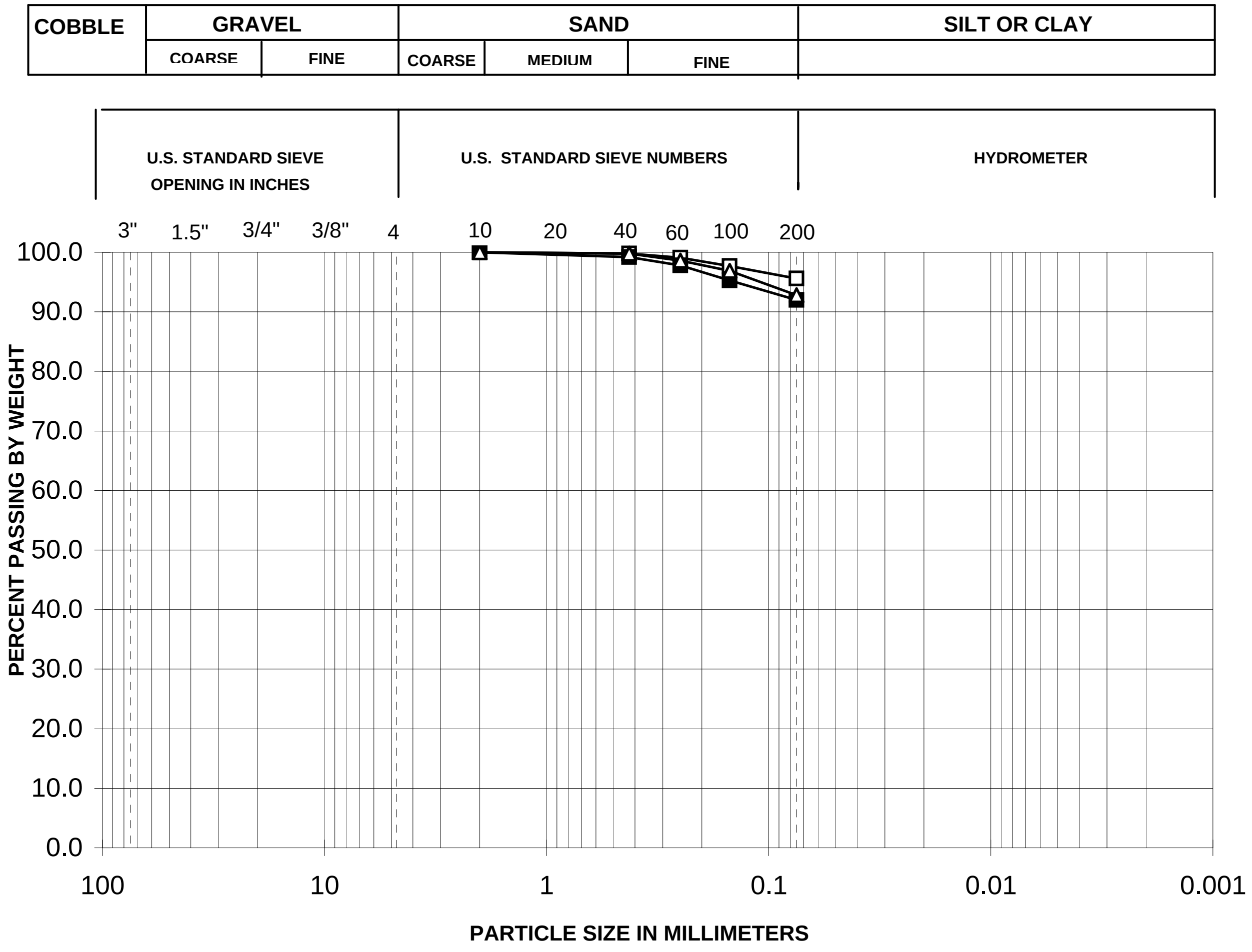
Project: North Hill Property MHP

Project No: 14444

Performed Date: 4/21/09

ECS MID-ATLANTIC, LLC
Chantilly, Virginia

Grain Size Analysis



Boring/ Sample No.	Depth (feet)	Symbol	LL	PI	Description
ECS-12 S-6	18.5-20.0	□	55	23	Elastic Silt Brown (MH)
ECS-5 Tube	15.0-17.0	■	66	38	Fat Clay Tr/Mica Yellow Brown (CH)
ECS-1 Tube	11.0-13.0	△	60	32	Fat Clay Yellow Brown (CH)

Applicable ASTM: D-422

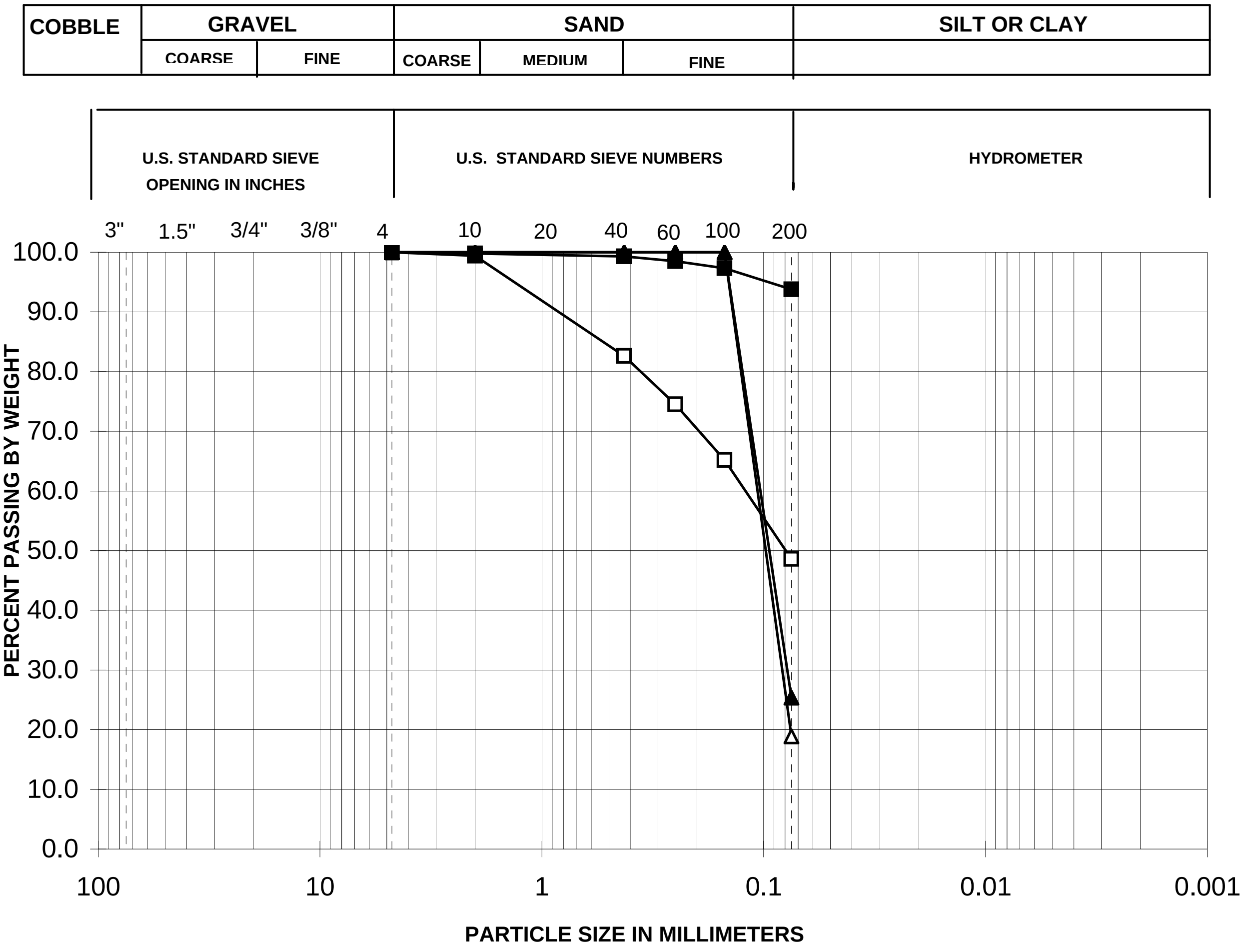
Project: North Hill Property MHP

Project No: 14444

Performed Date: 4/21/09

ECS MID-ATLANTIC, LLC
Chantilly, Virginia

Grain Size Analysis



Boring/ Sample No.	Depth (feet)	Symbol	LL	PI	Description
C-2 S-11	43.5-45.0	□	36	14	Clayey Sand Olive (SC)
C-3 S-8	28.5-30.0	■	64	35	Fat Clay Yellow (CH)
C-1 S-3	6.0-8.0	△	76	35	Sand W/Elastic Silt (SM)
C-4 Bag	8.0-10.0	▲	52	24	Silty Sand (SM)

Applicable ASTM: D-422

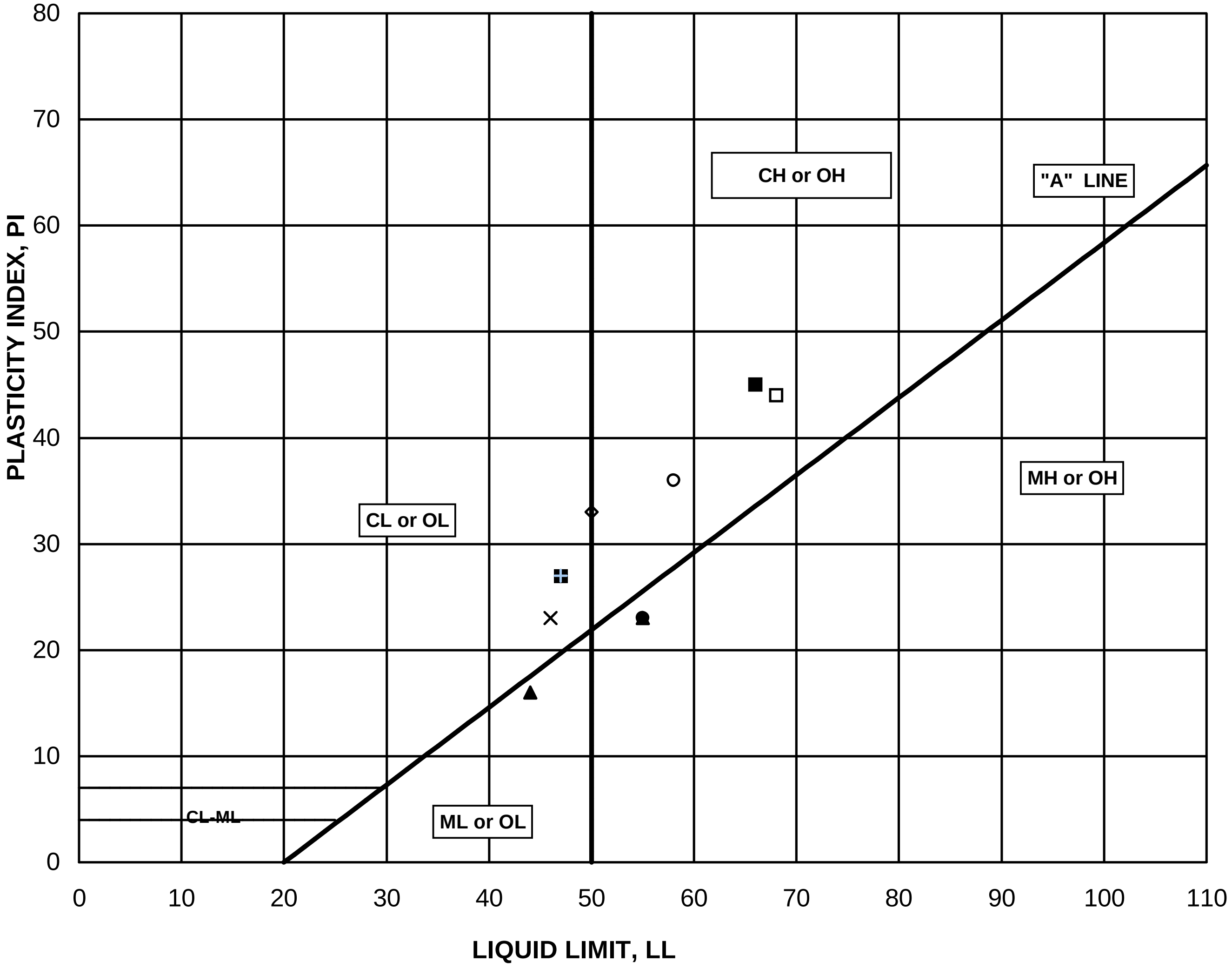
Project: North Hill Property MHP

Project No: 14444

Performed Date: 7/29/09

ECS MID-ATLANTIC, LLC
Chantilly, Virginia

Grain Size Analysis



BORING/ SAMPLE No.	DEPTH (feet)	TEST SYMBOL	DESCRIPTION	WATER CONTENT (%)	LL	PL	PI
ECS-2 / S-7	23.5-25.0	o	Fat Clay Yellowish Brown (CH)	25.1	68	24	44
ECS-3 / S-4	8.5-10.0	n	Fat Clay Reddish Brown (CH)	26.8	66	21	45
ECS-7 / S-8	28.5-30.	△	Elastic Silt Yellowish Olive (MH)	32.0	55	32	23
ECS-8 / S-7	23.5-25.0	▲	Silty Sand Grayish Brown (SM)	31.5	44	28	16
ECS-9 / S-8	28.5-30.0	X	Sandy Lean Clay Yellow (CL)	24.6	46	23	23
ECS-10 / S-5	13.5-15.0	○	Sandy Fat Clay Yellow (CH)	26.6	58	22	36
ECS-12 / S-6	18.5-20.0	●	Elastic Silt Yellowish Brown (MH)	29.1	55	32	23
ECS-1 / Bag	0-10.0	◇	Sandy Fat Clay Strong Brown (CH)	12.5	50	17	33
ECS-5 / Bag	0-10.0	t	Clayey Sand Yellow Brown (SC)	11.4	47	20	27

Applicable ASTM: D-4318

Project: **North Hill Property MHP**

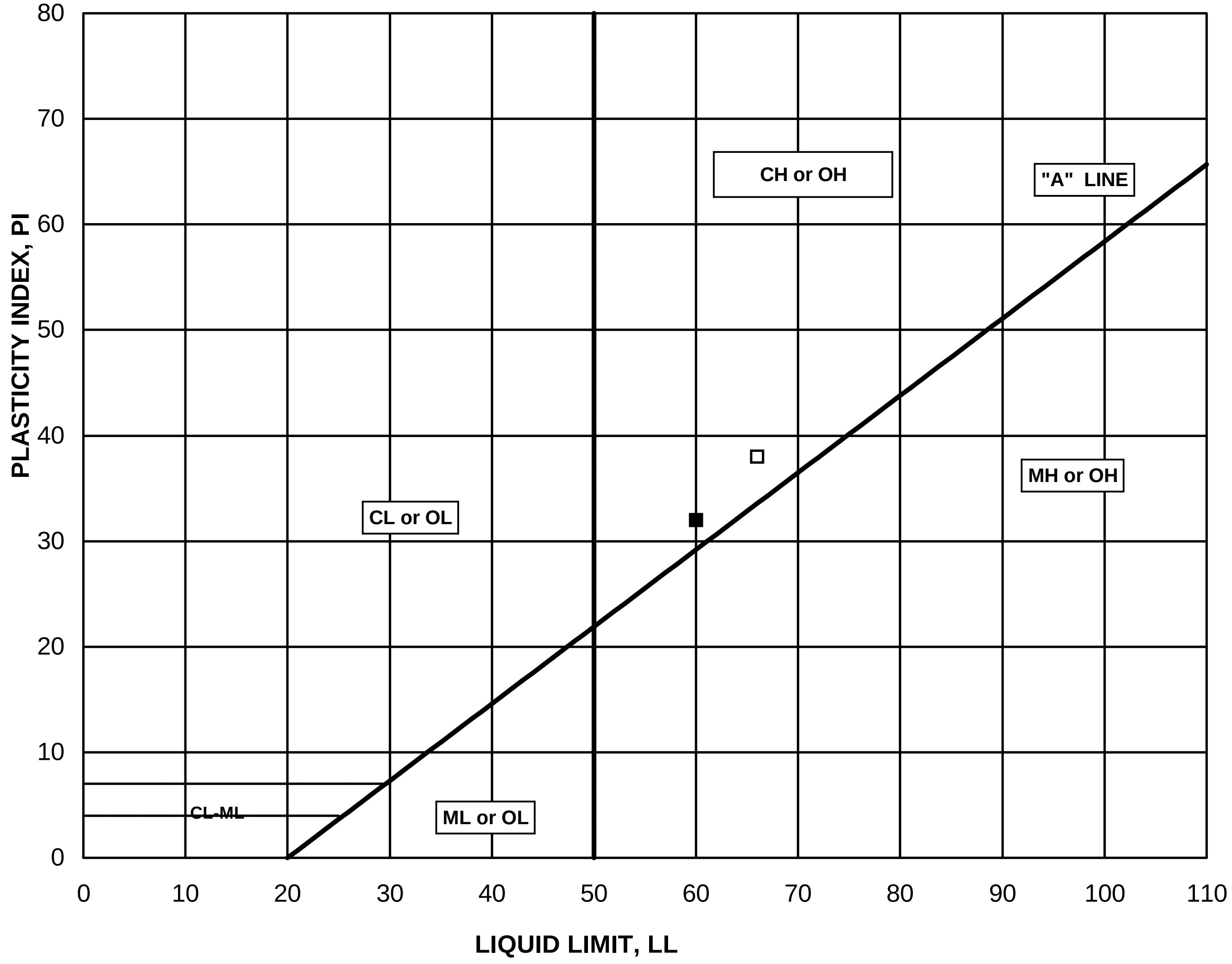
Project No.: **14444**

Date: **04/22/2009**

Engineering Consulting Services Ltd.

Chantilly, Virginia

Plasticity Chart



BORING/ SAMPLE No.	DEPTH (feet)	TEST SYMBOL	DESCRIPTION	WATER CONTENT (%)	LL	PL	PI
ECS-5 / Tube	15.0-17.0	o	Fat Clay Tr/Mica Yellow Brown (CH)		66	28	38
ECS-1 / Tube	11.0-13.0	n	Fat Clay Yellow Brown (CH)		60	28	32

Applicable ASTM: D-4318

Project: **North Hill Property MHP**

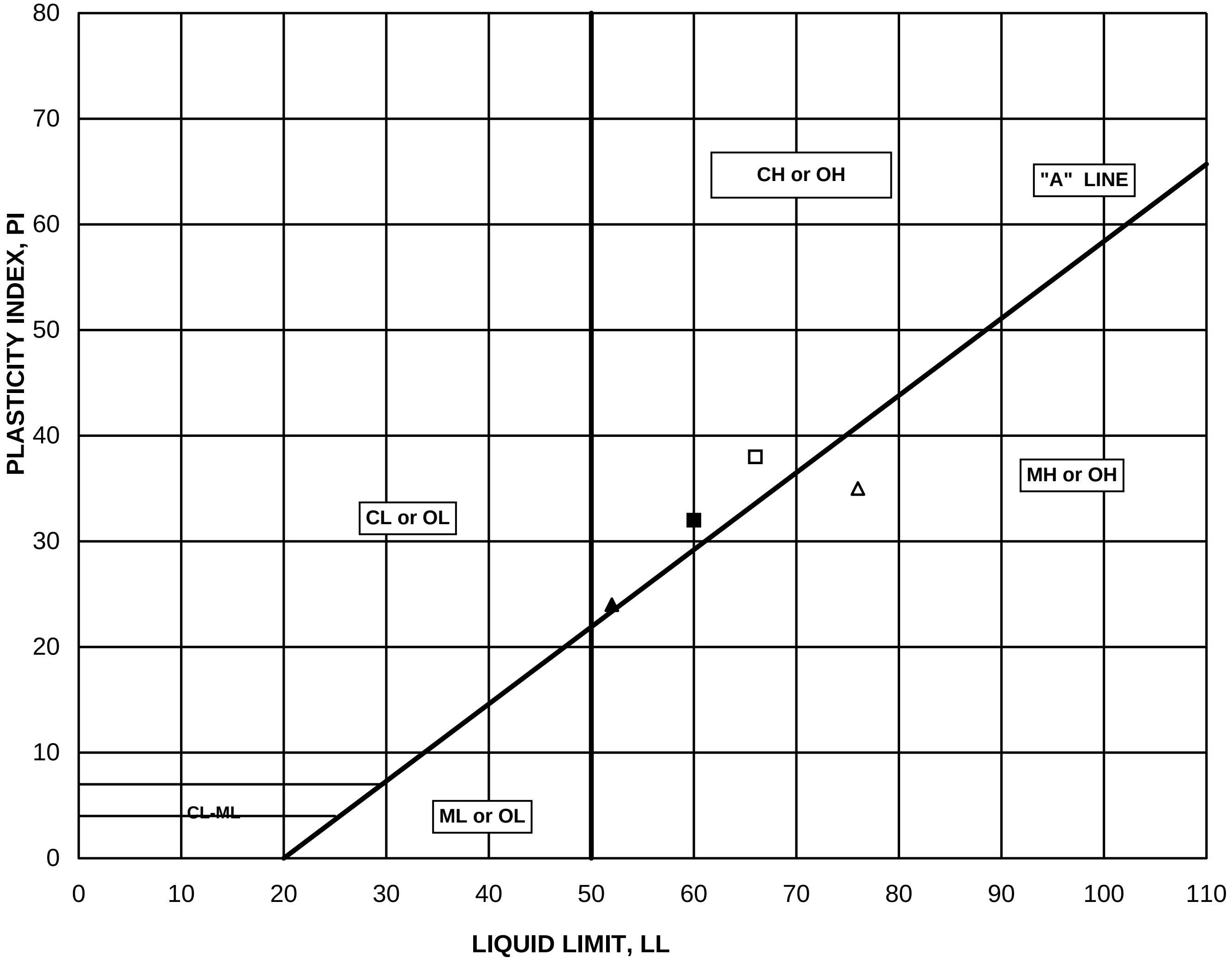
Project No.: **14444**

Performed Date: **04/27/2009**

ECS-Mid-Atlantic, LLC

Chantilly, Virginia

Plasticity Chart



BORING/ SAMPLE No.	DEPTH (feet)	TEST SYMBOL	DESCRIPTION	WATER CONTENT (%)	LL	PL	PI
ECS-5 / Tube	15.0-17.0	□	Fat Clay Tr/Mica Yellow Brown (CH)		66	28	38
ECS-1 / Tube	11.0-13.0	■	Fat Clay Yellow Brown (CH)		60	28	32
C-1 / S-3	6.0 - 8.0	△	Sand W/Elastic Silt (SM)		76	41	35
C-4 / Bag	8.0 - 10.0	▲	Silty Sand (SM)		52	28	24

Engineering Consulting Services Mid-Atlantic, LLC
Chantilly, Virginia

VTM-8 TESTING SUMMARY

Project Name: North Hill Property MHP

Project Number: 14444

Street: Bag

Completed Date: 4/29/09

Performed Date: 4/24/09

Project Engineer: MET

Summary By: HNT1

Station Number	Soil Description	Classification		Resiliency Factor	Corrected Max. Dry Density(pcf)	Corrected Optimum M/C (%)	Percent Compaction	CBR Soaked	Final Moisture Soaked (%)	Percent Swell	Sample No.
		USCS	AASHTO								
ECS-1	Sandy Fat Clay Strong Brown	CH	A-7-6	2.0	114.3	14.3	100.9	7.3	23.0	1.8	Bag
ECS-5	Clayey Sand Yellow Brown	SC	A-7-6	2.5	106.2	17.1	101.7	8.7	25.9	1.1	Bag

Average Laboratory CBR = 8.0

Design CBR Value (VDOT) = 5.3

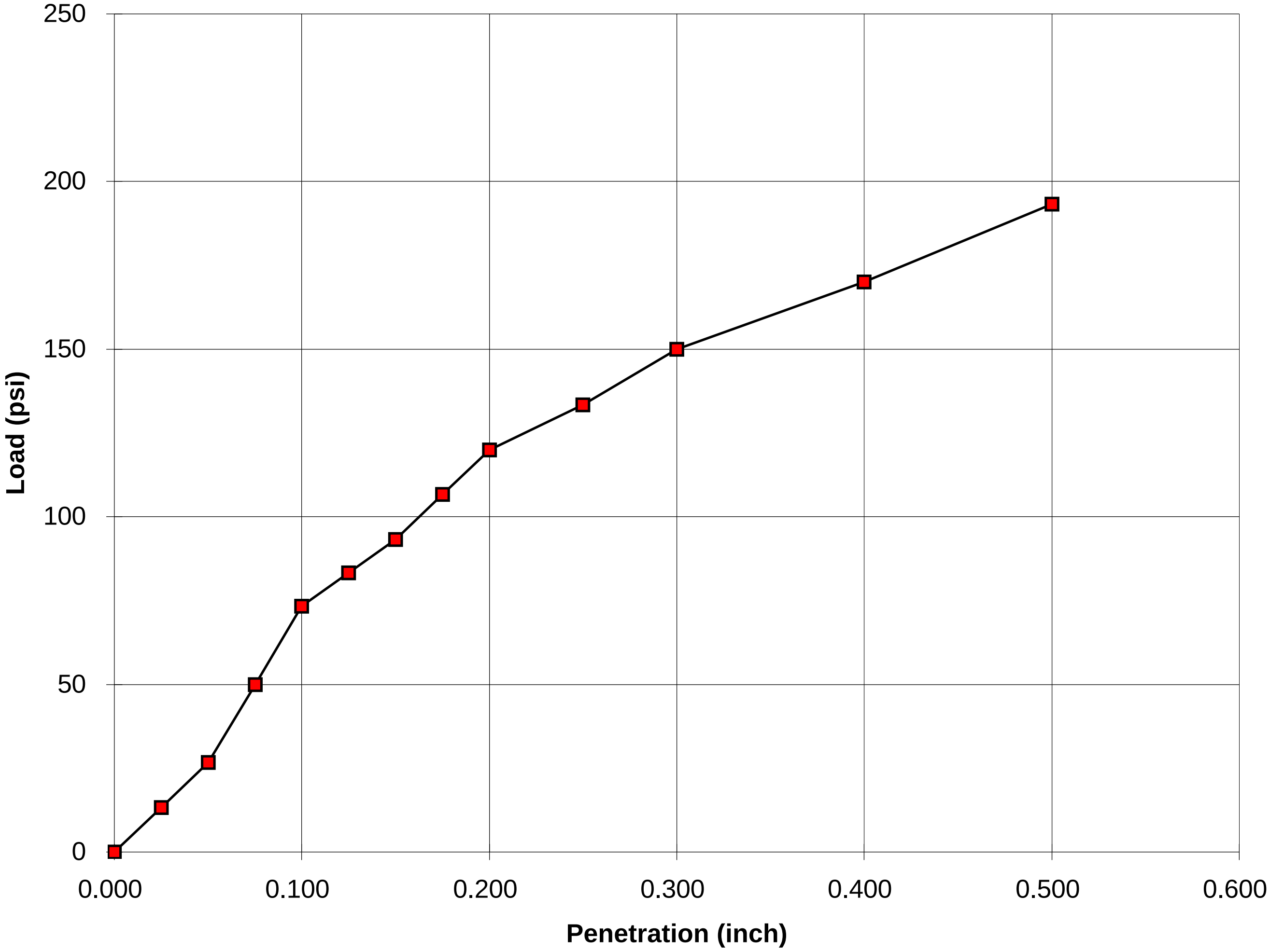
Mica Content = None

Resiliency Factor = 2

Stabilization Required = No

Principal Engineer: JCG

VTM-8 CBR Penetration

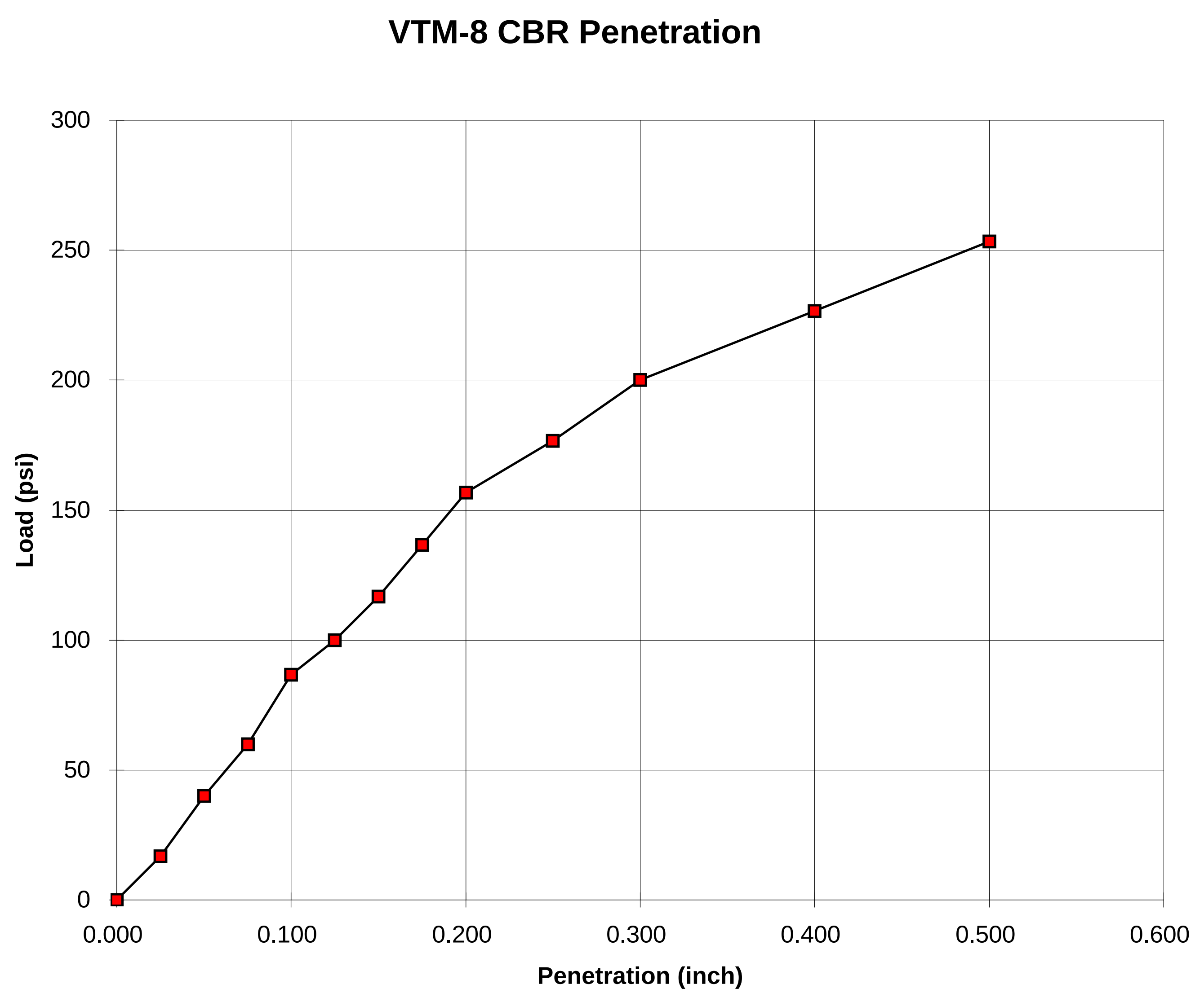


Street:	ECS-1, 0-10'	Sample #:	Bag
Description:	Sandy Fat Clay Strong Brown	Station No.:	_
Classification:	CH	Remark:	

Maximum Dry Density (pcf)	114.3		Soaked
Opt. Moisture Content (%)	14.3	Corrected CBR @ 0.1"	7.3
Natural Moisture Content	12.5	Corrected CBR @ 0.15"	6.7
Liquid Limit (LL)	50	Corrected CBR @ 0.2"	4.7
Plastic Limit (PL)	17	Dry Density as Molded	115.3
Plasticity Index (PI)	33	Molded Moisture Content	14.7
AASHTO	A-7-6	Percent of Maximum Density	100.9
Percent Retained 3/4" Sieve	0.0	Moisture Content +/- Opt	0.4
Percent Retained No. 4 Sieve	7.4	Percent (%)Swell	1.8
Percent Passing No.200 Sieve	64.1	Resiliency Factor	2

