# Geotechnical Data Report

**Gateway National Recreation Area (GATE) Staten Island Unit**

**Fort Wadsworth**

**Final Report #641 128512**

**Staten Island, New York**

May 1, 2015

Terracon Project No. J6155004

**Prepared for:**

National Park Service (NPS)

**Prepared by:**

Terracon Consultants, Inc.

South Plainfield, New Jersey

terracon.com

Terracon

Environmental ■ Facilities ■ Geotechnical ■ Materials

May 1, 2015

Terracon

VHB
351 McLaws Circle
Suite 3
Williamsburg, VA 23185

Attn: Mr. Tim Hogan, PE, PMP
P: (757) 220-0500
E: thogan@vhb.com

Re: Geotechnical Data Report
Proposed Slope Repair
Gateway National Recreation Area (GATE)
Staten Island-Unit
Fort Wadsworth
Staten Island, New York
Terracon Project No. J6155004

Dear Mr. Hogan:

Terracon Consultants, Inc. (Terracon) is submitting, herewith, the results of our geotechnical evaluation for the above-referenced project. The purpose of this evaluation was to obtain information on subsurface soil conditions at the project site and, based on this information, to provide geotechnical soil parameters for use in the design of the slope repair and stabilization.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
**Terracon Consultants, Inc.**

Gregg Furson
Senior Project Manager

Steven D. Thorne, P.E., D. GE, F. ASCE
Principal
New Jersey Office Manager

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# EXECUTIVE SUMMARY

A geotechnical data report has been completed for the proposed slope repair and stabilization project that is situated within the Gateway National Recreation Area (GATE) Staten Island Unit-Fort Wadsworth which is located in Staten Island, New York. Two borings were advanced to a depth of approximately 60 feet below the existing surface grade at locations immediately behind the existing slope. In addition, samples of the surface soils were obtained along six equally spaced lines along the face of the slope.

Subsurface conditions at the boring locations generally consist of uncontrolled fill material underlain by natural deposits of medium dense to very dense silty sand soils. The surface soils within the slope consisted of natural silty sands, with an isolate layer of silt soils and varying amounts of organic matter (roots, etc.). The surface soils within the face of the existing slope were generally in a relatively loose condition, subject to raveling due to wind, precipitation, etc.

Geotechnical parameters are provided in this report to assist with the design of potential slope repair and stabilization options. At this time, a slope repair option has not been selected. Terracon should be provided the opportunity to review and confirm these design parameters once plans have been finalized.

This summary should be used in conjunction with the entire report. Details are not included or fully developed in this summary; the report must be read in its entirety of a comprehensive understanding of the information contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

# GEOTECHNICAL DATA REPORT
# GATEWAY NATIONAL RECREATION AREA (GATE)
# STATEN ISLAND UNIT
# FORT WADSWORTH
# STATEN ISLAND, NEW YORK

**Terracon Project No. J6155004**
**May 1, 2015**

## 1.0 INTRODUCTION

The geotechnical data report for the proposed repairs to the exposed slope located in Fort Wadsworth National Park in Staten Island, New York (see Exhibit A-1, Site Location Map) has been completed. Two soil borings (B-1 and B-2) were drilled to a depth of approximately 60 feet below the existing ground surface. Individual test boring logs and an Exploration Location Diagram (Exhibit A-2) are included in Appendix A. In addition, a total of 29 samples were obtained of the surface soils along six lines perpendicular to the face of the slope. This report describes the subsurface conditions encountered in the explorations and provides a discussion of geotechnical considerations related to the soil parameters assigned to the in-situ soils.

The purpose of these services is to provide data regarding subsurface conditions at the explored locations and geotechnical recommendations related to the soil parameters.

## 2.0 PROJECT BACKGROUND

The project would consist of the stabilization and repair of approximately 2,000 linear feet of slope that was damaged during Superstorm Sandy in October 2012. As a result of the storm, the existing slope was cut from an approximate 2:1 configuration to an approximate 1:1 configuration. It appears that a varying degree of scouring of the lower portion of the slope occurred during the storm surge. As a result of this scouring action, sloughing of the upper portion of the slope occurred over time. In addition, a majority of the vegetation previously located along the slope was removed as a result of the sloughing.

## 3.0 SUBSURFACE EXPLORATIONS AND CONDITIONS

### 3.1 Subsurface Soil Strata

Based on the results of the borings and observations at the time of drilling, subsurface conditions at the project site can be generalized as follows:

| Stratum | Approximate Depth to Bottom of Stratum (feet) | Material Description | Consistency / Density |
|---|---|---|---|
| 1[1] | 11 to 11.5 | Uncontrolled fill | Variable |
| 2[2] | 60 | Silty sand (SM, SP) | Medium Dense to Very Dense |

1. A surface layer of topsoil was encountered in all the explorations ranging from 5 to 6 inches in thickness.
2. B-1 and B-2 were terminated in this layer.

Conditions encountered at each boring location are indicated on the individual boring logs in Appendix A of this report. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; *in situ*, the transition between materials may be gradual. Further details of the borings can be found on the boring logs.

### 3.2 Groundwater

Groundwater was encountered both borings at depths of approximately 56 feet and 32 feet below the existing ground surface, respectively. Perched or trapped seepage may be encountered at higher elevations depending on precipitation during or preceding construction. Fluctuations in the groundwater level may occur because of seasonal variations in the amount of rainfall, runoff, tides and other factors that may differ from those present at the time the explorations were performed. Additionally, grade adjustments on and around the site, as well as surrounding drainage improvements, may affect the water table. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

## 4.0 GEOTECHNICAL CONSIDERATIONS

It is our understanding that formal options for repair and stabilization of the slope have not been prepared. However one preliminary option would consist of reconstructing the slope back to its original configuration, as well as installing armoring at the base of the slope to protect the face from future storm events. In addition, the slope would be vegetated with native plantings to further protect it from future sloughing.

The repair and stabilization of the slope should be designed by a registered professional engineer. We have provided suggested geotechnical design parameters for each of the encountered strata in

the table below. However, Terracon should be provided the opportunity to review these parameters after detailed plans for the repairs have been developed. In addition, the engineer responsible for the design should review these parameters and boring logs for consistency with his/her design approach and the specific design requirements of the selected repair option. The friction and unit weight parameters provided below are conservative and are based on index correlations with the test boring data, not on specific laboratory tests for those parameters. If during design it is discovered that the final design may be sensitive to variations in these parameters, or that significant savings could be achieved if higher friction or cohesion values could be used, a supplemental investigation including laboratory testing of these materials would be required.

| Soil Type | $\gamma$ (pcf) | Internal Angle of Friction, $\phi$ (degrees) |
|---|---|---|
| Fill | 130 - 140 | 27 - 30 |
| Loose Silty Sand | 110 - 120 | 28 - 30 |
| Medium Dense to Very Dense Silty Sand | 125 - 135 | 30 - 34 |

## 5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications, so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during excavation phases of the project.

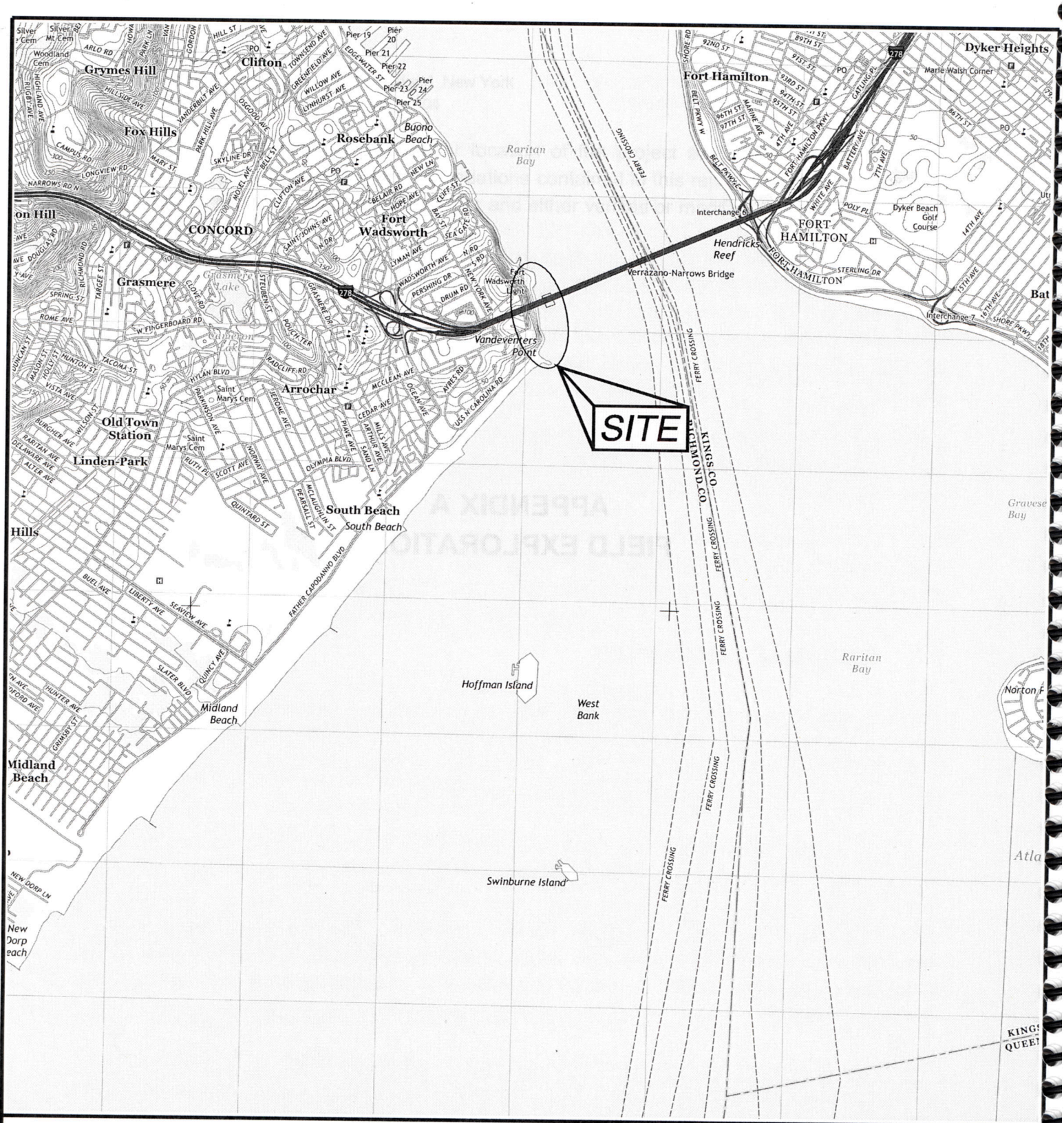
The analysis and recommendations presented in this report are based upon the data obtained from the explorations performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between explorations, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination of pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event

that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

# APPENDIX A
# FIELD EXPLORATION




| | | | |
|---|---|---|---|
| Project Mngr: GF | Project No. J6155004 | Terracon Consulting Engineers and Scientists | SITE LOCATION MAP |
| Drawn By: HH | Quadrangle: THE_NARROWS,NY-NJ,2013 | 4081 Hadley Road, Unit B South Plainfield, NJ 07080 | GATEWAY NATIONAL RECREATION AREA (GATE) STATEN ISLAND UNIT-FORT WADSWORTH |
| Checked By: GF | File No. J6155004-BLP | PH. (908) 546 6161 Fax. (908) 546 6160 | EXHIBIT A-1 |
| Approved By: SDT | Date: APRIL-2015 | | |

projects\2015\j6155004\working files\diagrams-drawings-figures\j6155004 blp.dwg

## Field Exploration Description

The test boring locations, which are shown on Exhibit A-2, were located in the field by representatives of VHB. Ground elevations of the explorations were determined by interpolation of a topographic plan prepared by VHB. The locations and elevations of the explorations should be considered accurate only to the degree implied by the method used to define them.

