
PREPARED FOR:



LAND PLANNING SOLUTIONS
1403 GREENBRIER PARKWAY STE. 205
CHESAPEAKE, VA 23320
O 757.935.9014 F 757.935.9015

TABLE OF CONTENTS

DRAINAGE NARRATIVE	PAGE 2
SECTION I – STORMWATER QUALITY CALCULATIONS	PAGE 5
SECTION II – CONCEPTUAL MASTER PLAN	PAGE 12
SOIL SURVEY	



5857 Harbour View Boulevard, Suite 202
Suffolk, Virginia 23435
O. 757.935.9014 F. 757.935.9015
www.landplanningsolutions.com

The Pointe at harbor View
Suffolk, Virginia

Major Water Quality Impact Analysis
December 11, 2017

DRAINAGE NARRATIVE

Project Description

The existing property (approximately 55.6+/- acres) consists of a single parcel that is bounded by Armstead Avenue to the north, College Drive to the west, and Interstate 664 to the east. The entire property is currently undeveloped and largely forested. The proposed development will impact the majority of the 55.6-acre parcel. The proposed land use is identified as the Pointe at Harbour View development consisting of retail space, office spaces and approximately 500 multi-family residential units.

Existing Conditions

The site is currently undeveloped with the exception of several unpaved access paths and an abandoned building, roughly 26' x 42'. A narrow strip of jurisdictional wetlands is located along the northeast portion of the property adjacent to Armstead Avenue, and another small pocket of wetlands exists in the center of the property adjacent to I-664. Runoff, generally as sheet flow, shallow concentrated flow, and open channel flow, currently drains the property to culverts located at the perimeter of the site. Ground elevations fall gently from south to north across the parcel.

This property is located within the Chesapeake Bay Preservation Overlay District as shown on the City of Suffolk's Official Preservation Area District Map but it is not located within a RPA. A majority of the site will be disturbed during construction. Due to the topography & control measures, no negative erosion & sediment control impacts are anticipated to affect adjacent properties.

The site drains from the south to the north to the James River. The site lies within flood zone X (outside 500-year floodplain) on community-panel number 5101560043E of the FEMA Flood Insurance Rate Map. Based upon the soil survey of City of Suffolk, Virginia, the soils for this site consist of five types. Nansemond Fine sandy loam is located in the majority of the site and is considered moderately well drained with a Hydrologic Soil Group rating of B. Kalmia fine sandy loam is located in the northern and southern portion of the site and is considered well drained with an HSG rating of B. Dragston fine sandy loam loam is located in the center of the site and is considered somewhat poorly drained with an HSG rating of A/D. Groundwater was found on-site from 4-12 feet below existing grade. A complete soils report has been generated on the subject property as required. Please see the accompanying *Custom Soil Resource Report for City of Suffolk, Virginia* for soils information about this site and the GET Solutions, Inc. report included in the appendices of this report.

The site currently has no sanitary sewer service; however, City sanitary sewer will be stubbed into it from the Harbour View Blvd gravity main with the College Drive Roundabout project currently under construction. Due to the size of the site, it is anticipated that a new City pump station will be required. A 16" City waterline also exists on the southern end of the property from under I-664. The College Drive roundabout project will also extend a 16" water main from Harbour View Boulevard on the northwest side of the site which will be utilized as well. It is expected that the two lines will be connected and provide domestic and fire protection for the site. Additional survey information and supporting calculations will be provided during final site plan development to ensure the capacity of both of these systems to the site.

Proposed Conditions

It is proposed to develop the site into 346,800 square feet of retail space, 110,000 square feet of office space and 500 residential units with associated parking and wet detention basins for stormwater management. The site will be designed to comply with all applicable state and local stormwater regulations during the development of the site and after final stabilization has been achieved. To the greatest extent possible, runoff will be directed to the stormwater basin for treatment before being released downstream at a rate less than the pre-developed condition. Supporting calculations for the stormwater management are provided in the Drainage and Stormwater Management report.

The final site plan will minimize encroachment into the wetlands to the greatest extent possible. The post-developed impervious coverage will require BMPs for water quality and quantity control and will comply with the DCR regulations and will therefore also meet the City's buffer area sediment and nutrient removal requirements described in the Water Quality Impact Assessment requirements.

The site will be served by City water and sewer. Private connections will be made to the water and gravity sewer mains throughout the site as needed. The installation of these services will be designed as to not disturb any environmentally sensitive areas. Calculations supporting these connections are provided in the Public Facilities Analysis report.

Water Quality Impact Assessment

The stormwater management for this site will consist of Water Quantity controls to maintain the post-developed runoff flow rate under the pre-developed rate. Controls will be required to meet the DCR Water Quality regulations due to the fact that the post-developed condition impervious cover (I_{post}) is more than the average land cover condition (I_{watershed}) as shown in the DQR-based Water Quality calculations in Section II of this report. Calculations supporting the design of the bio-retention and wet-detention basins are provided in Section I of this report. Additional design calculations supporting sizing of the detention basins for compliance with DCR Water Quantity controls are provided in the Drainage and Stormwater Management Report.

Additional Hydrogeological Assessments

- (i) Disturbance or impacts to the wetlands will be minimized to the greatest extent possible. There is no RPA within the site development.
- (ii) Due to the City's and State's Stormwater regulations, bio-retention and wet detention basin(s) will be constructed for stormwater management. The basins have been designed to treat and release storm runoff as required by the applicable standards. Disruption or reduction in the supply of water to the downstream wetlands and resources will be minimized to the greatest extent possible.
- (iii) It is anticipated that no disruption to existing hydrology including wetland and stream circulation patterns will be realized by this development. Existing drainage patterns will be maintained to the greatest extent possible.
- (iv) Final site design will balance cut and fill materials on-site as much as possible. A large amount of fill material for site development is not anticipated.
- (v) Dredging and likewise dumping of such material onsite will not be required for site development.
- (vi) No known shellfish beds, submerged aquatic vegetation, or fish spawning areas exist on site. A BMP will be incorporated in the site to minimize any impact to these resources which likely exist downstream in the James River.
- (vii) The estimated pre- development pollutant load in runoff is 5.07 pounds/year.
The estimated post- development pollutant load in runoff is 22.54 pounds/year.
Supporting calculations are included in Section I of this report.
- (viii) Anticipated impervious area totals approximately 47.24 acres out of a total of 55.58 acres. This yields a post-developed impervious number of 85%. Surfacing materials will include a building, asphalt paving, and concrete walks and curbing.
- (ix) As the majority of the site is currently wooded, site clearing is expected for approximately 51.6 acres.
- (x) It is expected to begin the project by the end of 2018. Based on the size of the development, a phased buildout over 3-5 years is expected.
- (xi) It is anticipated that permits required to complete this project will be required from: The City of Suffolk for site plan approval, Virginia Department of Health for water main extensions, Wetlands General Permit from the Corp of Engineers and the Virginia DEQ for sanitary and land disturbance.
- (xii) Proposed mitigation measures for potential hydrogeological impacts include implementing an Erosion and Sedimentation Control Plan completed by a Licensed Virginia PE, temporary construction and permanent stormwater management systems, and a site design to minimize cut and fill. Any disturbed wetlands will be mitigated as the need arises during final design.

Landscape Element

Existing vegetation ranges from small understory trees to large hardwood canopy trees. General limits of clearing will be at and directly adjacent to the sites proposed features. The clearing and grading will be minimized to the greatest extent practical. Mature trees along the perimeter of the property will be saved to the greatest extent possible. Mitigation will be implemented for the impacted trees removal consistent with the tree canopy requirements of the City. Tree and shrubs will be selected from the approved plan list found in the City's UDO.

SECTION I
STORMWATER QUALITY CALCULATIONS

2011 BMP Standards and Specifications 2013 Draft BMP Standards and Specifications

Project Name: **The Pointe at Harbour View**
 Date: **8-Dec-17**

CLEAR ALL
 (Ctrl+Shift+R)

- data input cells
- constant values
- calculation cells
- final results

BMP Design Specifications List: 2011 Stds & Specs

Site Information

Post-Development Project (Treatment Volume and Loads)

Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land			4.00		4.00 *
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed			4.34		4.34
Impervious Cover (acres)			47.24		47.24
					55.58

* Forest/Open Space areas must be protected in accordance with the Virginia Runoff Reduction Method

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr) 82.11

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary	
Forest/Open Space Cover (acres)	4.00
Weighted Rv (forest)	0.04
% Forest	7%
Managed Turf Cover (acres)	4.34
Weighted Rv (turf)	0.22
% Managed Turf	8%
Impervious Cover (acres)	47.24
Rv (impervious)	0.95
% Impervious	85%
Site Area (acres)	55.58
Site Rv	0.83

Treatment Volume and Nutrient Loads	
Treatment Volume (acre-ft)	3.8327
Treatment Volume (cubic feet)	166,954
TP Load (lb/yr)	104.90
TN Load (lb/yr) (Informational Purposes Only)	750.41

Drainage Area A

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)			4.00		4.00	0.04
Managed Turf (acres)			4.34		4.34	0.22
Impervious Cover (acres)			47.24		47.24	0.95
Total					55.58	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. A (lb/yr)	104.53
Post Development Treatment Volume in D.A. A (ft ³)	166,373

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft ³)	Runoff Reduction (ft ³)	Remaining Runoff Volume (ft ³)	Total BMP Treatment Volume (ft ³)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)													
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)													
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretenion #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretenion #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)													
3.a. Permeable Pavement #1 (Spec #7)	45			0	0	0	0	25	0.00	0.00	0.00	0.00	
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00	
4. Grass Channel (RR)													
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	30			0	0	0	0	15	0.00	0.00	0.00	0.00	
5. Dry Swale (RR)													
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00	
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00	
6. Bioretention (RR)													
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80	2.60	34.50	0	96,840	24,210	121,050	50	0.00	75.97	68.37	7.60	13.b. Wet Pond #1 (Coastal Plain)
7. Infiltration (RR)													
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
8. Extended Detention Pond (RR)													

Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)				
0		0.00	0.00	0.00
0		0.00	0.00	0.00

2. Rooftop Disconnection (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
60	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00

3. Permeable Pavement (RR)				
25	0.00	0.00	0.00	0.00
25		0.00	0.00	0.00

4. Grass Channel (RR)				
20	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00

5. Dry Swale (RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

6. Bioretention (RR)				
40	0.00	0.00	0.00	0.00
60	0.00	543.47	499.99	43.48

7. Infiltration (RR)				
15	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00

8. Extended Detention Pond (RR)				
--	--	--	--	--

8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00	
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00	

10	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00

9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

9. Sheetflow to Filter/Open Space (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	34.50	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	2.60	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft ³)	96,840	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	104.53	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	68.37	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	36.16	
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS		

TOTAL RUNOFF REDUCTION IN D.A. A (ft ³)	96,840
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	499.99
SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)	

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	

10. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

11. Filtering Practices (no RR)													
11.a. Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

11. Filtering Practices (no RR)				
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00

12. Constructed Wetland (no RR)													
12.a. Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	

12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00

13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0	1.50	10.50	24,210	0	61,617	61,617	45	7.60	23.48	13.98	17.09	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

13. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	43.48	167.95	42.28	169.14
40	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00

14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	45.00	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	4.10	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	82.11	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	104.53	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	13.98	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	68.37	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	82.36	

TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr) 22.18

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	499.99
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	42.28
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	542.28

Site Results (Water Quality Compliance)

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST/OPEN SPACE (sq)	4.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (sq)	47.24	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER TREATED (sq)	45.00	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (sq)	4.34	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA TREATED (sq)	4.10	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft³)

4

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft ³)	96,840	0	0	0	0	96,840
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	104.53	0.00	0.00	0.00	0.00	104.53
TP LOAD REDUCTION ACHIEVED (lb/yr)	82.36	0.00	0.00	0.00	0.00	82.36
TP LOAD REMAINING (lb/yr)	22.18	0.00	0.00	0.00	0.00	22.18
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	542.28	0.00	0.00	0.00	0.00	542.28

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	104.90
TP LOAD REDUCTION REQUIRED (lb/yr)	82.11
TP LOAD REDUCTION ACHIEVED (lb/yr)	82.36
TP LOAD REMAINING (lb/yr)	22.54
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr)	0.00

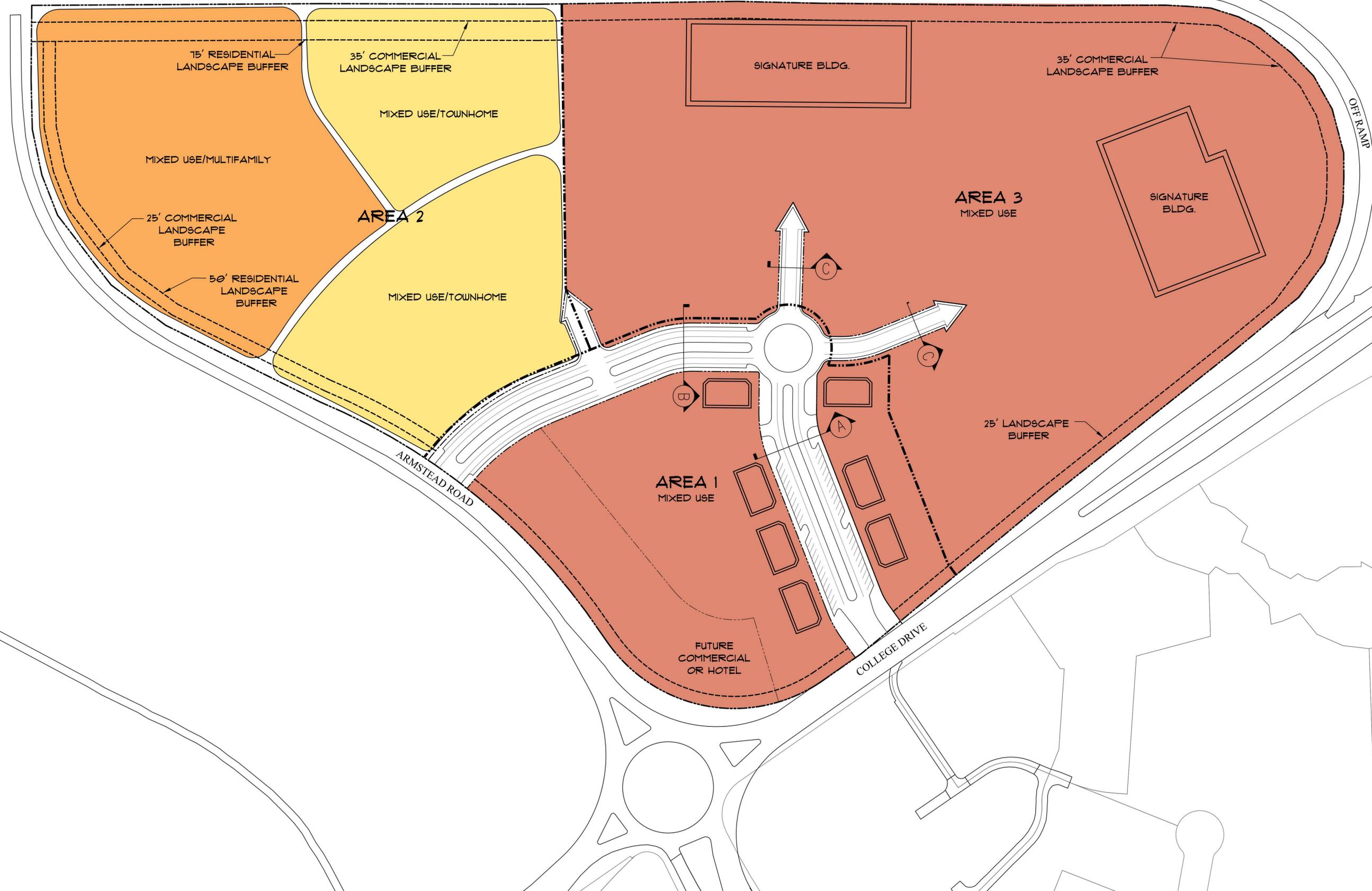
** TARGET TP REDUCTION EXCEEDED BY 0.25 LB/YEAR **

Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	750.41
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	542.28
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	208.14

SECTION II
CONCEPTUAL MASTER PLAN

INTERSTATE 664





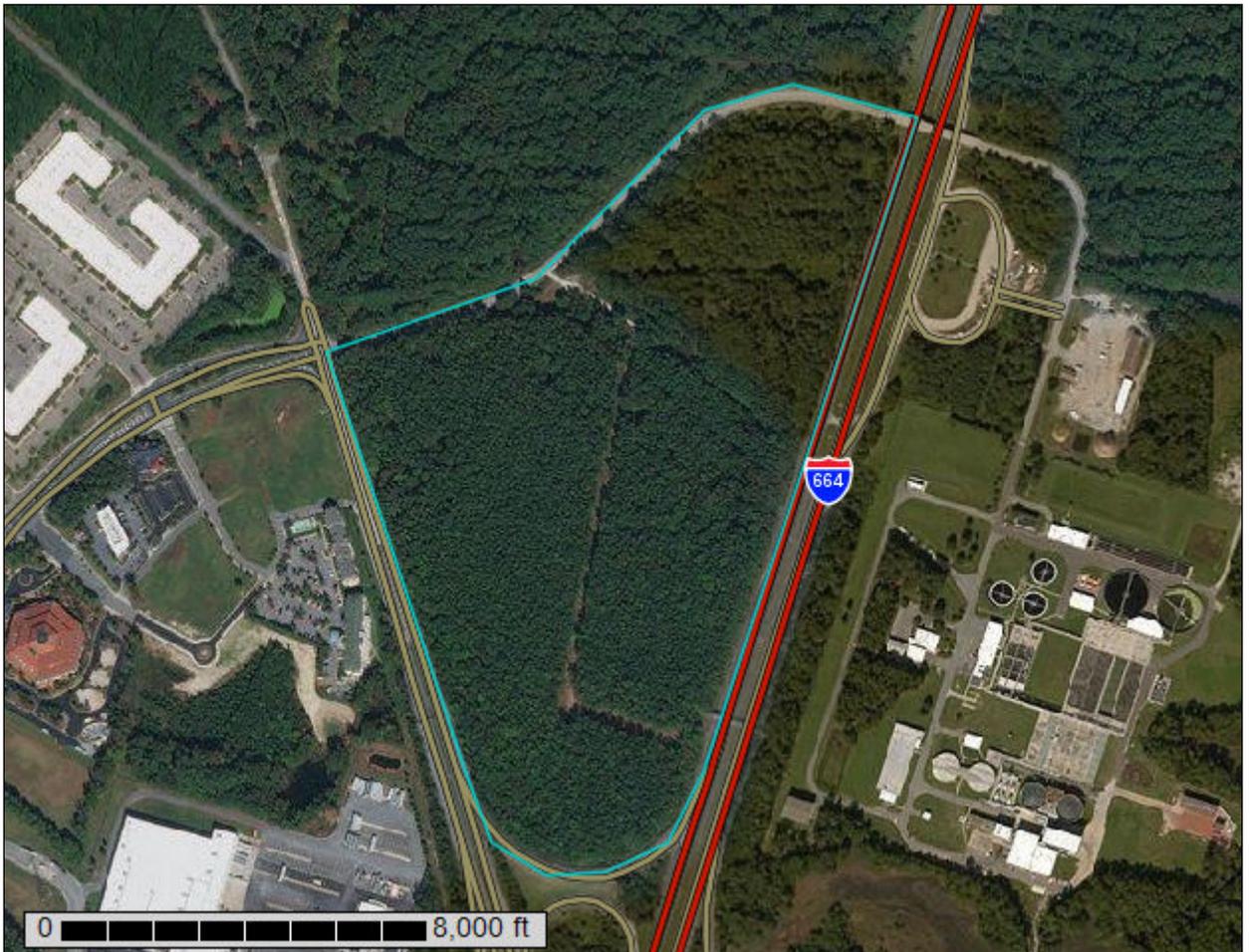
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for City of Suffolk, Virginia