Project: North Hill Property MHP
Project No.: 14444
Performed Date: 4/24/09

ECS Mid-Atlantic, LLC
Chantilly, Virginia
California Bearing Ratio Curves



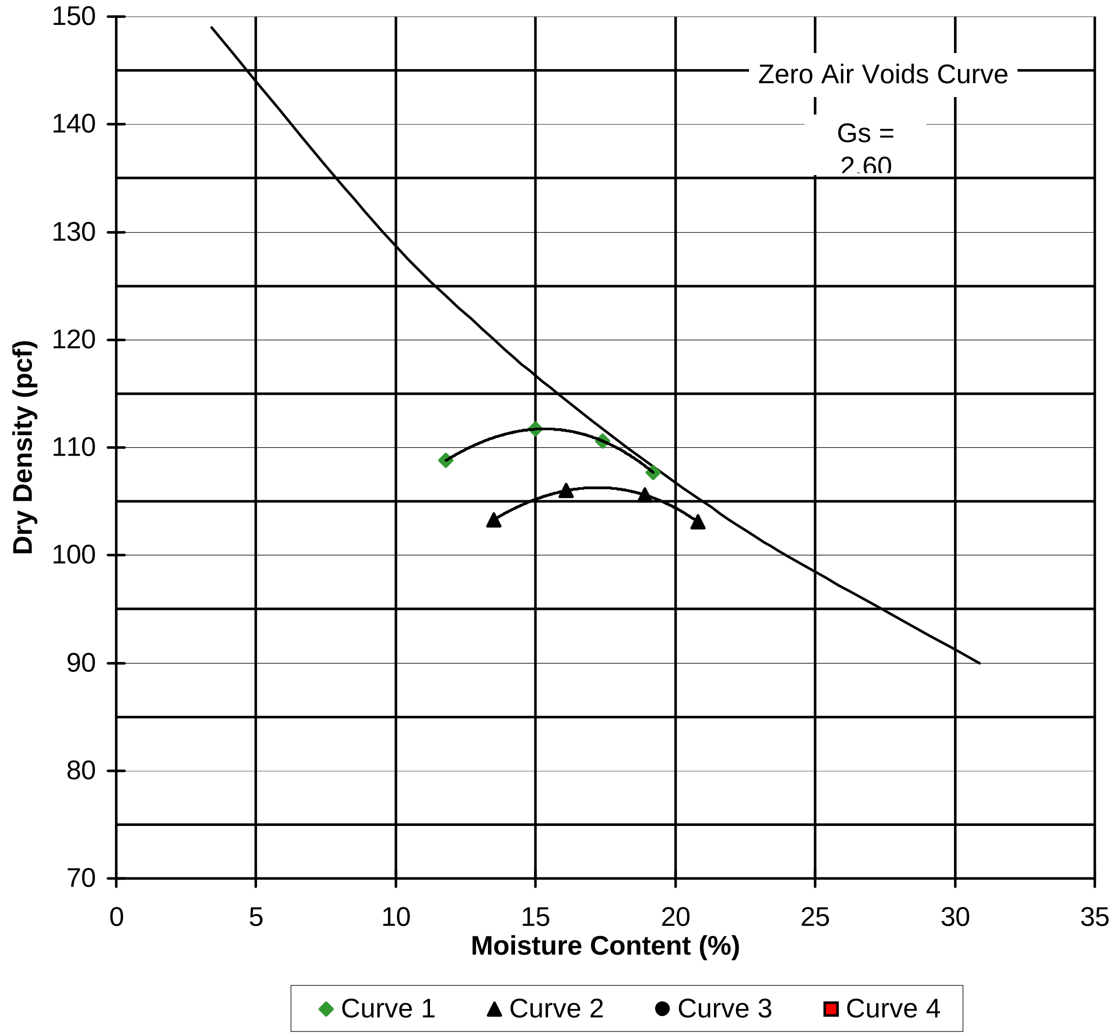
Street:	ECS-5, 0-10'	Sample #:	Bag
Description:	Clayey Sand Yellow Brown	Station No.:	_
Classification:	SC	Remark:	

Maximum Dry Density (pcf)	106.2		Soaked
Opt. Moisture Content (%)	17.1	Corrected CBR @ 0.1"	8.7
Natural Moisture Content	11.4	Corrected CBR @ 0.15"	7.7
Liquid Limit (LL)	47	Corrected CBR @ 0.2"	7.0
Plastic Limit (PL)	20	Dry Density as Molded	108.0
Plasticity Index (PI)	27	Molded Moisture Content	17.0
AASHTO	A-7-6	Percent of Maximum Density	101.7
Percent Retained 3/4" Sieve	0.0	Moisture Content +/- Opt	-0.1
Percent Retained No. 4 Sieve	0.0	Percent (%)Swell	1.1
Percent Passing No.200 Sieve	46.1	Resiliency Factor	2.5

Project: North Hill Property MHP
Project No.: 14444
Performed Date: 4/24/09

ECS Mid-Atlantic, LLC
Chantilly, Virginia
California Bearing Ratio Curves

112512 VTM8.xls



Curve Number	1	2	3	4
Sample No.	Bag	Bag		
Street	ECS-1	ECS-5		
Station	_	_		
Description	Sandy Fat Clay Strong Brown	Clayey Sand Yellow Brown		
Classification	CH / A-7-6	SC / A-7-6		
Liquid Limit (LL)	50	47		
Plastic Limit (PL)	17	20		
Plasticity Index (PI)	33	27		
Percent Passing No.200	64.1	46.1		
Percent Retained on No. 4	7.4			
Percent Retained on No. 3/8	1.9			
Percent Retained on No. 3/4				
Test Method	VTM-1 _	VTM-1 _		
Maximum Density as Tested	111.7	106.2		
Opitmum Moisture as Tested	15.3	17.1		
Corr. Max Density (pcf)	114.3	106.2		
Corr. Optimum Moisture (%)	14.3	17.1		

Project: North Hill Property MHP
Project No.: 14444
Date: 08/27/09

ECS - Mid-Atlantic, LLC
Chantilly, Virginia
Moisture Density Relationship Curve

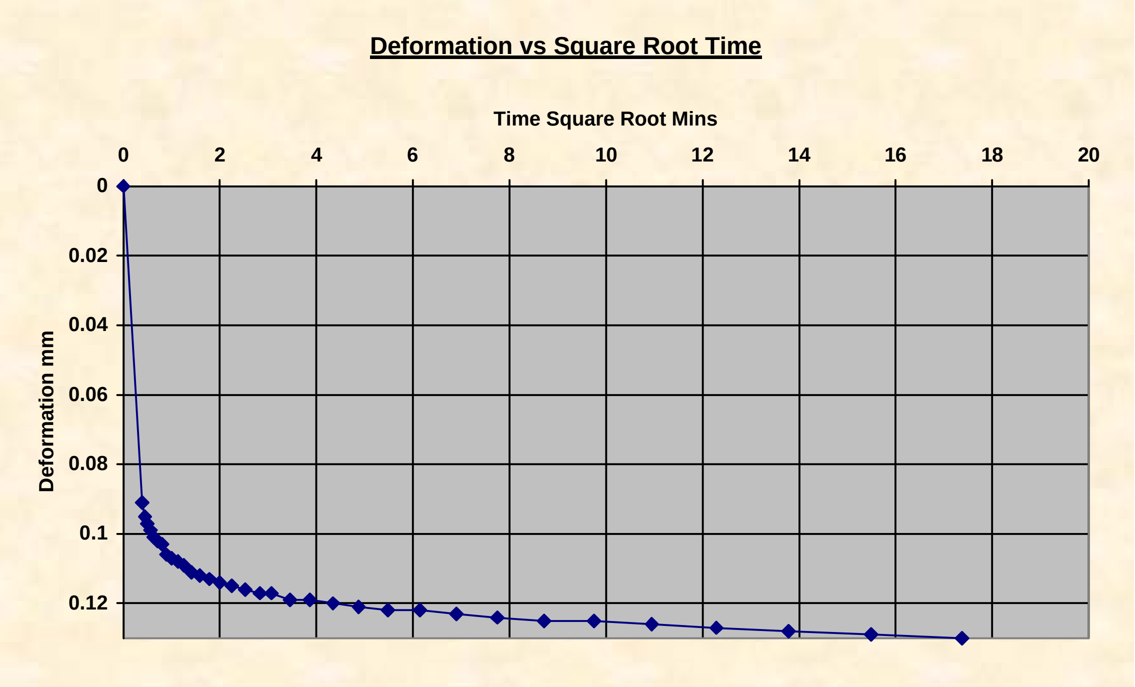
ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	0.5 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-5	**Sample**	112512-1

Test Details			
Standard	ASTM D3080-03 / AASHTO T236-92	**Particle Specific Gravity**	2.65
Sample Type	Undisturbed sample - open drive	**Single or Multi Stage**	Multi Stage : 5 Stages
Lab. Temperature	23.0 deg.C	**Location**	ECS-5 15.0-17.0
Sample Description	Fat Clay Tr/Mica Yellow Brown(CH)		
Variations from procedure	None		

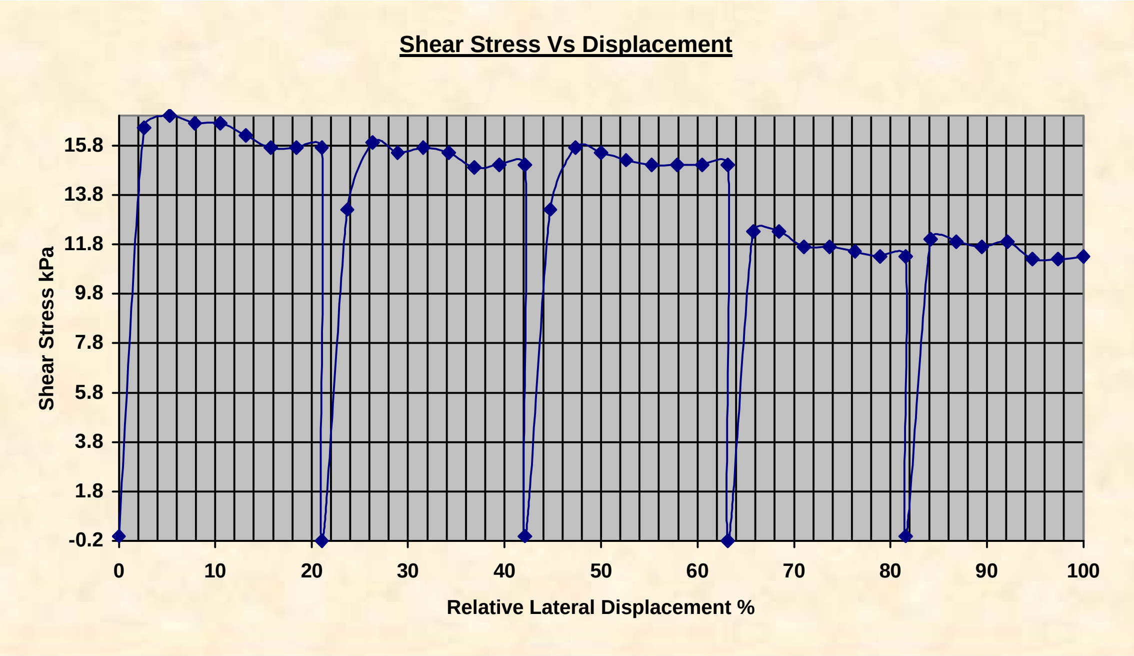
Specimen Details			
Specimen Reference	A	**Description**	Fat Clay Tr/Mica Yellow Brown(CH)
Depth within Sample	0.00mm	**Orientation within Sample**	
Initial Height	19.810 mm	**Area**	3167.74 mm2
Structure / Preparation	HNT	**Initial Water Content***	33.9 % (trimmings: 35.3 %)
Initial Wet Unit Weight	17.48 kN/m3	**Degree of Saturation**	90.67 %
Initial Dry Unit Weight	13.05 kN/m3	**Initial Voids Ratio**	0.992
Final Wet Unit Weight	18.24 kN/m3	**Final Water Content**	39.14%
Final Dry Unit Weight	13.11 kN/m3	**Dry Mass**	83.50 g
Tested Dry or Submerged	Submerged		
Comments			

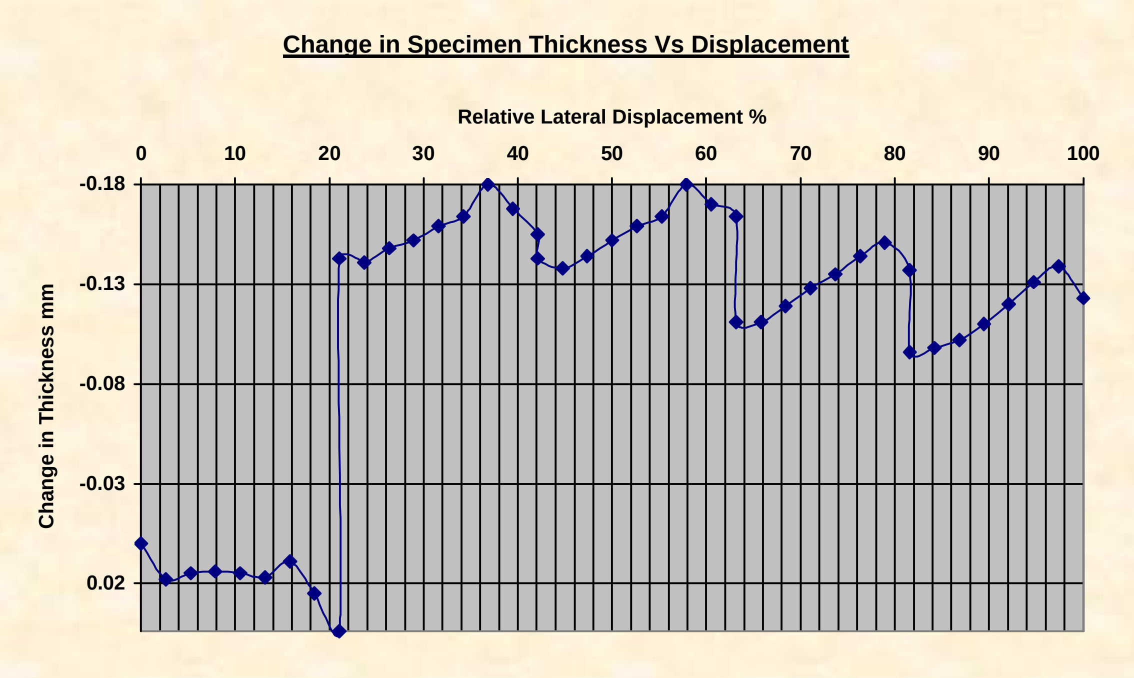
* Calculated from initial and dry weights of whole specimen



ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	0.5 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-5	**Sample**	112512-1





Rate of Horizontal Displacement	Stage 1: 0.0203mm/min Stage 2: 0.0203mm/min Stage 3: 0.0203mm/min Stage 4: 0.0203mm/min Stage 5: 0.0203mm/min

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	0.5 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-5	**Sample**	112512-1

Conditions at Failure	
Normal Stress	47.9 kPa
Peak Strength	17.0 kPa
Horizontal Deformation	2.402 mm
Residual Stress	11.3 kPa
Vertical Deformation	0.157 mm

Tested By and Date:	4/24/09
Checked By and Date:	5/24/09
Approved By and Date:	5/25/09

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	1.0 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-5	**Sample**	112512-1

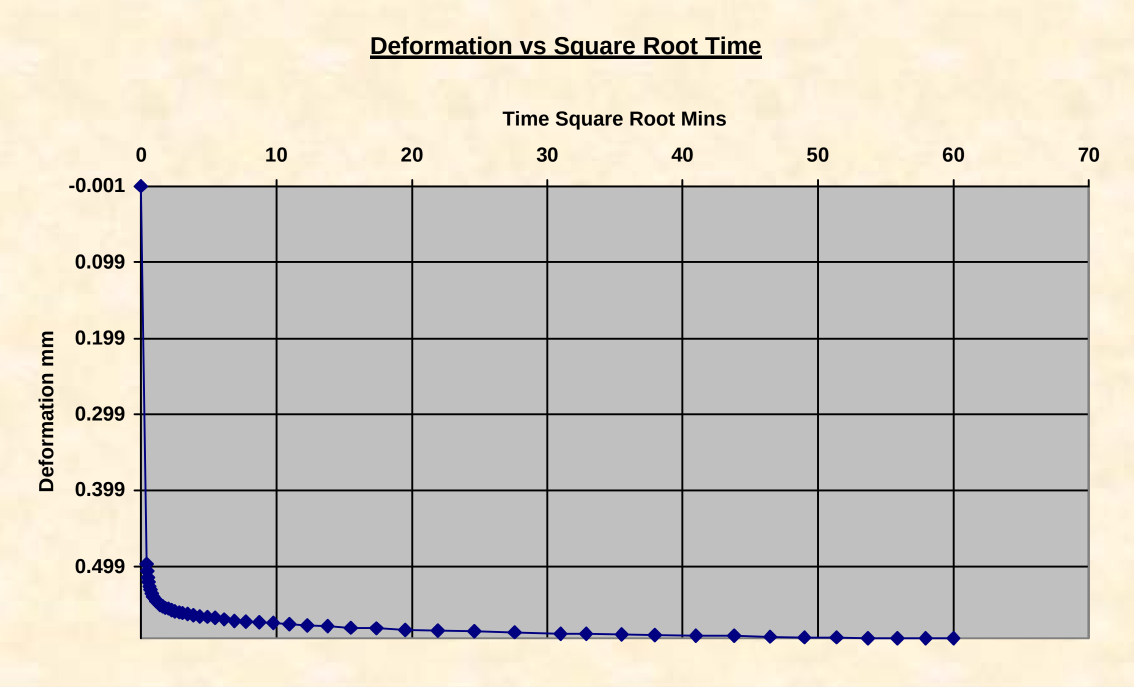
Test Details

Standard	ASTM D3080-03 / AASHTO T236-92	**Particle Specific Gravity**	2.65
Sample Type	Undisturbed sample - open drive	**Single or Multi Stage**	Multi Stage : 5 Stages
Lab. Temperature	23.0 deg.C	**Location**	ECS-5 15.0-17.0
Sample Description	Fat Clay Tr/Mica Yellow Brown(CH)		
Variations from procedure	None		

Specimen Details

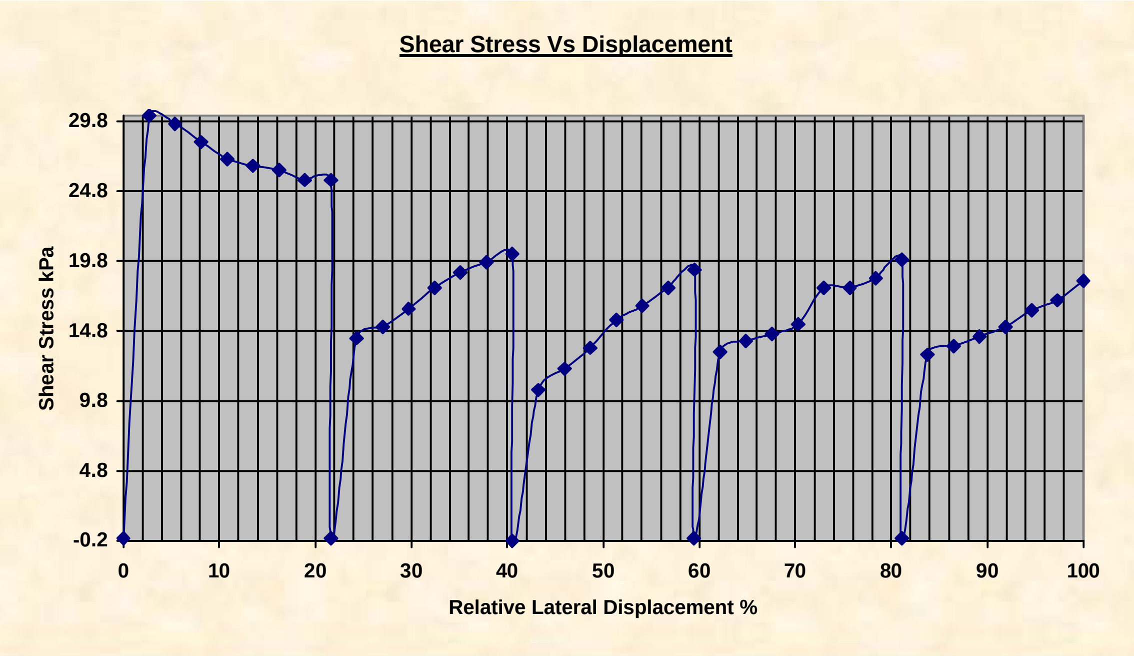
Specimen Reference	B	**Description**	Fat Clay Tr/Mica Yellow Brown(CH)
Depth within Sample	0.00mm	**Orientation within Sample**	
Initial Height	19.810 mm	**Area**	3167.74 mm2
Structure / Preparation	HNT 5/1/09	**Initial Water Content***	34.8 % (trimmings: 33.7 %)
Initial Wet Unit Weight	17.71 kN/m3	**Degree of Saturation**	94.22 %
Initial Dry Unit Weight	13.13 kN/m3	**Initial Voids Ratio**	0.980
Final Wet Unit Weight	18.14 kN/m3	**Final Water Content**	40.30%
Final Dry Unit Weight	12.93 kN/m3	**Dry Mass**	84.00 g
Tested Dry or Submerged	Submerged		
Comments			

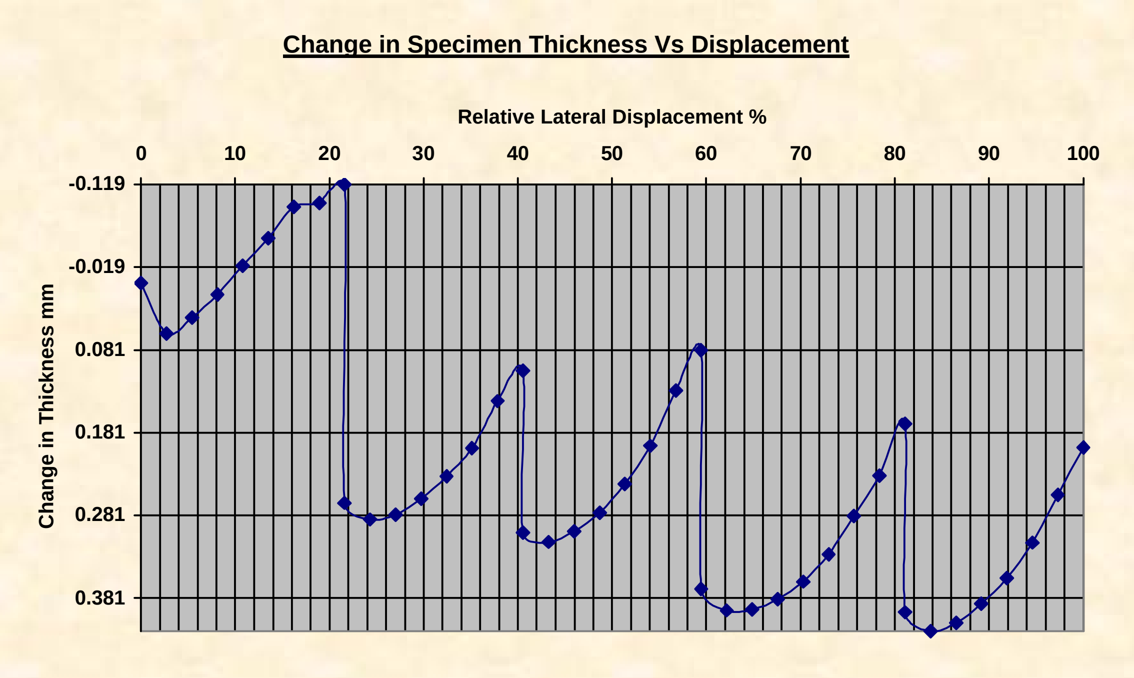
* Calculated from initial and dry weights of whole specimen



ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	1.0 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-5	**Sample**	112512-1





Rate of Horizontal Displacement	Stage 1: 0.0203mm/min Stage 2: 0.2032mm/min Stage 3: 0.0203mm/min Stage 4: 0.0203mm/min Stage 5: 0.0203mm/min

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O’Mara, Inc.	**Lab Ref**	1.0 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-5	**Sample**	112512-1

Conditions at Failure	
Normal Stress	95.8 kPa
Peak Strength	30.2 kPa
Horizontal Deformation	1.199 mm
Residual Stress	18.4 kPa
Vertical Deformation	0.655 mm

Tested By and Date:	5/1/09
Checked By and Date:	5/11/09
Approved By and Date:	MET

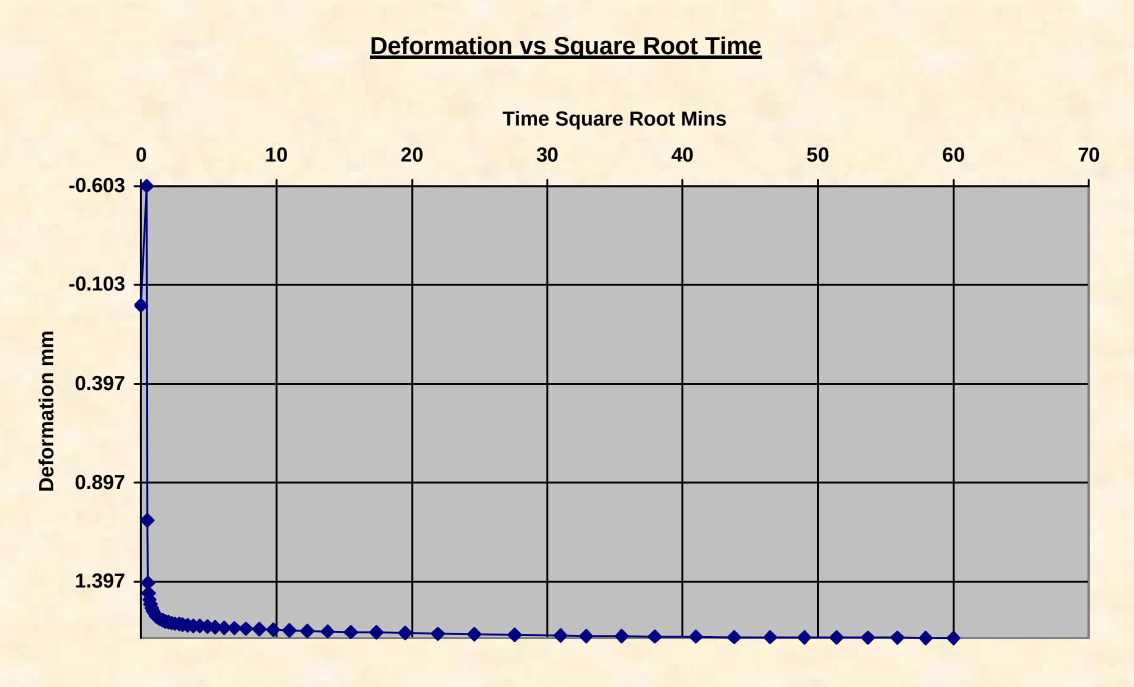
ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	2.0 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-5	**Sample**	112512-1

Test Details			
Standard	ASTM D3080-03 / AASHTO T236-92	**Particle Specific Gravity**	2.65
Sample Type	Undisturbed sample - open drive	**Single or Multi Stage**	Multi Stage : 5 Stages
Lab. Temperature	23.0 deg.C	**Location**	ECS-5 15.0-17.0
Sample Description	Fat Clay Tr/Mica Yellow Brown(CH)		
Variations from procedure	None		

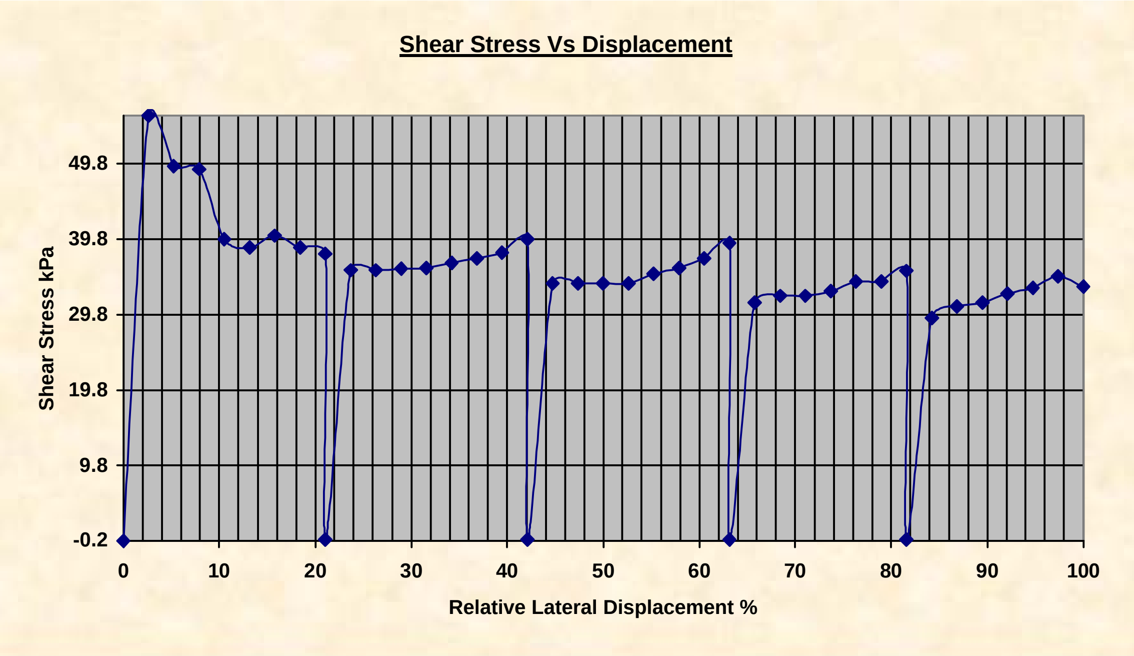
Specimen Details			
Specimen Reference	C	**Description**	Fat Clay Tr/Mica Yellow Brown(CH)
Depth within Sample	0.00mm	**Orientation within Sample**	
Initial Height	19.810 mm	**Area**	3167.74 mm2
Structure / Preparation	Fat Clay Tr/Mica Yellow Brown(CH)	**Initial Water Content***	32.8 % (trimmings: 35.6 %)
Initial Wet Unit Weight	17.02 kN/m3	**Degree of Saturation**	84.47 %
Initial Dry Unit Weight	12.82 kN/m3	**Initial Voids Ratio**	1.028
Final Wet Unit Weight	19.05 kN/m3	**Final Water Content**	37.32%
Final Dry Unit Weight	13.87 kN/m3	**Dry Mass**	82.00 g
Tested Dry or Submerged	Submerged		
Comments			

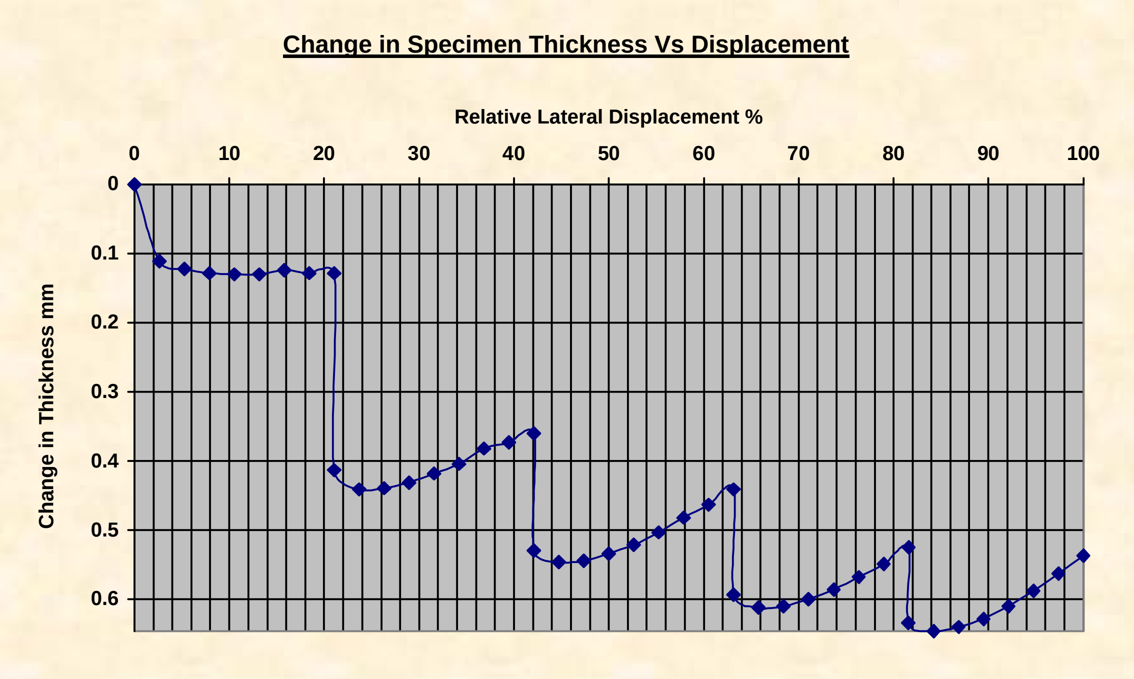
* Calculated from initial and dry weights of whole specimen



ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	2.0 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-5	**Sample**	112512-1





Rate of Horizontal Displacement	Stage 1: 0.0203mm/min Stage 2: 0.0203mm/min Stage 3: 0.0203mm/min Stage 4: 0.0203mm/min Stage 5: 0.0232mm/min

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	2.0 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-5	**Sample**	112512-1

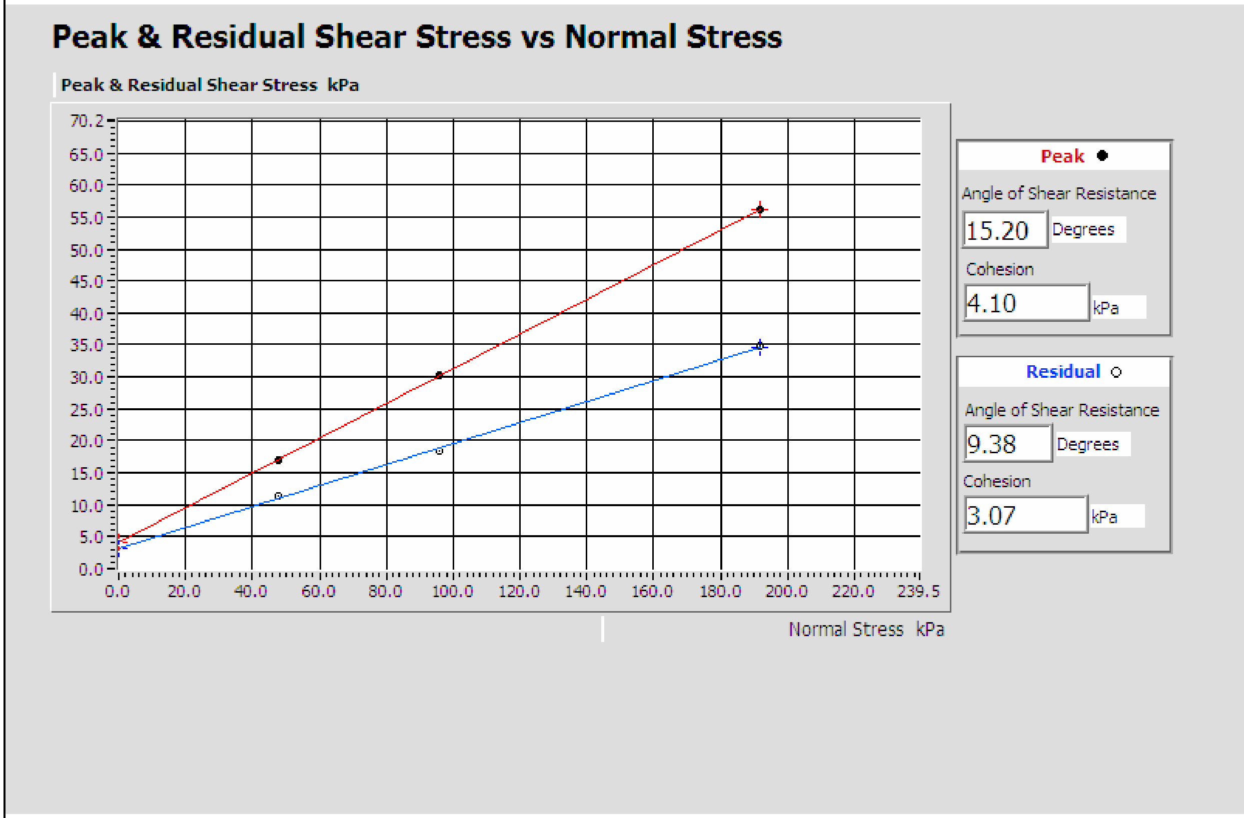
Conditions at Failure	
Normal Stress	191.6 kPa
Peak Strength	56.2 kPa
Horizontal Deformation	1.202 mm
Residual Stress	34.9 kPa
Vertical Deformation	1.792 mm