Terracon coordinated the advancement of two test borings (B-1 and B-2) on March 17 and 18, 2015. The borings were advanced using an all-terrain mounted drill rig, owned and operated by General Borings Inc of Prospect, CT. The borings were advanced using hollow stem auger drilling. The borings terminated in the underlying sand soils at a depth of approximately 60 feet.

In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler typically the bottom 12 inches of the total 18-inch penetration by means of a 140-pound safety autohammer with a free fall of 30 inches is the Standard Penetration Test (SPT) resistance value "N". This "N" value is used to estimate the *in-situ* relative density of cohesionless soils and consistency of cohesive soils.

The soil samples were placed in labeled glass jars and transported to our laboratory for further review and classification by a Terracon geotechnical engineer. Information provided on the boring logs attached to this report includes soil descriptions, relative density and/or consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with excess soil cuttings prior to the drill crews leaving the site.

Field logs of the explorations were prepared during drilling operations. These logs included visual classifications of the materials encountered during drilling as well as interpretation of the subsurface conditions between samples. Final exploration logs included with this report represent further interpretation by the geotechnical engineer of the field logs and incorporate, where appropriate, modifications based on laboratory classification of the samples.

# BORING LOG NO. B-1



**PROJECT: Slope Stability**

**CLIENT: VHB**

**SITE: Gateway National Recreation Area (GATE)**
**Staten Island, New York**

LOCATION See Exhibit A-2

Latitude: 40.60173° Longitude: -74.05361°

Surface Elev.: +58.5 (Ft.)

| DEPTH | ELEVATION (Ft.) | | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (In.) | FIELD TEST RESULTS | WATER CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 0.4 | 58 | **TOPSOIL** | | | | | | |
| | | **FILL -**, dark brown fine to coarse sand, little/and fine to coarse gravel, little to some silt | | | | 2 | 8-10-12-10 N=22 | |
| | | - obstruction at 2.5' | | | | 0 | 50/5" | |
| | | | 5 | | | 3 | 3-4-5-5 N=9 | 27 |
| | | | | | | 3 | 5-3-10-13 N=13 | 16 |
| | | - obstruction at 8' | | | | 2 | 35-50/2" | |
| | | | 10 | | | 1 | 50/5" | |
| 11.5 | 47 | **SILTY SAND (SM)**, brown fine to coarse sand, trace to little silt, trace fine gravel (medium dense to very dense) | | | | 1 | 5-7-9-14 N=16 | 9 |
| | | | 15 | | | 7 | 12-11-10-10 N=21 | |
| | | | | | | 12 | 6-6-10-11 N=16 | |
| | | | | | | 12 | 6-7-11-11 N=18 | |
| | | | 20 | | | 12 | 12-11-9-10 N=20 | |
| | | | | | | 24 | 9-9-11-11 N=20 | 3 |
| | | | 25 | | | 12 | 8-14-15-15 N=29 | |
| | | | | | | 12 | 15-11-16-17 N=27 | |
| | | | | | | 24 | 10-14-12-15 N=26 | |
| | | | 30 | | | 15 | 10-16-13-14 N=29 | 6 |
| | | - grading with no gravel at 32' | | | | 10 | 7-14-15-14 N=29 | |
| | | | 35 | | | 24 | 14-14-13-8 N=27 | |
| | | | | | | 8 | 11-11-16-17 N=27 | |
| | | | 40 | | | 14 | 18-20-19-21 N=39 | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

**WATER LEVEL OBSERVATIONS**

▽ *Ground water initially Observed while drilling*

Terracon

| | |
|---|---|
| Boring Started: 3/17/2015 | Boring Completed: 3/17/2015 |
| Drill Rig: Case 580 | Driller: Bob Poyton |
| Project No.: J6155004 | Exhibit: A-3 |

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL J6155004 BORING LOGS.GPJ

# BORING LOG NO. B-1



**PROJECT: Slope Stability**

**CLIENT: VHB**

**SITE: Gateway National Recreation Area (GATE)**
**Staten Island, New York**

LOCATION See Exhibit A-2

Latitude: 40.60173° Longitude: -74.05361°

Surface Elev.: +58.5 (Ft.)

| GRAPHIC LOG | DEPTH | ELEVATION (Ft.) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (In.) | FIELD TEST RESULTS | WATER CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| | | **SILTY SAND (SM)**, brown fine to coarse sand, trace to little silt, trace fine gravel (medium dense to very dense) *(continued)* | | | | | | |
| | | | | | | 10 | 15-16-20-21 N=36 | 3 |
| | | | | | | 12 | 18-20-19-16 N=39 | |
| | | | 45 | | | 22 | 10-11-15-21 N=26 | |
| | | | | | | 10 | 18-18-21-18 N=39 | |
| | | | | | | 18 | 18-21-17-19 N=38 | 3 |
| | | | 50 | | | 18 | 16-27-20-27 N=47 | |
| | | | | | | 10 | 21-22-19-16 N=41 | |
| | | | 55 | ▽ | | 22 | 16-19-38-51 N=57 | |
| | | - wet at 56' | | | | 10 | 41-16-11-10 N=27 | 6 |
| | | - grading with some fine gravel at 58' | | | | 8 | 16-11-11-12 N=22 | |
| | 60.0 | -1.5 | 60 | | | | | |
| | | ***Boring Terminated at 60 Feet*** | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

**WATER LEVEL OBSERVATIONS**

▽ *Ground water initially Observed while drilling*

Terracon

Boring Started: 3/17/2015 Boring Completed: 3/17/2015

Drill Rig: Case 580 Driller: Bob Poyton

Project No.: J6155004 Exhibit: A-3

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL J6155004 BORING LOGS.GPJ

# BORING LOG NO. B-2



**PROJECT:** Slope Stability

**CLIENT:** VHB

**SITE:** Gateway National Recreation Area (GATE)
Staten Island, New York

LOCATION See Exhibit A-2

Latitude: 40.60469° Longitude: -74.05436°

Surface Elev.: +34.69 (Ft.)

| DEPTH | ELEVATION (Ft.) | | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (In.) | FIELD TEST RESULTS | WATER CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 0.5 | 34 | **TOPSOIL** | | | | | | |
| | | **FILL -**, dark brown to brown fine to coarse sand, little to some silt, little to some fine to coarse gravel | | | | 5 | 2-3-10-6 N=13 | |
| | | | | | | 4 | 7-7-10-11 N=17 | 10 |
| | | | 5 | | | 5 | 50-50-1-17 N=51 | |
| | | | | | | 4 | 13-14-10-9 N=24 | 8 |
| 11.0 | 23.5 | **SILTY SAND (SM)**, brown fine to coarse sand, trace to little fine gravel, trace to little silt (medium dense to very dense) | 10 | | | 12 | 18-14-9-7 N=23 | |
| | | | | | | 12 | 6-5-5-4 N=10 | |
| | | - grading with some fine gravel at 16' | 15 | | | 3 | 8-12-7-10 N=19 | 6 |
| | | | | | | 2 | 18-14-10-8 N=24 | |
| | | - grading to fine to medium sand, trace silt, no gravel at 20' | 20 | | | 5 | 8-24-33-21 N=57 | |
| | | | | | | 20 | 10-15-16-10 N=31 | 4 |
| | | | | | | 18 | 12-12-18-16 N=30 | |
| | | | 25 | | | 18 | 6-10-15-19 N=25 | |
| | | | | | | 20 | 19-16-21-24 N=37 | 5 |
| | | - wet at 32' | 30 | ▽ | | 18 | 13-19-23-24 N=42 | |
| | | | | | | 18 | 13-20-19-21 N=39 | |
| | | | | | | 18 | 14-18-19-21 N=37 | |
| | | - grading with fine to coarse sand, trace to little silt, trace fine gravel at 36' | 35 | | | 24 | 10-9-11-13 N=20 | |
| | | | | | | 0 | 9-8-8-9 N=16 | 16 |
| | | | 40 | | | 24 | 5-9-15-16 N=24 | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

**WATER LEVEL OBSERVATIONS**

▽ *Ground water initially Observed while drilling*

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

Terracon

Boring Started: 3/18/2015 Boring Completed: 3/18/2015

Drill Rig: Case 580 Driller: Bob Poyton

Project No.: J6155004 Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL J6155004 BORING LOGS.GPJ

# BORING LOG NO. B-2



**PROJECT: Slope Stability**

**CLIENT: VHB**

**SITE: Gateway National Recreation Area (GATE)**
**Staten Island, New York**

LOCATION See Exhibit A-2

Latitude: 40.60469° Longitude: -74.05436°

Surface Elev.: +34.69 (Ft.)

| DEPTH | ELEVATION (Ft.) | DESCRIPTION | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (In.) | FIELD TEST RESULTS | WATER CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| | | **SILTY SAND (SM)**, brown fine to coarse sand, trace to little fine gravel, trace to little silt (medium dense to very dense) *(continued)* | | | | 24 | 9-9-11-10 N=20 | |
| | | | | | | 24 | 6-10-13-11 N=23 | 18 |
| | | | 45 | | | 24 | 5-13-16-15 N=29 | |
| | | | | | | 24 | 14-12-12-11 N=24 | |
| | | | | | | 24 | 6-8-16-15 N=24 | |
| | | | 50 | | | 24 | 8-9-13-11 N=22 | |
| | | | | | | 24 | 16-15-13-11 N=28 | |
| | | | 55 | | | 24 | 9-13-18-24 N=31 | |
| | | | | | | 24 | 9-9-7-11 N=16 | 16 |
| 60.0 | -25.5 | | | | | 24 | 11-14-9-18 N=23 | |
| | | ***Boring Terminated at 60 Feet*** | 60 | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