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface	2
How Soil Surveys Are Made	5
Soil Map	8
Soil Map.....	9
Legend.....	10
Map Unit Legend.....	11
Map Unit Descriptions.....	11
City of Suffolk, Virginia.....	13
6—Dragston fine sandy loam.....	13
10A—Kalmia fine sandy loam, wet substratum, 0 to 2 percent slopes.....	14
10B—Kalmia fine sandy loam, wet substratum, 2 to 6 percent slopes.....	15
16A—Nansemond fine sandy loam, 0 to 2 percent slopes.....	16
29—Weston fine sandy loam.....	17
References	19

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

Custom Soil Resource Report

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

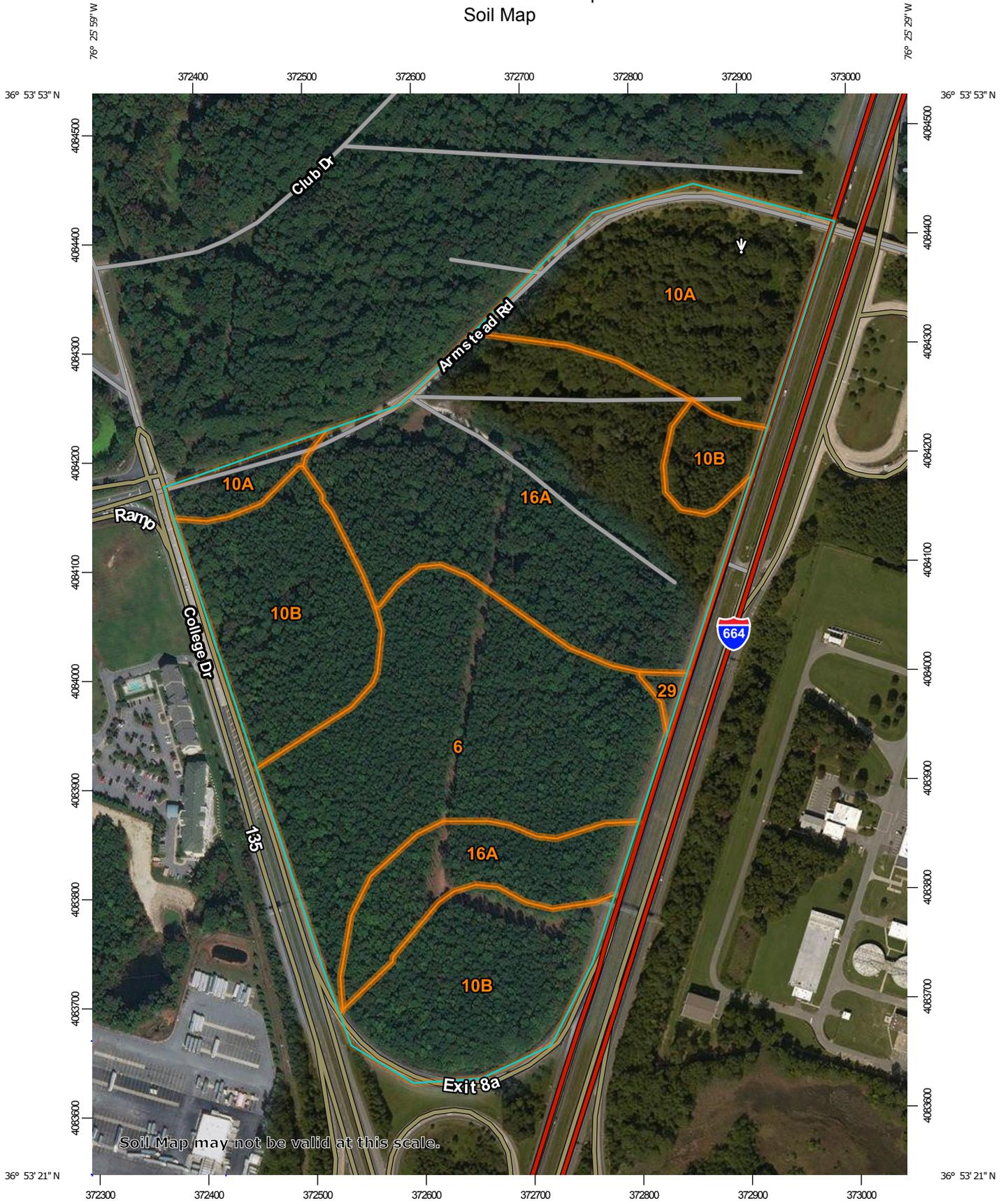
Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

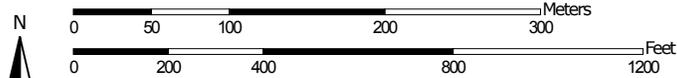
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



Map Scale: 1:4,830 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: City of Suffolk, Virginia
 Survey Area Data: Version 11, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Mar 8, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6	Dragston fine sandy loam	16.7	24.2%
10A	Kalmia fine sandy loam, wet substratum, 0 to 2 percent slopes	11.8	17.1%
10B	Kalmia fine sandy loam, wet substratum, 2 to 6 percent slopes	16.5	23.9%
16A	Nansemond fine sandy loam, 0 to 2 percent slopes	23.7	34.4%
29	Weston fine sandy loam	0.3	0.4%
Totals for Area of Interest		68.9	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

Custom Soil Resource Report

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

City of Suffolk, Virginia

6—Dragston fine sandy loam

Map Unit Setting

National map unit symbol: 41s5
Mean annual precipitation: 43 to 53 inches
Mean annual air temperature: 68 to 72 degrees F
Frost-free period: 165 to 192 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Dragston and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dragston

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy marine deposits

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 37 inches: fine sandy loam
H3 - 37 to 66 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A/D
Hydric soil rating: No

Minor Components

Tomotley

Percent of map unit: 8 percent
Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex

Hydric soil rating: Yes

10A—Kalmia fine sandy loam, wet substratum, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 41r2
Mean annual precipitation: 43 to 53 inches
Mean annual air temperature: 68 to 72 degrees F
Frost-free period: 165 to 192 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Kalmia and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kalmia

Setting

Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy marine deposits

Typical profile

H1 - 0 to 22 inches: fine sandy loam
H2 - 22 to 34 inches: sandy clay loam
H3 - 34 to 72 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

10B—Kalmia fine sandy loam, wet substratum, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 41r3
Mean annual precipitation: 43 to 53 inches
Mean annual air temperature: 68 to 72 degrees F
Frost-free period: 165 to 192 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Kalmia and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kalmia

Setting

Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy marine deposits

Typical profile

H1 - 0 to 22 inches: fine sandy loam
H2 - 22 to 34 inches: sandy clay loam
H3 - 34 to 72 inches: fine sandy loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

16A—Nansemond fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 41rc
Elevation: 120 to 250 feet
Mean annual precipitation: 43 to 53 inches
Mean annual air temperature: 68 to 72 degrees F
Frost-free period: 165 to 192 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Nansemond and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nansemond

Setting

Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy marine deposits

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 29 inches: fine sandy loam
H3 - 29 to 70 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Weston

Percent of map unit: 10 percent
Landform: Marine terraces

Custom Soil Resource Report

Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: Yes

29—Weston fine sandy loam

Map Unit Setting

National map unit symbol: 41s0
Elevation: 120 to 250 feet
Mean annual precipitation: 43 to 53 inches
Mean annual air temperature: 68 to 72 degrees F
Frost-free period: 165 to 192 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Weston and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Weston

Setting

Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy fluviomarine deposits

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 39 inches: loam
H3 - 39 to 62 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.57 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Custom Soil Resource Report

References

- American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
- American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.
- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.
- Federal Register. July 13, 1994. Changes in hydric soils of the United States.
- Federal Register. September 18, 2002. Hydric soils of the United States.
- Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.
- National Research Council. 1995. Wetlands: Characteristics and boundaries.
- Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262
- Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577
- Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580
- Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.
- United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.
- United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374
- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>



REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING SERVICES

**The Point at Harbour View
Feasibility Study**

Suffolk, Virginia

G E T Project No: VB17-124G

March 10, 2017

PREPARED FOR:





March 10, 2013

TO: **Gee's Group**
Twin Oaks I
5700 Lake Wright Drive, Suite 103
Norfolk, VA 23502

Attn: Mr. David Gianascoli

RE: Report for Subsurface Exploration & Geotechnical Engineering Services
The Point at Harbour View- Feasibility Study
Suffolk, Virginia
G E T Report No: VB17-124G

Dear Mr. Gianascoli:

In compliance with your request, we have completed our Subsurface Exploration and Geotechnical Engineering Services for the referenced project. The results of this study, together with our preliminary recommendations, are presented in this report.

Often, because of design and construction details that occur on a project, questions arise concerning subsurface conditions. **G E T Solutions, Inc.** would be pleased to continue its role as Geotechnical Engineer during the project implementation.

We appreciate the opportunity to be of service to you on this project. We trust that the information contained herein meets your immediate need, and should you have any questions or if we could be of further assistance, please do not hesitate to contact us.

Respectfully Submitted,
G E T Solutions, Inc.

Ioanna Kladou
Project Engineer

Chris M. Caton, P.E., P.G.
Geotechnical Engineer/Geologist
VA Lic. # 046947

Copies: (1) Client



TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
1.0 PROJECT INFORMATION.....	1
1.1 Project Authorization	1
1.2 Site and Project Description	1
1.3 Purpose and Scope of Services	2
2.0 FIELD AND LABORATORY PROCEDURES.....	3
2.1 Field Exploration	3
2.2 Laboratory Testing	3
3.0 SITE AND SUBSURFACE CONDITIONS	4
3.1 Site Geology.....	4
3.2 Subsurface Soil Conditions.....	4
3.3 Groundwater Information	5
4.0 PRELIMINARY AVALUATION AND RECOMMENDATIONS	6
4.1 Clearing and Grading.....	7
4.2 Subgrade Preparation.....	8
4.3 Structural Fill and Placement.....	8
4.4 Suitability of On-site Material	9
4.5 Alternative 1-Shallow Foundations: Column Loads less than 200 Kips.....	
Wall Loads less than 8 Klf	9
4.5.1 Foundation Excavations	9
4.5.2 Slab-on-Grade Design	10
4.5.3 Settlements	11
4.6 Alternative 2-Surcharge: Column Loads 200-300 Kips, Wall Loads 8-10 klf... 11	
4.7 Alternative 3-Deep Foundation System: Column Loads greater than 300 kips	
Wall Loads greater than 10 klf.....	12
4.8 Preliminary Pavement Design.....	12
4.9 Seismic Evaluation.....	12
5.0 CONSTRUCTION CONSIDERATIONS	12
5.1 Drainage and Groundwater Concerns.....	12
5.2 Site Utility Installation	13
5.3 Additional Geotechnical Investigation.....	13
5.4 Excavations.....	13
6.0 REPORT LIMITATIONS	14
APPENDIX I BORING LOCATION PLAN	
APPENDIX II SUMMARY OF SOIL CLASSIFICATION	
APPENDIX III SUMMARY OF LABORATORY RESULTS	
APPENDIX IV CBR SUMMARY DATA	
APPENDIX V BORING LOGS	
APPENDIX VI GENERALIZED SOIL PROFILES	

EXECUTIVE SUMMARY

The project site is located on the northern quadrant of the intersection of Interstate 664 and College Drive in Suffolk, Virginia. The site currently consists of undeveloped land extending from the intersection of I-664 and College Drive to Armstead Road. It is expected that several 2- to 4-story structures will be constructed at the site. The project is in the preliminary design stage; thus, the exact locations and type of buildings are unknown.

Our field and laboratory program included:

- Seventeen (17) 10- to 60-foot deep Standard Penetration Test (SPT) soil test borings.
- Five (5) bulk soil samples for CBR testing.

A brief description of the natural subsurface soil conditions is tabulated below.

DEPTH (feet)	STRATUM	DESCRIPTION	RANGES OF SPT ⁽¹⁾ UNCORRECTED N-VALUES
0 to 0.13-0.5	Topsoil	1.5 to 6 inches of topsoil	-
0.13-0.5 to 16.5-31.5	I	SAND (SM, SC, SP-SM, SP) with varying amounts of Silt and Clay <i>* Deposits of CLAY (CL) were recovered at boring locations B-3, B-5, B-6 & D-3 between 0 to 2 feet below current grades. * Borings B-1 through B-8 and CBR-1 through CBR-5 were terminated within this layer.</i>	WOH ⁽²⁾ -31
16.5-31.5 to 21.5-38.5	II	CLAY (CH) with varying amounts of Sand, Silt and organics <i>* This layer was only recovered at boring locations B-2, B-8, D-2, D-3 & D-5.</i>	3-5
21.5-38.5 to 60	III	SAND (SM, SP-SM) with varying amounts of Silt and marine shell fragments <i>* The Yorktown Formation was recovered starting at depths of 21.5 to 46.5 feet below grades.</i>	7-44

Notes: (1) SPT = Standard Penetration Test, Uncorrected N-Values in Blows-per-foot
 (2) WOH = Weight-of-Hammer

The initial groundwater level was recorded at depths ranging from 4 to 12 to feet below grades (corresponding to elevations of 0.5 to 15 feet MSL) at the time of our drilling activities. In the projects' areas, seasonal groundwater fluctuations of ± 2 to 3 feet or more feet are common; however, greater fluctuations have been documented.

The following preliminary evaluations and recommendations were developed based on our field exploration and laboratory-testing program:

- It is estimated that a cut of up to 6 inches in depth will be required to remove the topsoil materials within the construction areas. In addition, the construction areas which encroach on the existing drainage ditches, should be “de-mucked” to remove very soft/loose organic soils and alluvial deposits.
- The foundation system will be dependent on the structural loading conditions which are unknown at this time. As such, the report focuses on three alternatives for the foundation design: shallow foundations, shallow foundations following ground improvements (surcharge) and deep foundations (piles).
- The pavements should be designed using a CBR Value of 11.9.
- Based on our experience within the vicinity of the project site and the recovered soils at this location, it is our opinion that this site may be classified as a Site Class “D” in accordance with Chapter 20 of ASCE 7 as referenced by the 2012 International Building Code. A 100-foot deep CPT probe with soil shear wave velocity measurements will be necessary to substantiate the site classification.
- A comprehensive geotechnical investigation is recommended once the final design and the structural loads are determined to better ascertain the soil conditions within the vicinity of each structure.

This summary briefly discusses some of the major topics mentioned in the attached report. Accordingly, this report should be read in its entirety to thoroughly evaluate the contents.

1.0 PROJECT INFORMATION

1.1 Project Authorization

G E T Solutions, Inc. has completed the subsurface exploration and geotechnical engineering services for the proposed The Point at Harbour View- Feasibility Study project in Suffolk, Virginia. The geotechnical engineering services were conducted in general accordance with **G E T** Proposal No. PVB16-830G. Authorization to proceed with the services was obtained in the form of a signed Work Authorization Form from David Gianascoli with Gee's Group.

1.2 Site and Project Description

The project site is located on the northern quadrant of the intersection of Interstate 664 and College Drive in Suffolk, Virginia. The site currently consists of undeveloped land extending from the intersection of I-664 and College Drive to Armstead Road. The project site is bounded to the north by Armistead Road, to the east by Interstate 664, to the south by the I-664 exit ramp and to the west by College Drive. At the time of our site reconnaissance, the project site consisted of undeveloped land with dense trees and shrubs, dirt paths and shallow ditches. Current site grades ranged approximately between 11.5 to 19 feet MSL (surface elevations identified from the site survey provided by the client only at the boring locations). A site vicinity aerial map is presented below in Figure 1.