Tested By and Date:	5/8/09 DVT
Checked By and Date:	5/18/09 DVT
Approved By and Date:	MET

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Test Summary

Reference	A	B	C	
Normal Stress	47.9 kPa	95.8 kPa	191.6 kPa	
Peak Strength	17.0 kPa	30.2 kPa	56.2 kPa	
Corresponding Horizontal Displacement	2.402 mm	1.199 mm	1.202 mm	
Residual Stress	11.3 kPa	18.4 kPa	34.9 kPa	
Rate of Shear Displacement	Stage 1: 0.0203mm/min Stage 2: 0.0203mm/min Stage 3: 0.0203mm/min Stage 4: 0.0203mm/min Stage 5: 0.0203mm/min	Stage 1: 0.0203mm/min Stage 2: 0.2032mm/min Stage 3: 0.0203mm/min Stage 4: 0.0203mm/min Stage 5: 0.0203mm/min	Stage 1: 0.0203mm/min Stage 2: 0.0203mm/min Stage 3: 0.0203mm/min Stage 4: 0.0203mm/min Stage 5: 0.0232mm/min	
Final Height	19.72 mm	20.12 mm	18.31 mm	
Sample Area	3167.74 mm2	3167.74 mm2	3167.74 mm2	
Initial Wet Unit Weight	17.48 kN/m3	17.71 kN/m3	17.02 kN/m3	
Initial Dry Unit Weight	13.05 kN/m3	13.13 kN/m3	12.82 kN/m3	
Final Wet Unit Weight	18.24 kN/m3	18.14 kN/m3	19.05 kN/m3	
Final Dry Unit Weight				
Final Moisture Content	39.1 %	40.3 %	37.3 %	
Particle Specific Gravity	2.65	2.65	2.65	
Final Void Ratio	0.9828	1.0102	0.8741	
Final Saturation	105.53%	105.71%	113.13%	



Peak & Residual Shear Stress vs Normal Stress

Peak ●

Angle of Shear Resistance: 15.20 Degrees

Cohesion: 4.10 kPa

Residual ○

Angle of Shear Resistance: 9.38 Degrees

Cohesion: 3.07 kPa

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	0.5tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-1	**Sample**	112512-2

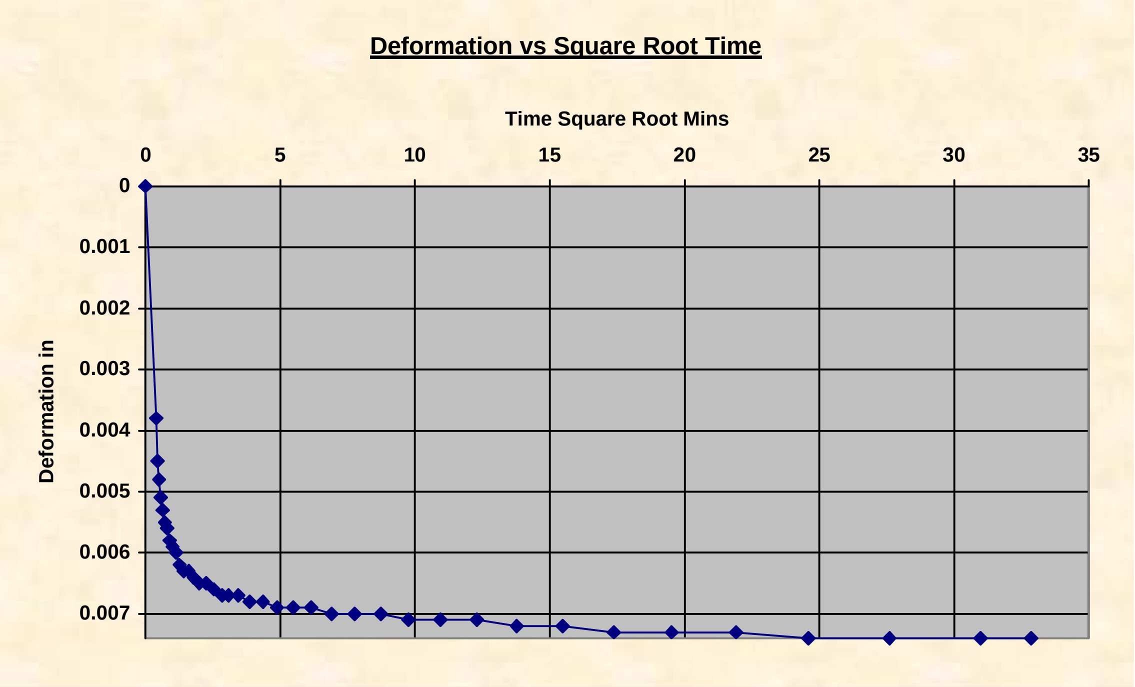
Test Details

Standard	ASTM D3080-03 / AASHTO T236-92	**Particle Specific Gravity**	2.65
Sample Type	Undisturbed sample - open drive	**Single or Multi Stage**	Multi Stage : 5 Stages
Lab. Temperature	73.4 deg.F	**Location**	ECS-1 11.0-13.0
Sample Description	Fat Clay Tr/Mica Yellow Brown(CH)		
Variations from procedure	None		

Specimen Details

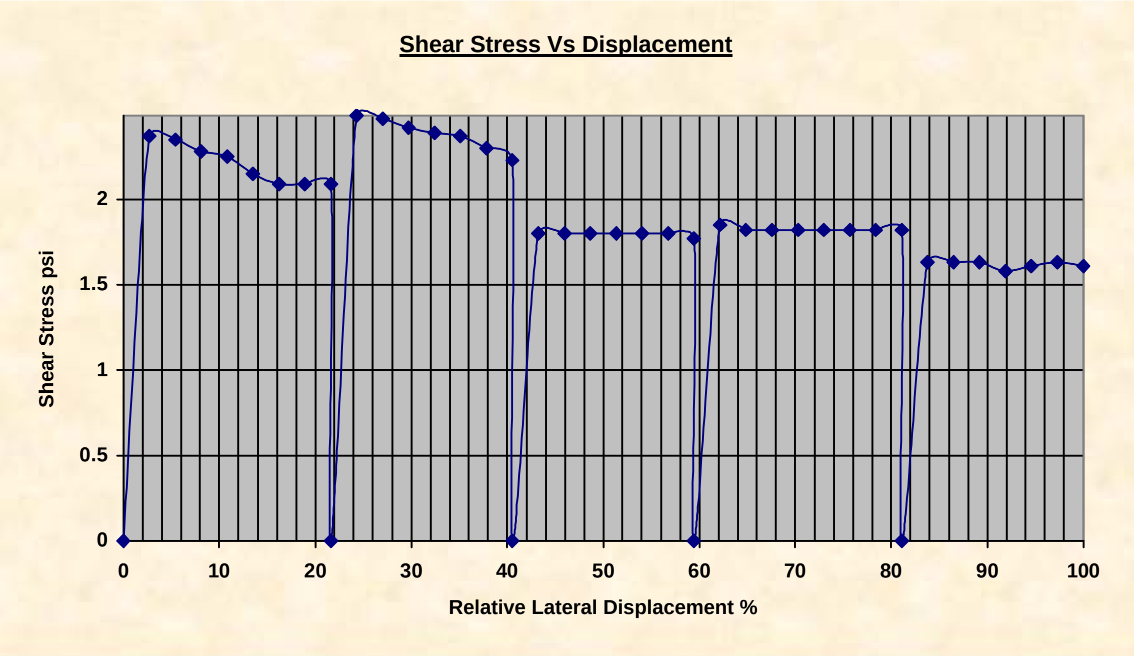
Specimen Reference	A	**Description**	Fat Clay Tr/Mica Yellow Brown(CH)
Depth within Sample	0.0000in	**Orientation within Sample**	
Initial Height	0.7799 in	**Area**	4.91000 in2
Structure / Preparation	HNT1	**Initial Water Content***	34.7 % (trimmings: 33.3 %)
Initial Wet Unit Weight	112.82 lbf/ft3	**Degree of Saturation**	94.26 %
Initial Dry Unit Weight	83.74 lbf/ft3	**Initial Voids Ratio**	0.976
Final Wet Unit Weight	116.95 lbf/ft3	**Final Water Content**	38.46%
Final Dry Unit Weight	84.47 lbf/ft3	**Dry Mass**	0.1855 lb
Tested Dry or Submerged	Submerged		
Comments			

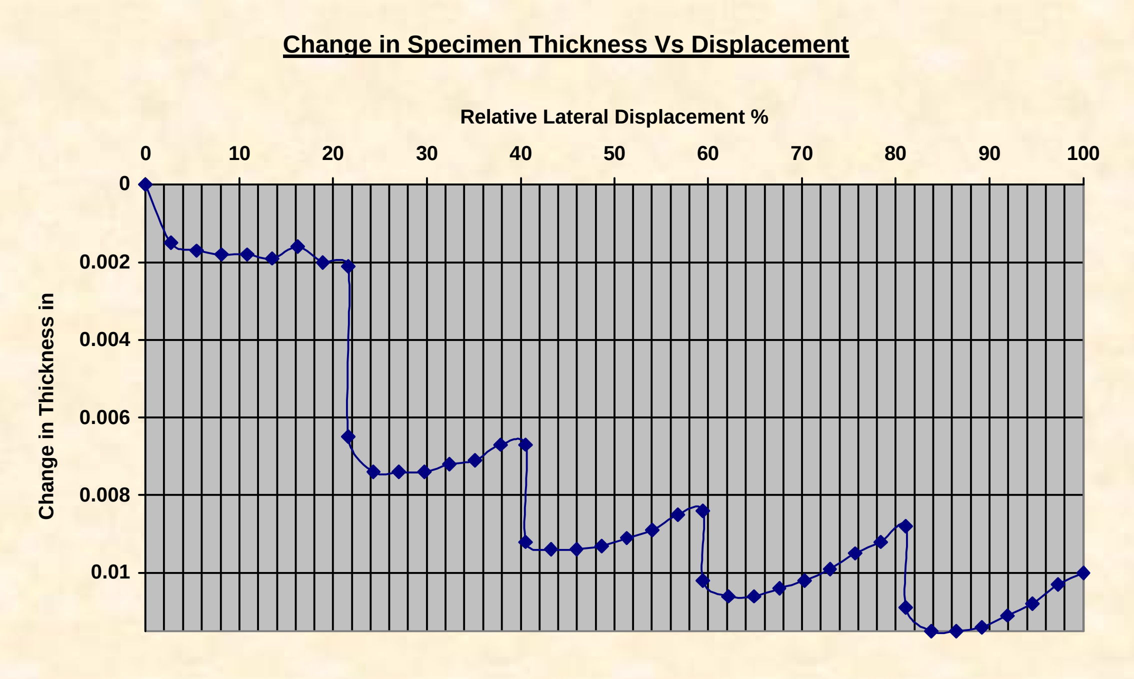
* Calculated from initial and dry weights of whole specimen



ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	0.5tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-1	**Sample**	112512-2





Rate of Horizontal Displacement	Stage 1: 0.000800in/min Stage 2: 0.000800in/min Stage 3: 0.000800in/min Stage 4: 0.000800in/min Stage 5: 0.000800in/min

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	0.5tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-1	**Sample**	112512-2

Conditions at Failure	
Normal Stress	6.95 psi
Peak Strength	2.49 psi
Horizontal Deformation	0.4258 in
Residual Stress	1.61 psi
Vertical Deformation	0.0149 in

Tested By and Date:	HNT1 5/16/09
Checked By and Date:	DVT
Approved By and Date:	MET

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	1.0 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-1	**Sample**	112512-2

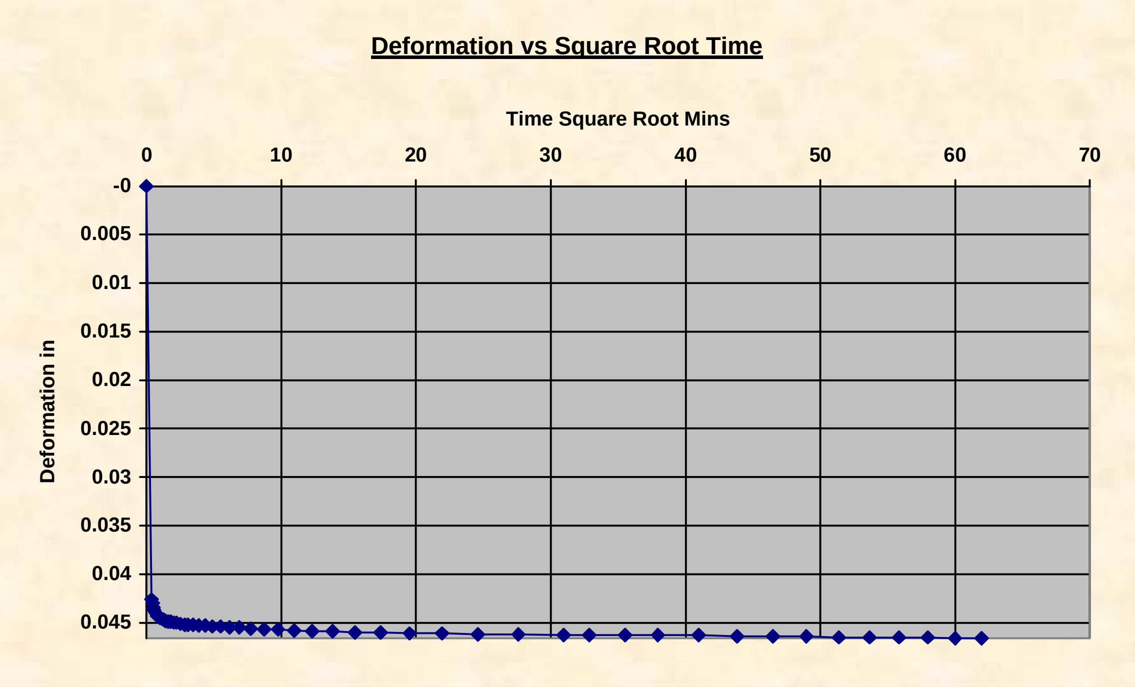
Test Details

Standard	ASTM D3080-03 / AASHTO T236-92	**Particle Specific Gravity**	2.65
Sample Type	Undisturbed sample - open drive	**Single or Multi Stage**	Multi Stage : 5 Stages
Lab. Temperature	73.4 deg.F	**Location**	ECS-1 11.0-13.0
Sample Description	Fat Clay Tr/Mica Yellow Brown(CH)		
Variations from procedure	None		

Specimen Details

Specimen Reference	B	**Description**	Fat Clay Tr/Mica Yellow L/Brown(CH)
Depth within Sample	0.0000in	**Orientation within Sample**	
Initial Height	0.7799 in	**Area**	4.91000 in2
Structure / Preparation	DVT 5/22/09	**Initial Water Content***	33.8 % (trimmings: 33.2 %)
Initial Wet Unit Weight	111.89 lbf/ft3	**Degree of Saturation**	91.46 %
Initial Dry Unit Weight	83.63 lbf/ft3	**Initial Voids Ratio**	0.979
Final Wet Unit Weight	123.07 lbf/ft3	**Final Water Content**	38.08%
Final Dry Unit Weight	89.13 lbf/ft3	**Dry Mass**	0.1853 lb
Tested Dry or Submerged	Submerged		
Comments			

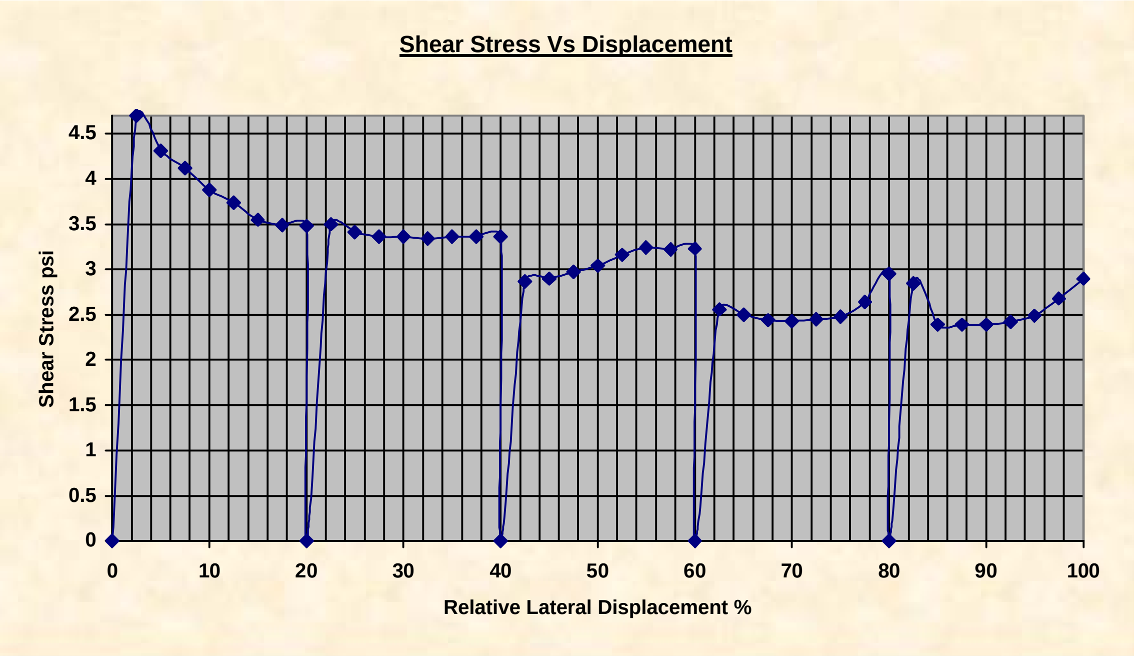
* Calculated from initial and dry weights of whole specimen

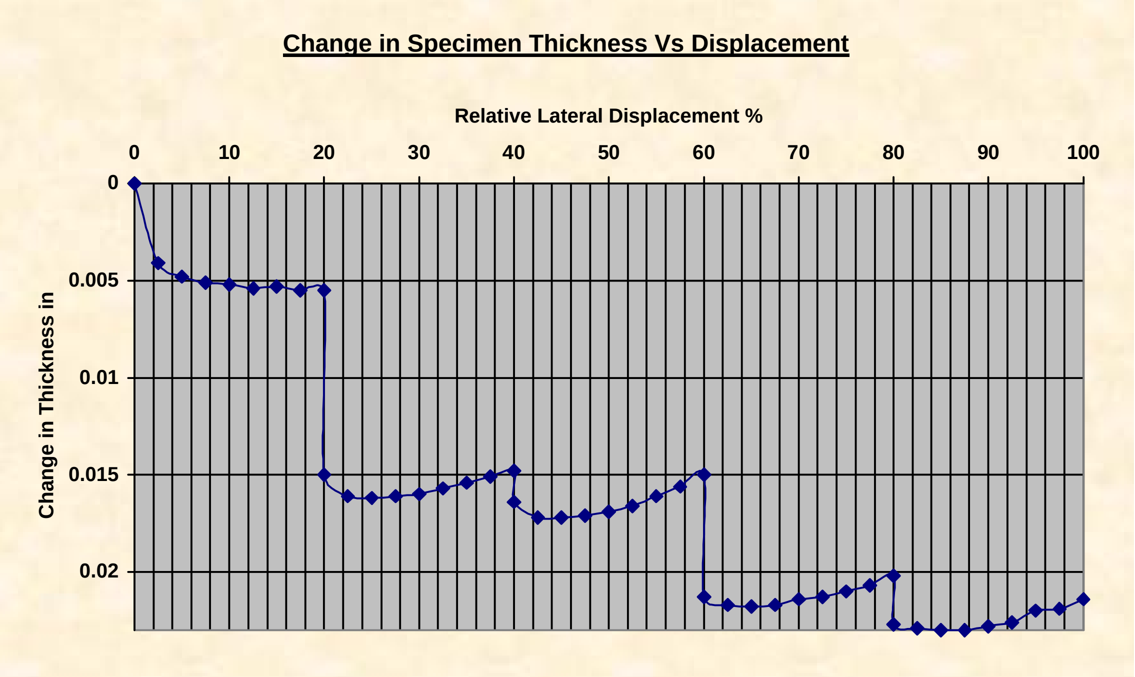


Deformation vs Square Root Time

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	1.0 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-1	**Sample**	112512-2





Rate of Horizontal Displacement	Stage 1: 0.000800in/min Stage 2: 0.000800in/min Stage 3: 0.000800in/min Stage 4: 0.000800in/min Stage 5: 0.000800in/min

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	1.0 tsf
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-1	**Sample**	112512-2

Conditions at Failure	
Normal Stress	13.89 psi
Peak Strength	4.70 psi
Horizontal Deformation	0.0474 in
Residual Stress	2.90 psi
Vertical Deformation	0.0507 in

Tested By and Date:	DVT 5/22/09
Checked By and Date:	DVT 6/1/09
Approved By and Date:	MET

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	112512-2
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-1	**Sample**	112512-2

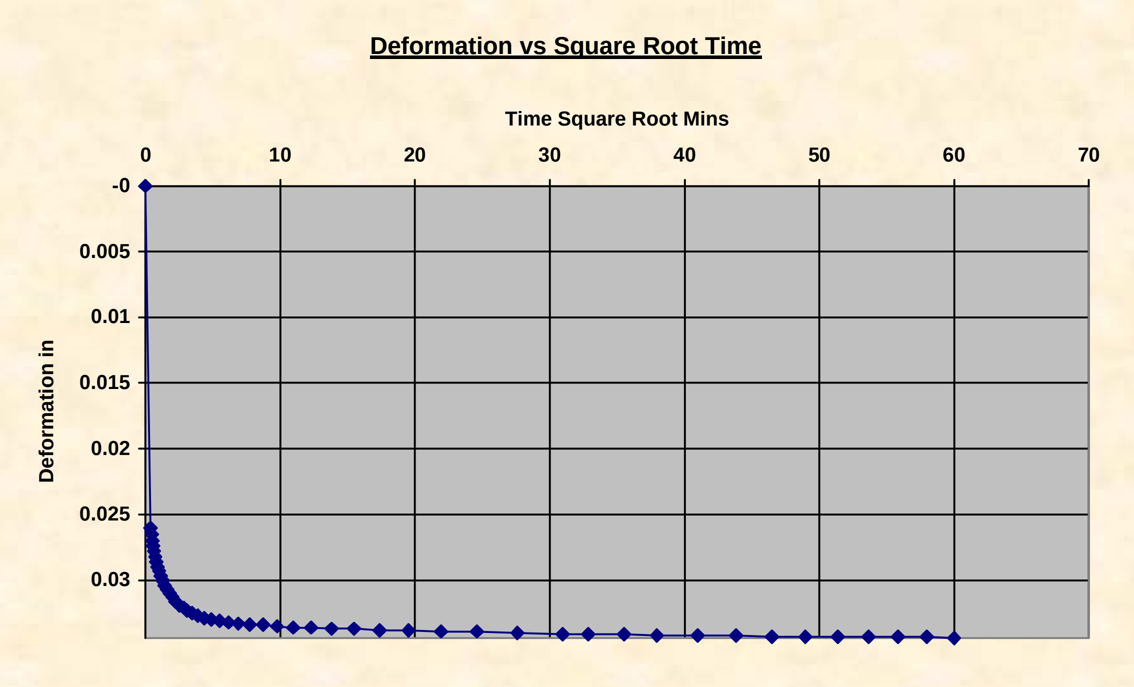
Test Details

Standard	ASTM D3080-03 / AASHTO T236-92	**Particle Specific Gravity**	2.65
Sample Type	Undisturbed sample - open drive	**Single or Multi Stage**	Multi Stage : 5 Stages
Lab. Temperature	73.4 deg.F	**Location**	ECS-1 11.0-13.0
Sample Description	Fat Clay Tr/Mica Yellow Brown(CH)		
Variations from procedure	None		

Specimen Details

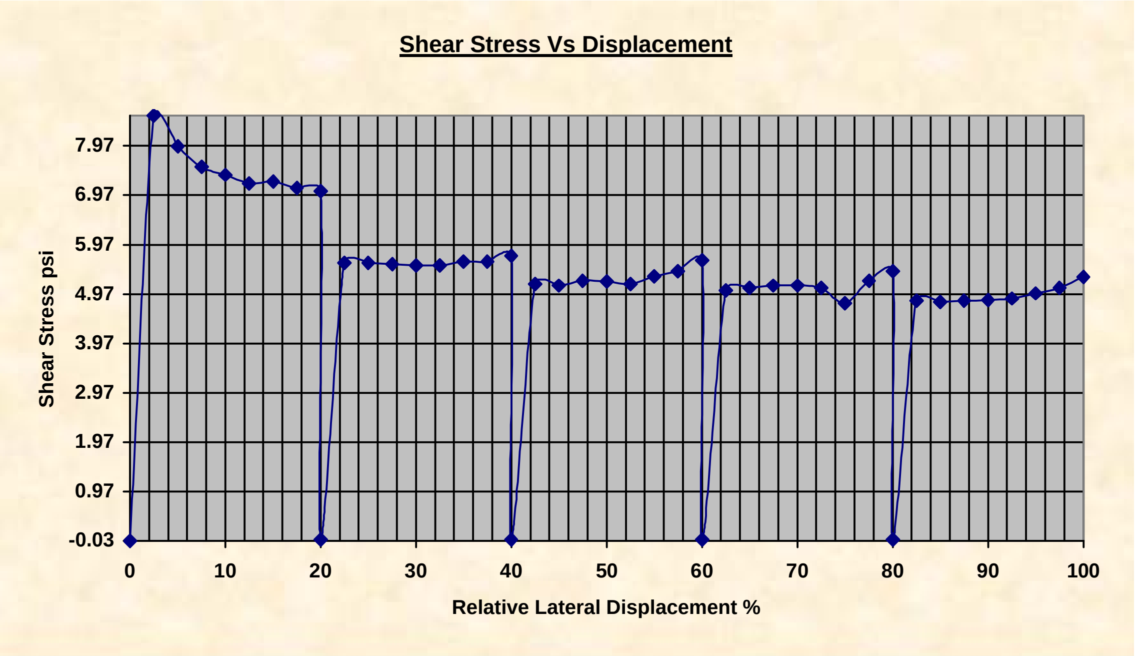
Specimen Reference	C	**Description**	Fat Clay Tr/Mica Yellow Brown(CH)
Depth within Sample	0.0000in	**Orientation within Sample**	
Initial Height	0.7799 in	**Area**	4.91000 in2
Structure / Preparation	Fat Clay Tr/Mica Yellow Brown(CH)	**Initial Water Content***	36.3 % (trimmings: 34.0 %)
Initial Wet Unit Weight	113.29 lbf/ft3	**Degree of Saturation**	97.11 %
Initial Dry Unit Weight	83.10 lbf/ft3	**Initial Voids Ratio**	0.992
Final Wet Unit Weight	119.34 lbf/ft3	**Final Water Content**	38.79%
Final Dry Unit Weight	85.99 lbf/ft3	**Dry Mass**	0.1841 lb
Tested Dry or Submerged	Submerged		
Comments			

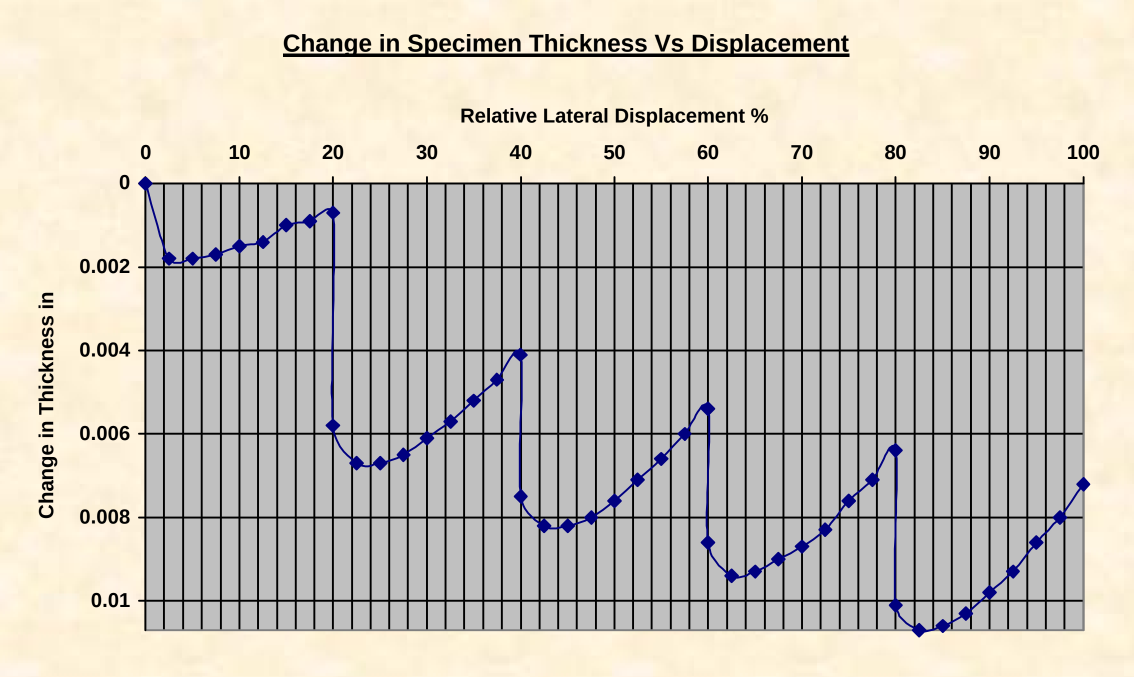
* Calculated from initial and dry weights of whole specimen



ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	112512-2
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-1	**Sample**	112512-2





Rate of Horizontal Displacement	Stage 1: 0.000800in/min Stage 2: 0.000800in/min Stage 3: 0.000800in/min Stage 4: 0.000800in/min Stage 5: 0.000800in/min

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Client	Greenhorne & O'Mara, Inc.	**Lab Ref**	112512-2
Project	North Hill Property MHP	**Job**	14444
Borehole	ECS-1	**Sample**	112512-2

Conditions at Failure	
Normal Stress	27.79 psi
Peak Strength	8.58 psi
Horizontal Deformation	0.0474 in
Residual Stress	5.31 psi
Vertical Deformation	0.0362 in

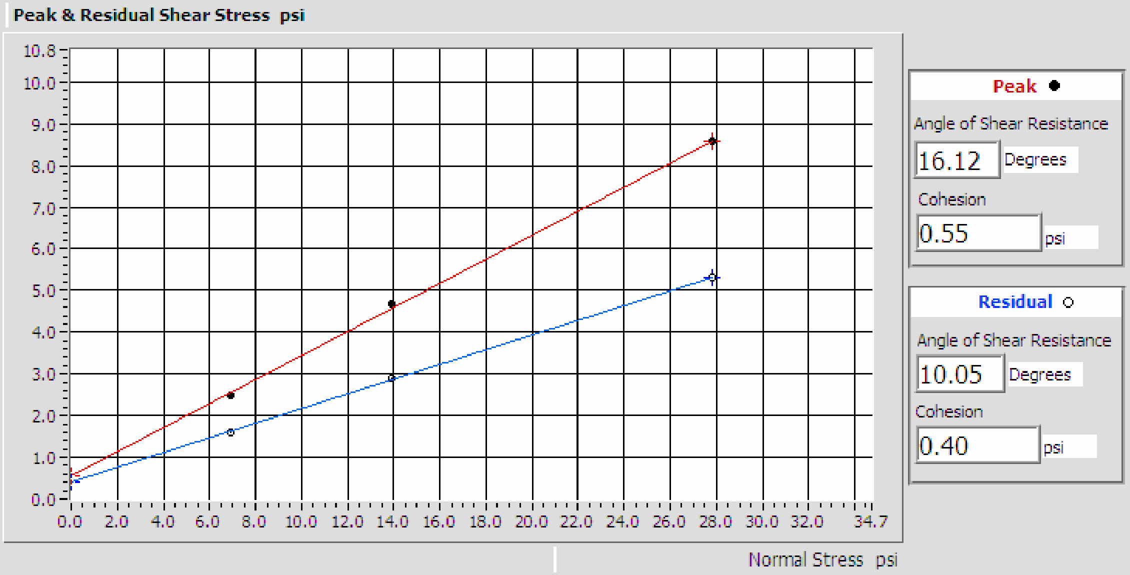
Tested By and Date:	5/29/09 DVT
Checked By and Date:	6/8/09 DVT
Approved By and Date:	MET