**WATER LEVEL OBSERVATIONS**

▽ *Ground water initially Observed while drilling*

Terracon

Boring Started: 3/18/2015 Boring Completed: 3/18/2015

Drill Rig: Case 580 Driller: Bob Poyton

Project No.: J6155004 Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL J6155004 BORING LOGS.GPJ

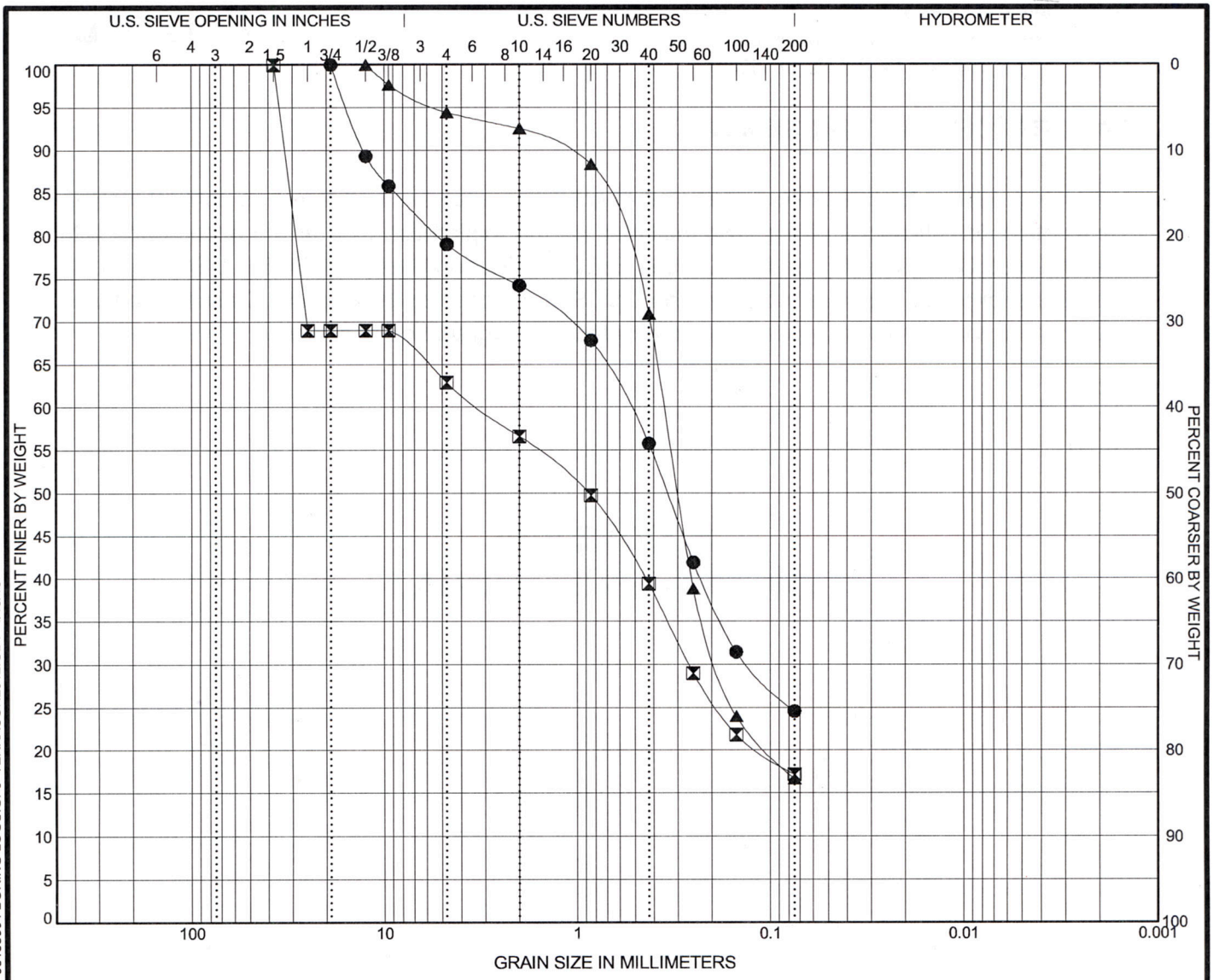
# APPENDIX B
# LABORATORY TESTING

## LABORATORY TESTING SUMMARY

Laboratory testing for this project consisted of gradation analyses and moisture content testing. Descriptive classifications of the soils indicated on the exploration logs are in accordance with the enclosed General Notes and the Unified Soil Classification System (USCS). USCS symbols are also shown. A brief description of the USCS is attached to this report. Classification was generally by visual/manual procedures, supported by the gradation analyses.

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | **B-1** | **4 - 6** | **0.0** | **21.0** | **54.5** | | **24.6** | | |
| ⊠ | **B-1** | **6 - 8** | **0.0** | **37.1** | **45.7** | | **17.2** | | |
| ▲ | **B-1** | **12 - 14** | **0.0** | **5.5** | **77.8** | | **16.7** | | **SM** |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | **0.542** | **3.191** | **0.355** |
| $D_{30}$ | **0.129** | **0.263** | **0.184** |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_C$ | | | |
| $C_U$ | | | |

| SIEVE (size) | PERCENT FINER ● | ⊠ | ▲ |
|---|---|---|---|
| **1 1/2"** | | **100.0** | |
| **1"** | | **68.96** | |
| **3/4"** | **100.0** | **68.96** | |
| **1/2"** | **89.33** | **68.96** | **100.0** |
| **3/8"** | **85.85** | **68.96** | **97.68** |
| **#4** | **79.05** | **62.88** | **94.45** |
| **#10** | **74.26** | **56.62** | **92.56** |
| **#20** | **67.8** | **49.77** | **88.37** |
| **#40** | **55.77** | **39.38** | **70.92** |
| **#60** | **41.89** | **28.99** | **38.83** |
| **#100** | **31.46** | **21.82** | **24.0** |
| **#200** | **24.58** | **17.19** | **16.67** |

SOIL DESCRIPTION
- ● FILL
- ⊠ FILL
- ▲ SILTY SAND

REMARKS
- ● Brown fine to coarse sand, some silt, some fine gravel
- ⊠ Brown fine to coarse sand and fine to coarse gravel, little silt
- ▲ Brown fine to coarse sand, little silt, trace fine gravel

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon
4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

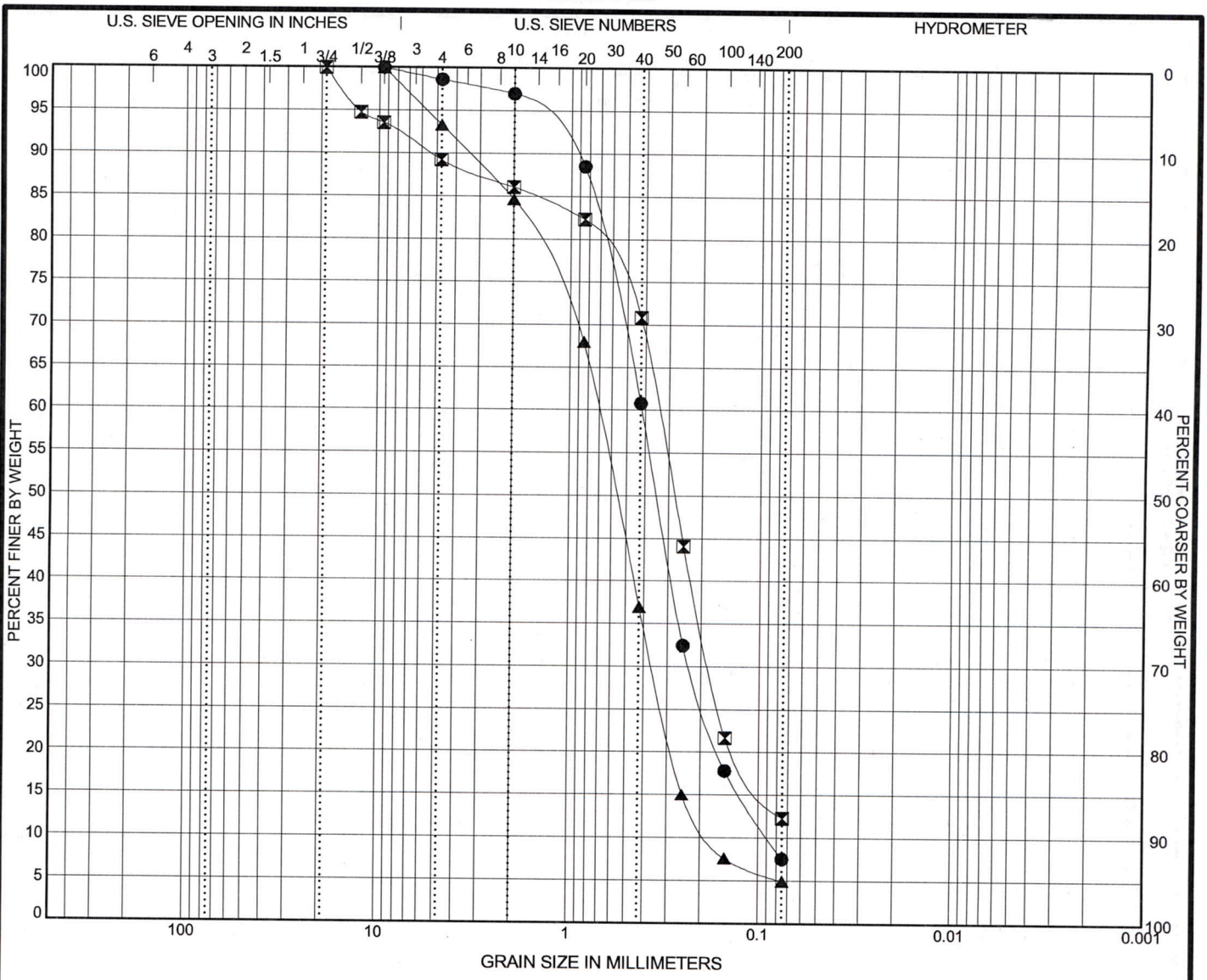
CLIENT: VHB

EXHIBIT: B-1

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | B-1 | 22 - 24 | 0.0 | 1.4 | 91.1 | | 7.5 | | SP-SM |
| ⊠ | B-1 | 30 - 32 | 0.0 | 10.8 | 76.9 | | 12.3 | | SM |
| ▲ | B-1 | 40 - 42 | 0.0 | 6.7 | 88.4 | | 4.9 | | SP |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | 0.419 | 0.343 | 0.711 |
| $D_{30}$ | 0.229 | 0.181 | 0.359 |
| $D_{10}$ | 0.089 | | 0.177 |
| | COEFFICIENTS | | |
| $C_C$ | 1.42 | 1.52 | 1.03 |
| $C_U$ | 4.73 | 5.42 | 4.02 |

| SIEVE (size) | PERCENT FINER ● | PERCENT FINER ⊠ | PERCENT FINER ▲ |
|---|---|---|---|
| 1 1/2" | | | |
| 1" | | | |
| 3/4" | | 100.0 | |
| 1/2" | | 94.76 | |
| 3/8" | 100.0 | 93.57 | 100.0 |
| #4 | 98.65 | 89.21 | 93.31 |
| #10 | 97.01 | 86.06 | 84.65 |
| #20 | 88.52 | 82.31 | 67.98 |
| #40 | 60.8 | 70.88 | 36.97 |
| #60 | 32.46 | 44.08 | 15.01 |
| #100 | 17.83 | 21.71 | 7.61 |
| #200 | 7.54 | 12.31 | 4.94 |