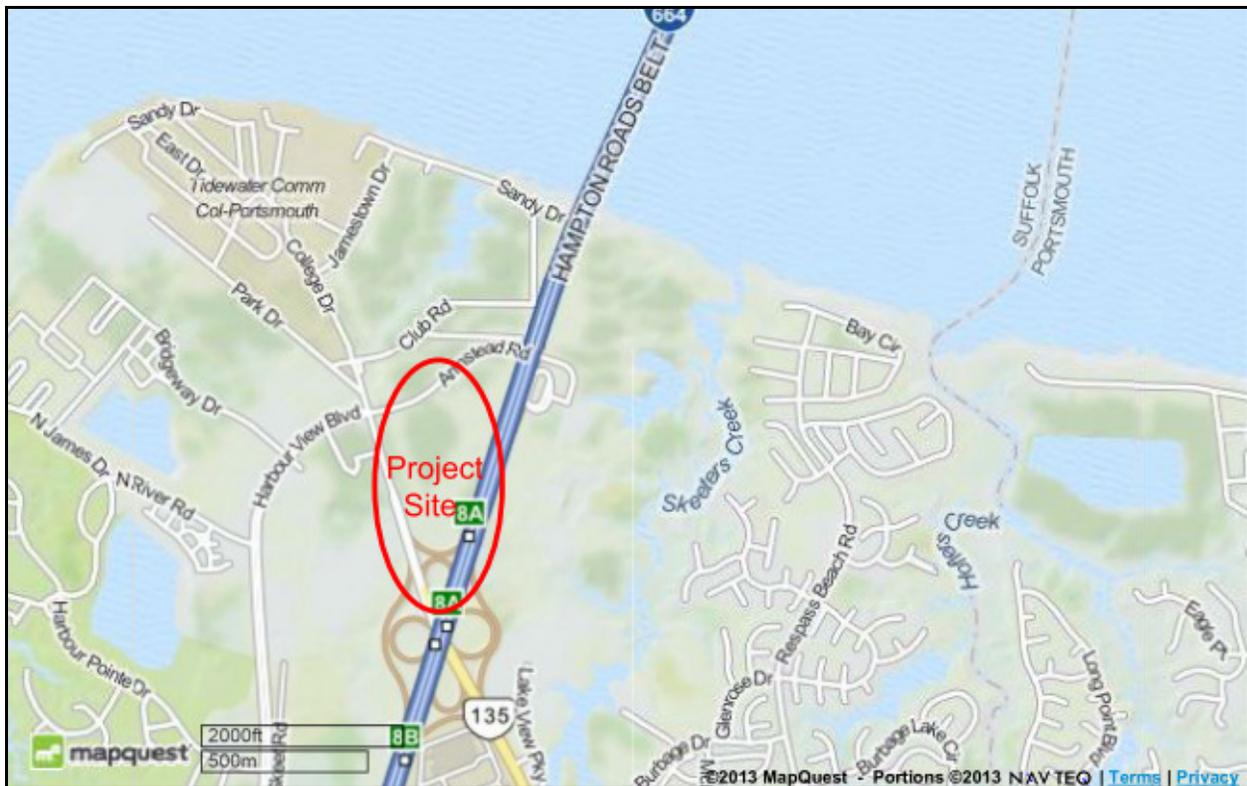


Figure 1: Site Vicinity Plan

The project is in the preliminary design stage; thus, the exact locations and type of buildings are unknown. The proposed construction will likely consist of building a mixed-use development comprised of numerous one-story retail structures and several new, 3- to 4-story apartment structures. In addition, there is the possibility of multi-story office/retail spaces and a parking deck. For these office and parking structures, deep foundations will likely be required as the structural loads are expected to induce excessive settlement within the compressible subsurface soils. The retail structures are expected to be of CMU and structural steel construction, and the apartment structures are expected to be of wood frame construction. The maximum wall and column loads are not expected to exceed 3 klf and 150 kips (one-story retail and 3 to 4-story wood frame residential). It is expected that the finish floor elevations of the proposed structures will coincide with the existing site grades, thus cuts and fills will be minimal (approximately 1 to 2 feet).

If any of the noted information is incorrect or has changed, please inform G E T Solutions, Inc. so that we may amend the recommendations presented in this report, if appropriate.

1.3 Purpose and Scope of Services

The purpose of this feasibility study was to obtain information on the general subsurface conditions at the project site as related to the preliminary design for the structures' foundations as well as pavement. The subsurface conditions encountered were then evaluated with respect to the available project characteristics. In this regard, engineering assessments for the following items were formulated:

1. General assessment of the soils revealed by the borings performed at the site.
2. General location and description of potentially deleterious material encountered in the borings that may interfere with construction progress or structure performance, including existing fills or surficial/subsurface organics.
3. Preliminary recommendations for foundation system alternatives depending on structural loading conditions. The foundation system preliminary recommendations provided in this reporting included: conventional shallow foundations and driven pile foundations as well as ground improvements (surcharge).
4. Preliminary pavement design recommendations based on the field exploration activities and our experience with similar soil conditions.
5. Seismic Site Class definition in accordance with the IBC 2012 requirements, available soil data, and our local experience.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic material in the soil, bedrock, surface water, groundwater or air, on or below or around this site. Prior to development of this site, an environmental assessment is advisable.

2.0 FIELD AND LABORATORY PROCEDURES

2.1 Field Exploration

In order to explore the general subsurface soil types and to aid in developing associated foundation, pavement and design parameters, the following subsurface exploration program was performed.

- Twelve (12) 25 to 60 foot deep SPT borings (designated as B-1 through B-8 and D-1 through D-4) were drilled throughout the site.
- Five (5) 10-foot deep SPT borings (designated as CBR-1 through CBR-5) were drilled throughout the site for pavement design.

The SPT borings were performed with the use of hollow stem auger and rotary wash “mud” drilling procedures in general accordance with ASTM D 1586. The tests were performed continuously from the ground surface to depths of 6 to 12 feet, and at 5-foot intervals thereafter. The soil samples were obtained with a standard 1.4” I.D., 2” O.D., 30” long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches, using an automatic hammer. The number of blows required to drive the sampler each 6-inch increment of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value (uncorrected for automatic hammer). A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a glass jar, sealed, labeled, and returned to our laboratory for review.

Five (5) bulk soil samples, designated as CBR-1 through CBR-5, were collected at their respective boring locations. The bulk subgrade soil samples were collected from depths ranging from 1 to 2 feet below existing site grades. The bulk soil samples were returned to our laboratory and subjected to CBR testing in accordance with VTM & ASTM standards.

The boring locations were established and staked in the field by a representative of **GET Solutions, Inc.** using a hand-held Global Position System tracker. The approximate boring locations are shown on the attached “Boring Location Plan” (Appendix I) which was reproduced based on a Google Earth Aerial Map.

2.2 Laboratory Testing

Representative portions of all soil samples collected during drilling were sealed in glass jars, labeled, and transferred to our laboratory for classification and analysis. A Project Engineer performed the soil classification in general accordance with ASTM Specification D 2487. A summary of the soil classification system is provided in Appendix II.

Representative split spoon soil samples were selected and subjected to natural moisture, - #200 sieve and Atterberg Limits testing in order to corroborate the visual classification. These test results are presented in Appendix III.

The bulk subgrade soil samples were subjected to natural moisture content, -#200 sieve, Atterberg Limits, Standard Proctor, and CBR testing in accordance with ASTM and VTM standards. A summary of the CBR test results and the moisture density relationship curves (Proctor Curves) are presented in Appendix IV.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Geology

The project site lies within a major physiographic province called the Atlantic Coastal Plain. Numerous transgressions and regressions of the Atlantic Ocean have deposited marine, lagoonal, and fluvial (stream lain) sediments. The regional geology is very complex, and generally consists of interbedded layers of varying mixtures of sands, silts and clays. Based on our review of existing geologic and soil boring data, the geologic stratigraphy encountered in our subsurface explorations generally consisted of marine deposited sands and clays.

3.2 Subsurface Soil Conditions

A description of the natural subsurface soil conditions is presented below in Table I.

Table I-Subsurface Soil Conditions

DEPTH (feet)	STRATUM	DESCRIPTION	RANGES OF SPT⁽¹⁾ UNCORRECTED N-VALUES
0 to 0.13-0.5	Topsoil	1.5 to 6 inches of topsoil	-
0.13-0.5 to 16.5-31.5	I	SAND (SM, SC, SP-SM, SP) with varying amounts of Silt and Clay * Deposits of CLAY (CL) were recovered at boring locations B-3, B-5, B-6 & D-3 between 0 to 2 feet below current grades. * Borings B-1 through B-8 and CBR-1 through CBR-5 were terminated within this layer.	WOH ⁽²⁾ -31
16.5-31.5 to 21.5-38.5	II	CLAY (CH) with varying amounts of Sand, Silt and organics * This layer was only recovered at boring locations B-2, B-8, D-2, D-3 & D-4.	3-5
21.5-38.5 to 60	III	SAND (SM, SP-SM) with varying amounts of Silt and marine shell fragments * The Yorktown Formation was recovered starting at depths of 21.5 to 46.5 feet below grades.	7-44

Notes: (1) SPT = Standard Penetration Test, Uncorrected N-Values in Blows-per-foot
 (2) WOH = Weight-of-Hammer

The subsurface descriptions are of a generalized nature provided to highlight the major soil strata encountered. The records of the subsurface exploration are included on the “Boring Log” sheets (Appendix V) and in the “Generalized Soil Profiles” (Appendix VI), which should be reviewed for specific information as to the individual borings. The stratifications shown on the records of the subsurface exploration represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual or occur between sample intervals. It is noted that the topsoil designation references the presence of surficial organic laden soil, and does not represent any particular quality specification. This material is to be tested for approval prior to use.

3.3 Groundwater Information

The initial groundwater level was recorded at the boring locations and as observed through the relative wetness of the recovered soil samples during the drilling operations. The initial groundwater level was recorded at depths ranging from 4 to 12 to feet below grades (corresponding to elevations of 0.5 to 15 feet MSL) at the time of our drilling activities. The boreholes were backfilled upon completion for safety considerations. As such, the reported groundwater level may not be indicative of the static groundwater level.

We also reviewed the Soil Survey of the City of Suffolk Virginia published by the United States Department of Agriculture Soil Conservation Service. The soils identified within the boundaries of the project site consisted mostly of “Kalmia” and “Dragston” soils with pockets of “Nansemond” soils. For these soil types the high water table was documented to commonly range between 1.5 to 6 feet below grades.

The discrepancies in the groundwater readings are most likely caused by the variations in relief of the terrain (up to 7.5 feet difference) and in some cases the restrictive soil layers recovered from the soil test borings which could cause perched groundwater conditions. Based on our experience of soils in the immediate vicinity of the project site and of our review of the Soil Survey of Suffolk, we anticipate that the groundwater level elevations range between 5 to 10 feet MSL. However, the groundwater level will have to be verified during the final design phase of the project, by means of installing temporary groundwater monitoring wells.

Groundwater conditions will vary with environmental variations, tidal fluctuations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.). In the project’s area, seasonal groundwater fluctuations of ± 2 to 3 feet or more are common; however, greater fluctuations have been documented. We recommend that the contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on the construction procedures, if necessary.

4.0 PRELIMINARY EVALUATION AND RECOMMENDATIONS

Our preliminary recommendations are based on the previously discussed project information, our interpretation of the soil test borings, laboratory data and our observations during our site reconnaissance. If the proposed construction should vary from what was described, we request the opportunity to review our recommendations and make any necessary changes.

Our preliminary engineering analysis is based on loading conditions that include 2 feet of fill to attain finished floor elevations and distributed floor loads in the order of 150 psf. Since the foundation loads are unknown at this time, three different maximum column and wall load combination alternatives were identified and an engineering analysis of the most appropriate foundation system was performed for each alternative. Based on our experience in the vicinity of the project site, structures that are 1 to 3 stories in height are typically supported on shallow foundations, whereas higher structures will likely require a deep foundation system. A summary of the loading conditions with their corresponding general foundation system is listed in Table II and the comprehensive preliminary recommendations are provided in the following sections of this reporting.

Table II-Loading Conditions and Preliminary Foundation Recommendations

Alternatives^(*)	Loading Combination	Foundation Type
Alternative 1	Maximum Column Load: 200 Kips Maximum Wall Load: 8 Klf Floor Loads: 150 psf 2 feet of FILL	Conventional Shallow Foundations
Alternative 2	Column Load: 200-300 Kips Wall Load: 8-10 Klf Floor Loads: 150 psf 2 feet of FILL to establish finish grades	Ground Improvements (surcharge) with conventional shallow foundations
Alternative 3	Maximum Column Load: 300 Kips or more Maximum Wall Load: 10 Klf or more Floor Loads: 150 psf 2 feet of FILL to establish finish grades	Deep Foundation System

() Based on worst case conditions*

Generally, the subsurface soil conditions within the northeastern portion of the site appear to have better subsurface soil conditions than the remaining areas of the project site. As such, the subsurface soils within these areas will likely be capable of supporting greater structural loadings, up to 300 Kips (without ground improvements). The following sections of this report address the general foundation recommendations based on assumed structural loading conditions and “worst case” soil characteristics documented during our exploration.

4.1 Clearing and Grading

Prior to proceeding with construction, all root mat, topsoil and other deleterious materials should be stripped from proposed construction areas. Clean topsoil should be stockpiled for later use in landscaped areas. It is estimated that a cut of up to 6 inches in depth will be required to remove the topsoil materials. In addition, based on our experience with similar site conditions, this initial cut to remove organic laden soils could extend to 12 inches or more within wooded areas of the project site. Removing any trees will also consist of stump and large root ball removal. These events will likely leave holes that may extend several feet in depth throughout the project site. Surface water may accumulate in these holes leading to subgrade deterioration if not properly addressed. These holes should be backfilled as recommended in Section 4.3. This cut is expected to extend deeper in isolated areas to remove deeper deposits of organic soils, or unsuitable soils, which become evident during the clearing.

In addition, the construction areas which encroach on the existing drainage ditches should be “de-mucked” to remove very soft/loose organic soils and alluvial deposits. Based on our field exploration and our experience with similar soils conditions the cut required to “de-muck” the soils in the base and sides of the drainage ditches are estimated to range from 12 to 18 inches. These cuts are expected to extend deeper in isolated areas to remove deeper deposits of unsuitable soils, which become evident during the clearing. It is recommended that the clearing operations extend laterally at least 5 feet beyond the perimeter of the proposed construction area.

The results of our field exploration program indicated that the subsurface soils were generally comprised of SAND (SC, SC-SM, SM) and CLAY (CL) soils. Also, the bulk soil samples indicated natural moistures up to 4.9% above their optimum moisture (as determined by means of laboratory testing). Accordingly, combinations of excess surface moisture from precipitation ponding on the site and the construction traffic, including heavy compaction equipment, may create pumping and general deterioration of the bearing capabilities of the surface soils. Therefore, undercutting to remove unstable surface soils should be anticipated. The extent of the undercut will be determined in the field during construction based on the outcome of the field testing procedures (subgrade proofroll).

Furthermore, inherently wet subgrade soils combined with potential poor site drainage make this site particularly susceptible to subgrade deterioration. Thus, grading should be performed during a dry season if at all possible. This should minimize these potential problems, although they likely will not be eliminated. The project’s budget should include an allowance for subgrade improvements (undercut and backfill with structural fill in the construction areas). Similar projects have required 12 to 18 inches of undercut and backfill with structural fill and additional aggregate base materials.

4.2 Subgrade Preparation

Following the clearing operation, the exposed subgrade soils should be densified with a large static drum roller within the construction areas. After the subgrade soils have been densified, they should be evaluated by **G E T Solutions, Inc.** for stability. Accordingly, the subgrade soils should be proofrolled to check for pockets of loose material hidden beneath a crust of better soil. Several passes should be made by a large rubber-tired roller, loaded dump truck or other heavy equipment over the construction areas. The number of passes will be determined in the field by the Geotechnical Engineer depending on the soils conditions. Any pumping and unstable areas observed during proofrolling (beyond the initial cut) should be undercut and/or stabilized at the directions of the Geotechnical Engineer.

Based on our experience on neighboring projects, some ground improvements (undercut and replacement with structural fill or additional aggregate base material) are expected. As such, it is recommended to include a line item in the budget for undercutting of unsuitable soils and subsequent backfilling (structural fill or aggregate base). This budgetary estimate can be refined once the final geotechnical report is completed.

4.3 Structural Fill and Placement

Following the approval of the natural subgrade soils by the Geotechnical Engineer, the placement of the fill required to establish the design grades may begin. Any material to be used for structural fill should be evaluated and tested by **G E T Solutions, Inc.** prior to placement to determine if they are suitable for the intended use. Suitable structural fill material should consist of sand or gravel containing less than 25% by weight of fines (SP, SM, SW, GP, GW), having a liquid limit less than 20 and plastic limit less than 6, and should be free of rubble, organics, clay, debris and other unsuitable material.

All structural fill should be compacted to a dry density of at least 95 percent of the standard Proctor maximum dry density (ASTM D698). In general, the compaction should be accomplished by placing the fill in maximum 10-inch loose lifts and mechanically compacting each lift to at least the specified minimum dry density. A representative of **G E T Solutions, Inc.** should perform field density tests on each lift as necessary to assure that adequate compaction is achieved.

Backfill material in utility trenches within the construction areas should consist of structural fill (as previously described), and should be compacted to at least 95 percent of ASTM D698. This fill should be placed in 4 to 6 inch loose lifts when hand compaction equipment is used.

Care should be used when operating the compactors near existing structures to avoid transmission of the vibrations that could cause settlement damage or disturb occupants. In this regard, it is recommended that the vibratory roller remain at least 25 feet away from existing structures; these areas should be compacted with small, hand-operated compaction equipment.

4.4 Suitability of On-site Material

Based on the laboratory testing program, the shallow subsurface SAND (SC) and CLAY (CL) soils recovered at the project site do not appear to meet the criteria recommended in this report for reuse as structural fill, but may be used as fill within the green areas. Pockets of granular soils (SP, SM, SP-SM) recovered at the boring locations could potentially qualify as structural backfill material. However, because the soils are not consistent across the project site, care must be taken to segregate the fine SAND with varying amounts of silt (SP, SP-SM, SM) soils from the clayey SAND (SC) and CLAY (CL) soils. Since these soils are near or below the current groundwater level, some means of drying the soils will be required prior to their use.

The drying can be accomplished by stockpiling or spreading in thin lifts and letting the material air-dry, which could prove time consuming and will be dependent on the weather conditions. Further classification testing (natural moisture content, gradation analysis, and Proctor testing) should be performed in the field during construction to evaluate the suitability of excavated soils for reuse as fill within building and pavement areas. At this time it is expected that the majority of the structural fill will have to be imported.

4.5 Alternative 1-Shallow Foundations: Column Loads less than 200 Kips, Wall Loads less than 8 Klif

Provided that the construction procedures are properly performed, the maximum column loads are less than 200 kips, maximum wall loads are less than 8 klif, floor loads approximately 150 psf and no more than 2 feet of fill are required to attain finished floor elevations, the proposed structures can be supported by shallow foundations bearing upon firm natural soil or well compacted structural fill material. The footings can be designed using a net allowable soil pressure of 2,000 pounds per square foot (psf). In using net pressures, the weight of the footings and backfill over the footings, including the weight of the floor slab, need not be considered. Hence, only loads applied at or above the finished floor need to be used for dimensioning the footings.