ECS-Mid-Atlantic, LLC
Shear Strength by Direct Shear

Test Summary

Reference	A	B	C	
Normal Stress	6.95 psi	13.89 psi	27.79 psi	
Peak Strength	2.49 psi	4.70 psi	8.58 psi	
Corresponding Horizontal Displacement	0.4258 in	0.0474 in	0.0474 in	
Residual Stress	1.61 psi	2.90 psi	5.31 psi	
Rate of Shear Displacement	Stage 1: 0.000800in/min Stage 2: 0.000800in/min Stage 3: 0.000800in/min Stage 4: 0.000800in/min Stage 5: 0.000800in/min	Stage 1: 0.000800in/min Stage 2: 0.000800in/min Stage 3: 0.000800in/min Stage 4: 0.000800in/min Stage 5: 0.000800in/min	Stage 1: 0.000800in/min Stage 2: 0.000800in/min Stage 3: 0.000800in/min Stage 4: 0.000800in/min Stage 5: 0.000800in/min	
Final Height	0.7733 in	0.7319 in	0.7537 in	
Sample Area	4.91000 in2	4.91000 in2	4.91000 in2	
Initial Wet Unit Weight	112.82 lbf/ft3	111.89 lbf/ft3	113.29 lbf/ft3	
Initial Dry Unit Weight	83.74 lbf/ft3	83.63 lbf/ft3	83.10 lbf/ft3	
Final Wet Unit Weight	116.95 lbf/ft3	123.07 lbf/ft3	119.34 lbf/ft3	
Final Dry Unit Weight				
Final Moisture Content	38.5 %	38.1 %	38.8 %	
Particle Specific Gravity	2.65	2.65	2.65	
Final Void Ratio	0.9593	0.8568	0.9246	
Final Saturation	106.23%	117.77%	111.18%	

Peak & Residual Shear Stress vs Normal Stress



Peak ●

Angle of Shear Resistance
16.12 Degrees

Cohesion
0.55 psi

Residual ○

Angle of Shear Resistance
10.05 Degrees

Cohesion
0.40 psi

Appendix D – Calculations

North Hill Soil Properties for Stability Analyses

JCG 8/7/2009
MET 8/24/2009 Checked

ECS Project No. 14444

Profile F-F

Stratum	**Soil Types**	**SPT ECS-8**	**SPT C-4**	**SPT ECS-4**	**Avg N**	**N_{60}**	**VDOT Stratum**	**Density Moist,** pcf	**Density Wet,** pcf	**C** psf	**Φ** deg
1	SC, CL		11, 10 ,8	9, 6	9	11	T-II	115	122	150	30
2	CH		14, 31, 30, 34	11, 19, 18	22	28	T-IIP	112	119	0	9.7
3	SC, SM	11, 17, 9, 7	30, 32	58, 31, 21	24	30	T-III	125	132	150	34
4	ML, SC, CL	14, 23, 21	16	26, 49, 53	29	36	T-III	125	132	150	32
5	CH		38, 45, 35, 42		40	50	T-IIP	112	119	0	9.7
6	SM	19, 25		32, 45	30	38	T-III	125	132	150	34

Profile D-D

Stratum	**Soil Types**	**SPT ECS-7**	**SPT C-3**	**SPT ECS-3**	**Avg N**	**N_{60}**	**VDOT Stratum**	**Density Moist,** pcf	**Density Wet,** pcf	**C** psf	**Φ** deg
1	SC, SM, CL	7, 12, 29	24, 30, 10, 32, 29	16, 13, 10	19	24	T-II	115	122	150	30
2	CH		17	13, 18, 19	17	21	T-IIP	112	119	0	9.7
3	SC	16, 15, 13	20, 30	29, 25, 20	21	26	T-II	115	122	150	30
4	CH			26, 32	29	36	T-IIP	112	119	0	9.7
5	SC, CL		30, 32, 29, 29	30, 29	30	37	T-III	125	132	150	34
6	CL, CH	18, 30, 54	31, 48		36	45	T-III	125	132	150	32
7	SM, SC	53, 55		22	43	54	T-III	125	132	150	34

Profile C-C

Stratum	**Soil Types**	**SPT ECS-6**	**SPT C-2**	**SPT ECS-2**	**Avg N**	**N_{60}**	**VDOT Stratum**	**Density Moist,** pcf	**Density Wet,** pcf	**C** psf	**Φ** deg
1	CL, SC	7, 10, 15	16, 7	15, 11, 32, 38, 14	17	21	T-II	115	122	150	30
2	CH		30	25, 31, 35, 25	29	37	T-IIP	112	119	0	9.7
3	SC, SM, SP	20, 18, 8, 17	21, 26, 24, 30, 34	26, 38	24	30	T-III	125	132	150	34
4	CL, SC	20, 41, 39			33	42	T-III	125	132	150	34
5	CH		29, 32, 32, 31	32	31	39	T-IIP	112	119	0	9.7
6	SM, SC, CL	46	74	27, 23	43	53	T-III	125	132	150	34

Direct Shear Specimen

Boring No.	**Density Moist,** pcf	**Density Moist,** pcf	**Density Moist,** pcf	**Avg. Density Wet,** pcf	**Density Wet,** pcf	**Density Wet,** pcf	**Density Wet,** pcf	**Avg. Density Wet,** pcf	**Φr** deg
ECS-1	112.82	111.89	113.29	112.67	116.95	123.07	119.34	119.79	10
ECS-5	111.26	112.72	108.33	110.77	116.1	115.46	121.26	117.61	9.4
Average				112				119	9.7

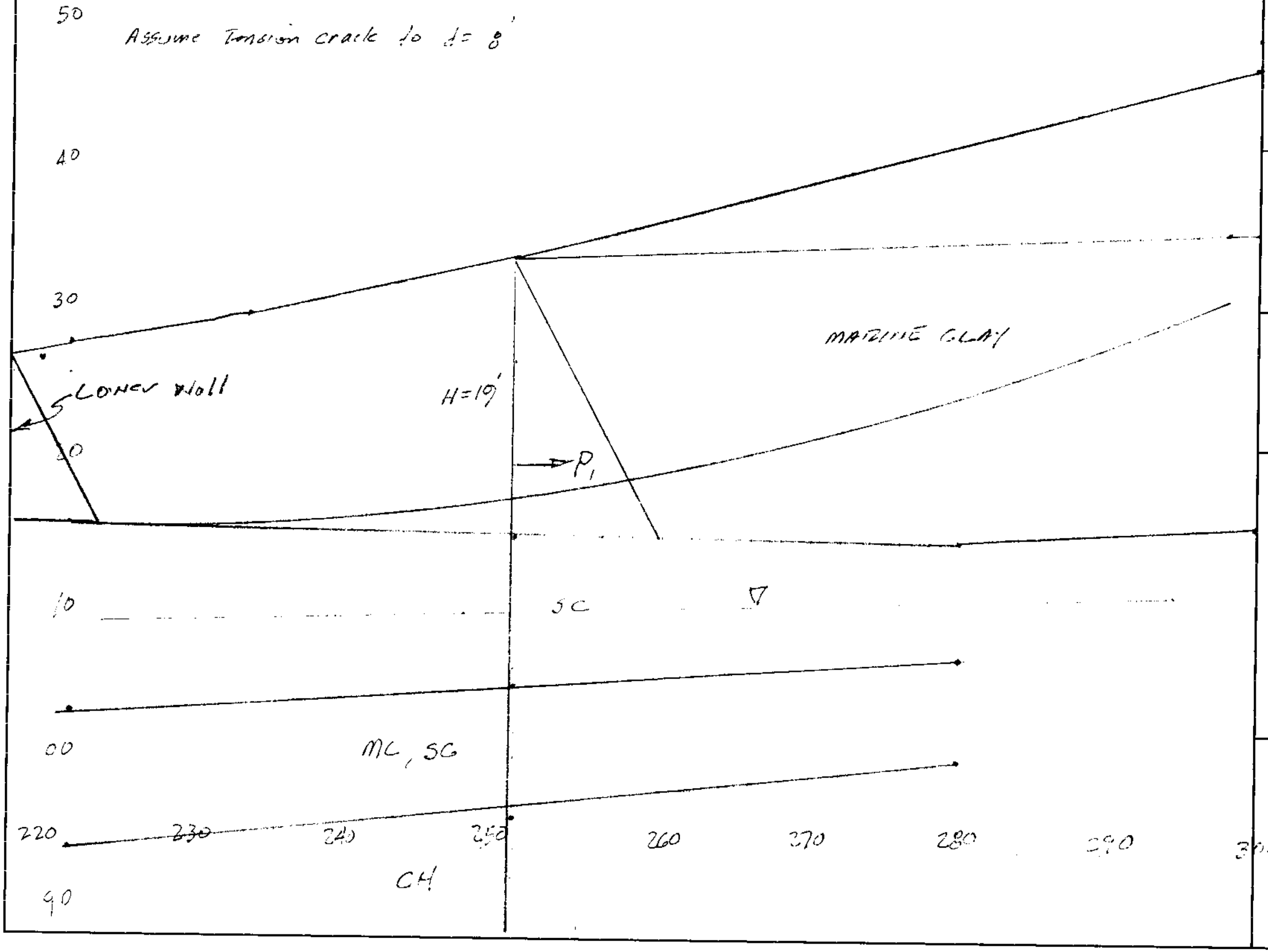
Note: Hammer efficiency assumed 75%

$P_1 = 15k = 0.5\ P_{BASE} \times H$

$P_{BASE} = \frac{15\ k}{19 \times 0.5} = 1.58$ kip

$P_2 = \frac{14}{11 \times 0.5} = 2.54$ kip

Assume Tension crack to d= 8'



ECS LLC
MID-ATLANTIC
CALCULATION SHEET

PROJECT: NORTH HILLS

TITLE: INPUT FOR LATERAL ANALYSIS

BY: [illegible]

DATE: 9-13-09

APPROVED BY: [illegible]

FIGURE NO.

JOB NO. 14444

SCALE: N/A

DATE 8-26-09

A-II	>5≤20	50 (2.4 kPa)	30	108 (17.3 kN/m3)	115 (18.4 kN/m3)
A-III	>20	50 (2.4 kPa)	32	115 (18.4 kN/m3)	122 (19.5 kN/m3)

Notes:

Natural condition, above the groundwater table

Saturated condition, below the groundwater table

Submerged (or buoyant) unit weight = Saturated unit weight - Unit weight of water

Stratum T - Terrace - These soils generally consist of coarse-grained silty and clayey sands and gravels with discontinuous lenses and thin layers of silts and clays. They are generally of low to medium plasticity but lenses of clay can be highly plastic. Typical SPT N60 values range from 5 to 50 bpf. Typical thickness is 5 to 40 feet.

Table 2: Typical Engineering Design Properties (Terrace Deposits)

Sub-Stratum	SPT N60 Value (bpf)	Cohesion, c (psf)	Friction Angle, ϕ (degrees)	Moist Unit Weight1 (pcf)	Saturated Unit Weight2, 3 (pcf)
T-I	≤10	150 (7.2 kPa)	26	105 (16.8 kN/m3)	112 (17.9 kN/m3)
T-II	>10≤30	150 (7.2 kPa)	30	115 (18.4 kN/m3)	122 (19.5 kN/m3)
T-III	>30	150 (7.2 kPa)	34	125 (20 kN/m3)	132 (21.1 kN/m3)

Notes:

Natural condition, above the groundwater table

Saturated condition, below the groundwater table

Submerged (or buoyant) unit weight = Saturated unit weight - Unit weight of water

Stratum P - Potomac Formation - These soils generally consist of interbedded highly plastic and medium plasticity clays with lenses and thin layers of silt and sand and are classified as CH, MH, CL and ML. Clays are generally highly overconsolidated and can contain "slickensides" which are indicative of extremely effective residual friction angles. Typically blue-gray clays are locally termed "marine clays". Below a weathered zone with SPT N60 values of 10 to 30 bpf, SPT N60 values typically range from 30 to >100 bpf. Typical thickness is 5 to 40 feet.

Table 3: Typical Engineering Design Properties (Potomac Formation)

Sub-Stratum	SPT N60 Value (bpf)	Cohesion, c (psf)	Friction Angle, ϕ (degrees)	Moist Unit Weight1 (pcf)	Saturated Unit Weight2, 3 (pcf)
P-I	≤10	150 (7.2 kPa)4	204	100 (16 kN/m3)	107 (17.1 kN/m3)
P-II	>10≤30	250 (12 kPa) 4	244	110 (17.6 kN/m3)	117 (18.7 kN/m3)
P-III	>30	350 (16.8 kPa) 4	284	120 (19.2 kN/m3)	127 (20.3 kN/m3)

Notes:

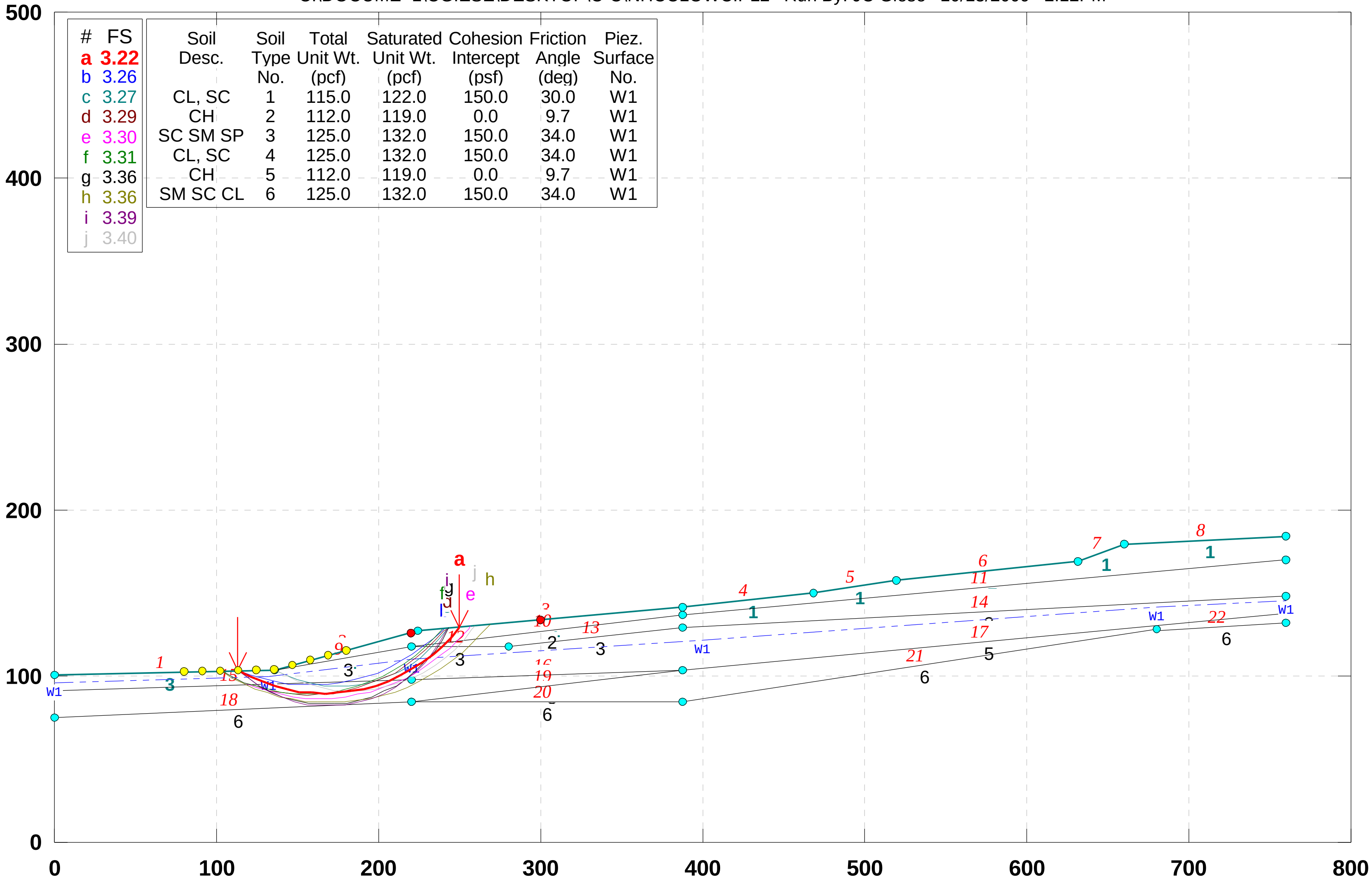
Natural condition, above the groundwater table

Saturated condition, below the groundwater table

Submerged (or buoyant) unit weight = Saturated unit weight - Unit weight of water

North Hill Analysis No. 1 Section C-C

C:\DOCUME~1\CGIESE\DESKTOP\C-C\NHCCLOWC.PL2 Run By: JC Giese 10/13/2009 2:12PM



#	FS
a	3.22
b	3.26
c	3.27
d	3.29
e	3.30
f	3.31
g	3.36
h	3.36
i	3.39
j	3.40

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CL, SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC SM SP	3	125.0	132.0	150.0	34.0	W1
CL, SC	4	125.0	132.0	150.0	34.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM SC CL	6	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=3.22

Safety Factors Are Calculated By The Modified Bishop Method

North Hill Analysis No. 2 Section C-C

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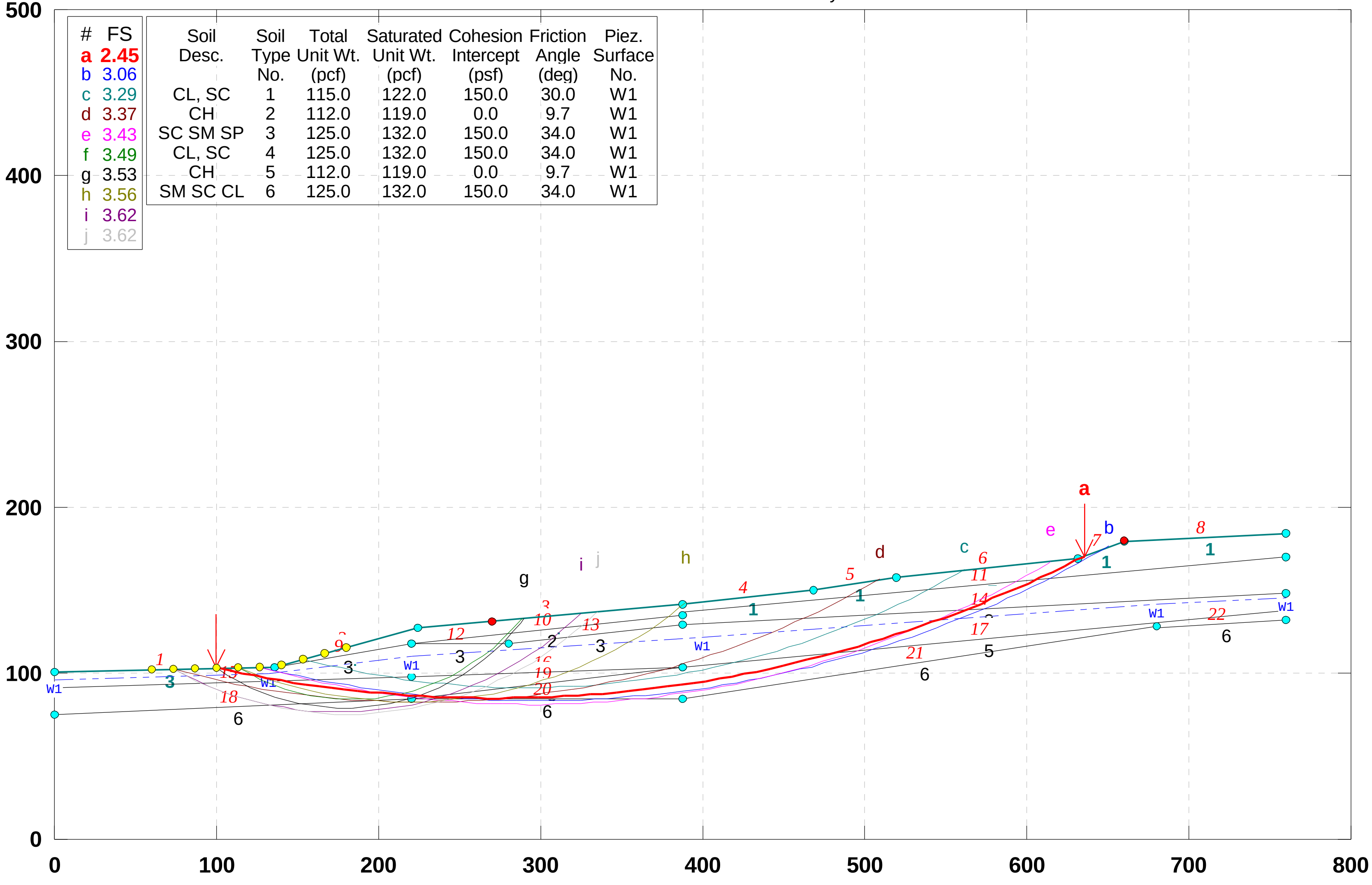

#	FS
a	**2.45**
b	3.06
c	3.29
d	3.37
e	3.43
f	3.49
g	3.53
h	3.56
i	3.62
j	3.62

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CL, SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC SM SP	3	125.0	132.0	150.0	34.0	W1
CL, SC	4	125.0	132.0	150.0	34.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM SC CL	6	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=2.45

Safety Factors Are Calculated By The Modified Bishop Method

North Hill Analysis No. 3 Section C-C

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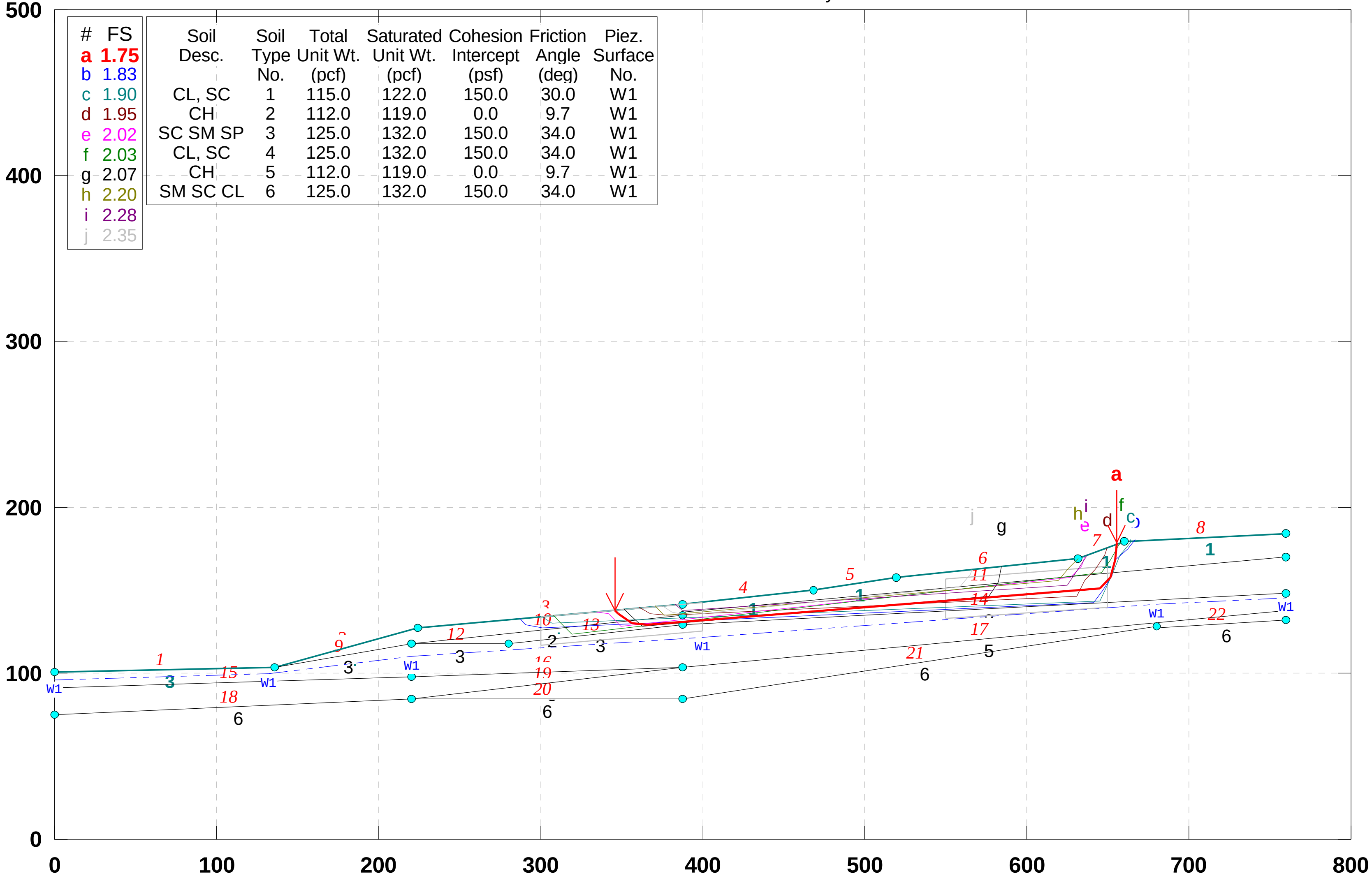

#	FS
a	1.75
b	1.83
c	1.90
d	1.95
e	2.02
f	2.03
g	2.07
h	2.20
i	2.28
j	2.35

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CL, SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC SM SP	3	125.0	132.0	150.0	34.0	W1
CL, SC	4	125.0	132.0	150.0	34.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM SC CL	6	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=1.75

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 4 Section D-D

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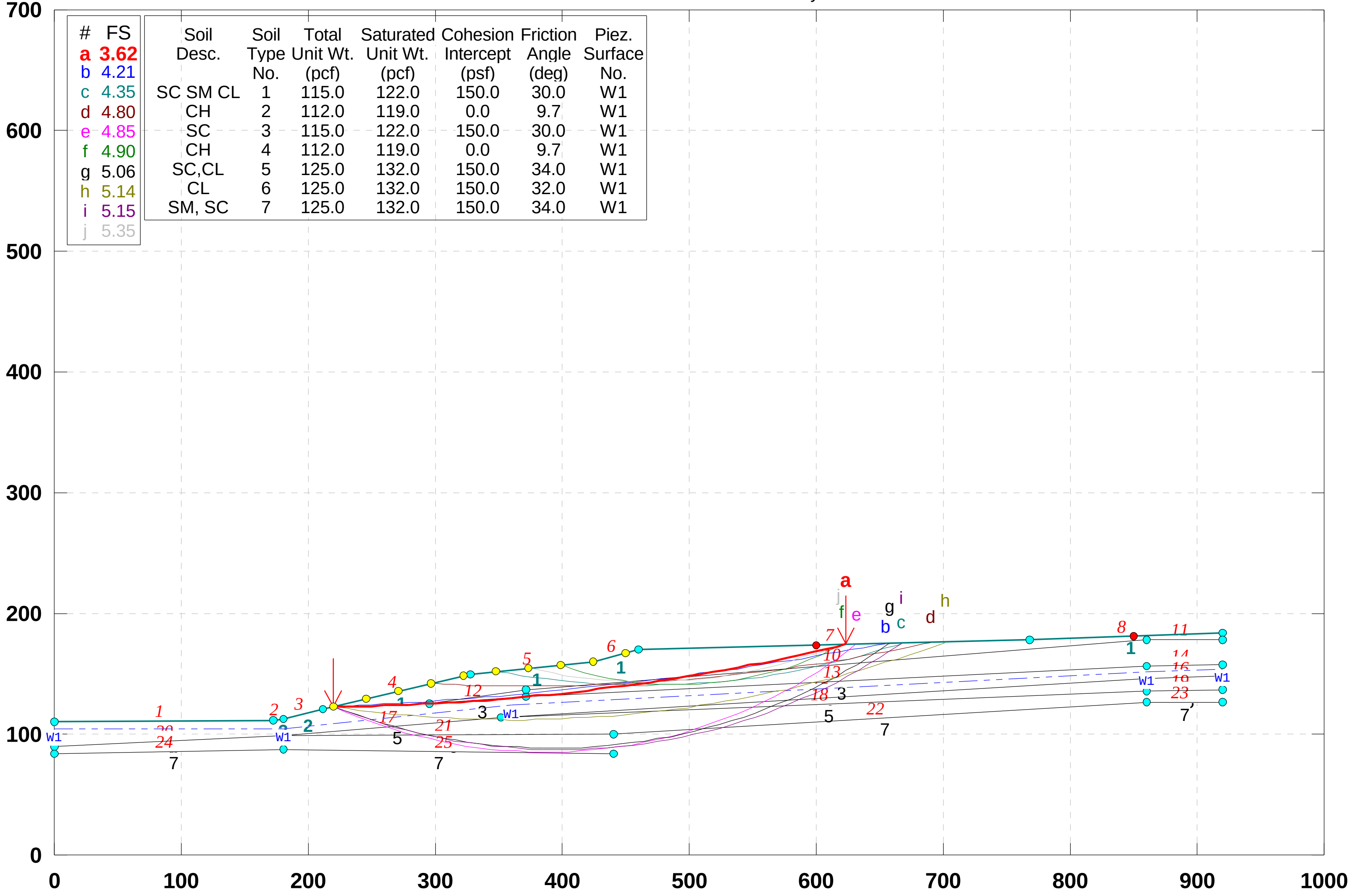

#	FS
a	3.62
b	4.21
c	4.35
d	4.80
e	4.85
f	4.90
g	5.06
h	5.14
i	5.15
j	5.35

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC SM CL	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC	3	115.0	122.0	150.0	30.0	W1
CH	4	112.0	119.0	0.0	9.7	W1
SC,CL	5	125.0	132.0	150.0	34.0	W1
CL	6	125.0	132.0	150.0	32.0	W1
SM, SC	7	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=3.62

Safety Factors Are Calculated By The Modified Bishop Method

North Hill Analysis No. 5 Section D-D

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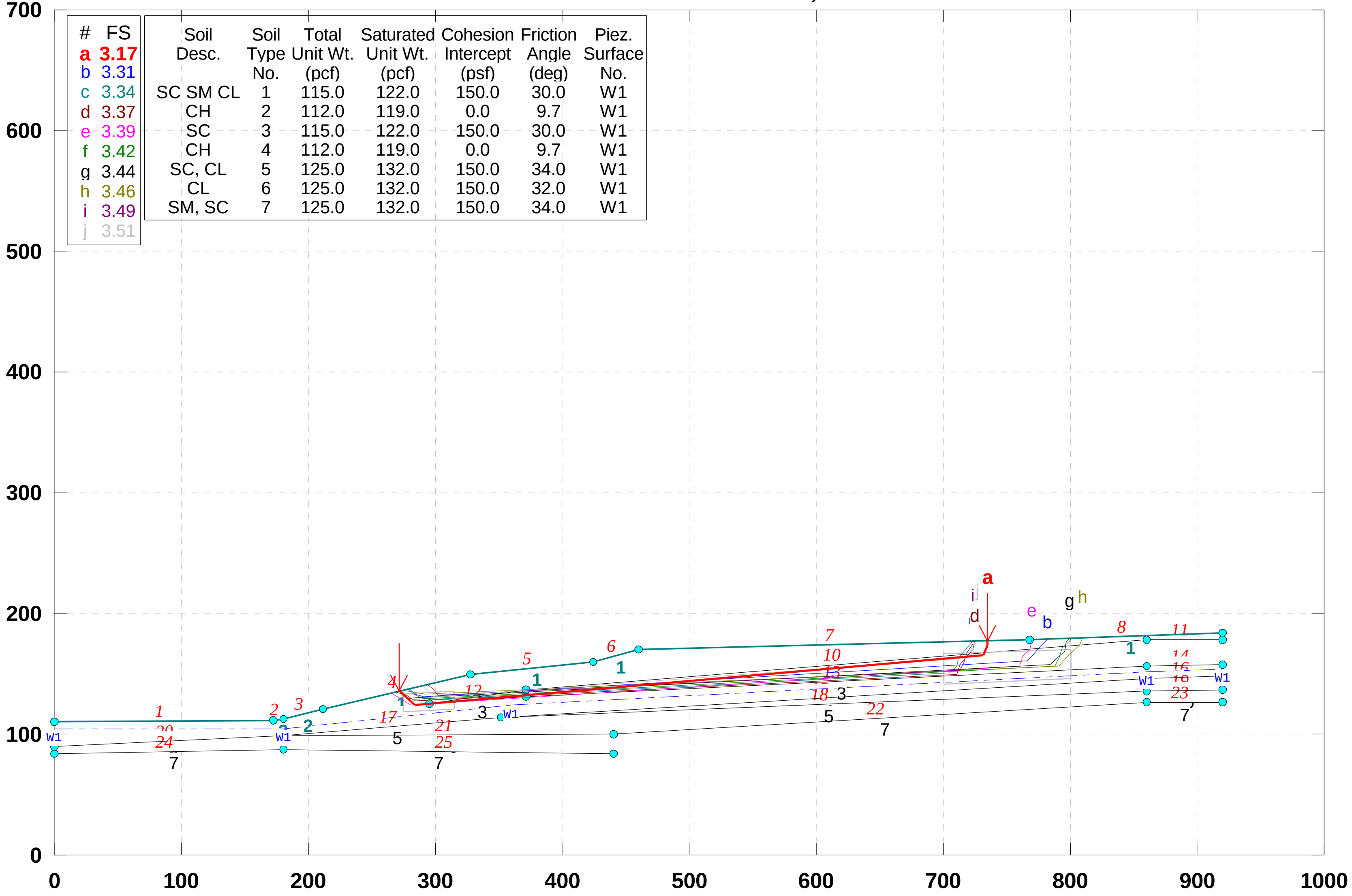

#	FS
a	3.17
b	3.31
c	3.34
d	3.37
e	3.39
f	3.42
g	3.44
h	3.46
i	3.49
j	3.51

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC SM CL	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC	3	115.0	122.0	150.0	30.0	W1
CH	4	112.0	119.0	0.0	9.7	W1
SC, CL	5	125.0	132.0	150.0	34.0	W1
CL	6	125.0	132.0	150.0	32.0	W1
SM, SC	7	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=3.17