SOIL DESCRIPTION
- ● POORLY GRADED SAND WITH SILT
- ⊠ SILTY SAND
- ▲ POORLY GRADED SAND

REMARKS
- ● Brown fine to coarse sand, trace silt, trace fine gravel
- ⊠ Brown fine to coarse sand, little silt, little fine gravel
- ▲ Brown fine to coarse sand, trace silt, trace fine gravel

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon
4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

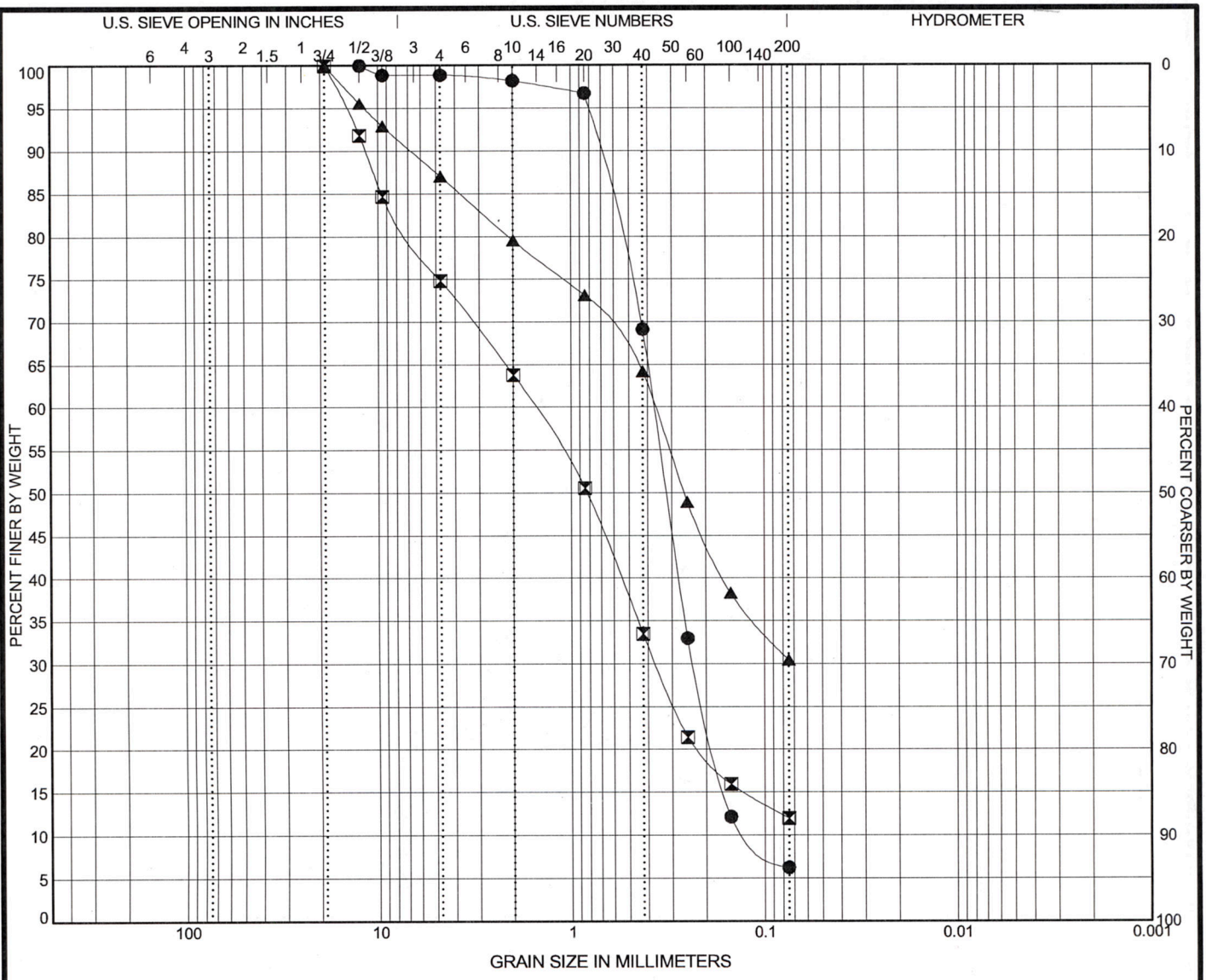
CLIENT: VHB

EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | B-1 | 48 - 50 | 0.0 | 1.1 | 92.6 | | 6.2 | | SP-SM |
| ⊠ | B-1 | 56 - 58 | 0.0 | 25.2 | 62.8 | | 12.0 | | SW-SM |
| ▲ | B-2 | 2 - 4 | 0.0 | 13.0 | 56.6 | | 30.5 | | |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | 0.372 | 1.563 | 0.367 |
| $D_{30}$ | 0.232 | 0.364 | |
| $D_{10}$ | 0.117 | | |
| | COEFFICIENTS | | |
| $C_C$ | 1.25 | 1.61 | |
| $C_U$ | 3.19 | 29.52 | |

| SIEVE (size) | PERCENT FINER ● | ⊠ | ▲ |
|---|---|---|---|
| 1 1/2" | | | |
| 1" | | | |
| 3/4" | | 100.0 | 100.0 |
| 1/2" | 100.0 | 91.85 | 95.58 |
| 3/8" | 98.89 | 84.65 | 92.94 |
| #4 | 98.89 | 74.82 | 87.04 |
| #10 | 98.22 | 63.81 | 79.54 |
| #20 | 96.76 | 50.6 | 73.16 |
| #40 | 69.13 | 33.48 | 64.2 |
| #60 | 32.99 | 21.46 | 48.95 |
| #100 | 12.15 | 15.94 | 38.29 |
| #200 | 6.24 | 11.99 | 30.49 |

SOIL DESCRIPTION

● POORLY GRADED SAND WITH SILT

⊠ WELL GRADED SAND WITH SILT

▲ FILL

REMARKS

● Brown fine to coarse sand, trace silt, trace fine gravel

⊠ Brown fine to coarse sand, some fine gravel, little silt

▲ Brown fine to coarse sand, some silt, little fine gravel

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon
4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

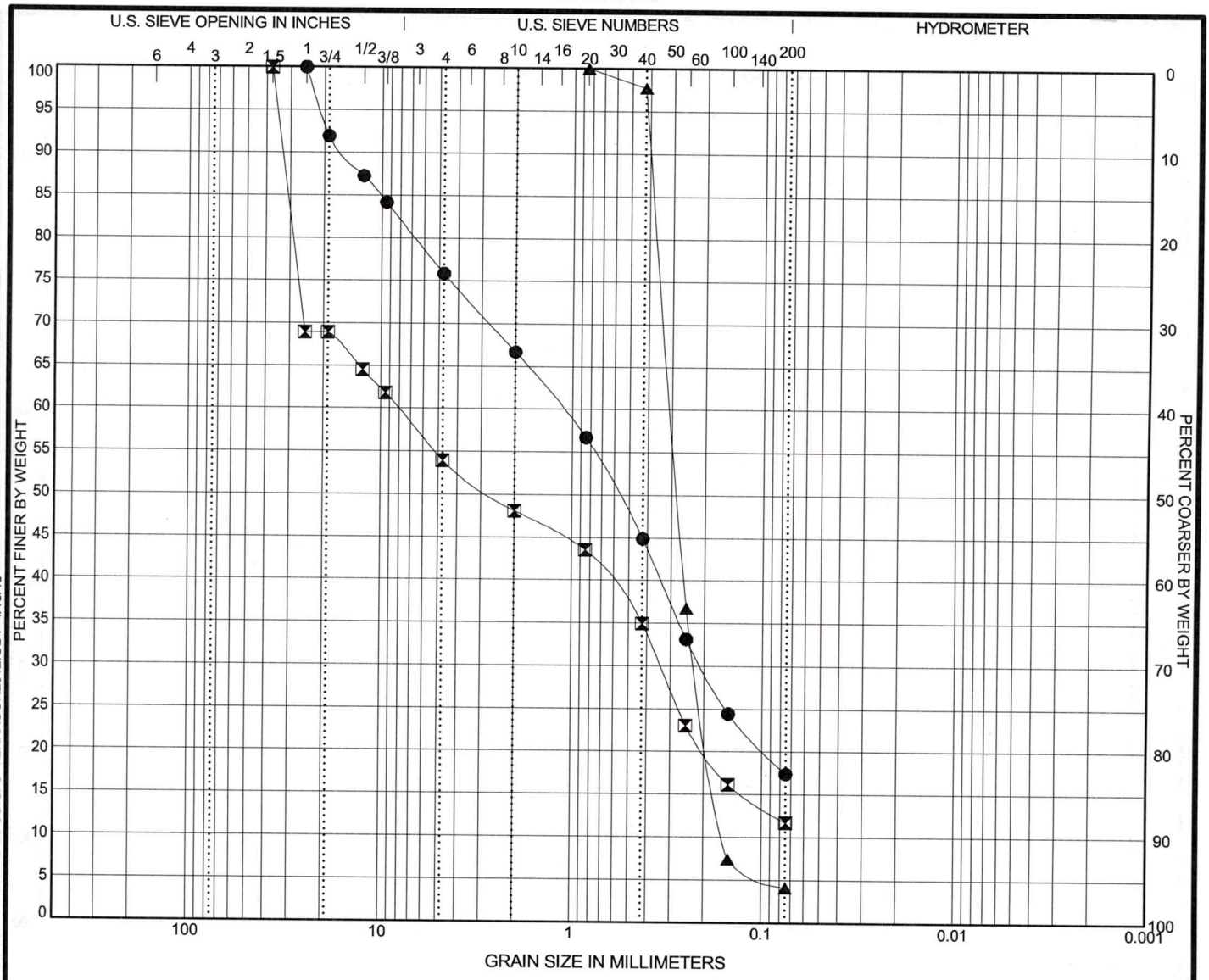
CLIENT: VHB

EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | B-2 | 6 - 8 | 0.0 | 24.1 | 58.4 | | 17.4 | | |
| ⊠ | B-2 | 14 - 16 | 0.0 | 46.0 | 42.3 | | 11.7 | | SW-SM |
| ▲ | B-2 | 20 - 22 | 0.0 | 0.0 | 95.9 | | 4.1 | | SP |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | 1.125 | 8.085 | 0.306 |
| $D_{30}$ | 0.208 | 0.34 | 0.222 |
| $D_{10}$ | | | 0.157 |
| | COEFFICIENTS | | |
| $C_C$ | | 0.25 | 1.03 |
| $C_U$ | | 139.87 | 1.95 |

| SIEVE (size) | PERCENT FINER ● | ⊠ | ▲ |
|---|---|---|---|
| 1 1/2" | | 100.0 | |
| 1" | 100.0 | 68.89 | |
| 3/4" | 91.95 | 68.89 | |
| 1/2" | 87.27 | 64.51 | |
| 3/8" | 84.17 | 61.83 | |
| #4 | 75.86 | 53.96 | |
| #10 | 66.69 | 48.1 | |
| #20 | 56.74 | 43.57 | 100.0 |
| #40 | 44.91 | 34.97 | 97.75 |
| #60 | 33.14 | 23.09 | 36.78 |
| #100 | 24.48 | 16.18 | 7.44 |
| #200 | 17.42 | 11.69 | 4.15 |