In order to develop the recommended bearing capacity of 2,000 pounds per square foot (psf), the base of the footings should have an embedment of at least 24 inches beneath finished grades and wall footings should have a minimum width of 24 inches. In addition, isolated square column footings are recommended to be a minimum of 3 feet by 3 feet in area for bearing capacity consideration. The recommended 24-inch footing embedment is considered sufficient to provide adequate cover against frost penetration to the bearing soils.

4.5.1 Foundation Excavations

In preparation for shallow foundation support, the footing excavations should extend into firm natural soil or well compacted structural fill. All foundation excavations should be observed by a representative of **G E T Solutions, Inc.**

At that time, the Geotechnical Engineer should also explore the extent of excessively loose, soft, or otherwise unsuitable material within the exposed excavations. Also, at the time of the footing observations, the Geotechnical Engineer will advance hand auger borings in the bases of the foundation excavations to verify that the bearing soils are consistent with those documented in this report. The necessary depth of penetration will be established during the subgrade observations.

When pockets of unsuitable soils requiring undercut are encountered in the footing excavations, the proposed footing elevation should be re-established by means of backfilling with "flowable fill" or a suitable structural fill material compacted to a dry density of at least 95 percent of the Standard Proctor maximum dry density (ASTM D698), as described in Section 4.3 of this report, prior to concrete placement. This construction procedure will provide for a net allowable bearing capacity of 2,000 psf.

Immediately prior to foundation concrete placement, it is suggested that the bearing surfaces of all foundations be compacted using hand operated mechanical tampers. In this manner, any localized areas, which have been loosened by excavation operations, should be adequately recompacted. The compaction testing in the base of the foundation may be waived by the Geotechnical Engineer, where firm bearing soils are observed during the foundation inspections.

Soils exposed in the bases of all satisfactory foundation excavations should be protected against any detrimental change in condition such as from physical disturbance, rain or frost. Surface run-off water should be drained away from the excavations and not be allowed to pond. If possible, all footing concrete should be placed the same day the excavation is made. If this is not possible, the footing excavations should be adequately protected.

4.5.2 Slab-on-Grade Design

The floor slabs may be constructed as slab-on-grade members provided the previously recommended earthwork activities and evaluations are carried out properly. It is recommended that all ground floor slabs be directly supported by at least a 4-inch layer of relatively clean, compacted, poorly graded sand (SP) or gravel (GP) with less than 5% passing the No. 200 Sieve (0.074 mm). The purpose of the 4-inch layer is to act as a capillary barrier and equalize moisture conditions beneath the slab.

It is recommended that all ground floor slabs be "floating". That is, generally ground supported and not rigidly connected to walls or foundations. This is to minimize the possibility of cracking and displacement of the floor slabs because of differential movements between the slab and the foundation.

It is also recommended that the floor slab bearing soils be covered by a vapor barrier or retarder in order to minimize the potential for floor dampness, which can affect the performance of glued tile and carpet. Generally, use a vapor retarder for minimal vapor resistance protection below the slab on grade.

When floor finishes, site conditions or other considerations require greater vapor resistance protection; consideration should be given to using a vapor barrier. Selection of a vapor retarder or barrier should be made by the architect based on project requirements.

4.5.3 Settlements

It is estimated that, with proper site preparation, the maximum post-construction total settlement of the foundations should be up to 1 inch. The maximum post-construction differential settlement magnitude is expected to be less than 1/2-inch between adjacent footings (wall footings and column footings of widely varying loading conditions). The settlements were estimated on the basis of the results of the field penetration tests and the consolidation tests. Careful field control will contribute substantially towards minimizing the settlements.

4.6 **Alternative 2-Surcharge: Column Loads 200-300 kips, Wall Loads 8-10 klf**

The second foundation design alternative consists of surcharging the building areas in order to minimize long term post-construction settlements associated with column loads ranging from 200 to 300 kips and wall loads ranging from 8 to 10 klf. Surcharging is a process where temporary weight is placed on the construction area so that the subsurface soils can settle (consolidate) prior to the foundation construction. It is well suited for clayey or other low permeability soils that require long periods of time to compress.

Surcharge will likely consist of placing approximately 8 to 10 feet of fill (will vary based on structural loading characteristics and site specific geotechnical information) above the finish floor elevation. The upper crest of the surcharge soil (edge of the top of the fill) should extend to at least 5 feet beyond the design edge of the building, then sloping at a 2H:1V. The surcharge soil should have a minimum in-place density of at least 115 pcf. In general, it is estimated that the surcharge load would remain in place for about 2 to 4 months to sufficiently compress the subsurface soils. The surcharge height can be modified to accommodate different construction schedules (i.e. lesser surcharge height results in longer surcharge time and vice versa).

In order to accurately determine when the surcharge load can be removed, it is recommended to install settlement platforms within the surcharged areas. The settlement platforms should be placed directly on the subgrade following the clearing procedures. Then following the installation of the settlement platforms, elevations must be obtained (zero/baseline readings), prior to the placement of any fill material. It is recommended to install the building pad structural fill material to the finish floor elevation, with each lift compacted to at least 95% of ASTM D698. Then the contractor can proceed with the surcharge placement.

Following successful ground improvements, the structures can be supported by a conventional shallow foundation system, as described in the previous sections of this report.

4.7 Alternative 3-Deep Foundation System: Column Loads greater than 300 Kips, Wall Loads greater than 10 klf

We evaluated a driven SPPC pile deep foundation system to support the proposed structures' framing if the maximum column and wall loads are expected to be in excess of 300 kips and 10 klf, respectively. The slabs can be constructed as slab-on-grade members. We conducted pile capacity analyses using static formulas with coefficients recommended by Geoffrey Myerhoff and George Sowers. The analyses include the contributions of shaft friction and end bearing to the pile capacity. The piles are expected to derive their capacity from a combination of shaft friction and end bearing in the denser Sand layers of soil stratum III.

Our preliminary recommendations include of a deep foundation system consisting of 12-inch SPPC piles with embedment depths ranging from 50 to 60 feet below grades (pile tip elevations ranging from -35 to -45 feet MSL). The allowable pile capacities were calculated to range from 60 to 75 tons in compression. Difficult driving conditions can be expected at depths beneath 30 feet below grades. If more than 2 feet of fill are anticipated at the project site within the construction areas, the piles would also have to be designed to account for negative skin friction forces.

4.8 Preliminary Pavement Design

The California Bearing Ratio (CBR) test results indicated an average soaked CBR value of 17.9. In accordance with VDOT standards the average soaked CBR value was multiplied by a factor of two-thirds to determine a pavement design CBR value. The two-thirds factor provides the necessary safety margins to compensate for some non-uniformity of the soil. Therefore, a CBR value of 11.9 should be used in designing the pavement sections.

4.9 Seismic Evaluation

Based on our experience within the vicinity of the project site and the recovered soils at this location, it is our opinion that this site may be classified as a Site Class "D" in accordance with Chapter 20 of ASCE 7 as referenced by the 2012 International Building Code. A 100-foot deep CPT probe with soil shear wave velocity measurements will be necessary to substantiate the site classification.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Drainage and Groundwater Concerns

It is expected that dewatering may be required for excavations that extend below groundwater table level. Dewatering above the groundwater level is expected to be accomplished by pumping from sumps. Dewatering at greater depths below the groundwater level may require well pointing and/or shoring.

It would be advantageous to construct all fills early in the construction. If this is not accomplished, disturbance of the existing site drainage could result in collection of surface water in some areas, thus rendering these areas wet and very loose. Temporary drainage ditches should be employed by the contractor to accentuate drainage during construction. Again, we recommend that the contractor determine the actual groundwater levels at the time of construction to determine groundwater impact on this project.

5.2 Site Utility Installation

Based on the visual classification and the relative density (as determined by the Standard Penetration Test) of the soils encountered at the boring locations, it is our opinion that the proposed utility alignments can be supported by a suitable bedding surface bearing in native subgrade soils. Based on the estimated subsurface soil characteristics, it is recommended that all subsurface soils be considered Type C in accordance with Occupational Safety and Health Administration (OSHA) criteria.

The base of the utility trenches should be observed by a qualified inspector prior to the pipe and structure placement to verify the suitability of the bearing soils. Based on the results of our field exploration program it is expected that the utilities and structures will, in some instances, bear in the wet cohesive and/or granular soils. In these instances the bearing soils may require some stabilization to provide suitable bedding. This stabilization is commonly accomplished by adding 12 inches or more of bedding stone VDOT No. 57. It is expected that excavations penetrating the SAND soils of Strata I and II will experience varying degrees of cave-in. A combination of dewatering and shoring should be implemented to reduce the potential cave-ins. The resulting excavations should be backfilled with structural fill, as described in Section 4.3 of this report. Imported structural fill material may be required to facilitate the utility installation.

5.3 Additional Geotechnical Investigation

A comprehensive geotechnical investigation is recommended once the final design and the structural loads are determined to better ascertain the soil conditions within the vicinity of each structure. The subsurface data documented during this feasibility study can be incorporated within the final geotechnical investigation. Specifically, it is recommended to perform additional SPT borings and dilatometer test (DMT) soundings within the limits of the proposed construction areas. The frequency of tests should be developed based on the final design scheme and will likely require refined laboratory testing (Atterberg Limits, gradation, moisture content and consolidation testing).

5.4 Excavations

In Federal Register, Volume 54, No. 209 (October, 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better insure the safety of workmen entering trenches or excavations.

It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new (OSHA) guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. **G E T Solutions, Inc.** is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.0 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by **G E T Solutions, Inc.** and the information supplied by the client and their consultants for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **G E T Solutions, Inc.** should be notified immediately to determine if changes in the foundation recommendations are required. If **G E T Solutions, Inc.** is not retained to perform these functions, **G E T Solutions, Inc.** can not be responsible for the impact of those conditions on the geotechnical recommendations for the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete the Geotechnical Engineer should be provided the opportunity to review the final design plans and specifications to assure our engineering recommendations have been properly incorporated into the design documents, in order that the earthwork and foundation recommendations may be properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of the Client and their consultants for the specific application to the The Point at Harbour View- Feasibility Study project in Suffolk, Virginia.

APPENDICES

I BORING LOCATION PLAN

II SUMMARY OF SOIL CLASSIFICATION

III SUMMARY OF LABORATORY RESULTS

IV CBR SUMMARY DATA

V BORING LOGS

VI GENERALIZED SOIL PROFILES

APPENDIX I

BORING LOCATION PLAN

Boring Location Plan

Project Name: The Point at Harbour View, Suffolk, VA

GET Project No.: VB17-124G

Project Location: Suffolk, VA

Client: Gee's Group.



APPENDIX II

SUMMARY OF SOIL CLASSIFICATION

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

Standard Penetration Test (SPT), N-value

Standard Penetration Tests (SPT) were performed in the field in general accordance with ASTM D 1586. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches. The number of blows required to drive the sampler each 6-inch increment (4 increments for each soil sample) of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value.

NON COHESIVE SOILS

(SILT, SAND, GRAVEL and Combinations)

Relative Density

Very Loose	4 blows/ft. or less
Loose	5 to 10 blows/ft.
Medium Dense	11 to 30 blows/ft.
Dense	31 to 50 blows/ft.
Very Dense	51 blows/ft. or more

Particle Size Identification

Boulders	8 inch diameter or more
Cobbles	3 to 8 inch diameter
Gravel	Coarse 1 to 3 inch diameter
	Medium 1/2 to 1 inch diameter
	Fine 1/4 to 1/2 inch diameter
Sand	Coarse 2.00 mm to 1/4 inch (diameter of pencil lead)
	Medium 0.42 to 2.00 mm (diameter of broom straw)
	Fine 0.074 to 0.42 mm (diameter of human hair)
Silt	0.002 to 0.074 mm (cannot see particles)

CLASSIFICATION SYMBOLS (ASTM D 2487 and D 2488)

Coarse Grained Soils

More than 50% retained on No. 200 sieve

- GW** - Well-graded Gravel
- GP** - Poorly graded Gravel
- GW-GM** - Well-graded Gravel w/Silt
- GW-GC** - Well-graded Gravel w/Clay
- GP-GM** - Poorly graded Gravel w/Silt
- GP-GC** - Poorly graded Gravel w/Clay
- GM** - Silty Gravel
- GC** - Clayey Gravel
- GC-GM** - Silty, Clayey Gravel
- SW** - Well-graded Sand
- SP** - Poorly graded Sand
- SW-SM** - Well-graded Sand w/Silt
- SW-SC** - Well-graded Sand w/Clay
- SP-SM** - Poorly graded Sand w/Silt
- SP-SC** - Poorly graded Sand w/Clay
- SM** - Silty Sand
- SC** - Clayey Sand
- SC-SM** - Silty, Clayey Sand

Fine-Grained Soils

50% or more passes the No. 200 sieve

- CL** - Lean Clay
- CL-ML** - Silty Clay
- ML** - Silt
- OL** - Organic Clay/Silt
Liquid Limit 50% or greater
- CH** - Fat Clay
- MH** - Elastic Silt
- OH** - Organic Clay/Silt

Highly Organic Soils

- PT** - Peat

COHESIVE SOILS

(CLAY, SILT and Combinations)

Consistency

Very Soft	2 blows/ft. or less
Soft	3 to 4 blows/ft.
Medium Stiff	5 to 8 blows/ft.
Stiff	9 to 15 blows/ft.
Very Stiff	16 to 30 blows/ft.
Hard	31 blows/ft. or more

Relative Proportions

Descriptive Term	Percent
Trace	0-5
Few	5-10
Little	15-25
Some	30-45
Mostly	50-100

Strata Changes

In the column "Description" on the boring log, the horizontal lines represent approximate strata changes.

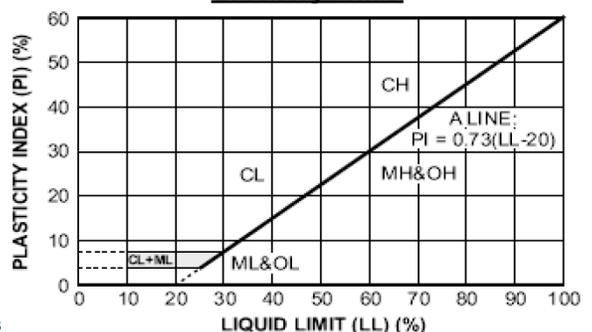
Groundwater Readings

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as tidal influences and man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.).

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

Plasticity Chart



APPENDIX III

SUMMARY OF LABORATORY RESULTS



GET Solutions, Inc.

SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

CLIENT Gee's Group

PROJECT NAME The Point at Harbour View-Feasibility Study

PROJECT NUMBER VB17-124G

PROJECT LOCATION Suffolk, VA

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
B-1	1.0	31	12	19	0.075	40	SC	17.1			
B-1	11.0	NP	NP	NP	0.075	23	SM	24.6			
B-1	24.0	NP	NP	NP	0.075	19	SM	18.0			
B-2	9.0	25	13	12	0.075	32	SC	20.8			
B-2	19.0	48	18	30	0.075	88	CL	37.0			
B-3	9.0	NP	NP	NP	0.075	18	SM	24.6			
B-4	11.0	23	14	9	0.075	24	SC	20.5			
B-7	1.0	20	11	9	0.075	42	SC	12.4			
B-8	24.0	60	18	42	0.075	96	CH	42.4			
CBR-1	1.5	22	10	12	0.075	27	SC	10.0			
CBR-1	5.0	NP	NP	NP	4.75	10	SP-SM	22.7			
CBR-2	1.5	23	14	9	0.075	47	SC	18.0			
CBR-2	7.0	NP	NP	NP	4.75	12	SP-SM	22.8			
CBR-3	1.5	22	13	9	0.075	38	SC	13.0			
CBR-3	9.0	28	12	16	0.075	35	SC	21.4			
CBR-4	1.5	19	11	8	0.075	43	SC	15.0			
CBR-5	1.5	19	10	9	0.075	24	SC	9.0			
D-1	1.0	18	12	6	0.075	35	SC-SM	10.4			
D-1	14.0	25	16	9	0.075	24	SC	25.3			
D-3	3.0	21	13	8	0.075	40	SC	13.3			
D-3	7.0	31	12	19	0.075	49	SC	18.6			
D-3	34.0	47	24	23	0.075	93	CL	34.4			
D-5	11.0	NP	NP	NP	0.075	27	SM	28.3			
D-5	24.0	56	20	36	0.075	91	CH	36.8			
D-5	44.0	NP	NP	NP	4.75	11	SP-SM	31.9			

(1) GET - LABORATORY TEST SUMMARY - GET_STANDARD_DATA_TEMPLATE(03-17-14).GDT - 3/11/17 14:07 - G:\GINT\PROJECTS\VB17\VB17-124G THE POINT AT HARBOUR VIEW-FEASIBILITY STUDY.GPJ