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 6 Section D-D

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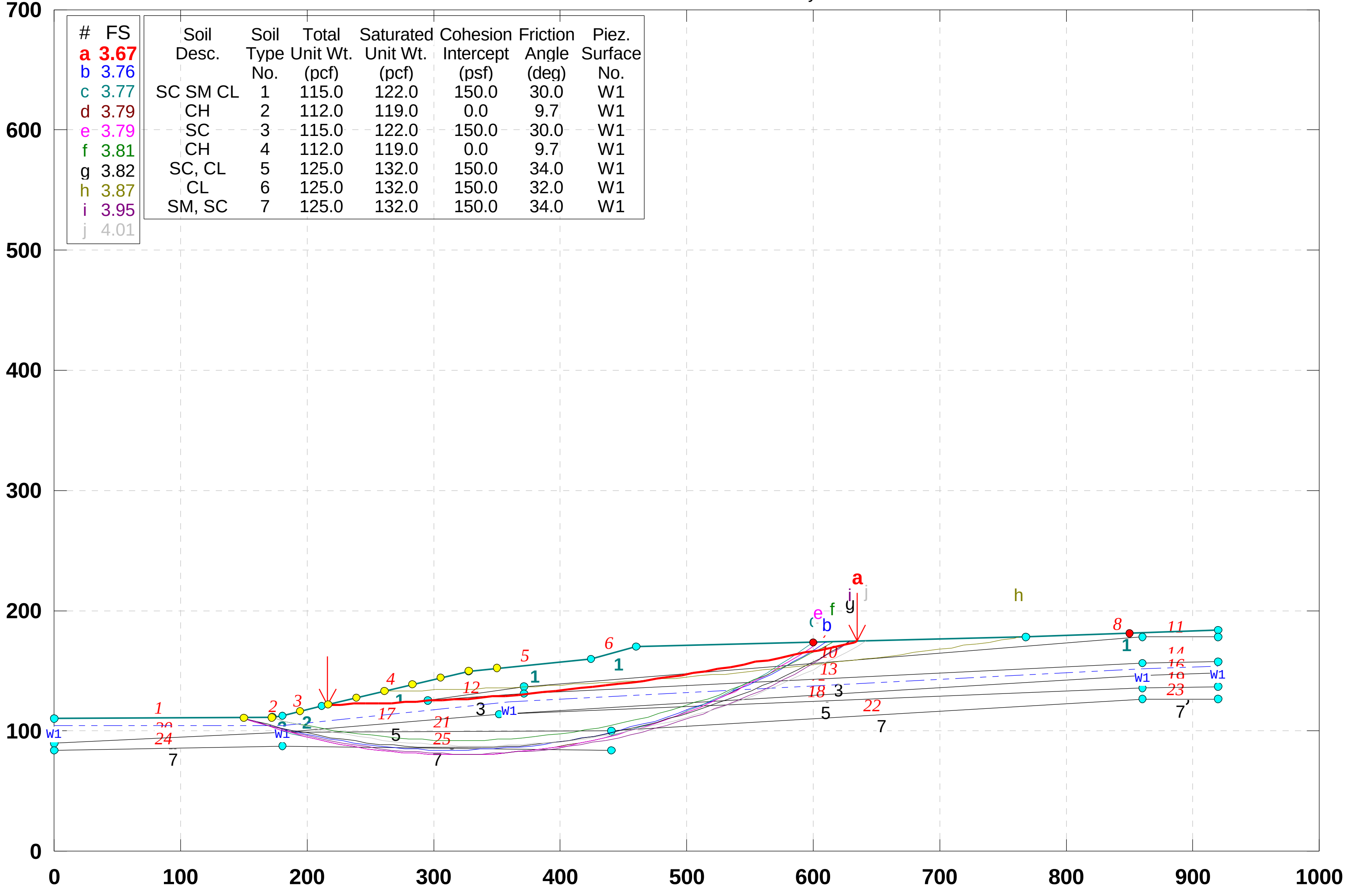


#	FS
a	3.67
b	3.76
c	3.77
d	3.79
e	3.79
f	3.81
g	3.82
h	3.87
i	3.95
j	4.01

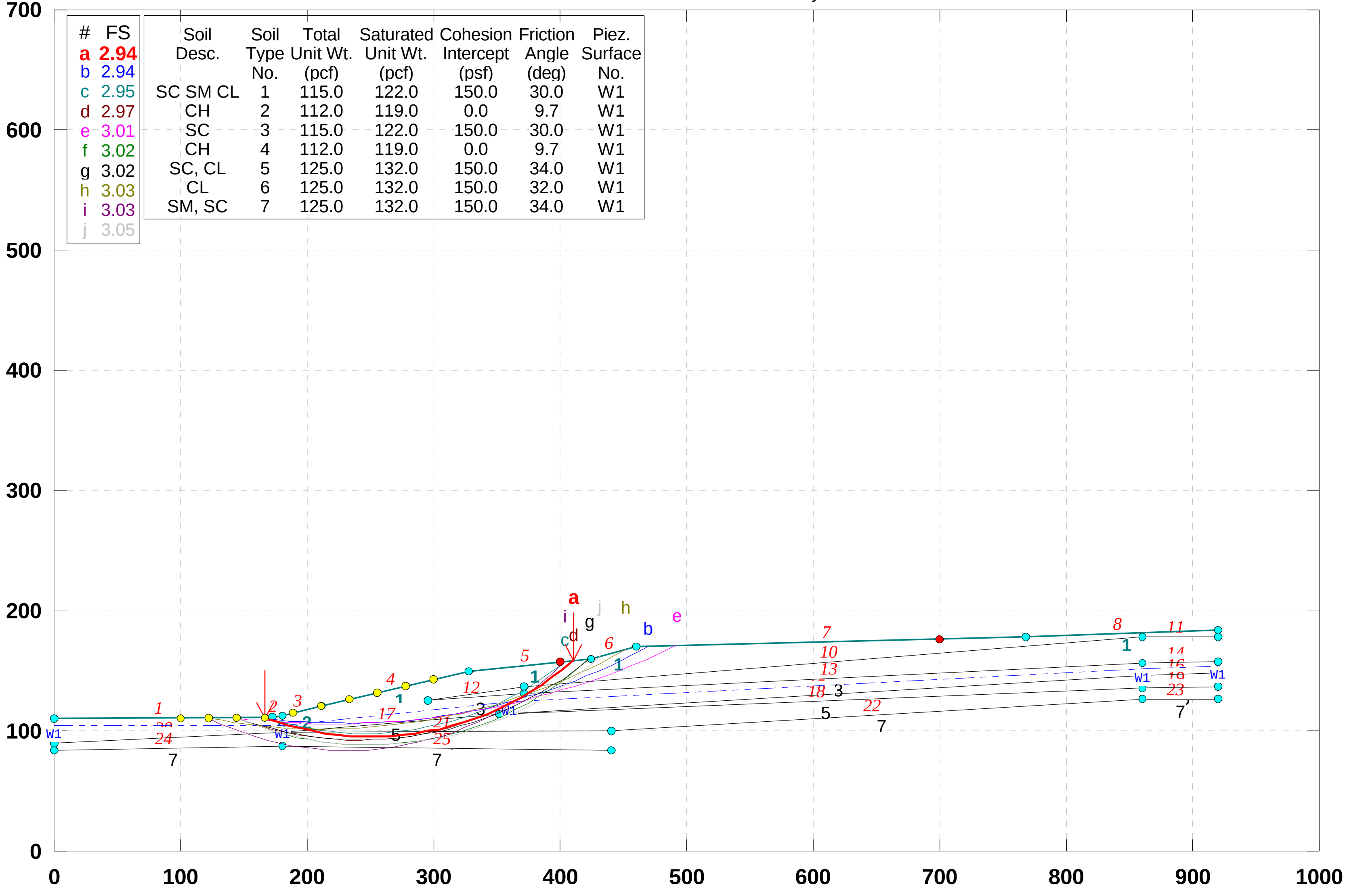
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC SM CL	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC	3	115.0	122.0	150.0	30.0	W1
CH	4	112.0	119.0	0.0	9.7	W1
SC, CL	5	125.0	132.0	150.0	34.0	W1
CL	6	125.0	132.0	150.0	32.0	W1
SM, SC	7	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=3.67

Safety Factors Are Calculated By The Modified Bishop Method

North Hill Analysis No. 7 Section D-D

C:\DOCUME~1\CGIESE\DESKTOP\D-D\NHDDMIDC.PL2   Run By: JC Giese   10/13/2009   3:03PM



#	FS
a	**2.94**
b	2.94
c	2.95
d	2.97
e	3.01
f	3.02
g	3.02
h	3.03
i	3.03
j	3.05

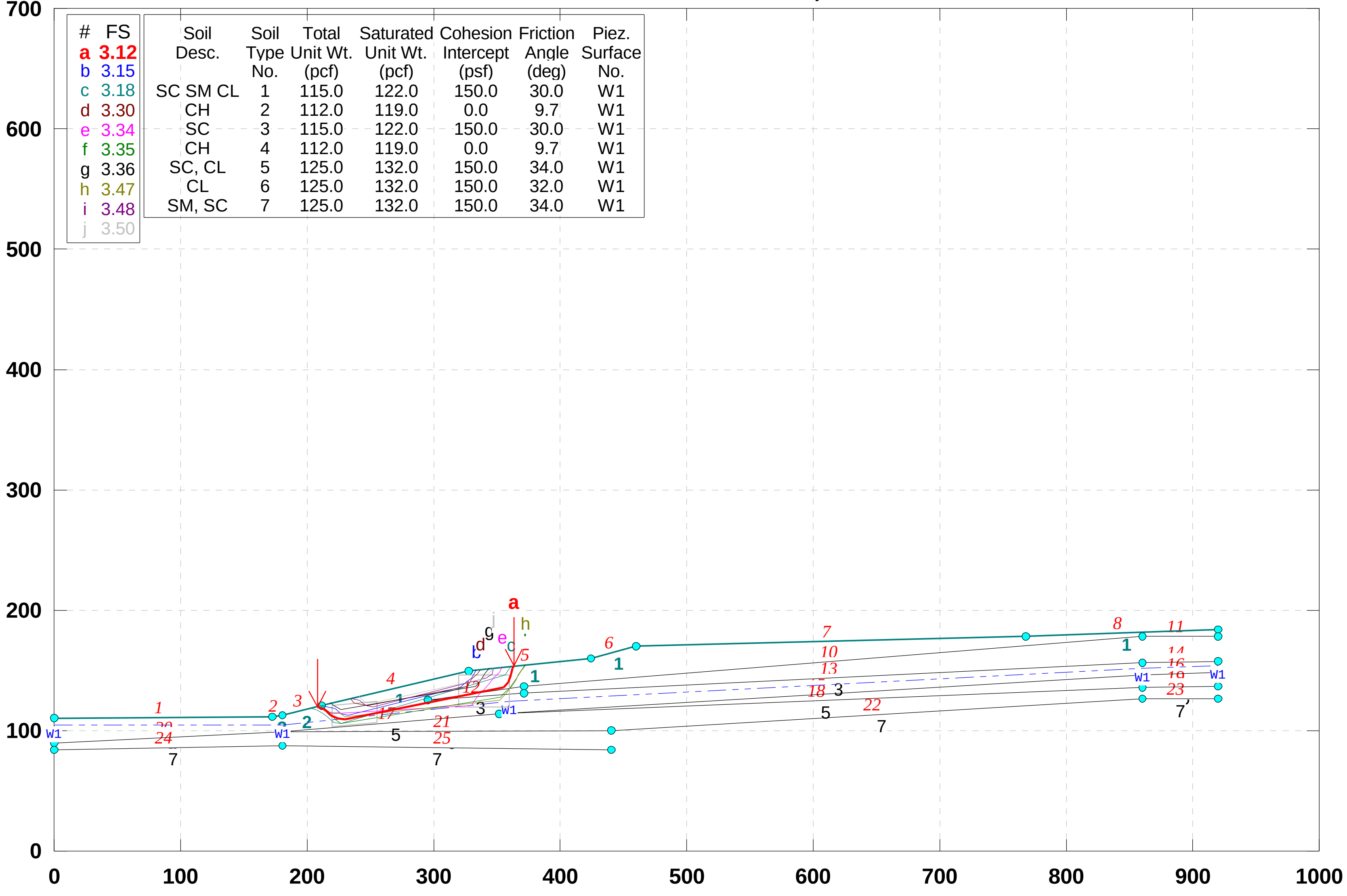
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC SM CL	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC	3	115.0	122.0	150.0	30.0	W1
CH	4	112.0	119.0	0.0	9.7	W1
SC, CL	5	125.0	132.0	150.0	34.0	W1
CL	6	125.0	132.0	150.0	32.0	W1
SM, SC	7	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=2.94

Safety Factors Are Calculated By The Modified Bishop Method

North Hill Analysis No. 8 Section D-D

C:\DOCUME~1\CGIESE\DESKTOP\D-D\NHDDLOWB.PL2 Run By: JC Giese 10/13/2009 4:31PM



#	FS
a	3.12
b	3.15
c	3.18
d	3.30
e	3.34
f	3.35
g	3.36
h	3.47
i	3.48
j	3.50

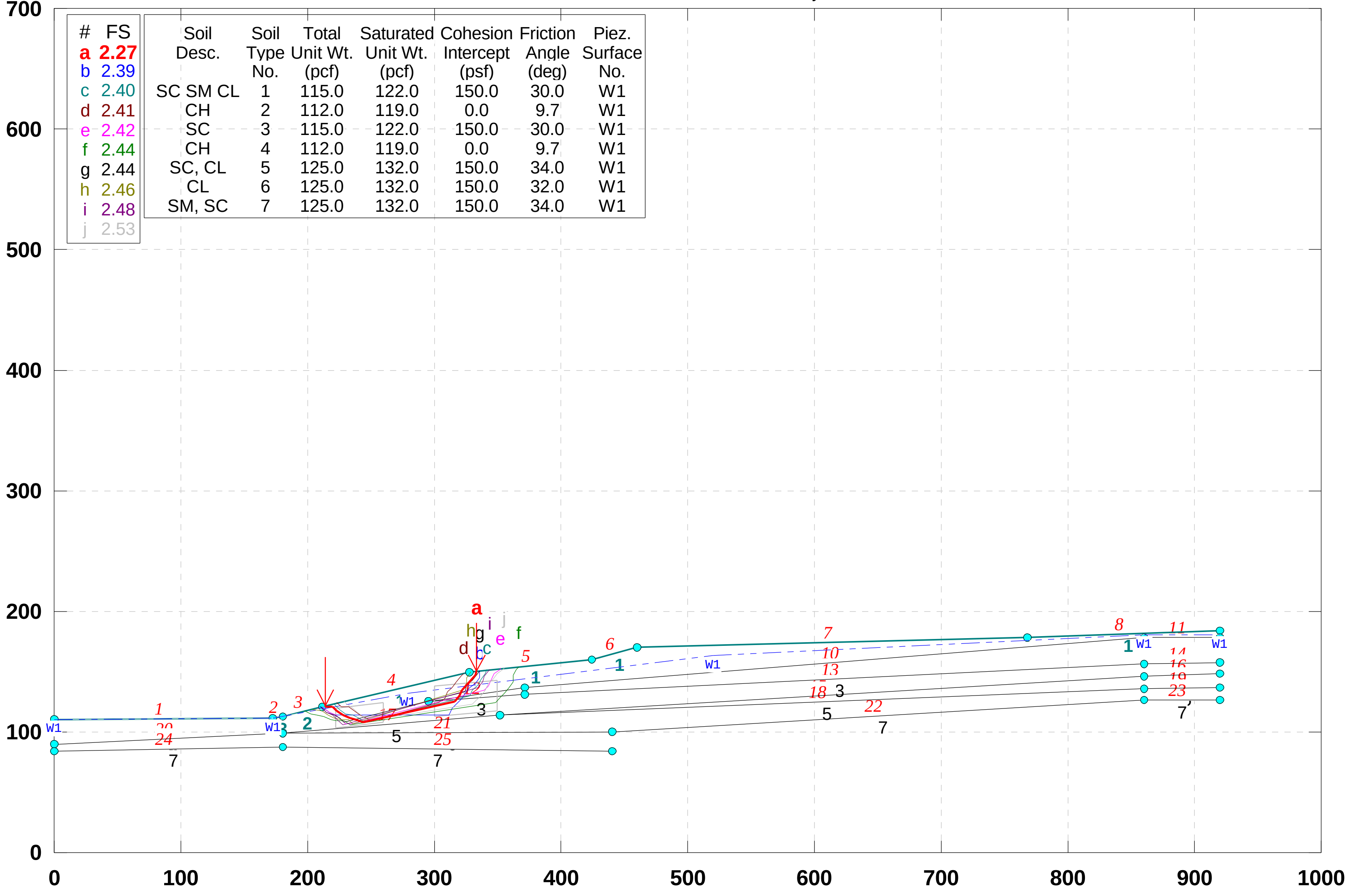
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC SM CL	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC	3	115.0	122.0	150.0	30.0	W1
CH	4	112.0	119.0	0.0	9.7	W1
SC, CL	5	125.0	132.0	150.0	34.0	W1
CL	6	125.0	132.0	150.0	32.0	W1
SM, SC	7	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=3.12

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 9 Lower Slope BlSection D-D

C:\DOCUME~1\CGIESE\DESKTOP\D-D\DDLOWBW.PL2 Run By: JC Giese 10/13/2009 3:01PM



#	FS
a	2.27
b	2.39
c	2.40
d	2.41
e	2.42
f	2.44
g	2.44
h	2.46
i	2.48
j	2.53

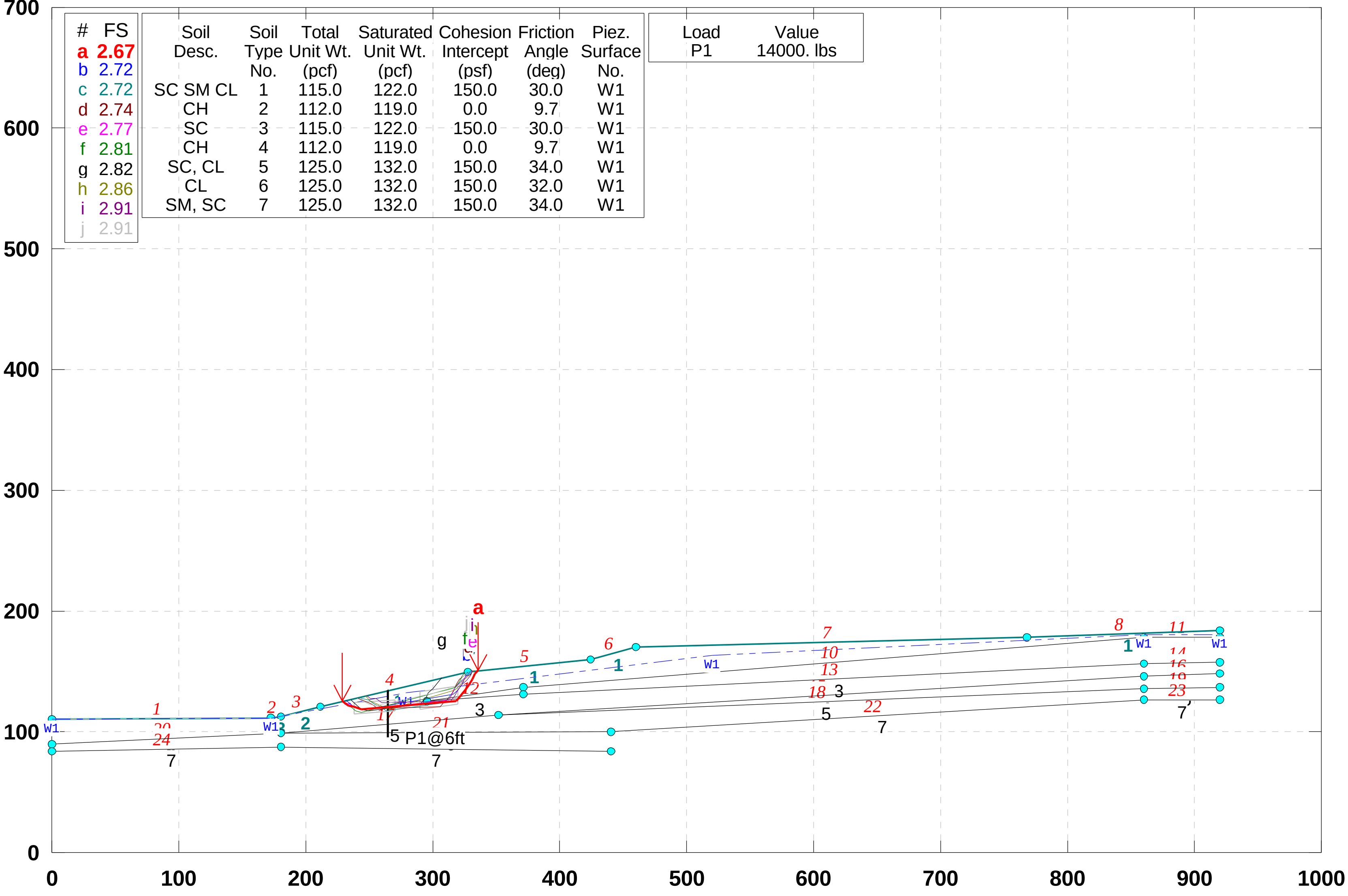
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC SM CL	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC	3	115.0	122.0	150.0	30.0	W1
CH	4	112.0	119.0	0.0	9.7	W1
SC, CL	5	125.0	132.0	150.0	34.0	W1
CL	6	125.0	132.0	150.0	32.0	W1
SM, SC	7	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=2.27

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 10 Section D-D

C:\DOCUME~1\CGIESE\DESKTOP\D-D\DLOWBW2.PL2   Run By: JC Giese   10/13/2009   2:49PM



#	FS
a	2.67
b	2.72
c	2.72
d	2.74
e	2.77
f	2.81
g	2.82
h	2.86
i	2.91
j	2.91

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC SM CL	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC	3	115.0	122.0	150.0	30.0	W1
CH	4	112.0	119.0	0.0	9.7	W1
SC, CL	5	125.0	132.0	150.0	34.0	W1
CL	6	125.0	132.0	150.0	32.0	W1
SM, SC	7	125.0	132.0	150.0	34.0	W1

Load	Value
P1	14000. lbs

GSTABL7 FSmin=2.67

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 11 Section F-F

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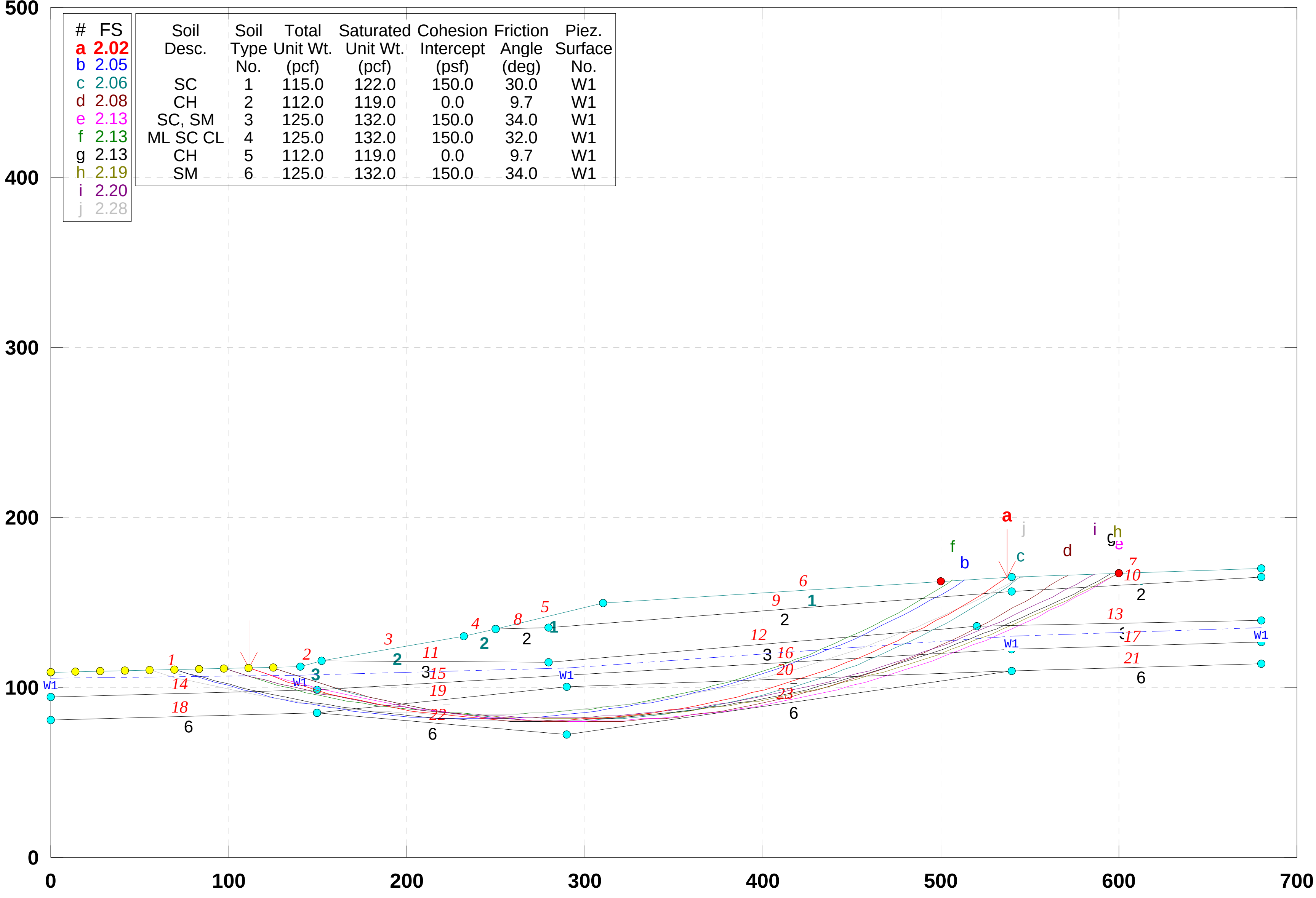

#	FS
a	2.02
b	2.05
c	2.06
d	2.08
e	2.13
f	2.13
g	2.13
h	2.19
i	2.20
j	2.28

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=2.02

Safety Factors Are Calculated By The Modified Bishop Method

North Hill Analysis No. 12 Section F-F

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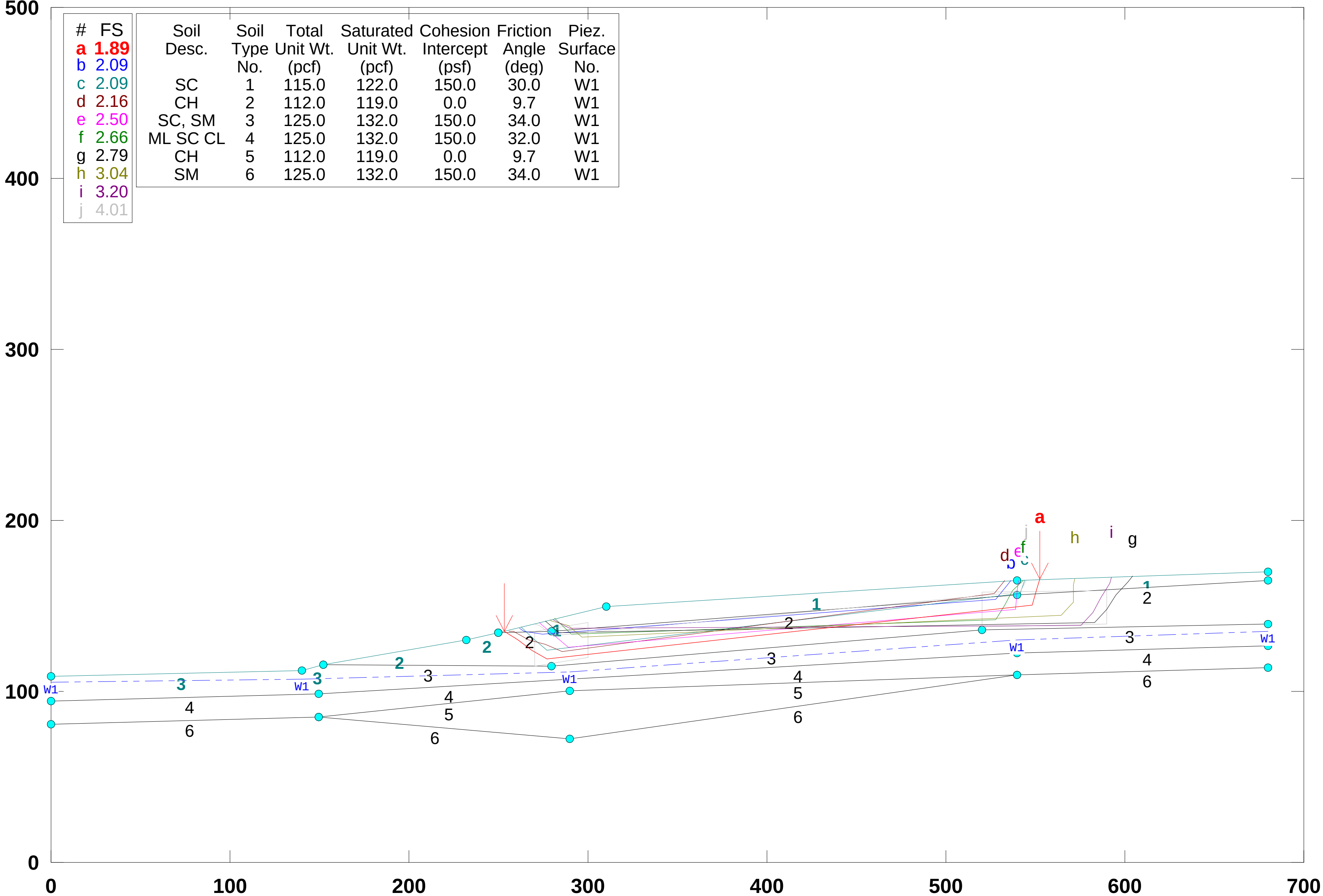


#	FS
a	1.89
b	2.09
c	2.09
d	2.16
e	2.50
f	2.66
g	2.79
h	3.04
i	3.20
j	4.01

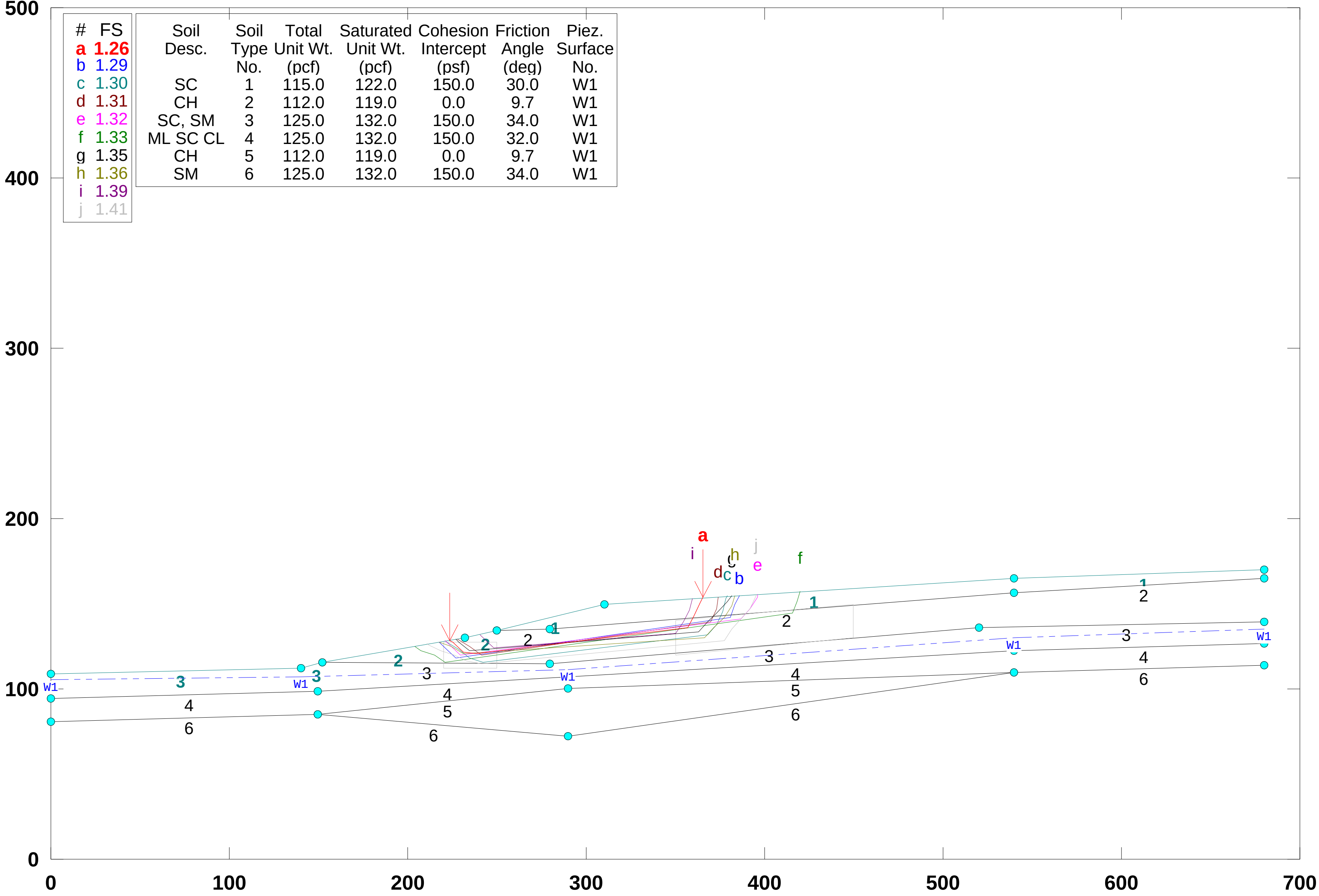
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=1.89