SOIL DESCRIPTION

● FILL

⊠ WELL GRADED SAND WITH SILT

▲ POORLY GRADED SAND

REMARKS

● Brown fine to coarse sand, some fine gravel, little silt

⊠ Brown fine to coarse sand and fine to coarse gravel, little silt

▲ Brown fine to medium sand, trace silt

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon
4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

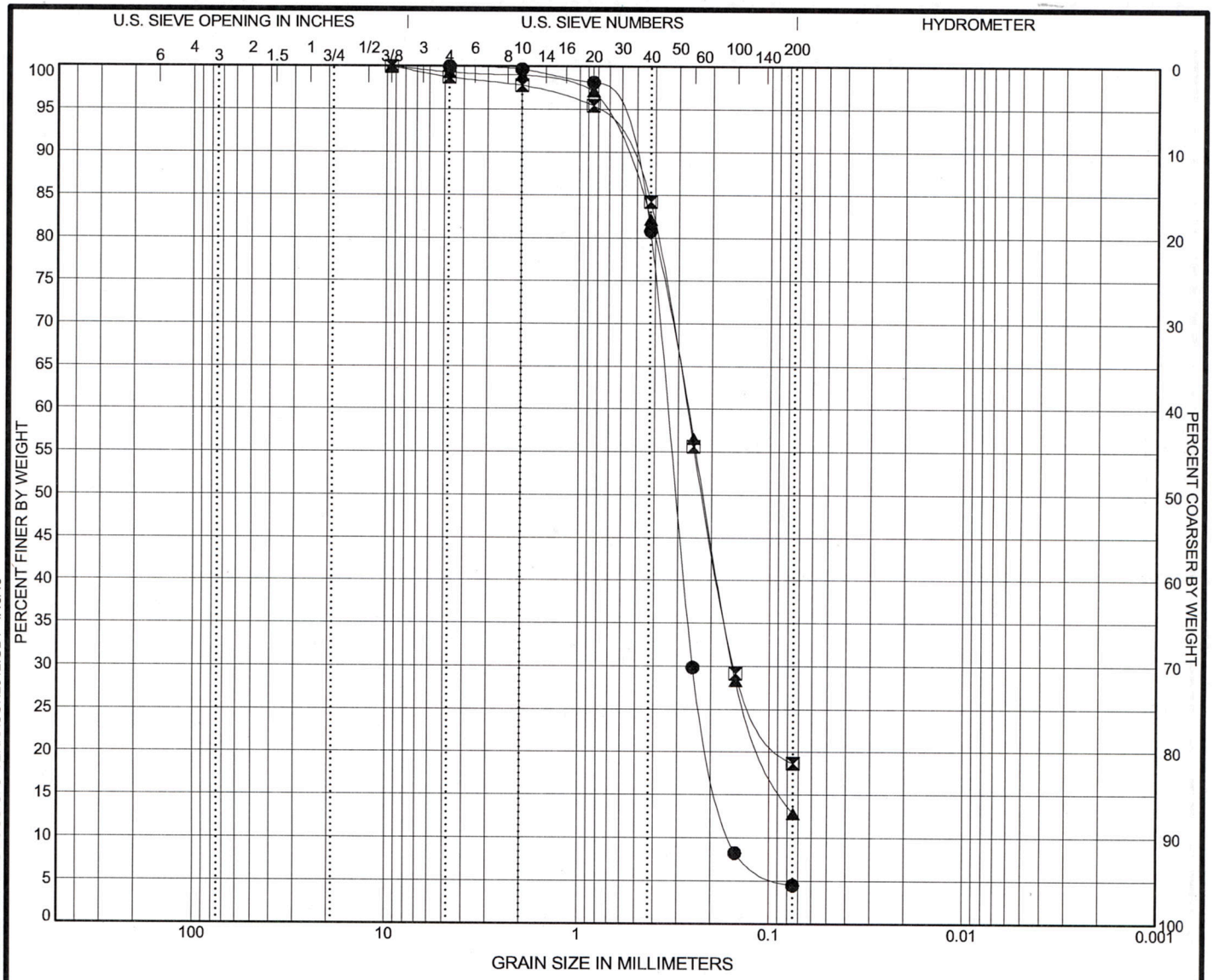
CLIENT: VHB

EXHIBIT: B-4

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | B-2 | 26 - 28 | 0.0 | 0.0 | 95.5 | | 4.5 | | SP |
| ⊠ | B-2 | 36 - 38 | 0.0 | 1.3 | 80.1 | | 18.7 | | SM |
| ▲ | B-2 | 42 - 44 | 0.0 | 0.7 | 86.5 | | 12.8 | | SM |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | 0.342 | 0.271 | 0.268 |
| $D_{30}$ | 0.25 | 0.152 | 0.155 |
| $D_{10}$ | 0.156 | | |
| | COEFFICIENTS | | |
| $C_C$ | 1.17 | | |
| $C_U$ | 2.19 | | |

| SIEVE (size) | PERCENT FINER ● | ⊠ | ▲ |
|---|---|---|---|
| 1 1/2" | | | |
| 1" | | | |
| 3/4" | | | |
| 1/2" | | | |
| 3/8" | | 100.0 | 100.0 |
| #4 | 100.0 | 98.74 | 99.29 |
| #10 | 99.68 | 97.78 | 99.0 |
| #20 | 98.16 | 95.44 | 97.13 |
| #40 | 80.8 | 84.2 | 82.18 |
| #60 | 29.86 | 55.64 | 56.59 |
| #100 | 8.24 | 29.15 | 28.31 |
| #200 | 4.5 | 18.67 | 12.84 |

SOIL DESCRIPTION
- ● POORLY GRADED SAND
- ⊠ SILTY SAND
- ▲ SILTY SAND

REMARKS
- ● Brown fine to medium sand, trace silt
- ⊠ Brown fine to coarse sand, little silt, trace fine gravel
- ▲ Brown fine to coarse sand, little silt, trace fine gravel

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon
4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

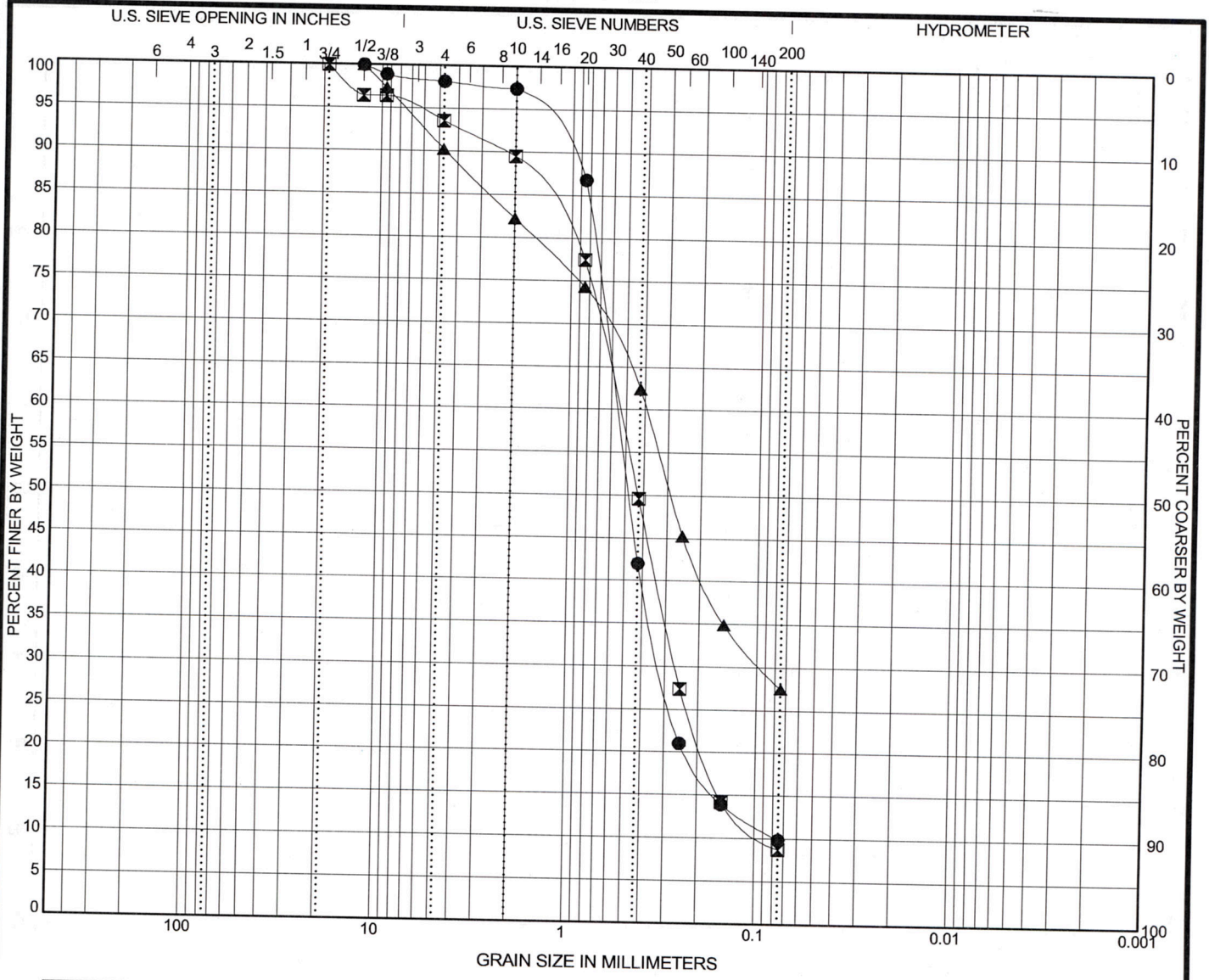
CLIENT: VHB

EXHIBIT: B-5

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | B-2 | 56 - 58 | 0.0 | 1.8 | 88.3 | | 9.8 | | SW-SM |
| ⊠ | 1A | 0 | 0.0 | 6.4 | 84.9 | | 8.7 | | SW-SM |
| ▲ | 1C | 0 | 0.0 | 9.8 | 62.7 | | 27.5 | | SM |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | 0.561 | 0.55 | 0.394 |
| $D_{30}$ | 0.314 | 0.266 | 0.095 |
| $D_{10}$ | 0.077 | 0.088 | |
| | COEFFICIENTS | | |
| $C_C$ | 2.28 | 1.46 | |
| $C_U$ | 7.30 | 6.23 | |

| SIEVE (size) | PERCENT FINER | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| 1 1/2" | | | |
| 1" | | | |
| 3/4" | | 100.0 | |
| 1/2" | 100.0 | 96.38 | 100.0 |
| 3/8" | 98.91 | 96.38 | 97.35 |
| #4 | 98.15 | 93.59 | 90.25 |
| #10 | 97.4 | 89.52 | 82.23 |
| #20 | 86.82 | 77.47 | 74.34 |
| #40 | 42.01 | 49.61 | 62.43 |
| #60 | 21.02 | 27.39 | 45.29 |
| #100 | 13.92 | 14.18 | 34.92 |
| #200 | 9.85 | 8.71 | 27.53 |