APPENDIX IV

CBR SUMMARY DATA

SUMMARY OF CBR TEST RESULTS

Project: The Point at Harbour View- Feasibility Study

Project Location: Suffolk, Virginia

Client: Gee's Group

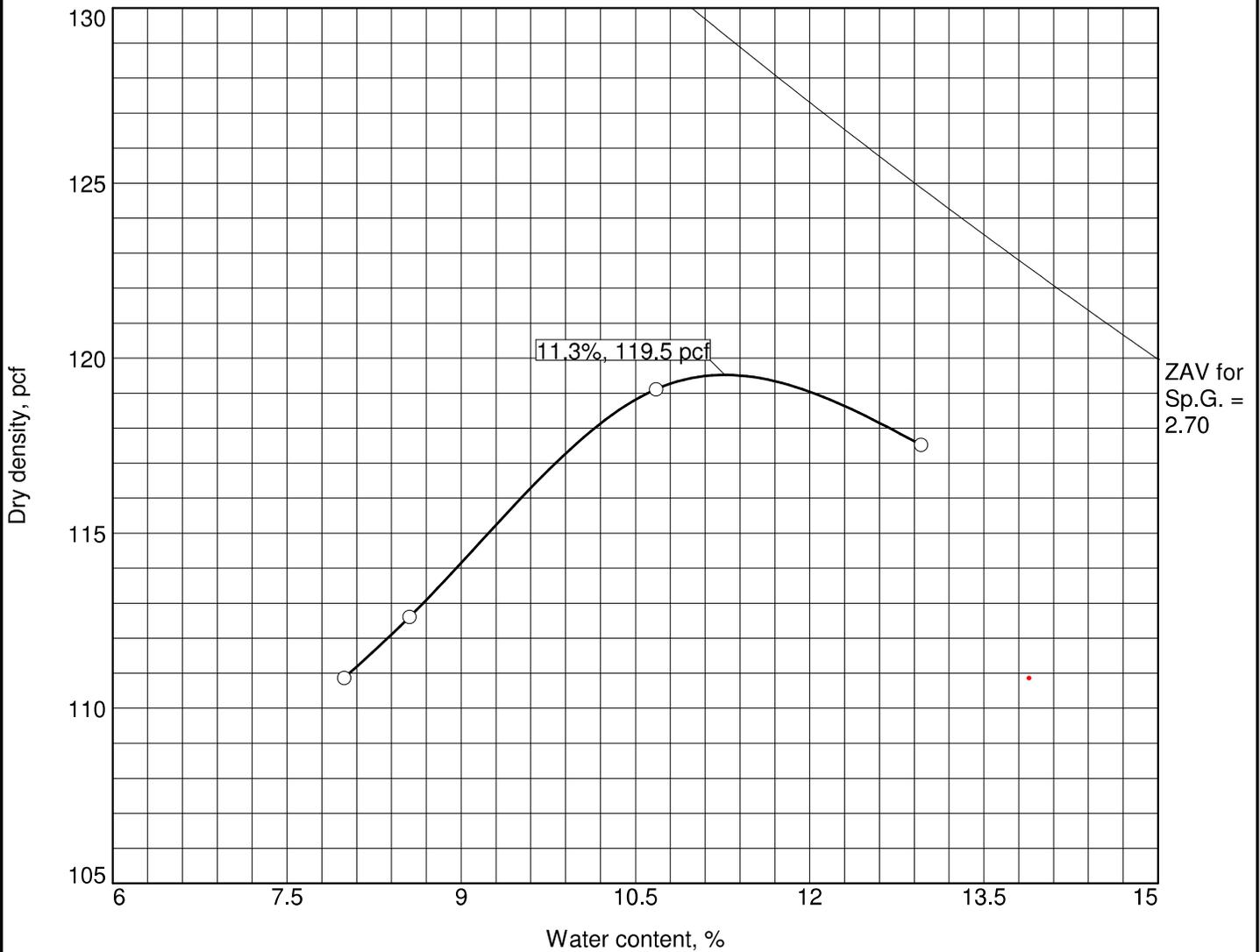
Project Number: VB17-124G

Sample Number	Sample Location	Sample Depth (ft)	USCS Symbol	Natural Moisture Content (%)	Atterberg Limits (LL/PL/PI)	Passing #200 Sieve (%)	Maximum Dry Density (pcf)	Optimum Moisture (%)	Soaked CBR Value	Resiliency Factor	Swell (%)
CBR-1	CBR-1	1-2	SC	10	22/10/12	26.7	119.5	11.3	30.0	3.0	0.1
CBR-2	CBR-2	1-2	SC	18	23/14/9	46.6	115.1	13.1	7.3	2.5	0.3
CBR-3	CBR-3	1-2	SC	13	22/13/9	37.7	116.4	11.2	11.0	3.0	0.9
CBR-4	CBR-4	1-2	SC	15	19/11/8	42.8	114.2	12.5	10.2	2.5	0.2
CBR-5	CBR-5	1-2	SC	9	19/10/9	23.8	114.7	11.1	30.9	3.0	0.1



Geotechnical • Environmental • Testing
 204 Grayson Road
 Virginia Beach, Virginia 23462
 Tel: 757-518-1703 Fax: 757-518-1704

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



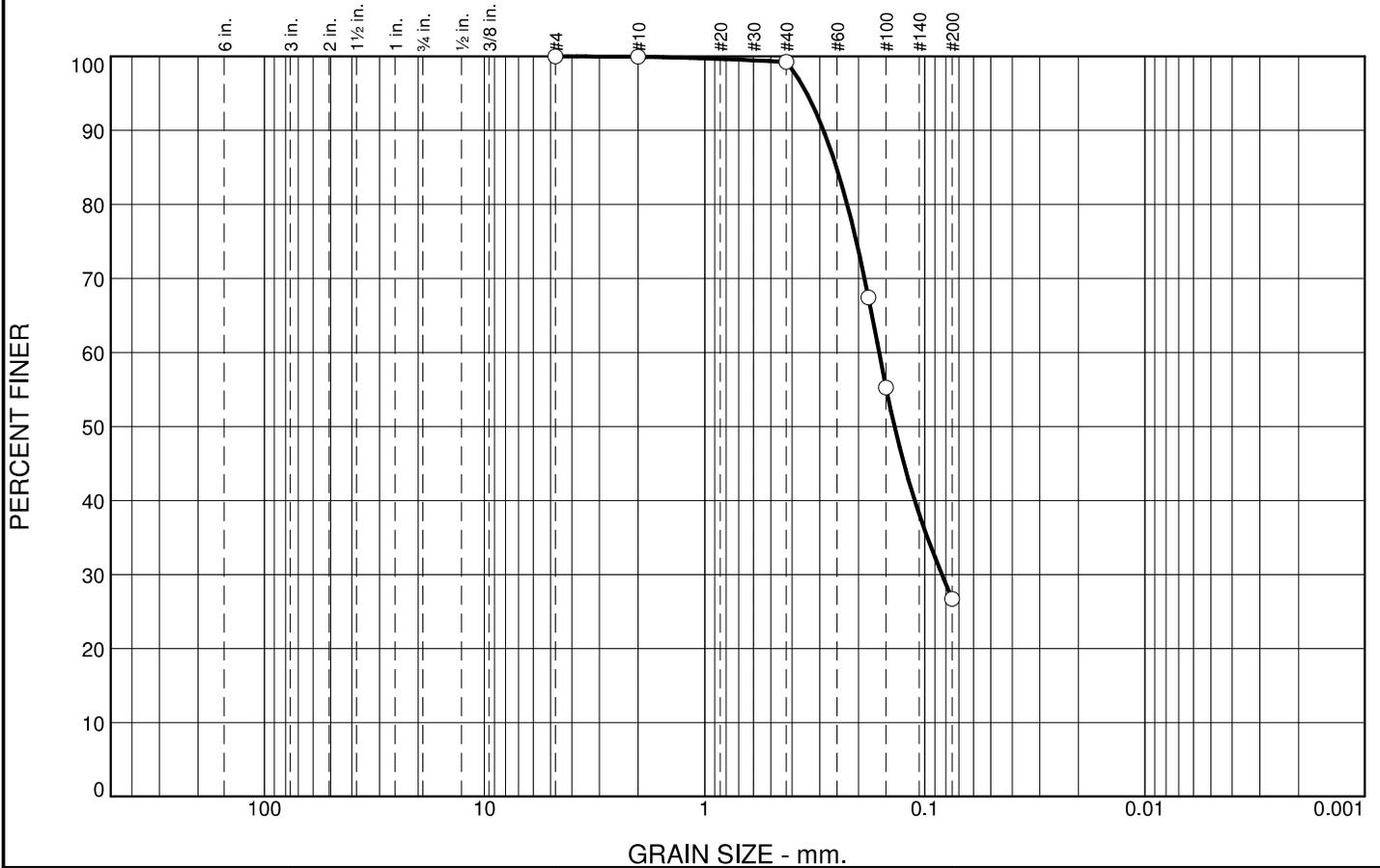
Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-2 ft.	SC	A-2-6(0)	10		22	12	0.0	26.7

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 119.5 pcf Optimum moisture = 11.3 %	Tan-Brown, Clayey SAND
Project No. VB17-124G Client: Gee's Group Project: The Point at Harbour View - Feasibility Study ○ Location: CBR-1 Sample Number: CBR-1	Remarks: Sample Obtained 2/8/17 CBR-1

GET SOLUTIONS, INC.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.7	72.5	26.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#40	99.2		
#80	67.4		
#100	55.3		
#200	26.7		

Material Description

Tan-Brown, Clayey SAND

Atterberg Limits

PL= 10 LL= 22 PI= 12

Coefficients

D₉₀= 0.2884 D₈₅= 0.2520 D₆₀= 0.1612
D₅₀= 0.1372 D₃₀= 0.0835 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Sample Obtained 2/8/17
CBR-1

* (no specification provided)

Location: CBR-1 **Sample Number:** CBR-1 **Depth:** 1-2 ft.

Date: 2/8/17

GET
SOLUTIONS, INC.

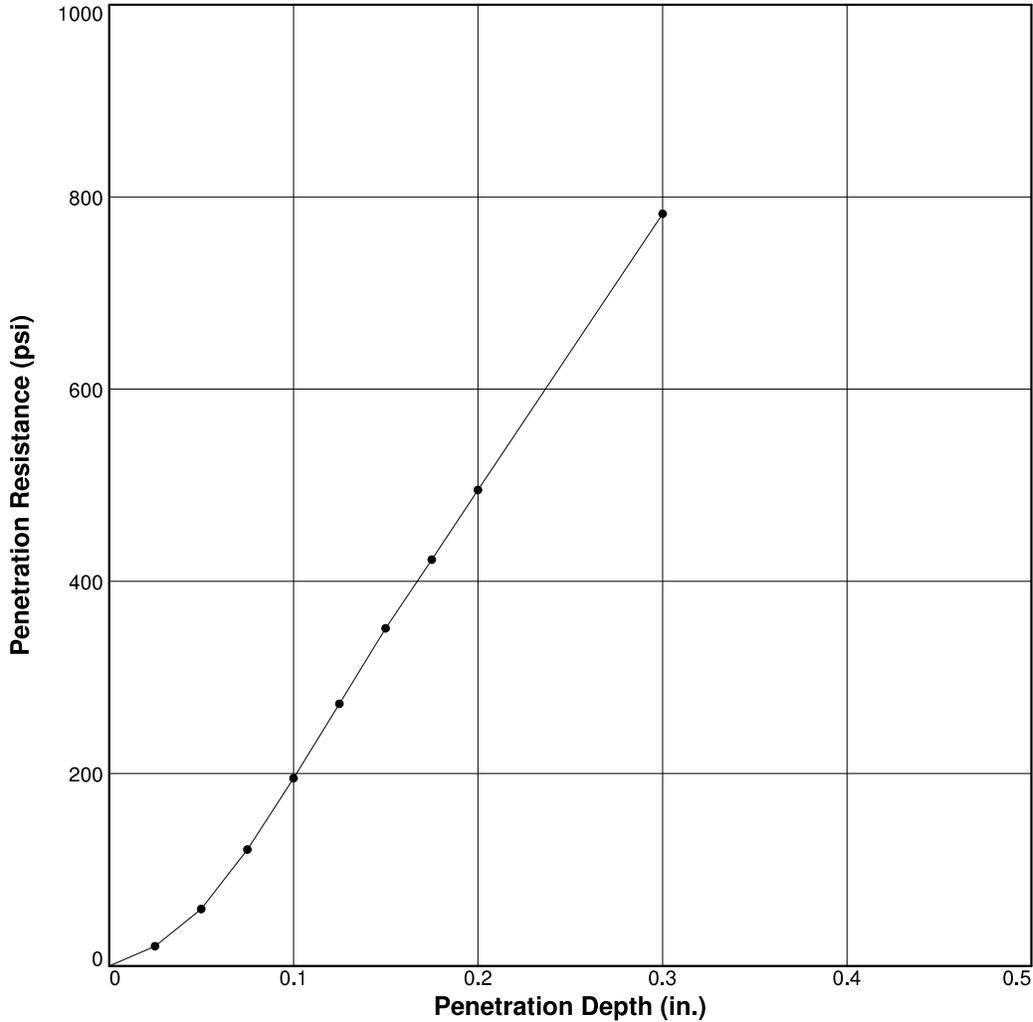
Client: Gee's Group
Project: The Point at Harbour View - Feasibility Study

Project No: VB17-124G

Figure 1A

BEARING RATIO TEST REPORT

VTM-008 (2005)



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	118.8	99.4	10.9	118.7	99.3	11.7	30.0	39.5	0.034	10	0.1
2 △											
3 □											

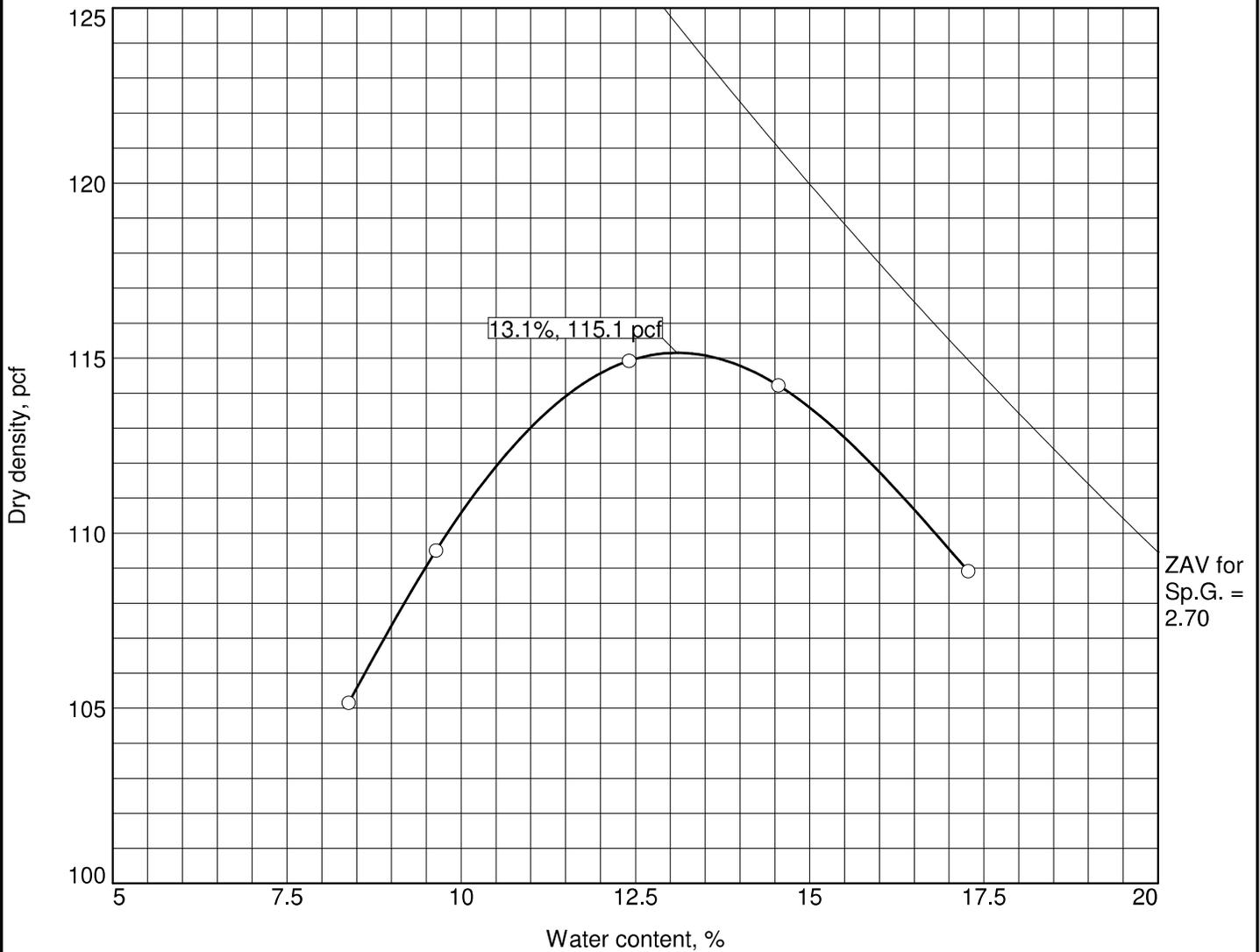
Material Description		USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Tan-Brown, Clayey SAND						

Project No: VB17-124G
Project: The Point at Harbour View - Feasibility Study
Location: CBR-1
Sample Number: CBR-1 **Depth:** 1-2 ft.
Date: 2/8/17

Test Description/Remarks:

CBR-1
 Resiliency Factor = 3.0

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



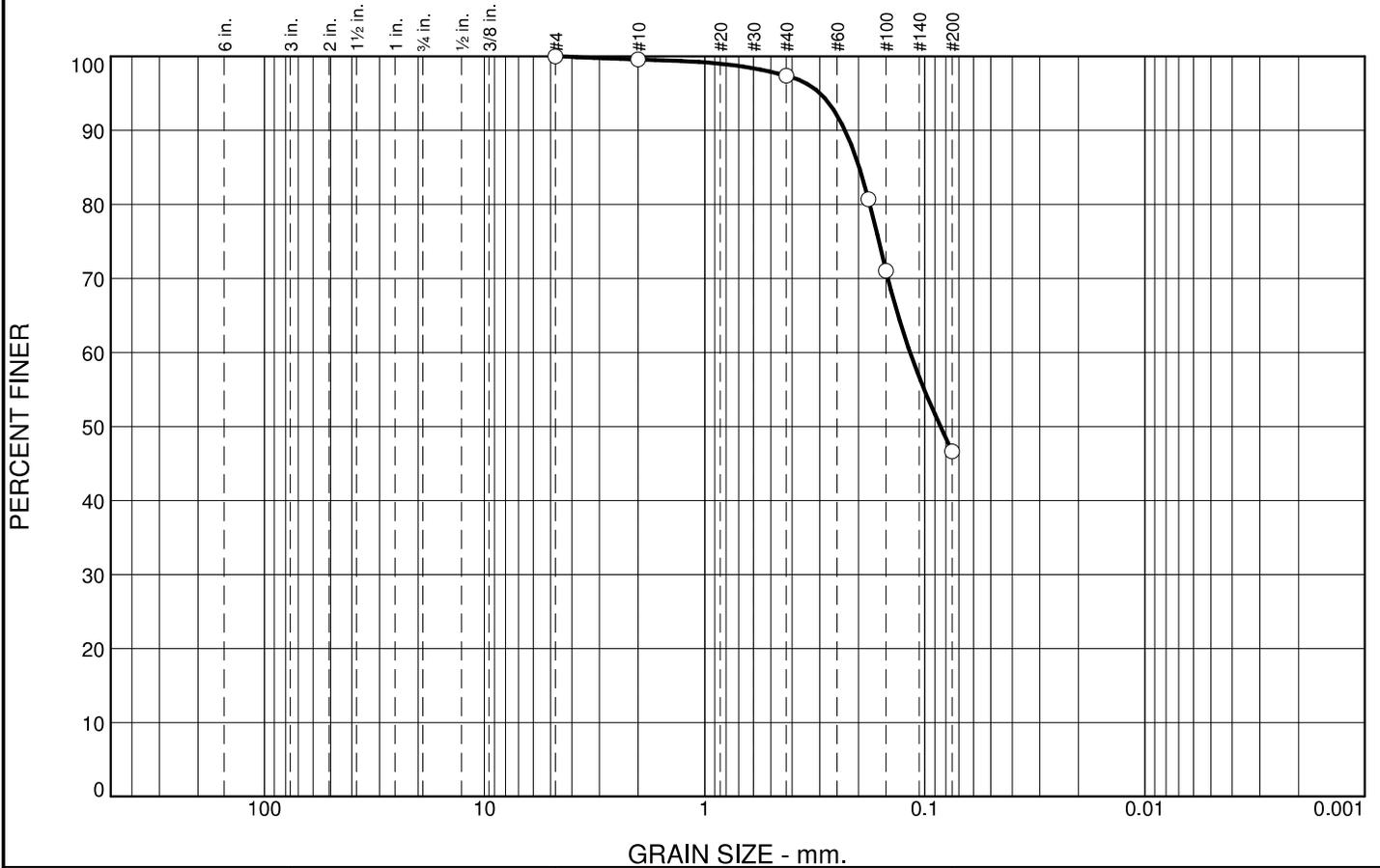
Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-2 ft.	SC	A-4(1)	18		23	9	0.0	46.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 115.1 pcf Optimum moisture = 13.1 %	Tan-Brown, Clayey SAND
Project No. VB17-124G Client: Gee's Group Project: The Point at Harbour View - Feasibility Study Location: CBR-2 Sample Number: CBR-2	Remarks: Sample Obtained 2/8/17 CBR-2

GET SOLUTIONS, INC.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	2.2	50.8	46.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.6		
#40	97.4		
#80	80.7		
#100	71.0		
#200	46.6		

Material Description

Tan-Brown, Clayey SAND

Atterberg Limits

PL= 14 LL= 23 PI= 9

Coefficients

D₉₀= 0.2304 D₈₅= 0.1984 D₆₀= 0.1166
D₅₀= 0.0849 D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= SC AASHTO= A-4(1)

Remarks

Sample Obtained 2/8/17
CBR-2

* (no specification provided)

Location: CBR-2 Sample Number: CBR-2 Depth: 1-2 ft. Date: 2/8/17

GET
SOLUTIONS, INC.