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 13 Section F-F

C:\DOCUME~1\MTOMEO\DESKTOP\GSTABL\NHFFMIDB.PL2   Run By: JCG/MET   08/26/2009   11:26am



#	FS
a	1.26
b	1.29
c	1.30
d	1.31
e	1.32
f	1.33
g	1.35
h	1.36
i	1.39
j	1.41

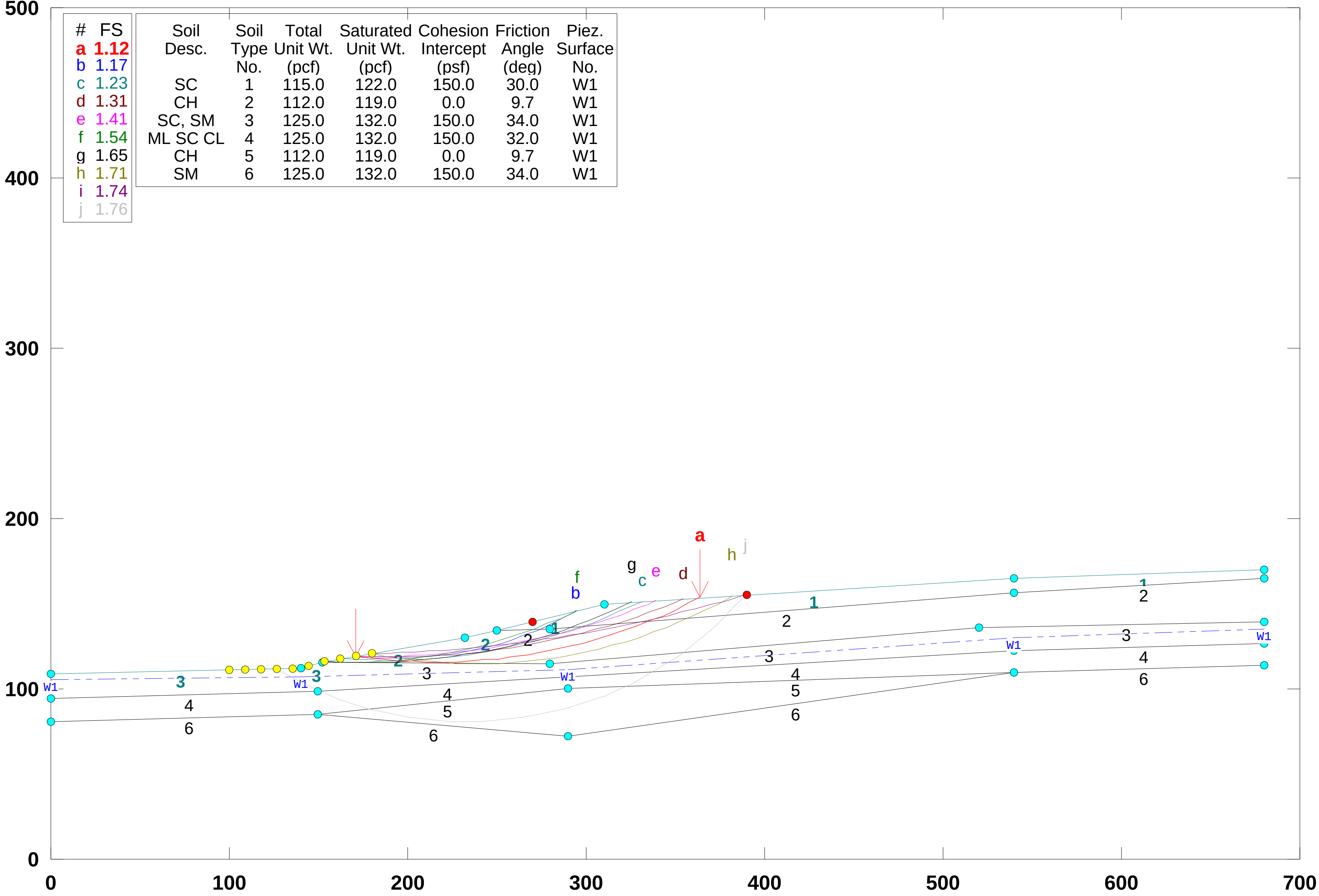
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=1.26

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 14 Section F-F

C:\DOCUME~1\MTOMEO\DESKTOP\GSTABL\NHFFLOWC.PL2   Run By: JCG/MET   08/26/2009   11:30am



#	FS
a	1.12
b	1.17
c	1.23
d	1.31
e	1.41
f	1.54
g	1.65
h	1.71
i	1.74
j	1.76

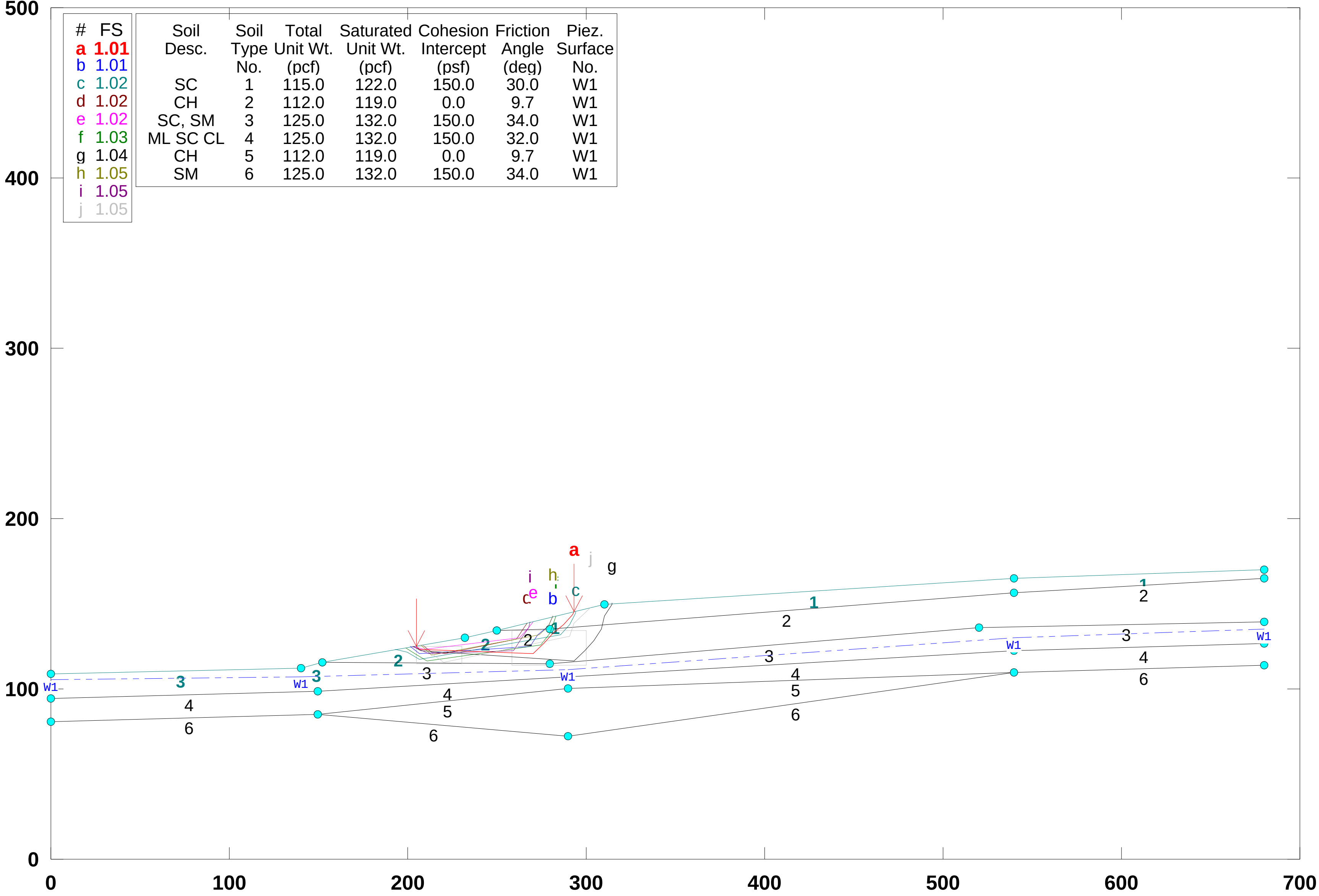
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=1.12

Safety Factors Are Calculated By The Modified Bishop Method

North Hill Analysis No. 15 Section F-F

C:\DOCUME~1\MTOMEO\DESKTOP\GSTABL\NHFFLOWB.PL2 Run By: JCG/MET 08/26/2009 11:35am



#	FS
a	1.01
b	1.01
c	1.02
d	1.02
e	1.02
f	1.03
g	1.04
h	1.05
i	1.05
j	1.05

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=1.01

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 16 Section F-F

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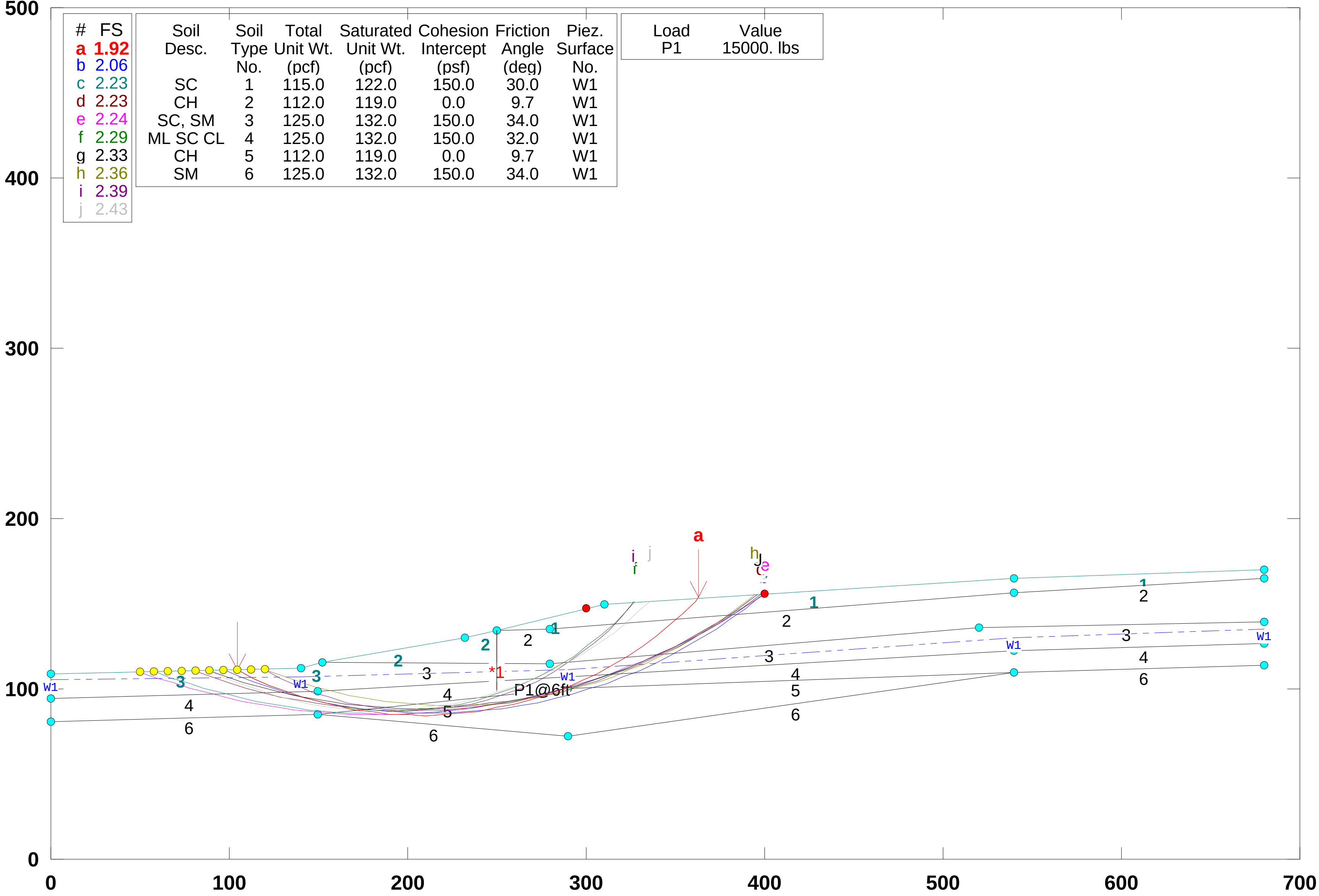


#	FS
a	1.92
b	2.06
c	2.23
d	2.23
e	2.24
f	2.29
g	2.33
h	2.36
i	2.39
j	2.43

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

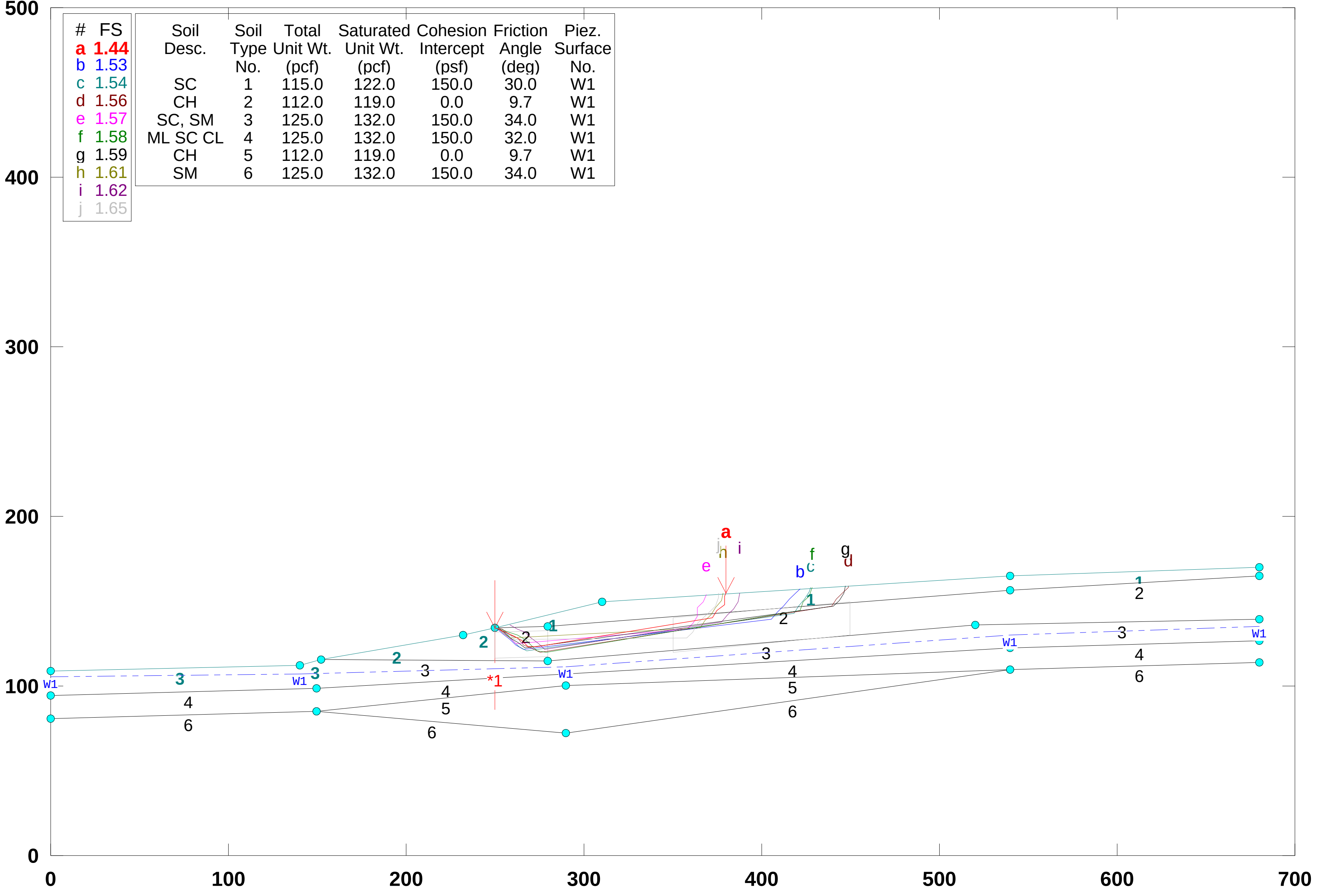
Load	Value
P1	15000. lbs

GSTABL7 FSmin=1.92

Safety Factors Are Calculated By The Modified Bishop Method

North Hill Analysis No. 17 Section F-F

C:\DOCUME~1\MTOMEO\DESKTOP\GSTABL\FFMIDBP.PL2   Run By: JCG/MET   08/26/2009   11:40am



#	FS
a	1.44
b	1.53
c	1.54
d	1.56
e	1.57
f	1.58
g	1.59
h	1.61
i	1.62
j	1.65

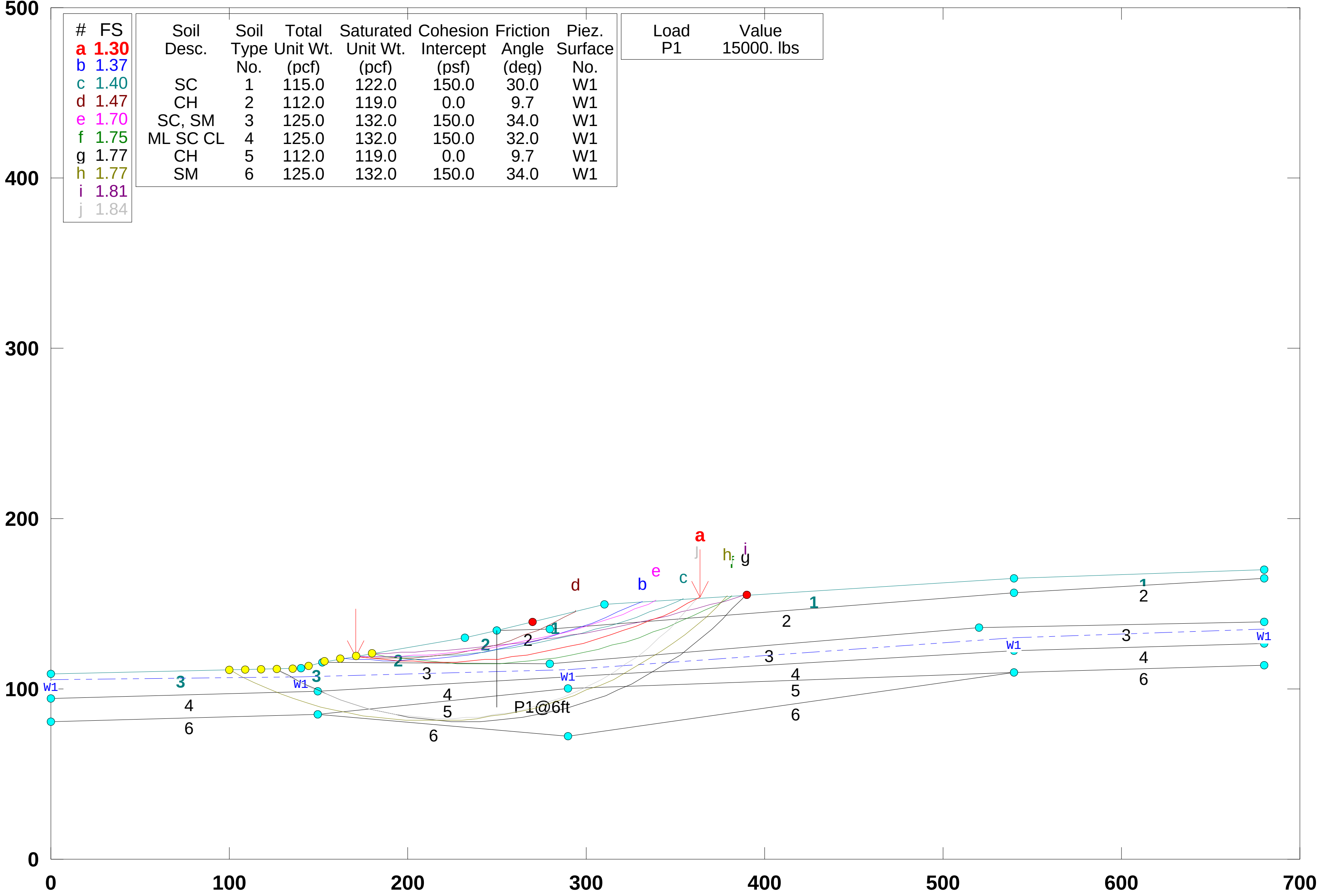
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

GSTABL7 FSmin=1.44

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 18 Section F-F

C:\DOCUME~1\MTOMEO\DESKTOP\GSTABL\FFLOWC2.PL2   Run By: JCG/MET   08/26/2009   11:32am



#	FS
a	1.30
b	1.37
c	1.40
d	1.47
e	1.70
f	1.75
g	1.77
h	1.77
i	1.81
j	1.84

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

Load	Value
P1	15000. lbs

GSTABL7 FSmin=1.30

Safety Factors Are Calculated By The Modified Bishop Method

North Hill Analysis No. 19 Section F-F

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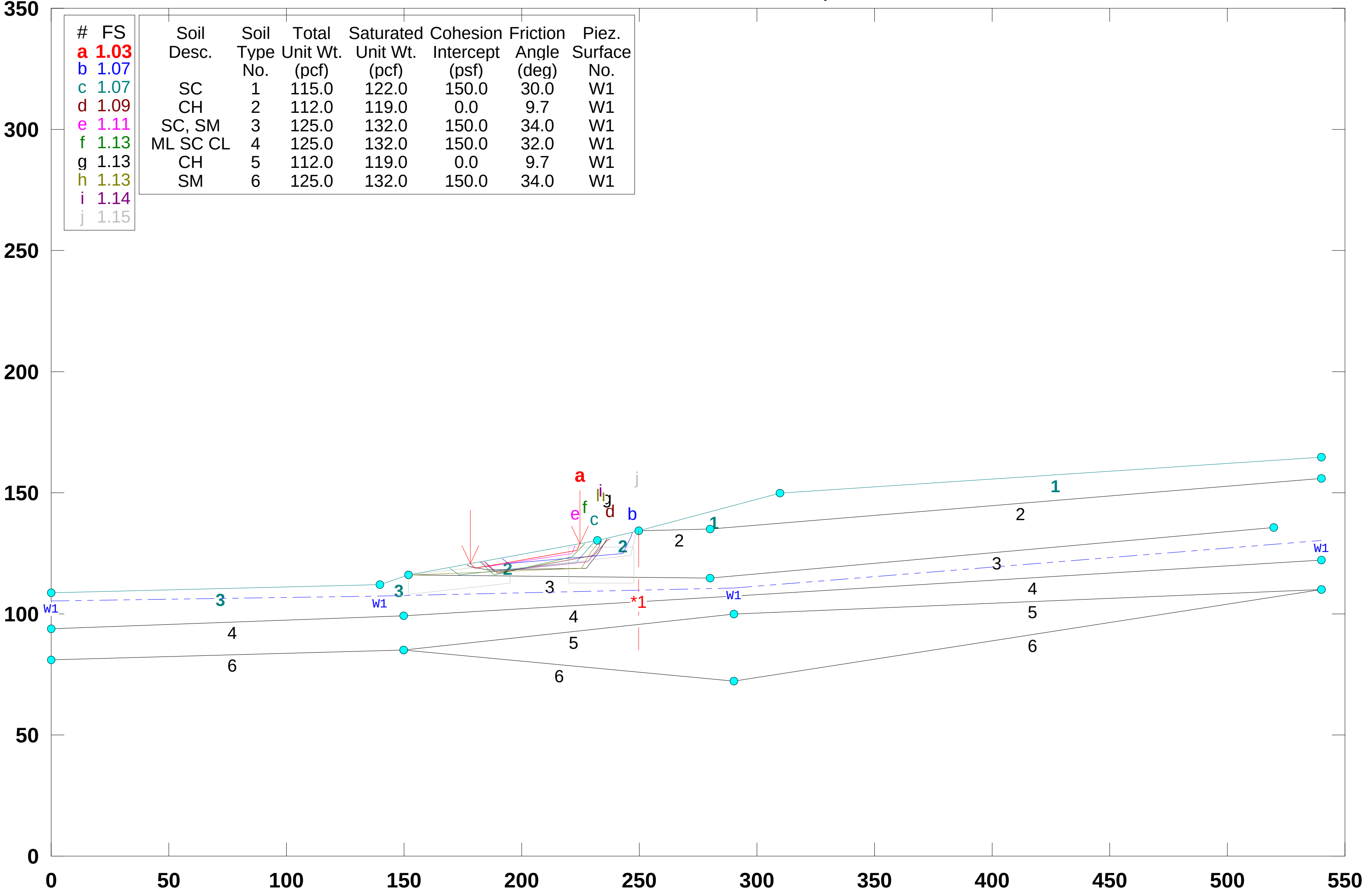


Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

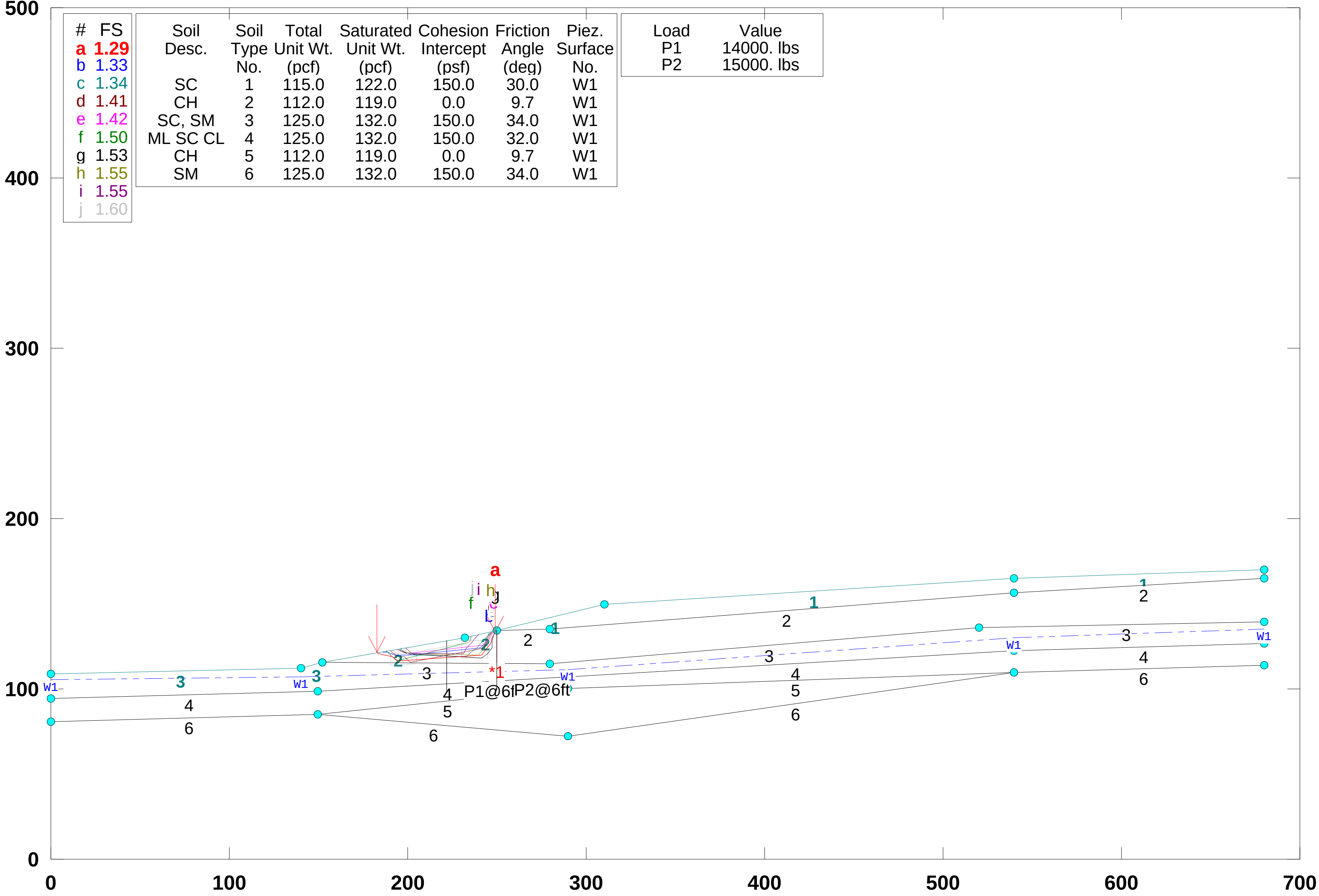
#	FS
a	1.03
b	1.07
c	1.07
d	1.09
e	1.11
f	1.13
g	1.13
h	1.13
i	1.14
j	1.15

GSTABL7 FSmin=1.03

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 20 Section F-F

C:\DOCUME~1\MTOMEO\DESKTOP\GSTABL\FFLOWCB.PL2   Run By: JCG/MET   08/26/2009   11:49am



#	FS
a	1.29
b	1.33
c	1.34
d	1.41
e	1.42
f	1.50
g	1.53
h	1.55
i	1.55
j	1.60

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

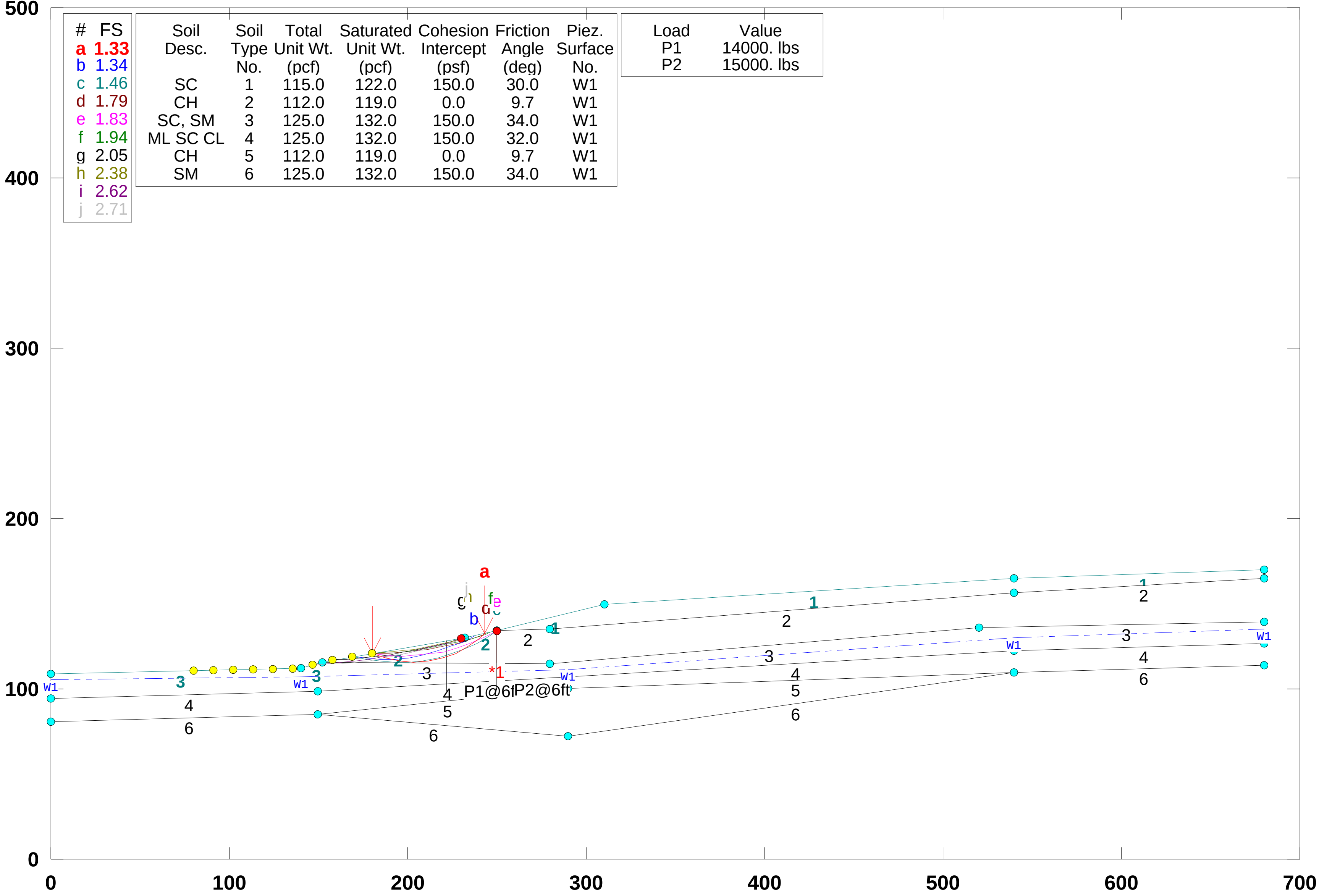
Load	Value
P1	14000. lbs
P2	15000. lbs

GSTABL7 FSmin=1.29

Safety Factors Are Calculated By The Simplified Janbu Method

North Hill Analysis No. 21 Section F-F

C:\DOCUME~1\MTOMEO\DESKTOP\GSTABL\FFLOWCC.PL2   Run By: JCG/MET   08/26/2009   11:51am



#	FS
a	1.33
b	1.34
c	1.46
d	1.79
e	1.83
f	1.94
g	2.05
h	2.38
i	2.62
j	2.71

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
SC	1	115.0	122.0	150.0	30.0	W1
CH	2	112.0	119.0	0.0	9.7	W1
SC, SM	3	125.0	132.0	150.0	34.0	W1
ML SC CL	4	125.0	132.0	150.0	32.0	W1
CH	5	112.0	119.0	0.0	9.7	W1
SM	6	125.0	132.0	150.0	34.0	W1

Load	Value
P1	14000. lbs
P2	15000. lbs

GSTABL7 FSmin=1.33

Safety Factors Are Calculated By The Modified Bishop Method

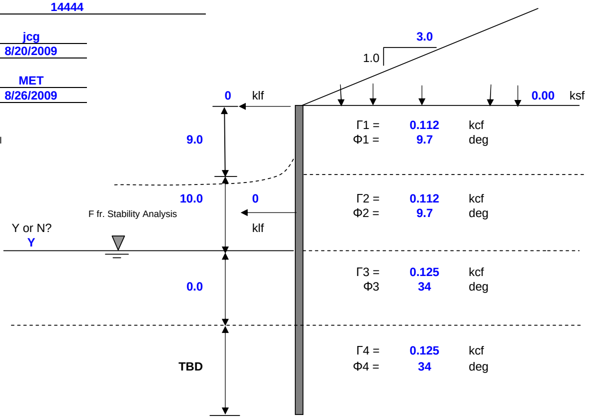
Design of Pile or Drilled Shaft Walls for North Hill MHP

Project North Hill Upper Wall
Project No. 14444

designed by: jcg
date: 8/20/2009

checked by: MET
date: 8/26/2009

Assume loss of material
on low side of wall =
0.5 H above slide plane



Pile spacing	6.0	ft
Flange or shaft width*	1.2	ft
Active flange factor	1.0	
Passive flange factor	2.75	
Pile or shaft?	P	
Grade steel	50	ksi
Bar size	1.25	in
No. bars		
Conc. Cover		in
Tension Crack	Yes	

HP 10X42	Sx =	43.4	in^3
HP 12X53	Sx =	66.9	in^3
HP 12X74	Sx =	93.4	in^3
HP 14x89	Sx =	131	in^3
HP 14x102	Sx =	150	in^3
HP 14x117	Sx =	173	in^3

* Use flange width (driven) or diameter of predrilled hole for piles

Instructions

1. Enter values indicated by bold blue.
2. Indicate Y or N for water table.
3. If the pile does not need to penetrate Layer 3, rerun and enter 0.0 depth for Layer 3.