SOIL DESCRIPTION
- ● WELL GRADED SAND WITH SILT
- ⊠ WELL-GRADED SAND WITH SILT
- ▲ SILTY SAND

REMARKS
- ● Brown fine to coarse sand, trace silt, trace fine gravel
- ⊠ Brown fine to coarse sand, trace silt, trace fine gravel (MC=6%)
- ▲ Brown fine to coarse sand, some silt, trace fine gravel (MC=15%)

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon
4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

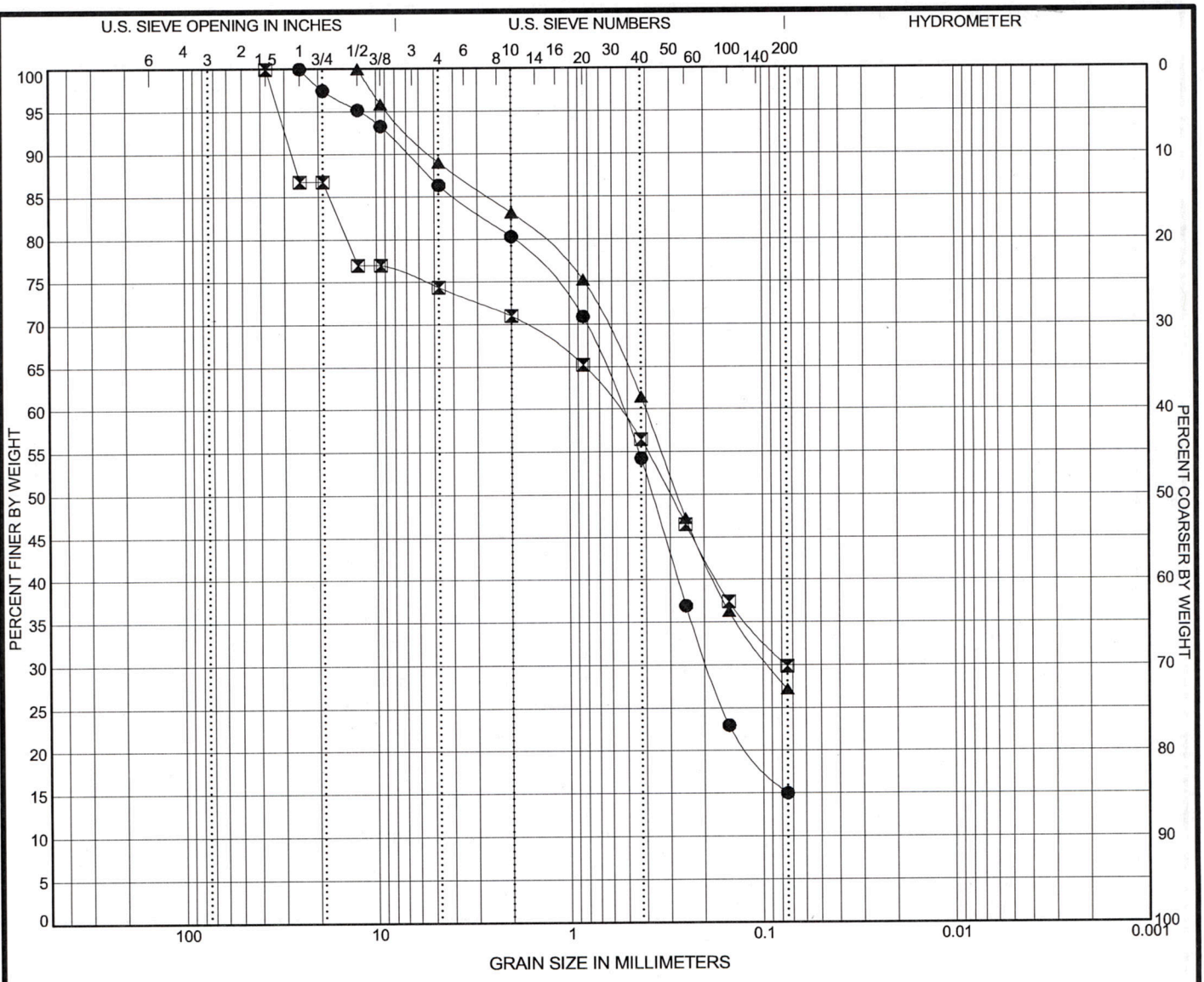
CLIENT: VHB

EXHIBIT: B-6

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | 1D | 0 | 0.0 | 13.7 | 71.3 | | 15.0 | | SM |
| ⊠ | 2B | 0 | 0.0 | 25.6 | 44.5 | | 29.9 | | SM |
| ▲ | 2D | 0 | 0.0 | 11.0 | 61.8 | | 27.2 | | SM |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | 0.54 | 0.562 | 0.402 |
| $D_{30}$ | 0.194 | 0.076 | 0.093 |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_C$ | | | |
| $C_U$ | | | |

| SIEVE (size) | PERCENT FINER ● | ⊠ | ▲ |
|---|---|---|---|
| 1 1/2" | | 100.0 | |
| 1" | 100.0 | 86.74 | |
| 3/4" | 97.48 | 86.74 | |
| 1/2" | 95.21 | 76.96 | 100.0 |
| 3/8" | 93.3 | 76.96 | 95.9 |
| #4 | 86.35 | 74.37 | 89.01 |
| #10 | 80.28 | 70.99 | 83.09 |
| #20 | 70.91 | 65.26 | 75.25 |
| #40 | 54.26 | 56.45 | 61.48 |
| #60 | 36.95 | 46.54 | 47.23 |
| #100 | 22.98 | 37.4 | 36.28 |
| #200 | 15.01 | 29.85 | 27.2 |

SOIL DESCRIPTION

● SILTY SAND

⊠ SILTY SAND WITH GRAVEL

▲ SILTY SAND

REMARKS

● Brown fine to coarse sand, little silt, little fine gravel (MC=9%)

⊠ Brown fine to coarse sand, some silt, some fine to coarse gravel (MC=15%)

▲ Brown fine to coarse sand, some silt, little fine gravel (MC=11%)

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon

4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

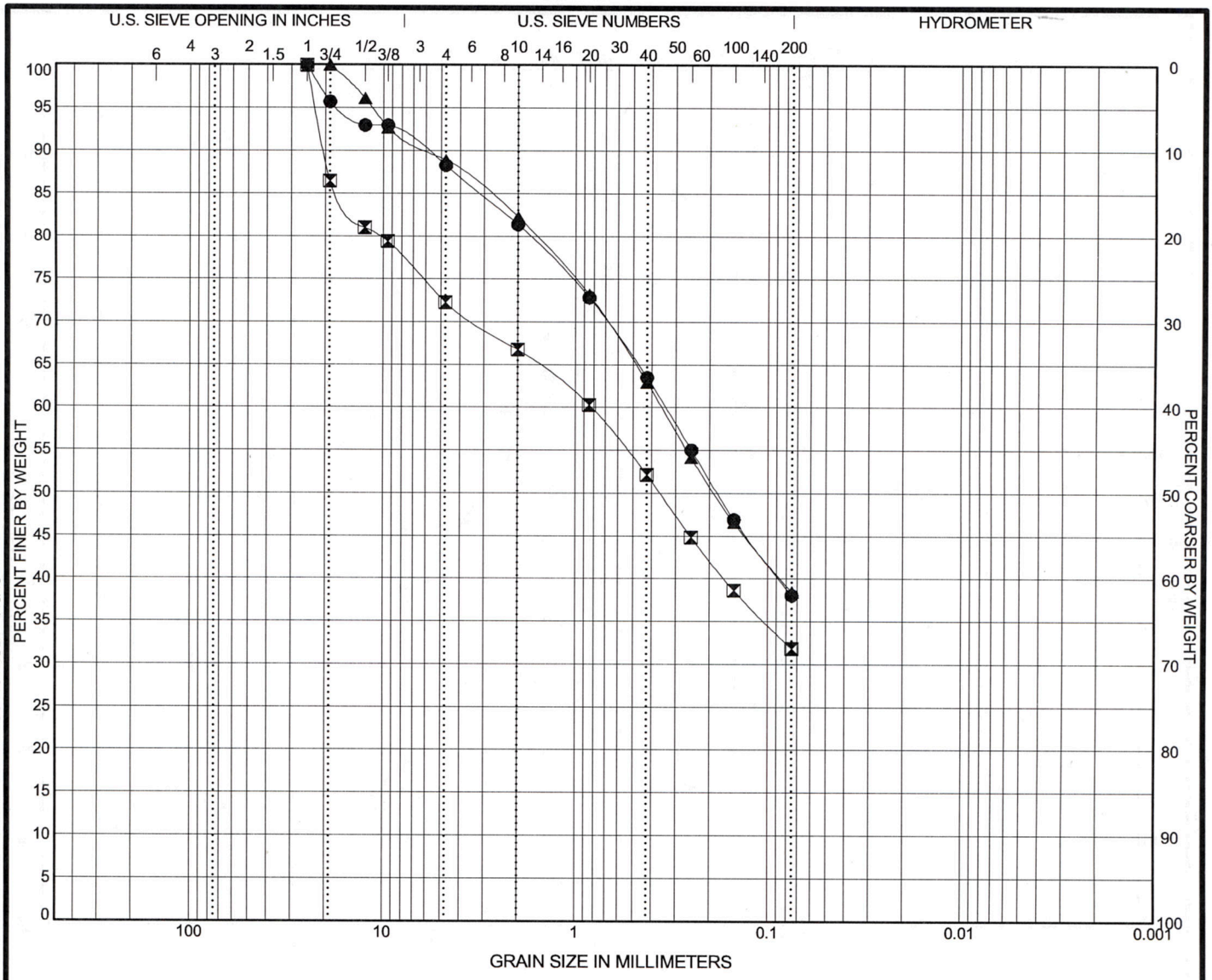
CLIENT: VHB

EXHIBIT: B-7

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | 3A | 0 | 0.0 | 11.7 | 50.2 | | 38.1 | | SM |
| ⊠ | 3B | 0 | 0.0 | 27.7 | 40.4 | | 31.8 | | SM |
| ▲ | 3C | 0 | 0.0 | 11.1 | 50.5 | | 38.5 | | SM |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | 0.341 | 0.827 | 0.356 |
| $D_{30}$ | | | |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_C$ | | | |
| $C_U$ | | | |

| SIEVE (size) | PERCENT FINER | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| 1 1/2" | | | |
| 1" | 100.0 | 100.0 | |
| 3/4" | 95.72 | 86.43 | 100.0 |
| 1/2" | 92.98 | 80.96 | 96.1 |
| 3/8" | 92.98 | 79.37 | 92.71 |
| #4 | 88.29 | 72.27 | 88.92 |
| #10 | 81.36 | 66.73 | 82.25 |
| #20 | 72.88 | 60.32 | 73.18 |
| #40 | 63.53 | 52.14 | 62.94 |
| #60 | 55.04 | 44.86 | 54.13 |
| #100 | 46.95 | 38.63 | 46.59 |
| #200 | 38.07 | 31.84 | 38.47 |