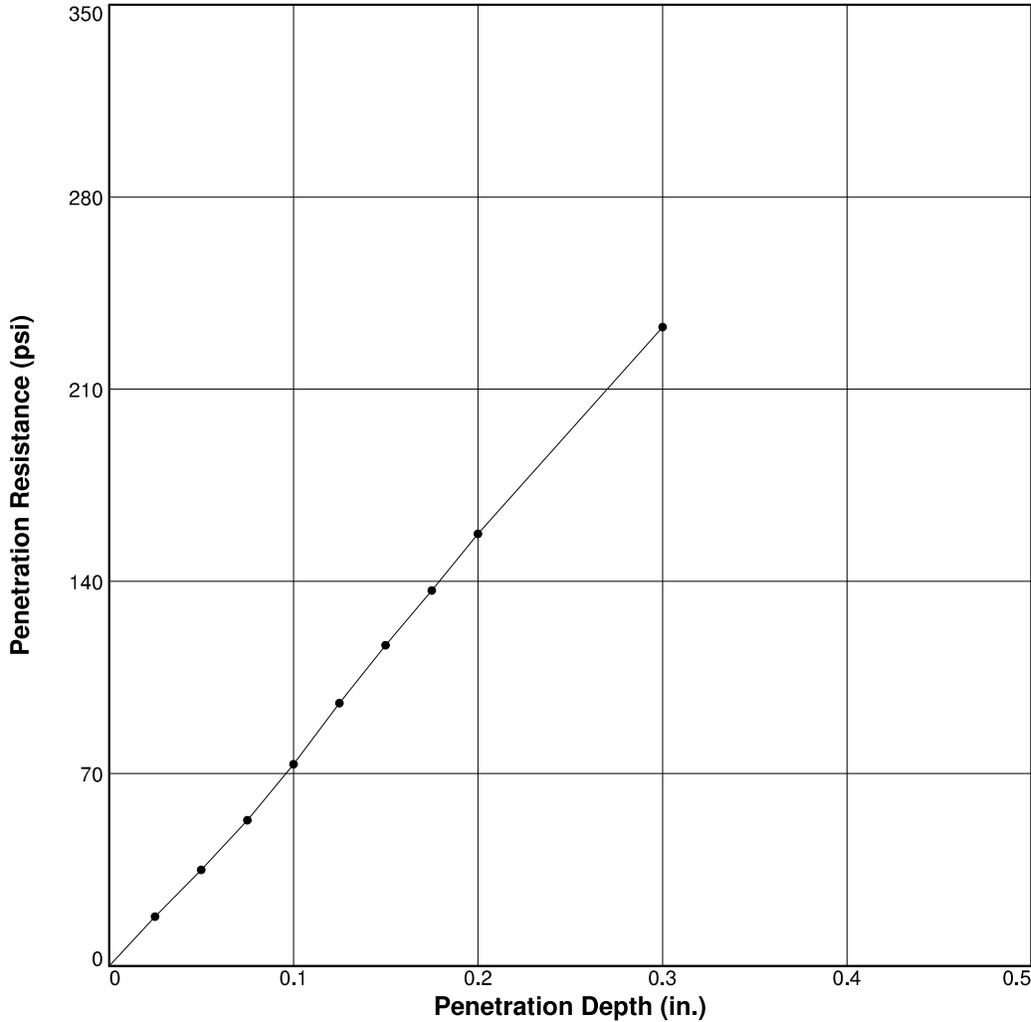
Client: Gee's Group
Project: The Point at Harbour View - Feasibility Study

Project No: VB17-124G

Figure 2A

BEARING RATIO TEST REPORT

VTM-008 (2005)



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	114.7	99.7	13.6	114.4	99.4	14.1	7.3	10.5	0.000	10	0.3
2 △											
3 □											

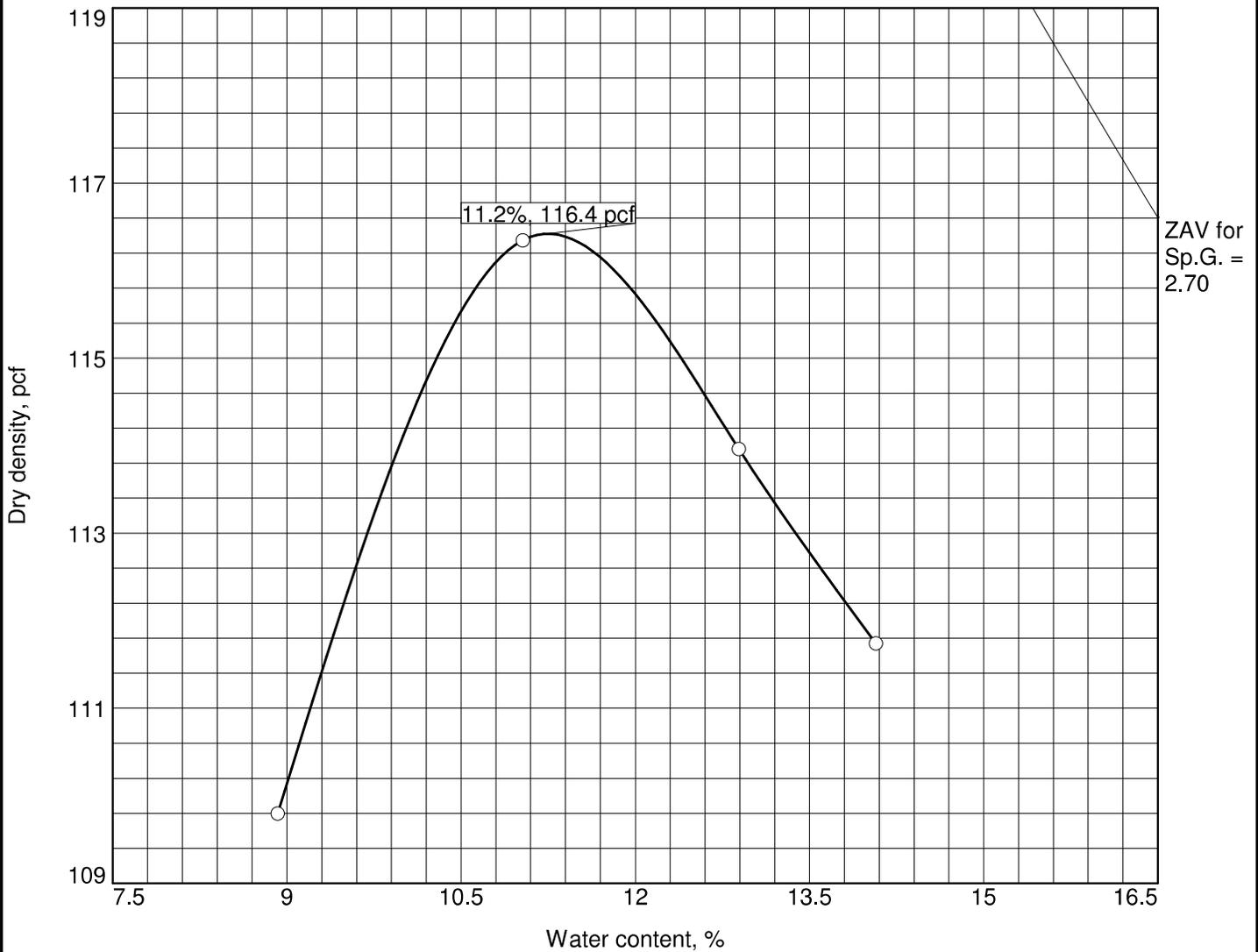
Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
	Tan-Brown, Clayey SAND	SC	115.1	13.1	23

Project No: VB17-124G
Project: The Point at Harbour View - Feasibility Study
Location: CBR-2
Sample Number: CBR-2 **Depth:** 1-2 ft.
Date: 2/8/17

Test Description/Remarks:

CBR-2
 Resiliency Factor = 2.5

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



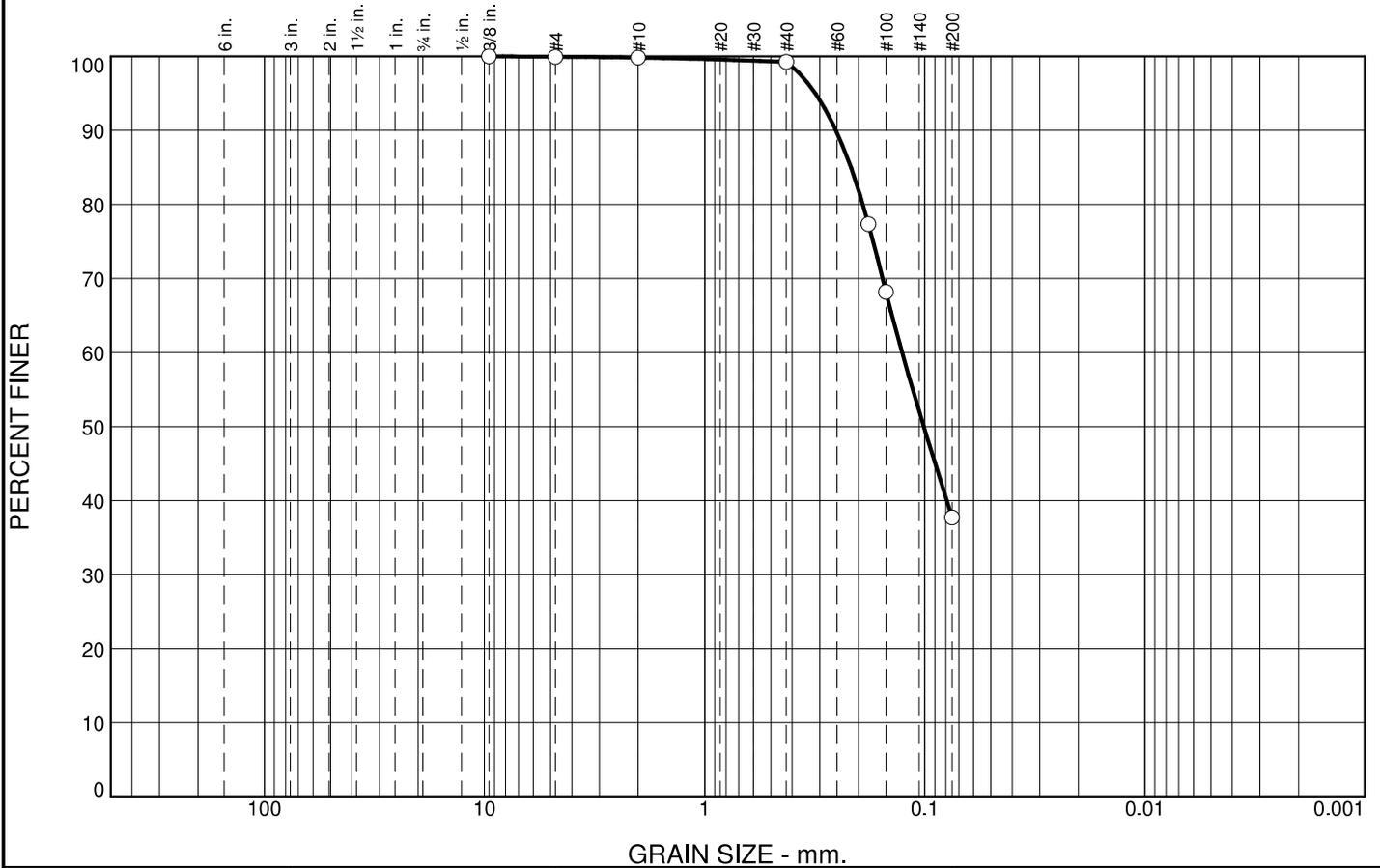
Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-2 ft.	SC	A-4(0)	13		22	9	0.1	37.7

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 116.4 pcf Optimum moisture = 11.2 %	Tan-Brown, Clayey SAND
Project No. VB17-124G Client: Gee's Group Project: The Point at Harbour View - Feasibility Study Location: CBR-3 Sample Number: CBR-3	Remarks: Sample Obtained 2/8/17 CBR-3

GET SOLUTIONS, INC.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.1	0.6	61.5	37.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.9		
#10	99.8		
#40	99.2		
#80	77.3		
#100	68.1		
#200	37.7		

Material Description

Tan-Brown, Clayey SAND

Atterberg Limits

PL= 13 LL= 22 PI= 9

Coefficients

D₉₀= 0.2534 D₈₅= 0.2166 D₆₀= 0.1267
D₅₀= 0.1010 D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= SC AASHTO= A-4(0)

Remarks

Sample Obtained 2/8/17
CBR-3

* (no specification provided)

Location: CBR-3 **Sample Number:** CBR-3 **Depth:** 1-2 ft.

Date: 2/8/17

GET SOLUTIONS, INC.

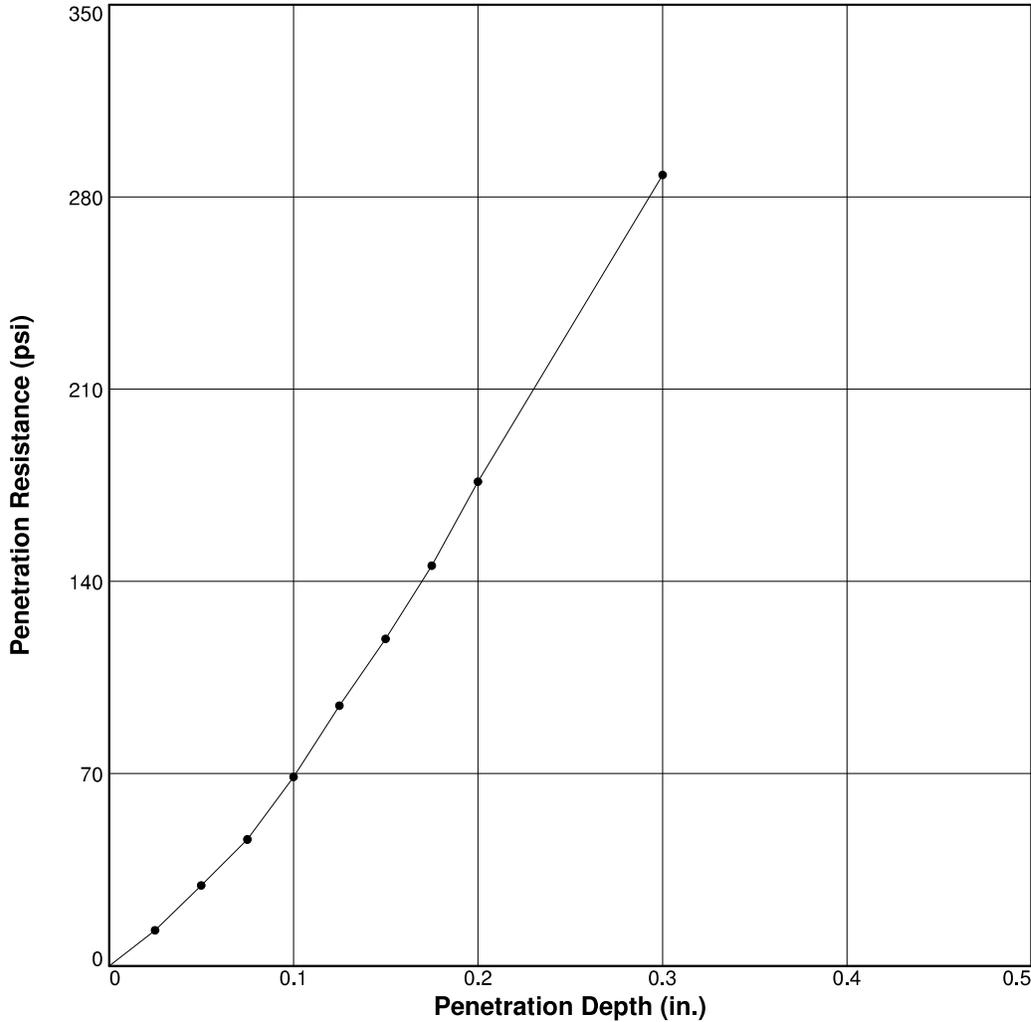
Client: Gee's Group
Project: The Point at Harbour View - Feasibility Study