RESULTS		
Embedment Required for 0 shear	2.81	ft
Embedment Required for Moment	3.94	ft
Maximum Moment	365.2	ft-kip
Sx Required	132.8	in^3
Depth to Max Shear	5.04	ft
Max Shear	40.8	kip

symbol	**name**	**units**		
Δ	tieback angle	deg	0.0	
H1	ht. layer 1	ft.	9.0	
H2	ht. layer 2	ft.	10.0	
H3	ht. layer 3	ft.	0.0	
H4	ht. layer 4	ft.	TBD	H4
Γ1	wt. layer 1	kcf	0.112	
Φ1	friction layer 1	deg	9.7	
Γ2	wt. layer 2	kcf	0.112	
Φ2	friction layer 2	deg	9.7	
Γ3	wt. layer 3	kcf	0.125	
Φ3	friction layer 3	deg	34	
Γ4	wt. layer 4	kcf	0.125	
Φ4	friction layer 4	deg	34	
S	surcharge	ksf	0.00	
H	horiz. component		3.0	
Y or N	water, yes or no		Y	
PS	pile spacing	ft.	6.0	
FW	flange width	ft.	1.22	
FA	active flange factor		1.0	
FP	passive flange factor		2.8	
β	slope angle	deg	18.4	
fy	grade steel	ksi	50.0	
Ka1	act. coef. layer 1		0.70	
Ka2	act. coef. layer 2		0.70	
Ka3	act. coef. layer 3		0.28	
Ka4	act. coef. layer 4		0.28	
Kp2	pass. coef. layer 2		1.40	
Kp3	pass. coef. layer 3		3.54	
Kp4	pass. coef. layer 4		3.54	
Γ3'	eff. wt. layer 3	kcf	0.063	
Γ4'	eff. wt. layer 4	kcf	0.063	
P1	stress bot, area 1	ksf	0.706	
P2	stress bot, area 2	ksf	0.706	
P3	stress bot, area 3	ksf	0.784	
P4	stress bot, area 4	ksf	1.490	
P5	stress bot, area 5	ksf	0.000	
P6	stress bot, area 6	ksf	1.490	
P7	stress bot, area 7	ksf	0.018	H4
P8	stress bot, area 8	ksf	0.000	
P9	stress bot, area 9	ksf	0.000	
P10	stress bot, area 10	ksf	0.221	H4
Fs	sound wall hor. Forc	kip	0.00	
P11	stress top, area 11	ksf (unfactored)	1.568	
P12	stress stab. Analy.	kip	0.0	
P13	stress top, area 11		1.6	

		force		lever arm	shear moment	
		kips		ft	ft-kip	
Fs		0.00		21.81	0.0	
F1	force area 1	19.05		15.81	301.3	10.85
F2	force area 2	42.34		7.81	330.8	24.11
F3	force area 3	23.52		6.15	144.6	13.4
F4	force area 4	0.00		2.81	0.0	1.02
F5	force area 5	0.00		2.81	0.0	12
F6	force area 6	1.81	H4	1.41	7.2	61.38
F7	force area 7	0.01	H4*H4	0.94	0.1	
F8	force area 8	0.00		2.81	0.0	
F9	force area 9	0.00	H4	1.41	0.0	
F10	force area 10	-0.37	H4*H4	0.94	-2.7	
F11a	force area 11b	0.00		2.81	0.0	
F11b	force area 11a	-18.54	H4	1.41	-73.4	
P12	stab. Force	0.00		9.15	0.0	
P-13	force area 13	-34.99		9.79	-342.6	
S1	surch. 1ayer 1	0.000		15.81	0.0	
S2	surch. layer 2	0.000		7.81	0.0	
S3	surch. layer 3	0.000		2.81	0.0	
S4	surch. layer 4	0.000	H4	1.41	0.0	
				ΣM =	365.2	

	a	b	c
moment	0.36	16.73	-49.92
shear 3	0.36	-1.81	
shear 4	0.36	-1.81	0.00

Sx reqd. = 132.8 in^3

H4 = 2.81 ft

Embedment for Moment 3.94 ft

D3 N/A Depth to max shear layer 3
D4 5.04 Depth to max shear layer 4

Max shear in layer 3? No

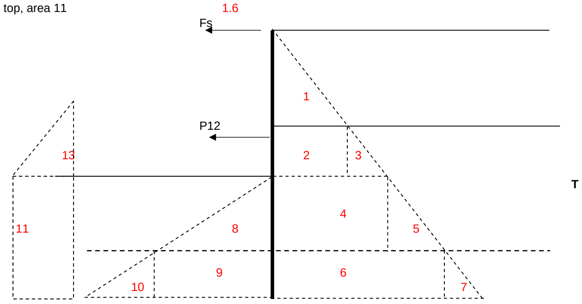
Max Shear in Layer 3 N/A kips

Pos Shear	1.81	D
Pos Shear	0.01	D*D
Neg Shear	0.37	D*D

Max Shear in Layer 4

Pos Shear	1.811	D
Pos Shear	0.011	D*D
Neg Shear	0.00	D
Neg Shear	0.37	D*D

Max Shear 40.79 kips



LPILE/GROUP DATA INPUT FORM

North Hill MHP

Project No. 14444

Structural Engineers Please Enter Info in Shaded Boxes

Input Required Noted in Blue

Red Values Are Calculated

By: JCG **Date:** 08/13/2009

Checked: MET **Date:** 08/27/2009

Bridge No. NH **Pier No.** Upper W **Top of Pile/Shaft El.** 134.0

Boring No. W5B-1

Indicate Analysis Type Required
X **L/PILE Single Pile/Shaft Free head**
☐ **L/PILE Single Pile/Shaft Fixed head**
☐ **GROUP Fixed Head**

126 **Top of Ground El.** (Assumes tension crack to a depth of 8 feet)

Indicate Load Type
X **Single Pile/Shaft Load**
☐ **Group Load**

1 **No. Piles/Shafts for GROUP**

Pier Dia. ft

Pile Size 12*74

enter triangular load as 1.58 klf to a depth of 19'

Tranverse Spacing, ft

Longit. Spacing, ft

Do not enter spacing for LPILE analysis.

Include secondary/tertiary loads when it is not readily apparent which load group is the dominant load group.

Max. Fv for Axial Capacity Analysis, kips 0 for dd

Include couple effects with Fv

Load Conditions (Primary)				**Load Conditions (Secondary)**				**Load Conditions (Tertiary)**			
Fv (FV)		kips (lbs)		Fv (FV)		kips (lbs)		Fv (FV)		kips (lbs)	
Fy (FL)		kips (lbs)		Fy (FL)		kips (lbs)		Fy (FL)		kips (lbs)	
Fz (FT)		kips (lbs)		Fz (FT)		kips (lbs)		Fz (FT)		kips (lbs)	
Mv (TOR)		kip-ft (lb-in)		Mv (TOR)		kip-ft (lb-in)		Mv (TOR)		kip-ft (lb-in)	
My (MT)		kip-ft (lb-in)		My (MT)		kip-ft (lb-in)		My (MT)		kip-ft (lb-in)	
Mz (ML)		kip-ft (lb-in)		Mz (ML)		kip-ft (lb-in)		Mz (ML)		kip-ft (lb-in)	

E_{50} required for CL, CH, MH, & R

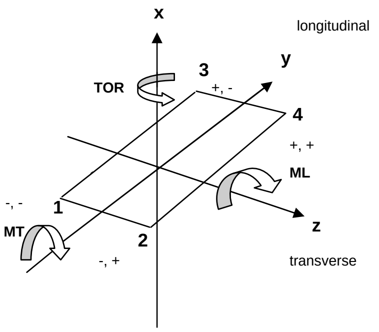
Soil Conditions Water Table El. 110.0 ft

LPILE / GROUP INPUT PARAMETERS

Layer No.	**El. Bottom of Layer**	**Layer Thickness**	**Soil Type**	**Province**	**Avg. N_{60}**	**Substrat.**	**Depth** inches	**Density** pci	**Φ°**	**Cohesion** p/in²	**Modulus** pci	**E_{50}**
Surface	ft	ft					96					
1	115.0	19.0	CH	CP	28	T-II	228	0.0666		24.3		0.002
2	110.0	5.0	SC	CP	30	T-III	288	0.0723	34.0		166	
3	105.0	5.0	SC	CP	30	T-III	348	0.0403	34.0		100	
4	97.0	8.0	ML	CP	36	T-III	444	0.0403	34.0		120	
5	90.0	7.0	CH	CP	50	T-III	528	0.0403		43.4		0.002
6												
7												
8												
9												
10												
11												

Pile Coordinates

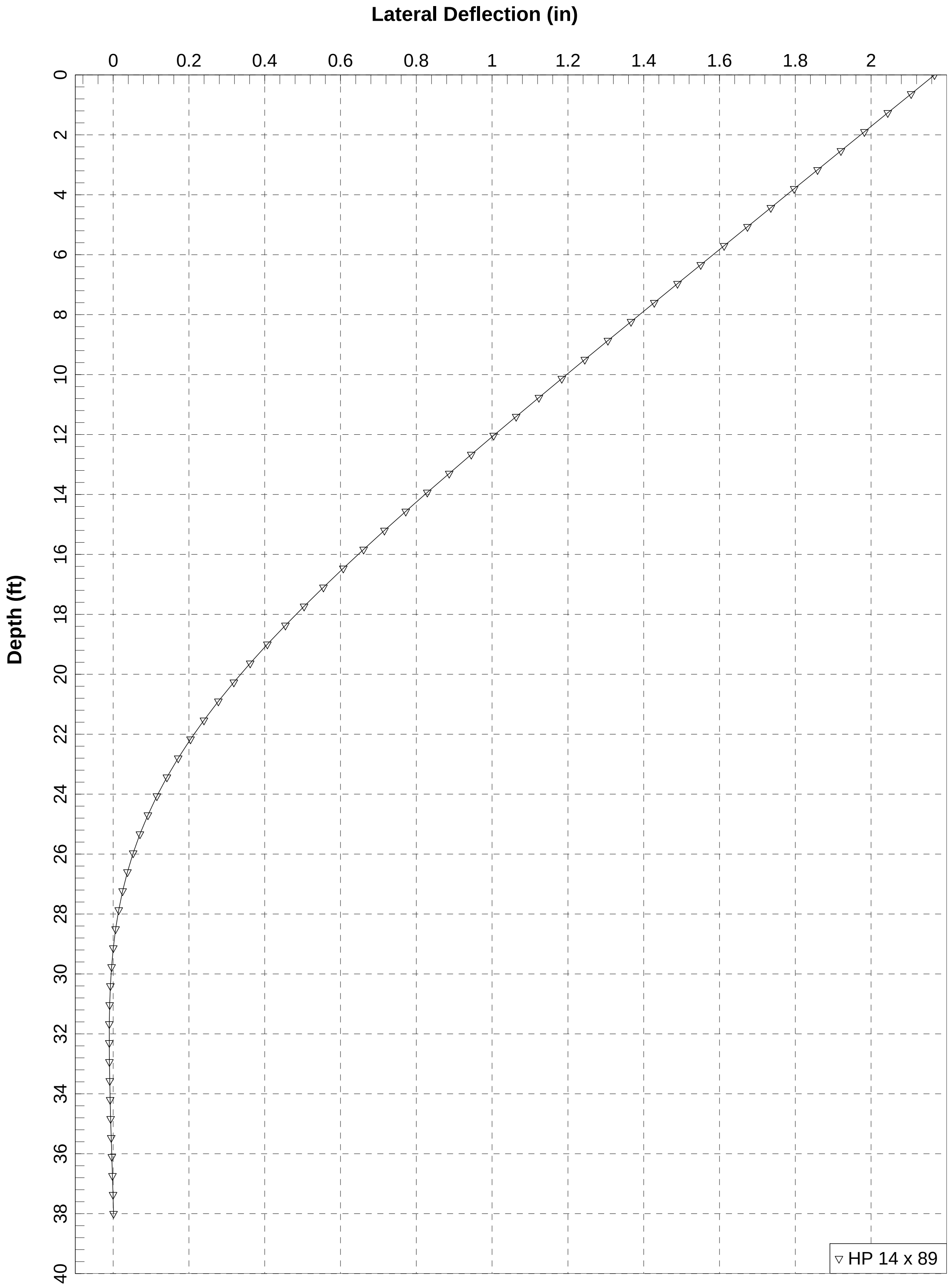
Pile No.	**Coordinate**	**Coordinate**
1		
2		
3		
4		



Diameter	**Mom. of I.** in⁴	**Area** in²
2.0	16,286	452
2.5	39,761	707
3.0	82,448	1,018
3.5	152,745	1,385
4.0	260,577	1,810
4.5	417,394	2,290
5.0	636,174	2,827
5.5	931,422	3,421
6.0	1,319,170	4,072
7.0	2,443,926	5,542
8.0	4,169,230	7,238
HP 12x53	394	16

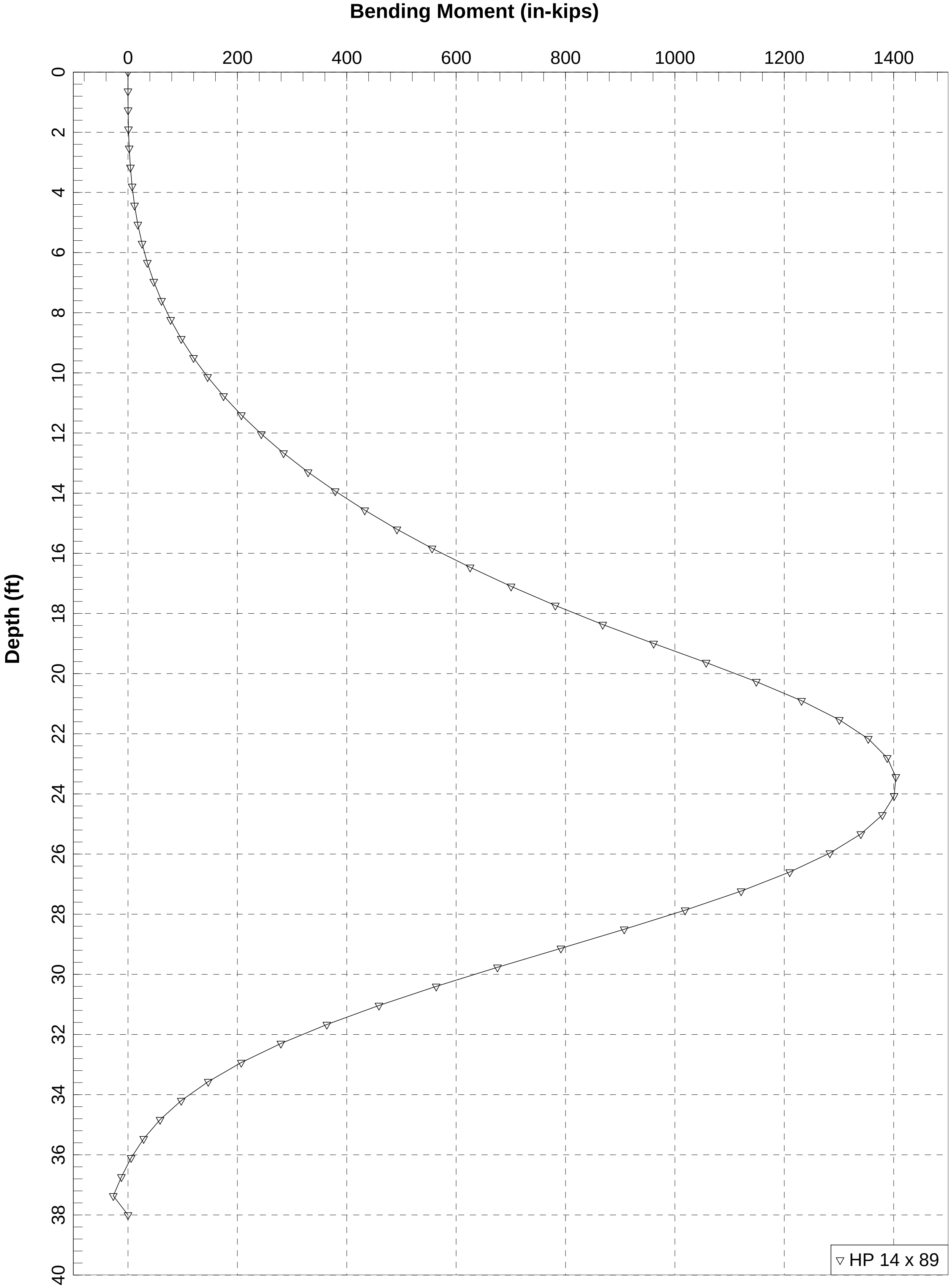
M concrete = 3,800,000 psi

M Steel = 30,000,000 psi

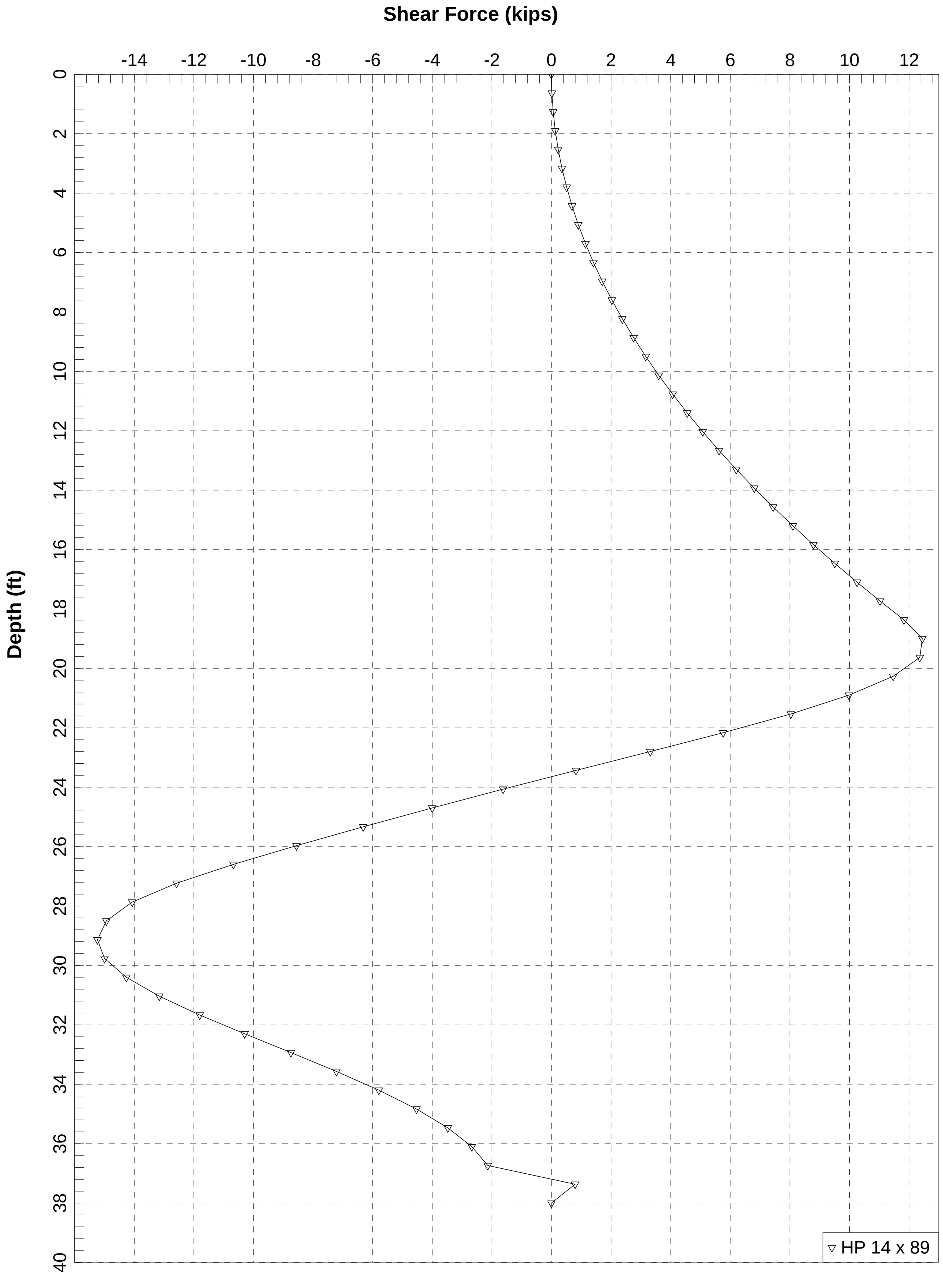


North Hill Upper Wall (No soil below wall above slide plane)

North Hill Upper Wall (No soil below wall above slide plane)



North Hill Upper Wall (No soil below wall above slide plane)



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==============================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.39)

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

                        (c) 1985-2007 by Ensoft, Inc.
                             All Rights Reserved

==============================================================================


This program is licensed to:

Margaret Tomeo
ECS

Path to file locations:
I:\Geotechnical\{eProjects}\14400-14499\01-14444\d-Working\FINAL ANALYSIS\LPILE\
Name of input data file:     north hill.lpd
Name of output file:         north hill.lpo
Name of plot output file:    north hill.lpp
Name of runtime file:        north hill.lpr


------------------------------------------------------------------------------
                          Time and Date of Analysis
------------------------------------------------------------------------------

               Date:  August 27, 2009     Time:  10:33:53


------------------------------------------------------------------------------
                                Problem Title
------------------------------------------------------------------------------

North Hill  Line F-F  Upper Wall


------------------------------------------------------------------------------
                                Program Options
------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments           =           60
```

```
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
------------------------------------------------------------------------------

Pile Length                               =     456.00 in

Depth of ground surface below top of pile =     228.00 in

Slope angle of ground surface             =        .00 deg.

Structural properties of pile defined using  2 points

Point    Depth        Pile      Moment of       Pile      Modulus of
           X        Diameter     Inertia        Area      Elasticity
           in          in         in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   14.20000000     910.0000      26.2000     30000000.
  2     456.0000   14.20000000     910.0000      26.2000     30000000.


------------------------------------------------------------------------------
                      Soil and Rock Layering Information
------------------------------------------------------------------------------

The soil profile is modelled using  4 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      228.000 in
Distance from top of pile to bottom of layer =      288.000 in
p-y subgrade modulus k for top of soil layer =      166.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      166.000 lbs/in**3

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      288.000 in
Distance from top of pile to bottom of layer =      348.000 in
p-y subgrade modulus k for top of soil layer =      100.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      100.000 lbs/in**3

Layer  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      348.000 in
Distance from top of pile to bottom of layer =      444.000 in
p-y subgrade modulus k for top of soil layer =      120.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      120.000 lbs/in**3

Layer  4 is stiff clay without free water
Distance from top of pile to top of layer    =      444.000 in
Distance from top of pile to bottom of layer =      550.000 in


(Depth of lowest layer extends   94.00 in below pile tip)


------------------------------------------------------------------------------
```

```
                                     north hill
                   Effective Unit Weight of Soil vs. Depth
------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in         lbs/in**3
-----      ----------   ----------------
  1         228.00        .07230
  2         288.00        .07230
  3         288.00        .04030
  4         348.00        .04030
  5         348.00        .04030
  6         444.00        .04030
  7         444.00        .04030
  8         550.00        .04030



------------------------------------------------------------------------------
                           Shear Strength of Soils
------------------------------------------------------------------------------

Shear strength parameters with depth defined using  8 points

Point    Depth X     Cohesion c     Angle of Friction     E50 or      RQD
 No.       in         lbs/in**2            Deg.            k_rm        %
-----   --------     ----------     ------------------    ------    ------
  1      228.000         .00000           34.00           ------    ------
  2      288.000         .00000           34.00           ------    ------
  3      288.000         .00000           34.00           ------    ------
  4      348.000         .00000           34.00           ------    ------
  5      348.000         .00000           34.00           ------    ------
  6      444.000         .00000           34.00           ------    ------
  7      444.000       43.00000             .00           .00200        .0
  8      550.000       43.00000             .00           .00200        .0

Notes:

(1)  Cohesion = uniaxial compressive strength for rock materials.
(2)  Values of E50 are reported for clay strata.
(3)  Default values will be generated for E50 when input values are 0.
(4)  RQD and k_rm are reported only for weak rock strata.



------------------------------------------------------------------------------
                                 Loading Type
------------------------------------------------------------------------------

Static loading criteria was used for computation of p-y curves.



------------------------------------------------------------------------------
                          Distributed Lateral Loading
------------------------------------------------------------------------------

Distributed lateral load intensity defined using  2 points

Point      Depth X       Dist. Load
 No.        in             lbs/in
```

```
-----     ----------     ----------
  1           .000         .00000
  2        228.000      111.00000



------------------------------------------------------------------------------
              Pile-head Loading and Pile-head Fixity Conditions
------------------------------------------------------------------------------

Number of loads specified =  1

Load Case Number  1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =            .000 lbs
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =            .000 lbs

(Zero moment at pile head for this load indicates a free-head condition)



------------------------------------------------------------------------------
             Computed Values of Load Distribution and Deflection
                 for Lateral Loading for Load Case Number  1
------------------------------------------------------------------------------

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head  =            .000 lbs
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

(Zero moment for this load indicates free-head conditions)

  Depth   Deflect.    Moment      Shear       Slope      Total       Soil Res.
Es*h
    X        y          M           V           S        Stress          p
F/L
    in       in        lbs-in        lbs         Rad.   lbs/in**2    lbs/in
lbs/in
-------- --------- ----------- ----------- ----------- ----------- -----------
-----------
   0.000     2.168 -2.5188E-06 -1.3809E-08   -.0081212  1.9652E-08      0.0000
0.0000
   7.600     2.106     13.3570     15.8175   -.0081212    .1042139      0.0000
0.0000
  15.200     2.044    240.4260     57.9975   -.0081211      1.8759      0.0000
0.0000
  22.800     1.982    894.9190    128.2975   -.0081210      6.9823      0.0000
0.0000
  30.400     1.921   2190.5480    226.7175   -.0081205     17.0911      0.0000
0.0000
  38.000     1.859   4341.0250    353.2575   -.0081196     33.8695      0.0000
0.0000
  45.600     1.797   7560.0620    507.9175   -.0081180     58.9851      0.0000
0.0000
  53.200     1.736  12061.3710    690.6975   -.0081152     94.1052      0.0000
0.0000
  60.800     1.674  18058.6640    901.5975   -.0081110    140.8973      0.0000
0.0000
  68.400     1.612  25765.6530   1140.6175   -.0081049    201.0287      0.0000
0.0000
```

```
  76.000     1.551  35396.0500   1407.7575   -.0080964    276.1670      0.0000
0.0000
  83.600     1.489  47163.5670   1703.0175   -.0080849    367.9795      0.0000
0.0000
  91.200     1.428  61281.9160   2026.3975   -.0080698    478.1336      0.0000
0.0000
  98.800     1.367  77964.8090   2377.8975   -.0080505    608.2969      0.0000
0.0000
 106.400     1.305  97425.9580   2757.5175   -.0080261    760.1366      0.0000
0.0000
 114.000     1.245     119879.   3165.2575   -.0079958    935.3203      0.0000
0.0000
 121.600     1.184     145538.   3601.1175   -.0079589   1135.5153      0.0000
0.0000
 129.200     1.124     174616.   4065.0975   -.0079143   1362.3890      0.0000
0.0000
 136.800     1.064     207327.   4557.1975   -.0078611   1617.6090      0.0000
0.0000
 144.400     1.004     243885.   5077.4175   -.0077983   1902.8426      0.0000
0.0000
 152.000   .945040     284504.   5625.7575   -.0077248   2219.7573      0.0000
0.0000
 159.600   .886633     329397.   6202.2175   -.0076393   2570.0204      0.0000
0.0000
 167.200   .828923     378778.   6806.7975   -.0075408   2955.2994      0.0000
0.0000
 174.800   .772013     432860.   7439.4975   -.0074278   3377.2617      0.0000
0.0000
 182.400   .716020     491858.   8100.3175   -.0072991   3837.5747      0.0000
0.0000
 190.000   .661068     555985.   8789.2575   -.0071532   4337.9059      0.0000
0.0000
 197.600   .607292     625455.   9506.3175   -.0069888   4879.9227      0.0000
0.0000
 205.200   .554839     700481.  10251.4975   -.0068042   5465.2925      0.0000
0.0000
 212.800   .503868     781278.  11024.7975   -.0065979   6095.6827      0.0000
0.0000
 220.400   .454550     868058.  11826.2175   -.0063684   6772.7608      0.0000
0.0000
 228.000   .407069     961036.  12443.1000   -.0061138   7498.1941      0.0000
0.0000
 235.600   .361621    1057193.  12361.4986   -.0058328   8248.4304    -76.5115
1608.0052
 243.200   .318409    1148931.  11465.0799   -.0055258   8964.1864   -159.3881
3804.3787
 250.800   .277629    1231462.   9985.0342   -.0051944   9608.1133   -230.0976
6298.8440
 258.400   .239454    1300703.   8033.5704   -.0048420  10148.3456   -283.4455
8996.2384
 266.000   .204031    1353573.   5761.4080   -.0044725  10560.8418   -314.4920
11714.5784
 273.600   .171472    1388277.   3315.0958   -.0040909  10831.6106   -329.2744
14594.1324
 281.200   .141850    1403962.    824.7015   -.0037022  10953.9903   -326.0925
17471.2736
 288.800   .115199    1400812.  -1620.7271   -.0033118  10929.4148   -317.4413
20942.5400
 296.400   .091511    1379327.  -4002.2265   -.0029248  10761.7827   -309.2691
25684.8123
 304.000   .070742    1339978.  -6318.7813   -.0025463  10454.7771   -300.3506
32267.5878
 311.600   .052807    1283282.  -8557.8224   -.0021811  10012.4169   -288.8707
```

```
41574.0140
 319.200   .037588    1209900. -10671.8147   -.0018341   9439.8758   -267.4431
54074.5321
 326.800   .024929    1121070. -12582.2101   -.0015097   8746.8101   -235.2926
71732.8895
 334.400   .014641    1018650. -14066.7023   -.0012118   7947.7086   -155.3633
80644.8794
 342.000   .006509     907256. -14938.3510   -.0009437   7078.5919    -74.0179
86420.8794
 349.600   .000297     791587. -15236.6676   -.0007073   6176.1187     -4.4864
114971.
 357.200  -.004241     675659. -14995.2036   -.0005030   5271.6236     68.0296
121902.
 364.800  -.007350     563660. -14263.2497   -.0003305   4397.7864    124.5898
128833.
 372.400  -.009265     458857. -13160.8471   -.0001882   3580.0962    165.5161
135764.
 380.000  -.010210     363615. -11803.3923 -7.3726E-05   2836.9967    191.7088
142695.
 387.600  -.010386     279446. -10297.8783  1.5784E-05   2180.2917    204.4791
149627.
 395.200  -.009971     207087.  -8740.3745  8.3507E-05   1615.7362    205.3904
156558.
 402.800  -.009117     146592.  -7214.6412    .0001327   1143.7409    196.1184
163489.
 410.400  -.007953  97424.7750  -5791.7204    .0001667    760.1274    178.3344
170420.
 418.000  -.006583  58557.9986  -4530.3031    .0001884    456.8811    153.6175
177351.
 425.600  -.005089  28564.1682  -3477.6462    .0002005    222.8633    123.3975
184283.
 433.200  -.003535   5697.7765  -2670.7938    .0002053     44.4552     88.9321
191214.
 440.800  -.001968 -12031.8979  -2137.8462    .0002044     93.8752     51.3173
198145.
 448.400  -.000427 -26797.4855    791.5722    .0001990    209.0793    719.5823
1.2796E+07
 456.000   .001057      0.0000      0.0000    .0001953      0.0000   -927.8908
3336299.