SOIL DESCRIPTION
- ● SILTY SAND
- ⊠ SILTY SAND WITH GRAVEL
- ▲ SILTY SAND

REMARKS
- ● Brown fine to coarse sand and silt, little fine gravel (MC=10%)
- ⊠ Brown fine to coarse sand, some silt, some fine gravel (MC=13%)
- ▲ Brown fine to coarse sand and silt, little fine gravel (MC=16%)

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon
4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

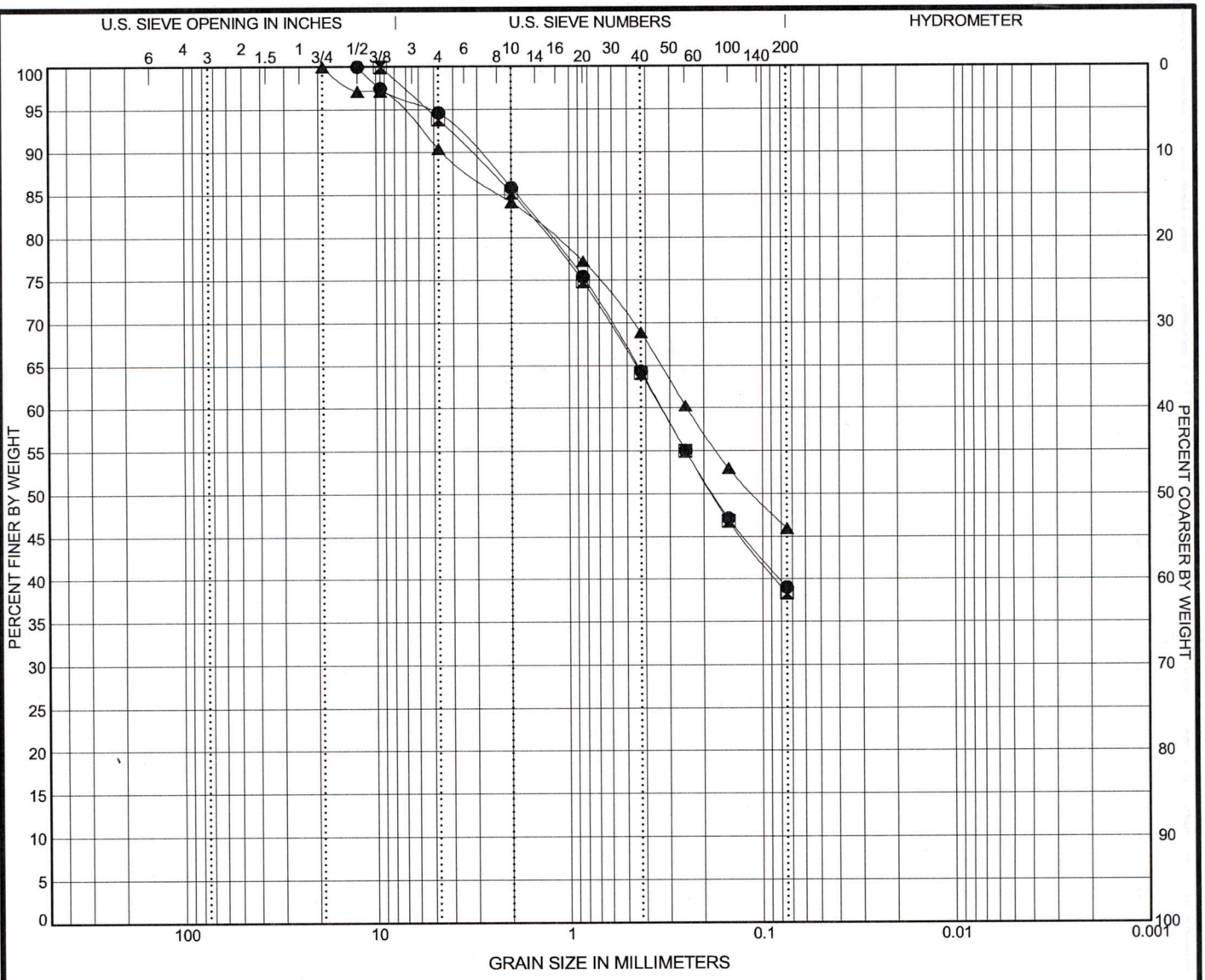
CLIENT: VHB

EXHIBIT: B-8

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | **3D** | **0** | **0.0** | **5.4** | **55.6** | | **39.0** | | **SM** |
| ⊠ | **3E** | **0** | **0.0** | **6.1** | **55.5** | | **38.4** | | **SM** |
| ▲ | **4B** | **0** | **0.0** | **9.6** | **44.4** | | **46.0** | | **SM** |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | **0.331** | **0.334** | **0.245** |
| $D_{30}$ | | | |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_C$ | | | |
| $C_U$ | | | |

| SIEVE (size) | PERCENT FINER ● | ⊠ | ▲ |
|---|---|---|---|
| 1 1/2" | | | |
| 1" | | | |
| 3/4" | | | 100.0 |
| 1/2" | 100.0 | | 97.15 |
| 3/8" | 97.48 | 100.0 | 97.15 |
| #4 | 94.65 | 93.9 | 90.4 |
| #10 | 85.83 | 85.27 | 84.11 |
| #20 | 75.42 | 74.9 | 77.24 |
| #40 | 64.35 | 64.09 | 68.89 |
| #60 | 55.06 | 55.05 | 60.28 |
| #100 | 47.14 | 46.82 | 53.01 |
| #200 | 39.03 | 38.38 | 45.99 |

SOIL DESCRIPTION
- ● SILTY SAND
- ⊠ SILTY SAND
- ▲ SANDY SILT

REMARKS
- ● Brown fine to coarse sand and silt, trace fine gravel (MC=17%)
- ⊠ Brown fine to coarse sand and silt, trace fine gravel (MC=18%)
- ▲ Brown silt and fine to coarse sand, trace fine gravel

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon
4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

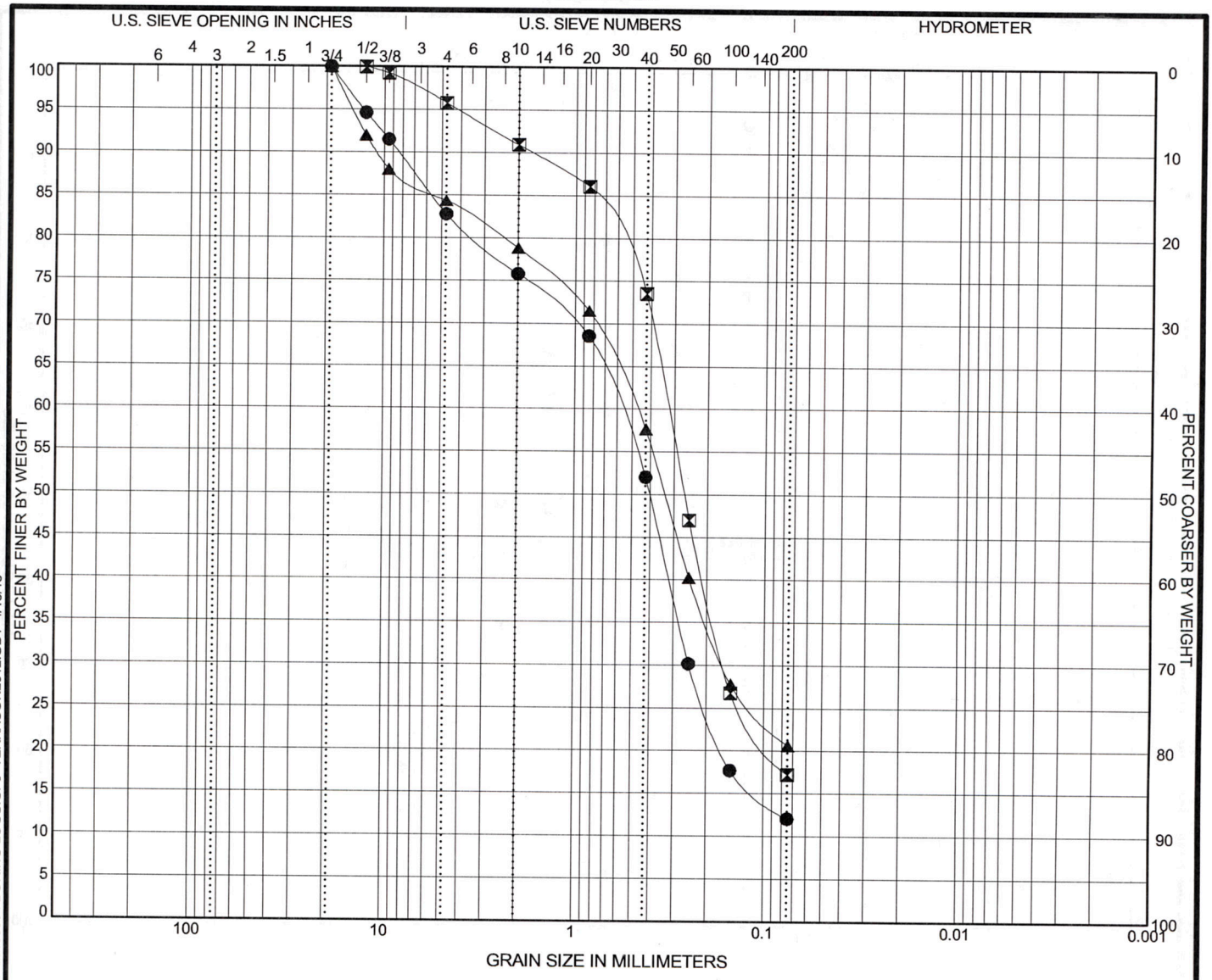
CLIENT: VHB

EXHIBIT: B-9

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | 4D | 0 | 0.0 | 17.2 | 70.7 | | 12.1 | | SM |
| ⊠ | 5A | 0 | 0.0 | 4.2 | 78.6 | | 17.2 | | SM |
| ▲ | 5C | 0 | 0.0 | 15.6 | 63.7 | | 20.7 | | SM |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | 0.593 | 0.324 | 0.478 |
| $D_{30}$ | 0.248 | 0.163 | 0.164 |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_C$ | 1.78 | | |
| $C_U$ | 10.18 | | |