Project No: VB17-124G

Figure 3A

BEARING RATIO TEST REPORT

VTM-008 (2005)



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	116.3	99.9	11.5	115.3	99.1	13.9	11.0	14.8	0.041	10	0.9
2 △											
3 □											

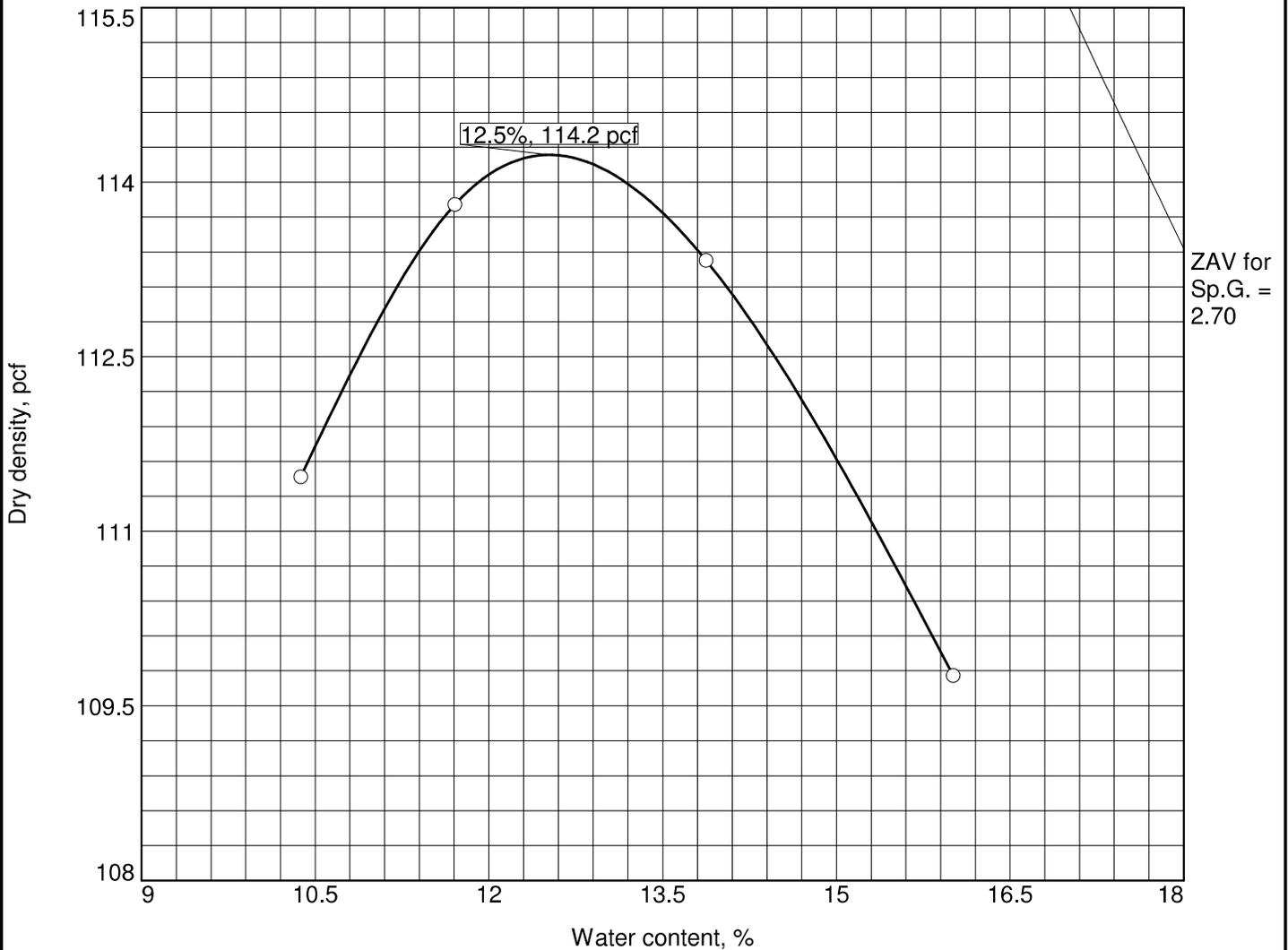
Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
	Tan-Brown, Clayey SAND	SC	116.4	11.2	22

Project No: VB17-124G
Project: The Point at Harbour View - Feasibility Study
Location: CBR-3
Sample Number: CBR-3 **Depth:** 1-2 ft.
Date: 2/8/17

Test Description/Remarks:

CBR-3
 Resiliency Factor = 3.0

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



Test specification: ASTM D 698-12 Method A Standard

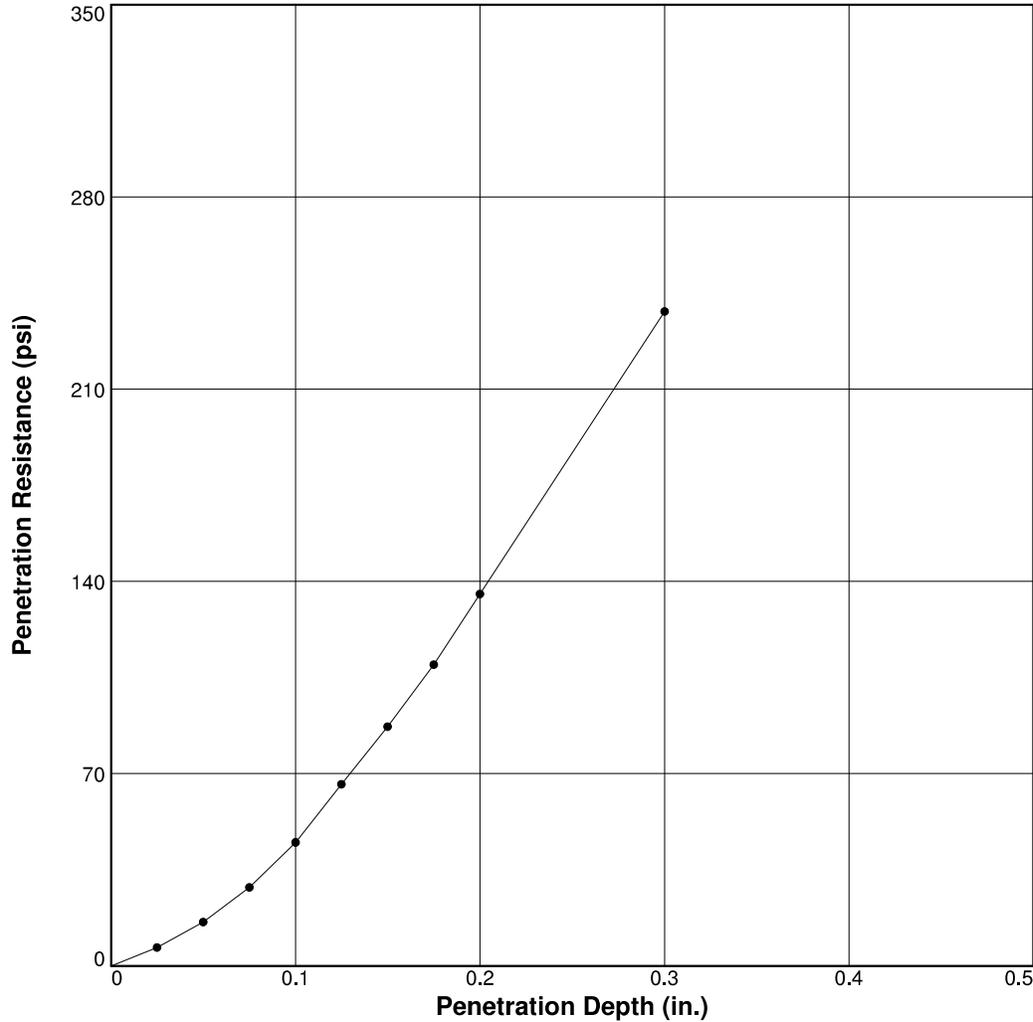
Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-2 ft.	SC	A-4(0)	15		19	8	0.1	42.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 114.2 pcf Optimum moisture = 12.5 %	Brown, Clayey SAND
Project No. VB17-124G Client: Gee's Group Project: The Point at Harbour View - Feasibility Study Location: CBR-4 Sample Number: CBR-4	Remarks: Sample Obtained 2/8/17 CBR-4

GET SOLUTIONS, INC.

BEARING RATIO TEST REPORT

VTM-008 (2005)



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	115.1	100.8	12.3	114.9	100.6	13.2	10.2	13.6	0.066	10	0.2
2 △											
3 □											

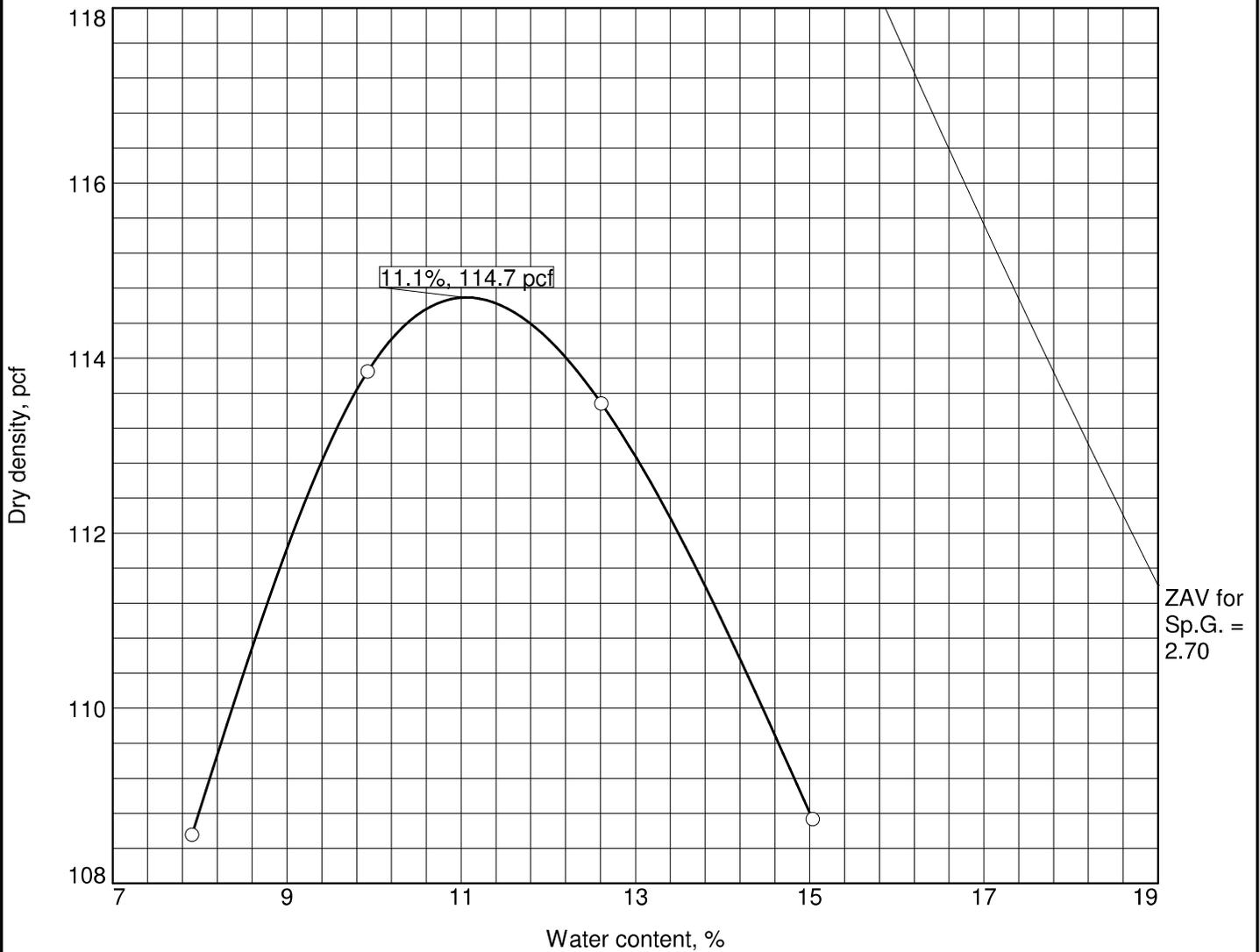
Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
	Brown, Clayey SAND	SC	114.2	12.5	19

Project No: VB17-124G
Project: The Point at Harbour View - Feasibility Study
Location: CBR-4
Sample Number: CBR-4 **Depth:** 1-2 ft.
Date: 2/8/17

Test Description/Remarks:

CBR-4
 Resiliency Factor = 2.5

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



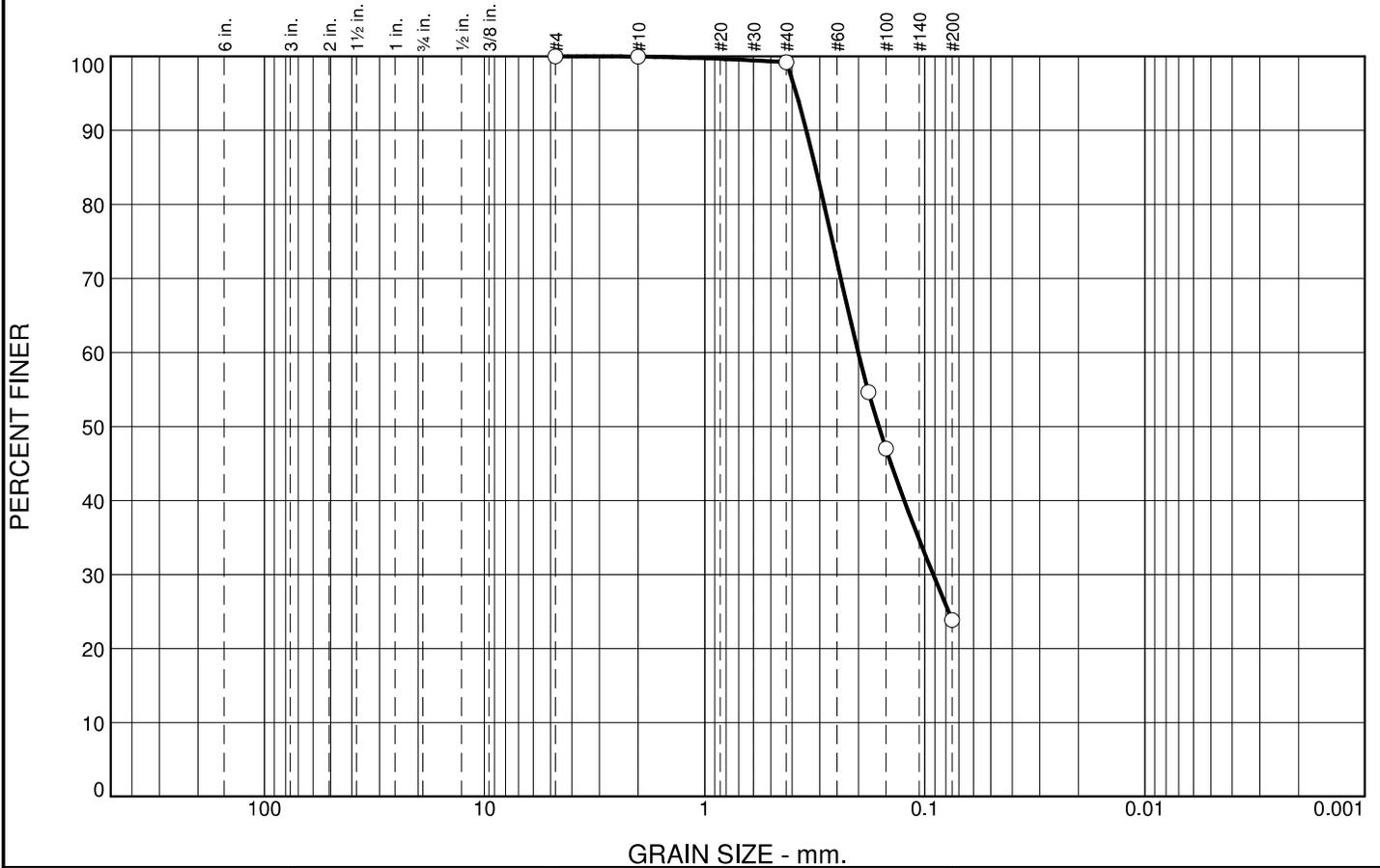
Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-2 ft.	SC	A-2-4(0)	9		19	9	0.0	23.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 114.7 pcf Optimum moisture = 11.1 %	Tan, Clayey SAND
Project No. VB17-124G Client: Gee's Group Project: The Point at Harbour View - Feasibility Study Location: CBR-5 Sample Number: CBR-5	Remarks: Sample Obtained 2/8/17 CBR-5

GET SOLUTIONS, INC.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.8	75.4	23.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#40	99.2		
#80	54.6		
#100	47.0		
#200	23.8		

Material Description

Tan, Clayey SAND

Atterberg Limits

PL= 10 LL= 19 PI= 9

Coefficients

D₉₀= 0.3451 D₈₅= 0.3137 D₆₀= 0.2007
D₅₀= 0.1618 D₃₀= 0.0915 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

Sample Obtained 2/8/17
CBR-5

* (no specification provided)

Location: CBR-5 **Sample Number:** CBR-5 **Depth:** 1-2 ft.

Date: 2/8/17

GET SOLUTIONS, INC.