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection             =     2.16751227 in
Computed slope at pile head      =     -.00812116
Maximum bending moment           =       1403962. lbs-in
Maximum shear force              =   -15236.66761 lbs
Depth of maximum bending moment  =      281.20000 in
Depth of maximum shear force     =      349.60000 in
Number of iterations             =             14
Number of zero deflection points =              2




------------------------------------------------------------------------------
                          Summary of Pile Response(s)
------------------------------------------------------------------------------
```

```
Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2            lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=     0.000 M=     0.000      0.0000      2.1675    1403962. -15236.6676

The analysis ended normally.
```

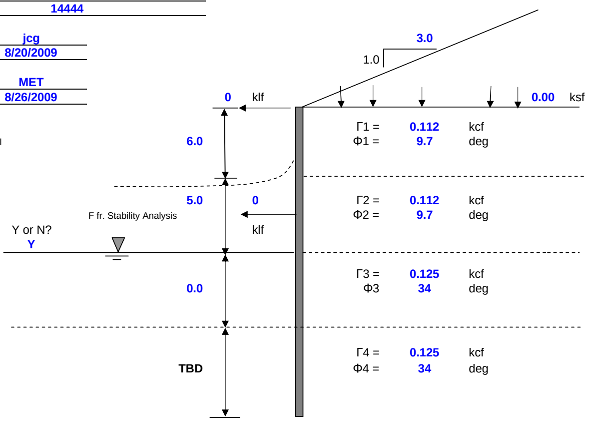
Design of Pile or Drilled Shaft Walls for North Hill MHP

Project North Hill Lower Wall
Project No. 14444

designed by: jcg
date: 8/20/2009

checked by: MET
date: 8/26/2009

Assume loss of material
on low side of wall =
0.5 H above slide plane



Pile spacing	6.0	ft
Flange or shaft width*	1.2	ft
Active flange factor	1.0	
Passive flange factor	2.8	
Pile or shaft?	S	
Grade steel	50	ksi
Bar size	1.25	in
No. bars		
Conc. Cover		in
Tension Crack	Yes	

HP 10X42	Sx =	43.4	in^3
HP 12X53	Sx =	66.9	in^3
HP 12X74	Sx =	93.4	in^3
HP 14x89	Sx =	131	in^3
HP 14x102	Sx =	150	in^3
HP 14x117	Sx =	173	in^3

* Use flange width (driven) or diameter of predrilled hole for piles

Instructions
1. Enter values indicated by bold blue.
2. Indicate Y or N for water table.
3. If the pile does not need to penetrate Layer 3, rerun and enter 0.0 depth for Layer 3.

RESULTS		
Embedment Required for 0 shear	1.50	ft
Embedment Required for Moment	2.11	ft
Maximum Moment	65.5	ft-kip
Sx Required	23.8	in^3
Depth to Max Shear	2.92	ft
Max Shear	13.1	kip

symbol	name	units		
Δ	tieback angle	deg	0.0	
H1	ht. layer 1	ft.	6.0	
H2	ht. layer 2	ft.	5.0	
H3	ht. layer 3	ft.	0.0	
H4	ht. layer 4	ft.	TBD	H4
Γ1	wt. layer 1	kcf	0.112	
Φ1	friction layer 1	deg	9.7	
Γ2	wt. layer 2	kcf	0.112	
Φ2	friction layer 2	deg	9.7	
Γ3	wt. layer 3	kcf	0.125	
Φ3	friction layer 3	deg	34	
Γ4	wt. layer 4	kcf	0.125	
Φ4	friction layer 4	deg	34	
S	surcharge	ksf	0.00	
H	horiz. component		3.0	
Y or N	water, yes or no		Y	
PS	pile spacing	ft.	6.0	
FW	flange width	ft.	1.22	
FA	active flange factor		1.0	
FP	passive flange factor		2.8	
β	slope angle	deg	18.4	
fy	grade steel	ksi	50.0	
Ka1	act. coef. layer 1		0.70	
Ka2	act. coef. layer 2		0.70	
Ka3	act. coef. layer 3		0.28	
Ka4	act. coef. layer 4		0.28	
Kp2	pass. coef. layer 2		1.40	
Kp3	pass. coef. layer 3		3.54	
Kp4	pass. coef. layer 4		3.54	
Γ3'	eff. wt. layer 3	kcf	0.063	
Γ4'	eff. wt. layer 4	kcf	0.063	
P1	stress bot, area 1	ksf	0.470	
P2	stress bot, area 2	ksf	0.470	
P3	stress bot, area 3	ksf	0.392	
P4	stress bot, area 4	ksf	0.862	
P5	stress bot, area 5	ksf	0.000	
P6	stress bot, area 6	ksf	0.862	
P7	stress bot, area 7	ksf	0.018	H4
P8	stress bot, area 8	ksf	0.000	
P9	stress bot, area 9	ksf	0.000	
P10	stress bot, area 10	ksf	0.221	H4
Fs	sound wall hor. Forc	kip	0.00	
P11	stress top, area 11	ksf (unfactored)	0.952	
P12	stress stab. Analy.	kip	0.0	
P13	stress top, area 11		1.0	

		force kips		lever arm ft	shear moment ft-kip	
Fs		0.00		12.50	0.0	
F1	force area 1	8.47		8.50	72.0	10.85
F2	force area 2	14.11		4.00	56.5	24.11
F3	force area 3	5.88		3.17	18.6	13.4
F4	force area 4	0.00		1.50	0.0	1.02
F5	force area 5	0.00		1.50	0.0	12
F6	force area 6	1.05	H4	0.75	1.2	61.38
F7	force area 7	0.01	H4*H4	0.50	0.0	
F8	force area 8	0.00		1.50	0.0	
F9	force area 9	0.00	H4	0.75	0.0	
F10	force area 10	-0.37	H4*H4	0.50	-0.4	
F11a	force area 11b	0.00		1.50	0.0	
F11b	force area 11a	-11.26	H4	0.75	-12.7	
P12	stab. Force	0.00		5.17	0.0	
P-13	force area 13	-12.30		5.67	-69.7	
S1	surch. 1ayer 1	0.000		8.50	0.0	
S2	surch. layer 2	0.000		4.00	0.0	
S3	surch. layer 3	0.000		1.50	0.0	
S4	surch. layer 4	0.000	H4	0.75	0.0	
				ΣM =	65.5	

	a	b	c
moment	0.36	10.21	-16.16
shear 3	0.36	-1.05	
shear 4	0.36	-1.05	0.00

Sx reqd. = 23.8 in^3

H4 = 1.50 ft

Embedment for Moment 2.11 ft

D3 N/A Depth to max shear layer 3
D4 2.92 Depth to max shear layer 4

Max shear in layer 3? No

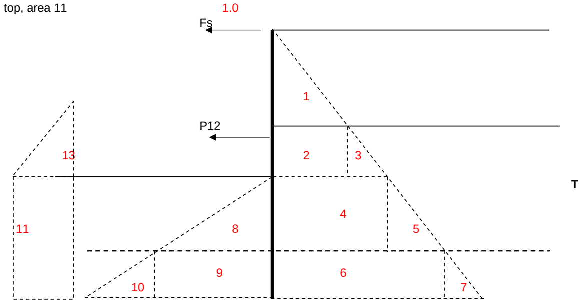
Max Shear in Layer 3 N/A kips

Pos Shear	1.05	D
Pos Shear	0.01	D*D
Neg Shear	0.37	D*D

Max Shear in Layer 4

Pos Shear	1.049	D
Pos Shear	0.011	D*D
Neg Shear	0.00	D
Neg Shear	0.37	D*D

Max Shear 13.10 kips



LPILE/GROUP DATA INPUT FORM

North Hill MHP

Project No. 14444

Structural Engineers Please Enter Info in Shaded Boxes

Input Required Noted in Blue

Red Values Are Calculated

By: jcg 08/13/2009

Checked: MET **Date:** 08/27/2009

Bridge No. NH **Pier No.** Lower W **Top of Pile/Shaft El.** 127.0

Boring No. Profile F-F'

Indicate Analysis Type Required
X **L/PILE Single Pile/Shaft Free head**
☐ **L/PILE Single Pile/Shaft Fixed head**
☐ **GROUP Fixed Head**

121 **Top of Ground El.** (Assumes 6-ft. deep Tension Crack)

Indicate Load Type
X **Single Pile/Shaft Load**
☐ **Group Load**

1 **No. Piles/Shafts for GROUP**

Pier Dia. ft ☐

Pile Size 14*73

enter triangular load as 2.54 klf to a depth of 11'

Tranverse Spacing, ft ☐

Longit. Spacing, ft ☐ Do not enter spacing for LPILE analysis.

Max. Fv for Axial Capacity Analysis, kips 0 for dd

Include secondary/tertiary loads when it is not readily apparent which load group is the dominant load group.

Include couple effects with Fv

Load Conditions (Primary)				Load Conditions (Secondary)				Load Conditions (Tertiary)			
Fv (FV)		kips (lbs)		Fv (FV)		kips (lbs)		Fv (FV)		kips (lbs)	
Fy (FL)		kips (lbs)		Fy (FL)		kips (lbs)		Fy (FL)		kips (lbs)	
Fz (FT)		kips (lbs)		Fz (FT)		kips (lbs)		Fz (FT)		kips (lbs)	
Mv (TOR)		kip-ft (lb-in)		Mv (TOR)		kip-ft (lb-in)		Mv (TOR)		kip-ft (lb-in)	
My (MT)		kip-ft (lb-in)		My (MT)		kip-ft (lb-in)		My (MT)		kip-ft (lb-in)	
Mz (ML)		kip-ft (lb-in)		Mz (ML)		kip-ft (lb-in)		Mz (ML)		kip-ft (lb-in)	

E_{50} required for CL, CH, MH, & R

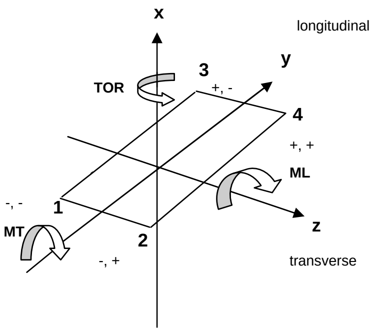
Soil Conditions Water Table El. 109.0 ft

LPILE / GROUP INPUT PARAMETERS

Layer No.	El. Bottom of Layer	Layer Thickness	Soil Type	Province	Avg. N_{60}	Substrat.	Depth inches	Density pci	Φ°	Cohesion p/in²	Modulus pci	E_{50}
Surface	ft	ft					72					
1	116.0	5.0	CH	CP	28	T-II	132	0.0666		24.3		0.002
2	109.0	7.0	SC	CP	30	T-III	216	0.0723	34.0		166	
3	103.0	6.0	SC	CP	30	T-III	288	0.0403	34.0		100	
4	94.0	9.0	ML	CP	36	T-III	396	0.0403	34.0		120	
5	91.0	3.0	CH	CP	50	T-III	432	0.0403		43.4		0.002
6												
7												
8												
9												
10												
11												

Pile Coordinates

Pile No.	Coordinate	Coordinate
1		
2		
3		
4		

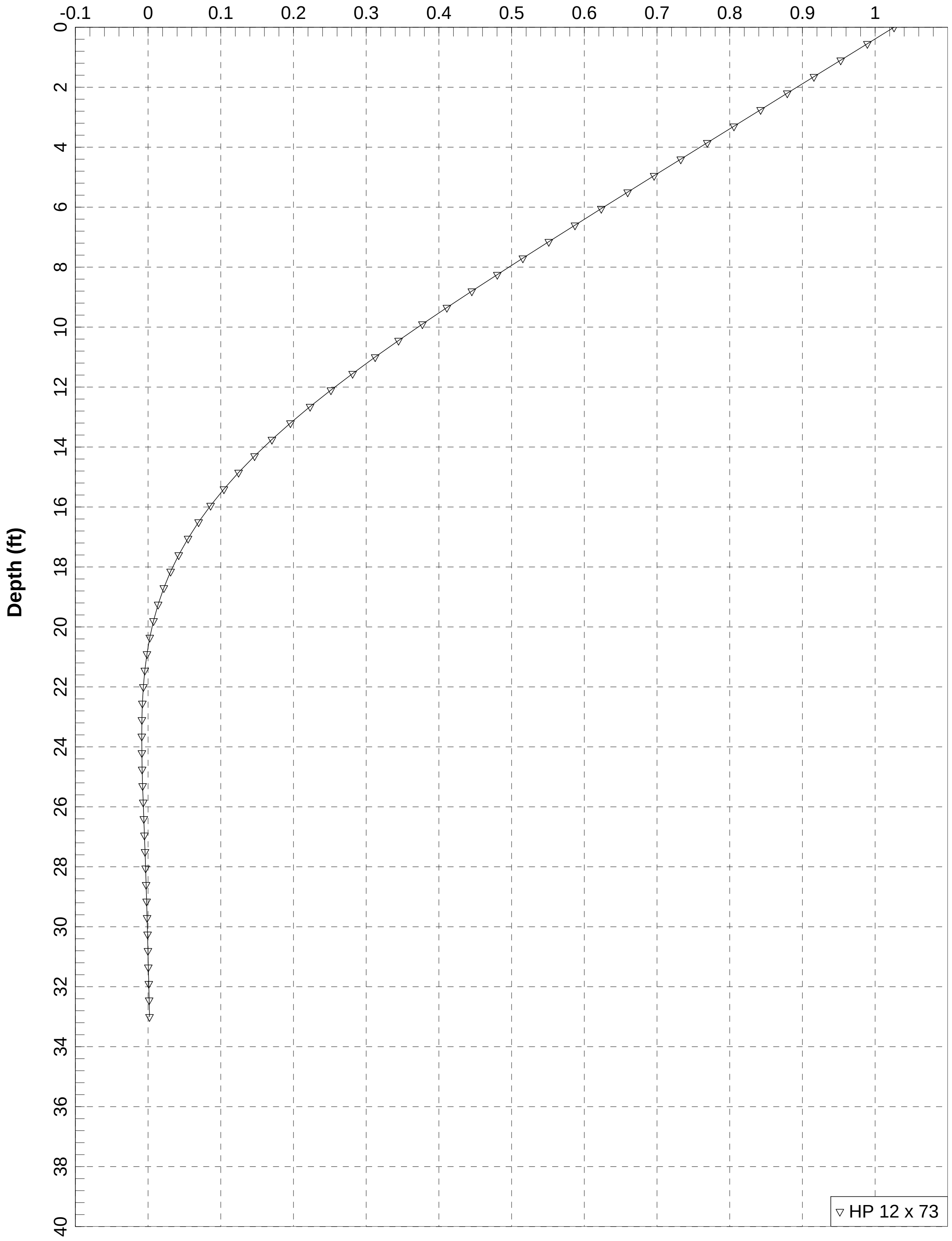


Diameter	Mom. of I. in⁴	Area in²
2.0	16,286	452
2.5	39,761	707
3.0	82,448	1,018
3.5	152,745	1,385
4.0	260,577	1,810
4.5	417,394	2,290
5.0	636,174	2,827
5.5	931,422	3,421
6.0	1,319,170	4,072
7.0	2,443,926	5,542
8.0	4,169,230	7,238
HP 12x53	394	16

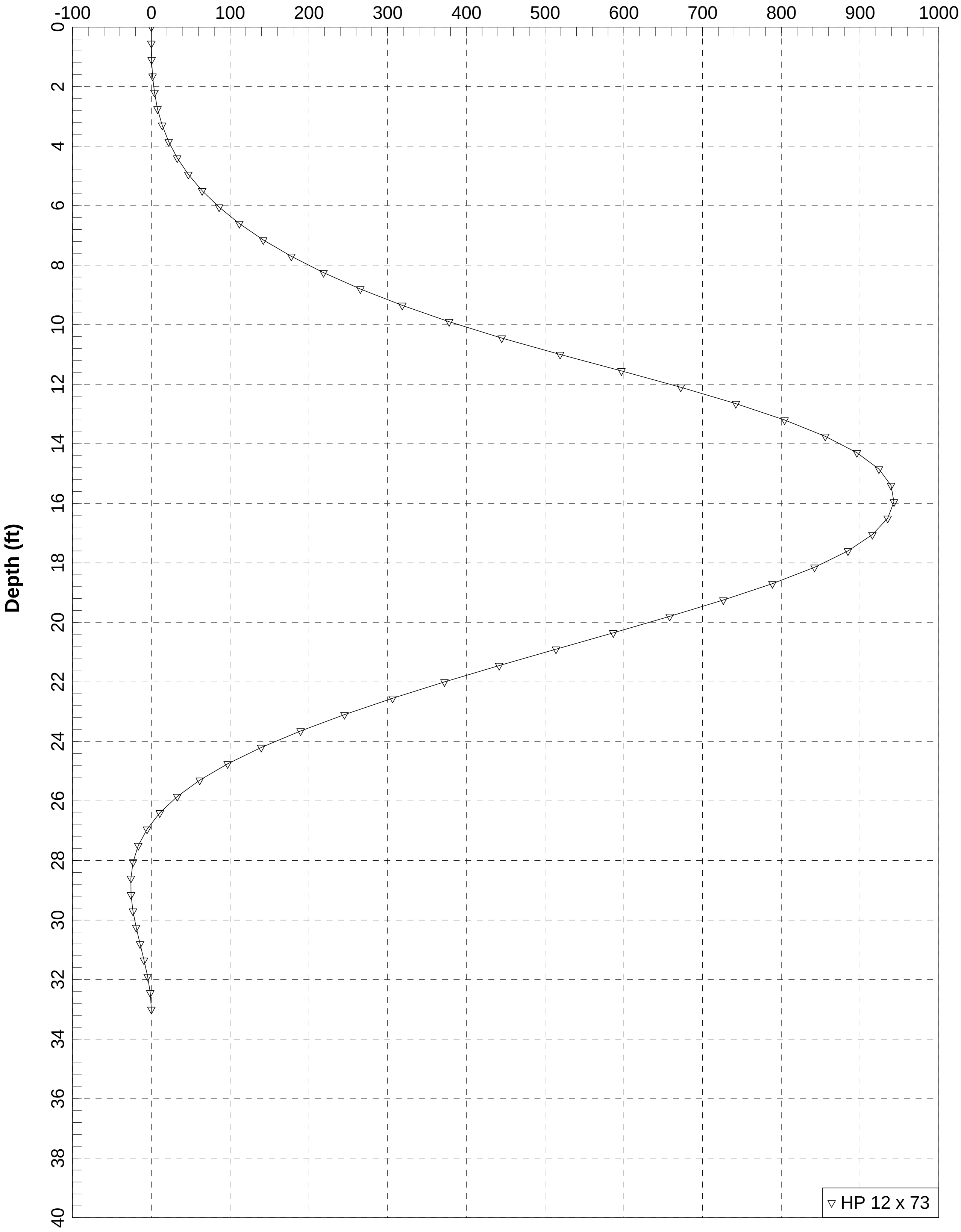
M concrete = 3,800,000 psi

M Steel = 30,000,000 psi

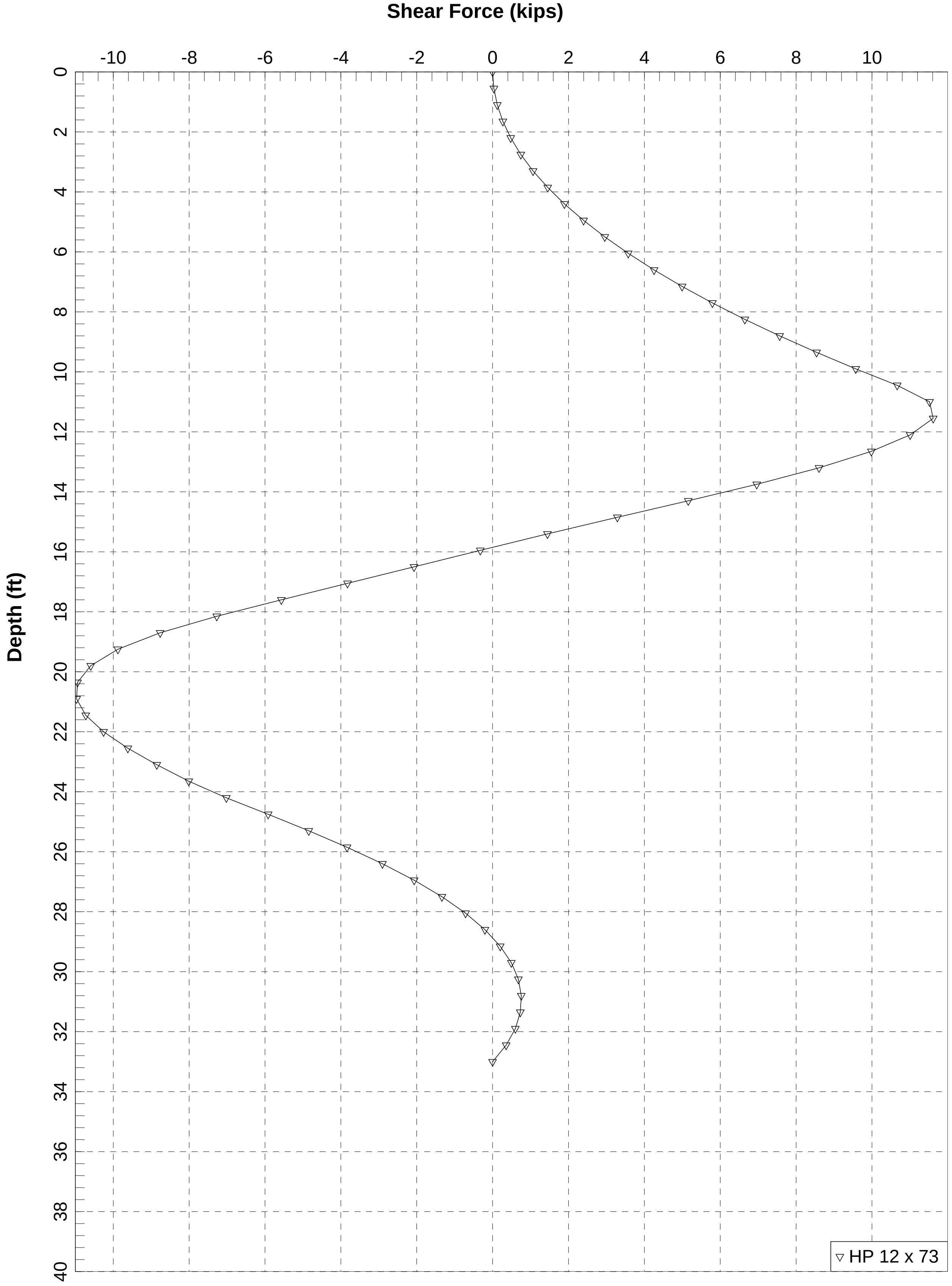
North Hill Lower Wall (No soil above slide plane below wall)



North Hill Lower Wall (No soil above slide plane below wall)



North Hill Lower Wall (No soil above slide plane below wall)



```
==============================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.39)

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

                        (c) 1985-2007 by Ensoft, Inc.
                             All Rights Reserved

==============================================================================


This program is licensed to:

Margaret Tomeo
ECS

Path to file locations:
I:\Geotechnical\{eProjects}\14400-14499\01-14444\d-Working\FINAL ANALYSIS\LPILE\
Name of input data file:     north hill lower.lpd
Name of output file:         north hill lower.lpo
Name of plot output file:    north hill lower.lpp
Name of runtime file:        north hill lower.lpr


------------------------------------------------------------------------------
                          Time and Date of Analysis
------------------------------------------------------------------------------

               Date:  August 27, 2009     Time:  10:48:22


------------------------------------------------------------------------------
                                Problem Title
------------------------------------------------------------------------------

North Hill  Line F-F  Lower Wall


------------------------------------------------------------------------------
                                Program Options
------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =           60
```

```
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
------------------------------------------------------------------------------

Pile Length                               =     396.00 in

Depth of ground surface below top of pile =     132.00 in

Slope angle of ground surface             =        .00 deg.

Structural properties of pile defined using  2 points

Point    Depth         Pile      Moment of       Pile      Modulus of
           X         Diameter     Inertia        Area      Elasticity
           in           in         in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   14.00000000     734.0000      21.5000     30000000.
  2     396.0000   14.00000000     734.0000      21.5000     30000000.


------------------------------------------------------------------------------
                      Soil and Rock Layering Information
------------------------------------------------------------------------------

The soil profile is modelled using  4 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      132.000 in
Distance from top of pile to bottom of layer =      216.000 in
p-y subgrade modulus k for top of soil layer =      166.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      166.000 lbs/in**3

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      216.000 in
Distance from top of pile to bottom of layer =      288.000 in
p-y subgrade modulus k for top of soil layer =      100.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      100.000 lbs/in**3

Layer  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      288.000 in
Distance from top of pile to bottom of layer =      396.000 in
p-y subgrade modulus k for top of soil layer =      120.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      120.000 lbs/in**3

Layer  4 is stiff clay without free water
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      550.000 in


(Depth of lowest layer extends  154.00 in below pile tip)


------------------------------------------------------------------------------
```

```
                                 north hill lower
                      Effective Unit Weight of Soil vs. Depth
------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1           132.00         .07230
  2           216.00         .07230
  3           216.00         .04030
  4           288.00         .04030
  5           288.00         .04030
  6           396.00         .04030
  7           396.00         .04030
  8           550.00         .04030



------------------------------------------------------------------------------
                           Shear Strength of Soils
------------------------------------------------------------------------------

Shear strength parameters with depth defined using  8 points

Point    Depth X     Cohesion c     Angle of Friction     E50 or      RQD
 No.       in        lbs/in**2            Deg.             k_rm        %
-----   --------    ----------     ------------------    ------    ------
  1      132.000        .00000           34.00            ------    ------
  2      216.000        .00000           34.00            ------    ------
  3      216.000        .00000           34.00            ------    ------
  4      288.000        .00000           34.00            ------    ------
  5      288.000        .00000           34.00            ------    ------
  6      396.000        .00000           34.00            ------    ------
  7      396.000      43.00000             .00            .00200        .0
  8      550.000      43.00000             .00            .00200        .0

Notes:

(1)  Cohesion = uniaxial compressive strength for rock materials.
(2)  Values of E50 are reported for clay strata.
(3)  Default values will be generated for E50 when input values are 0.
(4)  RQD and k_rm are reported only for weak rock strata.



------------------------------------------------------------------------------
                                 Loading Type
------------------------------------------------------------------------------

Static loading criteria was used for computation of p-y curves.



------------------------------------------------------------------------------
                          Distributed Lateral Loading
------------------------------------------------------------------------------

Distributed lateral load intensity defined using  2 points

Point      Depth X       Dist. Load
 No.        in             lbs/in
```

```
-----     ----------     ----------
  1           .000         .00000
  2        132.000      179.00000



------------------------------------------------------------------------------
              Pile-head Loading and Pile-head Fixity Conditions
------------------------------------------------------------------------------

Number of loads specified =  1

Load Case Number  1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =            .000 lbs
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =            .000 lbs

(Zero moment at pile head for this load indicates a free-head condition)



------------------------------------------------------------------------------
             Computed Values of Load Distribution and Deflection
                 for Lateral Loading for Load Case Number  1
------------------------------------------------------------------------------

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head  =            .000 lbs
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

(Zero moment for this load indicates free-head conditions)

  Depth   Deflect.    Moment      Shear       Slope      Total       Soil Res.
Es*h
    X        y          M           V           S        Stress          p
F/L
    in       in       lbs-in        lbs         Rad.   lbs/in**2    lbs/in
lbs/in
-------- --------- ----------- ----------- ----------- ----------- -----------
-----------
   0.000     1.026 -4.4898E-07      0.0000   -.0055610  4.2819E-09      0.0000
0.0000
   6.600   .989314     24.3664     33.2269   -.0055610    .2323769      0.0000
0.0000
  13.200   .952611    438.5947    121.8319   -.0055609      4.1828      0.0000
0.0000
  19.800   .915910   1632.5471    269.5069   -.0055606     15.5693      0.0000
0.0000
  26.400   .879211   3996.0855    476.2519   -.0055598     38.1098      0.0000
0.0000
  33.000   .842521   7919.0719    742.0669   -.0055580     75.5225      0.0000
0.0000
  39.600   .805846  13791.3682   1066.9519   -.0055547    131.5253      0.0000
0.0000
  46.200   .769198  22002.8366   1450.9069   -.0055494    209.8363      0.0000
0.0000
  52.800   .732594  32943.3390   1893.9319   -.0055411    314.1735      0.0000
0.0000
  59.400   .696056  47002.7374   2396.0269   -.0055291    448.2550      0.0000
0.0000
```

```
  66.000   .659610  64570.8937   2957.1919   -.0055124    615.7987      0.0000
0.0000
  72.600   .623292  86037.6701   3577.4269   -.0054899    820.5227      0.0000
0.0000
  79.200   .587144     111793.   4256.7319   -.0054602   1066.1451      0.0000
0.0000
  85.800   .551217     142227.   4995.1069   -.0054221   1356.3838      0.0000
0.0000
  92.400   .515571     177728.   5792.5519   -.0053742   1694.9569      0.0000
0.0000
  99.000   .480278     218688.   6649.0669   -.0053148   2085.5824      0.0000
0.0000
 105.600   .445416     265496.   7564.6519   -.0052422   2531.9784      0.0000
0.0000
 112.200   .411080     318542.   8539.3069   -.0051547   3037.8629      0.0000
0.0000
 118.800   .377374     378215.   9573.0319   -.0050503   3606.9538      0.0000
0.0000
 125.400   .344417     444906.  10665.8269   -.0049269   4242.9693      0.0000
0.0000
 132.000   .312339     519004.  11518.6500   -.0047825   4949.6274      0.0000
0.0000
 138.600   .281288     596952.  11614.7742   -.0046152   5693.0010    -59.2527
1390.2745
 145.200   .251418     672319.  11006.3820   -.0044250   6411.7597   -125.1086
3284.2352
 151.800   .222878     742236.   9983.8857   -.0042130   7078.5456   -184.7388
5470.5932
 158.400   .195806     804106.   8605.4885   -.0039813   7668.5868   -232.9573
7852.2347
 165.000   .170325     855829.   6961.0353   -.0037325   8161.8523   -265.3618
10282.5985
 171.600   .146537     895992.   5159.0615   -.0034700   8544.8806   -280.6908
12642.2322
 178.200   .124522     923928.   3290.0054   -.0031972   8811.3036   -285.6898
15142.3514
 184.800   .104334     939420.   1445.5974   -.0029180   8959.0448   -273.2217
17283.5804
 191.400   .086004     943010.   -324.8514   -.0026359   8993.2835   -263.2779
20204.0140
 198.000   .069540     935132.  -2072.7700   -.0023544   8918.1507   -266.3944
25283.2131
 204.600   .054926     915649.  -3825.5122   -.0020770   8732.3516   -264.7396
31811.4508
 211.200   .042123     884635.  -5570.1098   -.0018072   8436.5739   -263.9264
41352.7076
 217.800   .031070     842124.  -7272.4026   -.0015485   8031.1553   -251.9200
53512.8921
 224.400   .021684     788639.  -8765.3282   -.0013041   7521.0834   -200.4817
61022.3209
 231.000   .013857     726422.  -9879.8808   -.0010770   6927.7270   -137.2614
65378.3209
 237.600   .007467     658225. -10593.1899   -.0008695   6277.3491    -78.8928
69734.3209
 244.200   .002379     586592. -10941.6684   -.0006830   5594.1974    -26.7067
74090.3209
 250.800  -.001548     513795. -10969.0709   -.0005181   4899.9511     18.4030
78446.3209
 257.400  -.004459     441800. -10723.7215   -.0003748   4213.3498     55.9453
82802.3209
 264.000  -.006496     372242. -10255.9992   -.0002529   3549.9894     85.7887
87158.3209
 270.600  -.007797     306421.  -9616.1314   -.0001511   2922.2676    108.1106
```

```
91514.3209
 277.200  -.008491     245309.  -8852.3302 -6.8460E-05   2339.4573    123.3443
95870.3209
 283.800  -.008701     189570.  -8009.2796 -3.2875E-06   1807.8871    132.1255
100226.
 290.400  -.008535     139586.  -7019.1622  4.6041E-05   1331.2047    167.9101
129846.
 297.000  -.008093  96916.9334  -5918.4960  8.1484E-05    924.2759    165.6251
135073.
 303.600  -.007459  61462.1748  -4848.6699    .0001052    586.1515    158.5646
140300.
 310.200  -.006704  32914.4912  -3837.6022    .0001194    313.8984    147.8195
145527.
 316.800  -.005884  10805.8260  -2906.3079    .0001259    103.0528    134.3909
150755.
 323.400  -.005042  -5448.7733  -2069.5981    .0001267     51.9638    119.1576
155982.
 330.000  -.004211 -16512.8688  -1336.9591    .0001234    157.4797    102.8543
161209.
 336.600  -.003413 -23096.6329   -713.5471    .0001175    220.2676     86.0585
166436.
 343.200  -.002660 -25931.6901   -201.2384    .0001101    247.3049     69.1866
171663.
 349.800  -.001959 -25752.9803    200.3188    .0001024    245.6006     52.4974
176891.
 356.400  -.001308 -23287.4821    492.7009  9.5048E-05    222.0877     36.1032
182118.
 363.000  -.000704 -19249.3289    677.7966  8.8674E-05    183.5767     19.9864
187345.
 369.600  -.000138 -14340.5665    757.0296  8.3640E-05    136.7629      4.0236
192572.
 376.200   .000400  -9256.5382    730.7535  8.0103E-05     88.2776    -11.9860
197799.
 382.800   .000919  -4694.6206    597.8617  7.8013E-05     44.7716    -28.2842
203027.
 389.400   .001430  -1364.7638    355.6531  7.7104E-05     13.0155    -45.1123
208254.
 396.000   .001937      0.0000      0.0000  7.6900E-05      0.0000    -62.6613
106741.

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection             =     1.02601627 in
Computed slope at pile head      =     -.00556099
Maximum bending moment           =   943010.00822 lbs-in
Maximum shear force              =    11614.77420 lbs
Depth of maximum bending moment  =      191.40000 in
Depth of maximum shear force     =      138.60000 in
Number of iterations             =             14
Number of zero deflection points =              2




-------------------------------------------------------------------------------
                           Summary of Pile Response(s)
-------------------------------------------------------------------------------
```

```
Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2           lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=     0.000 M=     0.000      0.0000      1.0260     943010.  11614.7742

The analysis ended normally.
```