| SIEVE (size) | PERCENT FINER ● | ⊠ | ▲ |
|---|---|---|---|
| 1 1/2" | | | |
| 1" | | | |
| 3/4" | 100.0 | | 100.0 |
| 1/2" | 94.64 | 100.0 | 92.01 |
| 3/8" | 91.52 | 99.25 | 88.01 |
| #4 | 82.77 | 95.8 | 84.35 |
| #10 | 75.81 | 90.93 | 78.82 |
| #20 | 68.57 | 86.06 | 71.52 |
| #40 | 52.05 | 73.54 | 57.64 |
| #60 | 30.19 | 47.03 | 40.23 |
| #100 | 17.71 | 26.76 | 27.78 |
| #200 | 12.06 | 17.24 | 20.65 |

SOIL DESCRIPTION
- ● SILTY SAND
- ⊠ SILTY SAND
- ▲ SILTY SAND

REMARKS
- ● Brown fine to coarse sand, little silt, little fine gravel (MC=12%)
- ⊠ Brown fine to coarse sand, little silt, trace fine gravel (MC=15%)
- ▲ Brown fine to coarse sand, some silt, little fine gravel (MC=14%)

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon
4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

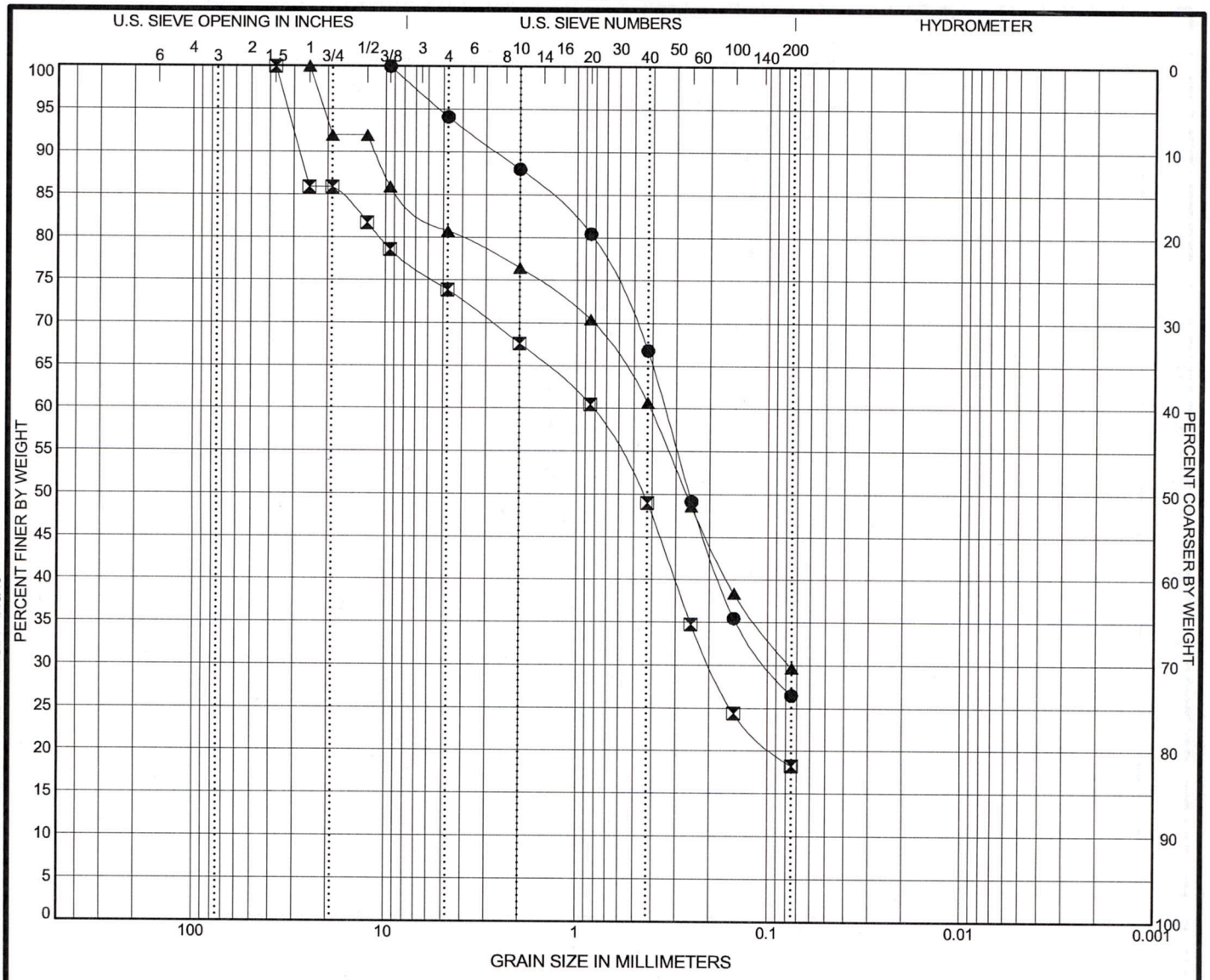
CLIENT: VHB

EXHIBIT: B-10

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# GRAIN SIZE DISTRIBUTION

**ASTM D422**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BORING ID | DEPTH | % COBBLES | % GRAVEL | % SAND | % SILT | % FINES | % CLAY | USCS |
|---|---|---|---|---|---|---|---|---|---|
| ● | **5E** | **0** | **0.0** | **5.9** | **67.6** | | **26.5** | | **SM** |
| ⊠ | **6A** | **0** | **0.0** | **26.1** | **55.6** | | **18.2** | | **SM** |
| ▲ | **6C** | **0** | **0.0** | **19.3** | **51.0** | | **29.7** | | **SM** |

| | GRAIN SIZE | | |
|---|---|---|---|
| | ● | ⊠ | ▲ |
| $D_{60}$ | **0.346** | **0.825** | **0.412** |
| $D_{30}$ | **0.098** | **0.198** | **0.077** |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_C$ | | | |
| $C_U$ | | | |

| SIEVE (size) | PERCENT FINER ● | ⊠ | ▲ |
|---|---|---|---|
| **1 1/2"** | | **100.0** | |
| **1"** | | **85.86** | **100.0** |
| **3/4"** | | **85.86** | **91.95** |
| **1/2"** | | **81.71** | **91.95** |
| **3/8"** | **100.0** | **78.54** | **85.89** |
| **#4** | **94.12** | **73.86** | **80.73** |
| **#10** | **87.99** | **67.6** | **76.45** |
| **#20** | **80.44** | **60.49** | **70.44** |
| **#40** | **66.79** | **49.01** | **60.69** |
| **#60** | **49.16** | **34.75** | **48.6** |
| **#100** | **35.48** | **24.38** | **38.4** |
| **#200** | **26.49** | **18.23** | **29.71** |

SOIL DESCRIPTION

● SILTY SAND

⊠ SILTY SAND WITH GRAVEL

▲ SILTY SAND WITH GRAVEL

REMARKS

● Brown fine to coarse sand, some silt, trace fine gravel (MC=21%)

⊠ Brown fine to coarse sand, some fine to coarse gravel, little silt (MC=11%)

▲ Brown fine to coarse sand, some fine to coarse gravel, some silt (MC=14%)

PROJECT: Slope Stability

SITE: Gateway National Recreation Area (GATE)
Staten Island, New York

Terracon

4081 Hadley Road, Suite B
South Plainfield, New Jersey

PROJECT NUMBER: J6155004

CLIENT: VHB

EXHIBIT: B-11

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J6155004 BORING LOGS.GPJ TERRACON2012.GDT 4/15/15

# APPENDIX C
# SUPPORTING DOCUMENTS

# GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

**SAMPLING**

Shelby Tube

Standard Penetration Test

**WATER LEVEL**

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

**FIELD TESTS**

| | |
|---|---|
| (HP) | Hand Penetrometer |
| (T) | Torvane |
| (DCP) | Dynamic Cone Penetrometer |
| (PID) | Photo-Ionization Detector |
| (OVA) | Organic Vapor Analyzer |

## DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays or silty clays if they are plastic, and silts or clayey silts if they are slightly plastic or non-plastic. Minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

## LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

**STRENGTH TERMS**

| RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance | | CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance | | |
|---|---|---|---|---|
| **Descriptive Term (Density)** | **Standard Penetration or N-Value Blows/Ft.** | **Descriptive Term (Consistency)** | **Unconfined Compressive Strength Qu, (psf)** | **Standard Penetration or N-Value Blows/Ft.** |
| Very Loose | 0 - 3 | Very Soft | less than 500 | 0 - 1 |
| Loose | 4 - 9 | Soft | 500 to 1,000 | 2 - 4 |
| Medium Dense | 10 - 29 | Medium Stiff | 1,000 to 2,000 | 4 - 8 |
| Dense | 30 - 50 | Stiff | 2,000 to 4,000 | 8 - 15 |
| Very Dense | > 50 | Very Stiff | 4,000 to 8,000 | 15 - 30 |
| | | Hard | > 8,000 | > 30 |

## RELATIVE PROPORTIONS OF MINOR CONSTITUENTS

| Descriptive Term(s) of other constituents | Percent of Dry Weight |
|---|---|
| Trace | < 10 |
| Little | 10 - 20 |
| Some | 20 - 35 |
| And | 35 - 50 |

## GRAIN SIZE TERMINOLOGY

| Major Component of Sample | Particle Size |
|---|---|
| Boulders | Over 12 in. (300 mm) |
| Cobbles | 12 in. to 3 in. (300mm to 75mm) |
| Gravel | 3 in. to #4 sieve (75mm to 4.75 mm) |
| Sand | #4 to #200 sieve (4.75mm to 0.075mm |
| Silt or Clay | Passing #200 sieve (0.075mm) |

## PLASTICITY DESCRIPTION

| Term | Plasticity Index |
|---|---|
| Non-plastic | 0 |
| Low | 1 - 10 |
| Medium | 11 - 30 |
| High | > 30 |

Terracon

Exhibit: C-1