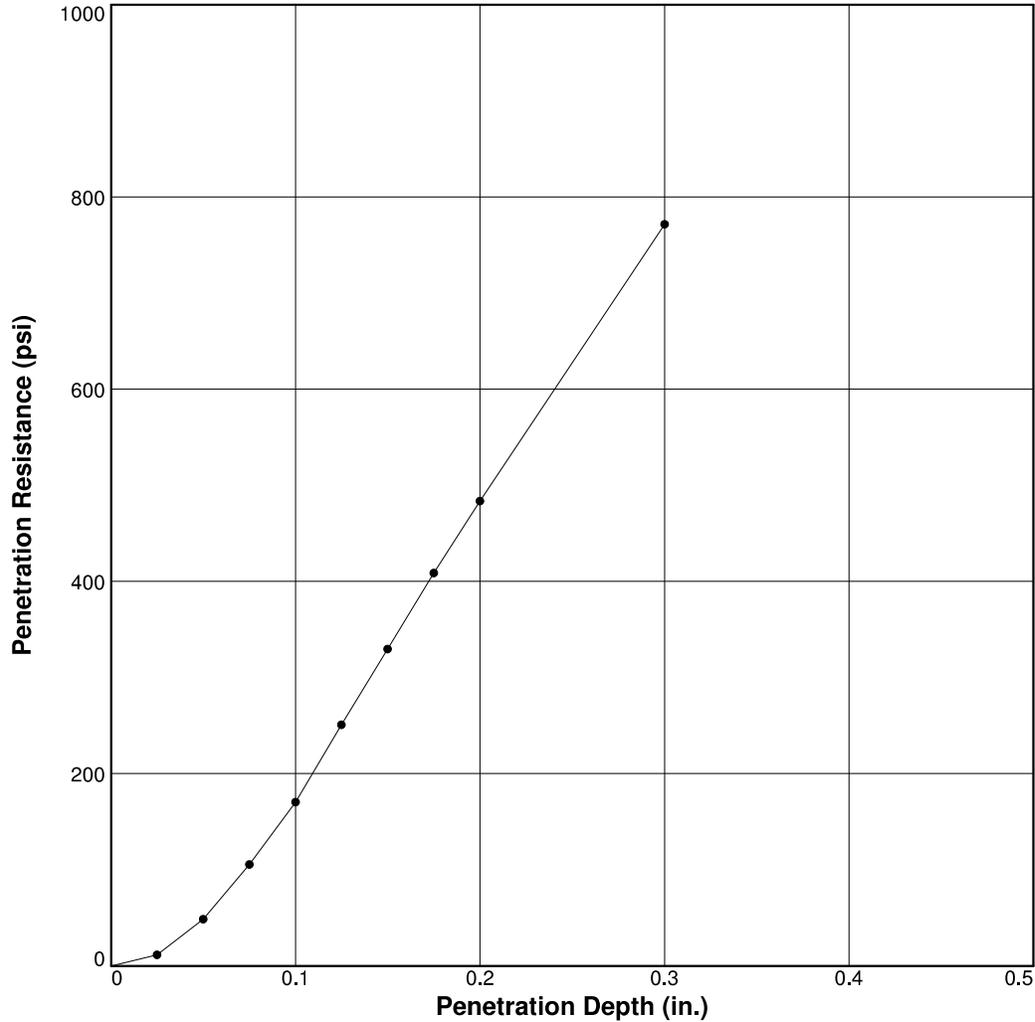
Client: Gee's Group
Project: The Point at Harbour View - Feasibility Study

Project No: VB17-124G

Figure 5A

BEARING RATIO TEST REPORT

VTM-008 (2005)



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	115.3	100.5	10.6	115.2	100.4	11.5	30.9	40.6	0.044	10	0.1
2 △											
3 □											

Material Description		USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Tan, Clayey SAND						

Project No: VB17-124G
Project: The Point at Harbour View - Feasibility Study
Location: CBR-5
Sample Number: CBR-5 **Depth:** 1-2 ft.
Date: 2/8/17

Test Description/Remarks:

CBR-5
 Resiliency Factor = 3.0

APPENDIX V
BORING LOGS



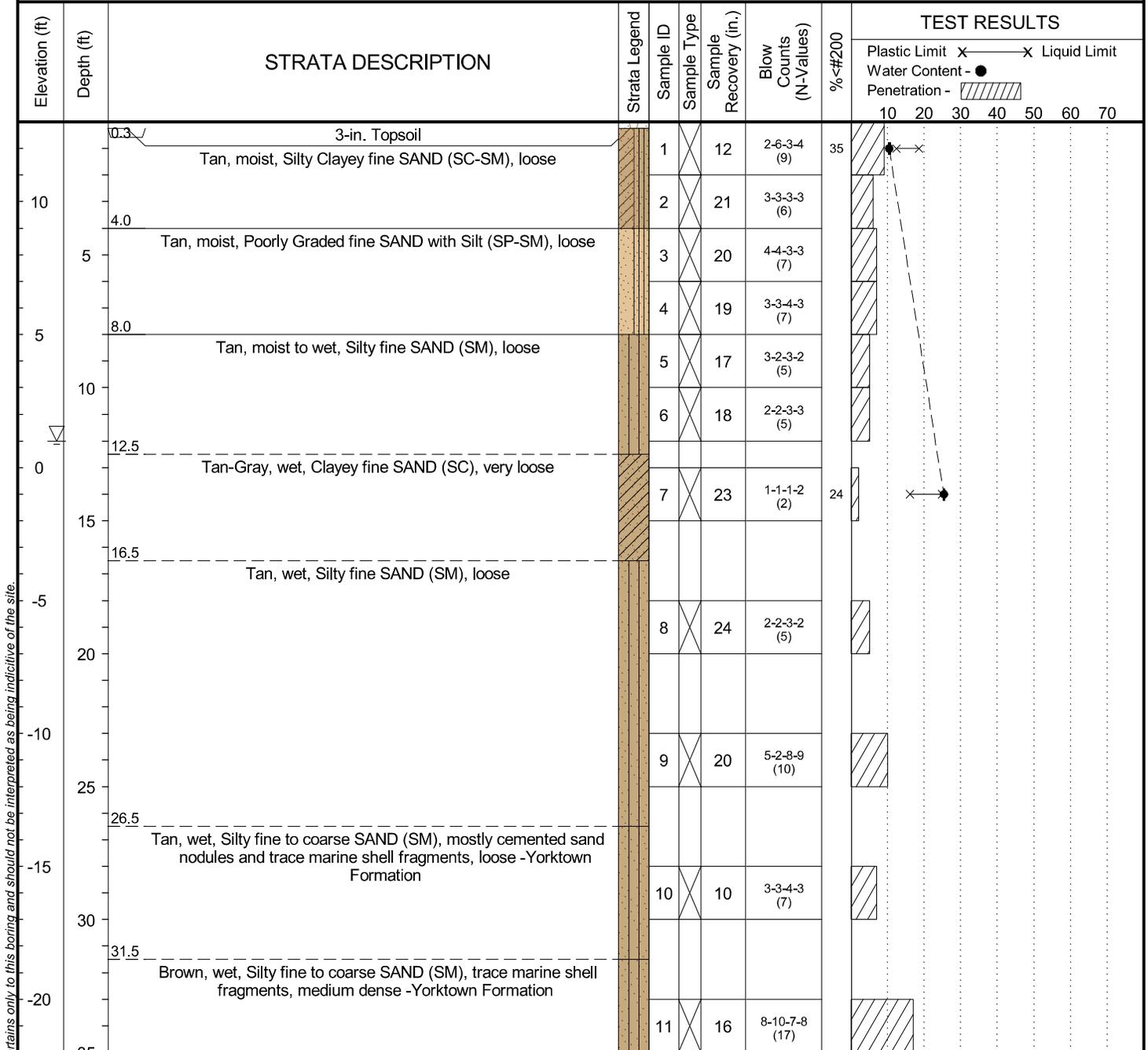
RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID D-1

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4269389 NORTH: 36.895725
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 12 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) Ⓞ: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 13
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.



Sample Type(s):
 SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicative of the site.



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID D-1

PROJECT NAME: **The Point at Harbour View-Feasibility Study**
 CLIENT: **Gee's Group**
 PROJECT LOCATION: **Suffolk, VA**
 BORING COORDINATES: **EAST: -76.4269389 NORTH: 36.895725**
 DRILLING METHOD(S): **Rotary wash "mud"**
 GROUNDWATER*: INITIAL (ft) ▽: **12** AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) Ⓞ: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **VB17-124G**
 SURFACE ELEVATION (MSL) (ft): **13**
 LOGGED BY: **E.Setnicky**
 DATE STARTED: **2/14/2017**
 DATE COMPLETED: **2/14/2017**
 DRILLER: **GET Solutions, Inc.**

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	% <#200	TEST RESULTS						
									Plastic Limit X	Liquid Limit X	Water Content - ●	Penetration - [diagonal lines]			
									10	20	30	40	50	60	70
-25	40	Brown, wet, Silty fine to coarse SAND (SM), trace marine shell fragments, medium dense -Yorktown Formation <i>(layer continued from previous page)</i>		12	SS	24	10-10-12-16 (22)		[diagonal lines]						
-30	41.5	Tan, wet, Silty fine to coarse SAND (SM), mostly marine shell fragments, medium dense -Yorktown Formation													
-35	45	Change to Red-Tan at 53 to 55 ft. below grade		13	SS	24	5-7-8-8 (15)		[diagonal lines]						
-40	50	Change to Tan at 58 to 60 ft. below grade		14	SS	24	7-6-6-5 (12)		[diagonal lines]						
-45	55			15	SS	24	6-9-9-14 (18)		[diagonal lines]						
-50	60	Boring terminated at 60 feet below existing grade.		16	SS	24	6-8-4-12 (12)		[diagonal lines]						

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



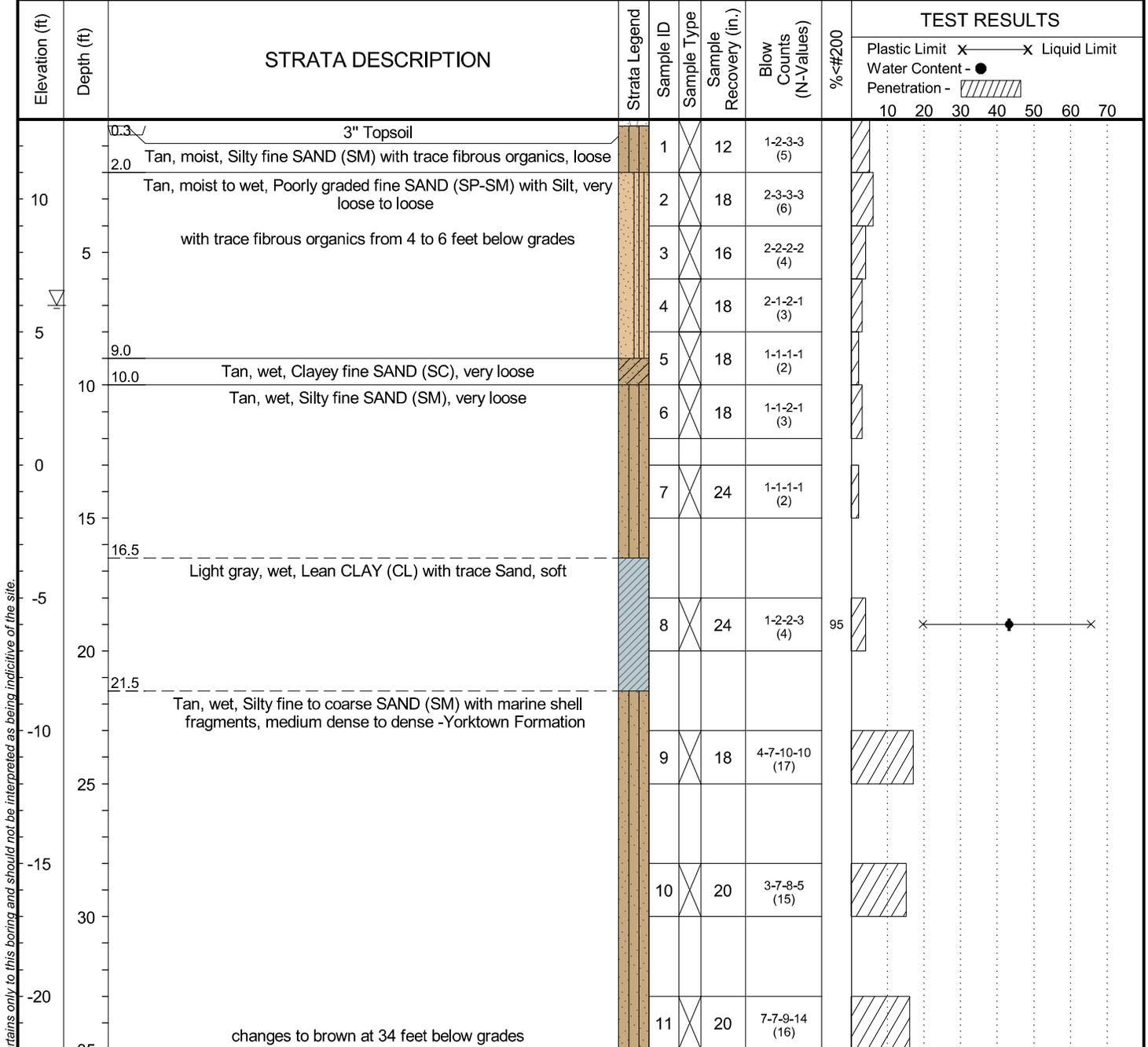
RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID D-2

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4283111 NORTH: 36.8963667
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ∇ : 7 AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 13
 LOGGED BY: I. Kladou
 DATE STARTED: 2/13/2017
 DATE COMPLETED: 2/13/2017
 DRILLER: GET Solutions, Inc.



Sample Type(s):
 SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicative of the site.



RECORD OF SUBSURFACE EXPLORATION

BORING ID D-2

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4283111 NORTH: 36.8963667
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ∇ : 7 AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 13
 LOGGED BY: I. Kladou
 DATE STARTED: 2/13/2017
 DATE COMPLETED: 2/13/2017
 DRILLER: GET Solutions, Inc.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	% <#200	TEST RESULTS											
									Plastic Limit	Water Content	Penetration	Liquid Limit								
		Tan, wet, Silty fine to coarse SAND (SM) with marine shell fragments, medium dense to dense -Yorktown Formation (layer continued from previous page)																		
-25	40			12	SS	20	7-11-14-10 (25)													
-30	45			13	SS	18	11-19-25-20 (44)													
-35	50	49.0 Gray, wet, Silty fine to coarse SAND (SM) with marine shell fragments, medium dense to dense -Yorktown Formation		14	SS	20	10-15-15-16 (30)													
-40	55			15	SS	20	5-6-15-16 (21)													
-45	60	60.0 Boring terminated at 60 feet below existing grade.		16	SS	20	5-7-11-18 (18)													

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



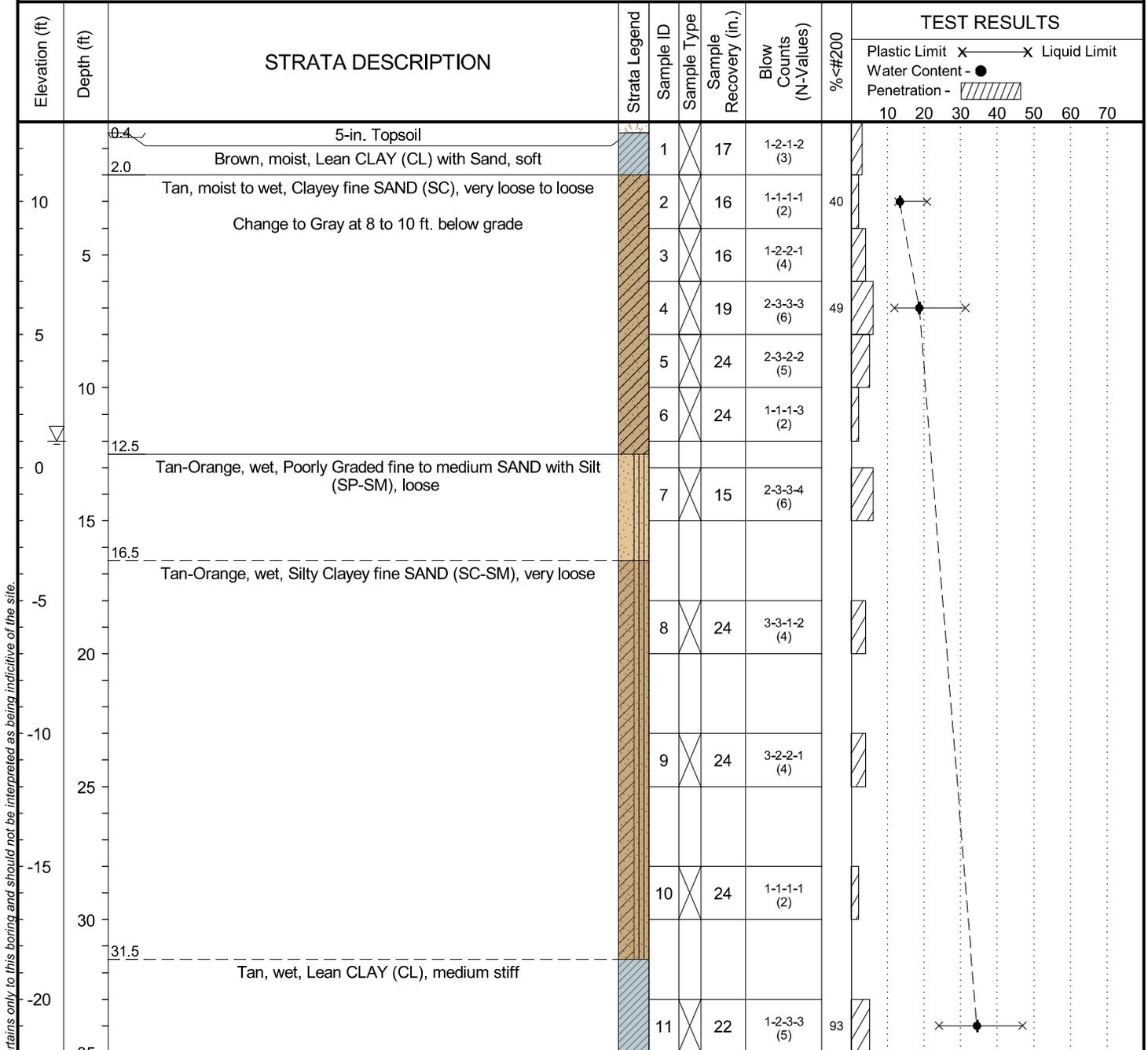
RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID D-3

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4276972 NORTH: 36.8950222
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 12 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ○: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 13
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.



Sample Type(s):
 SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicative of the site.



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID D-3

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4276972 NORTH: 36.8950222
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 12 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) Ⓞ: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 13
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS									
									Plastic Limit X	Water Content - ●	Penetration - [Hatched]	Liquid Limit X						
36.5		Tan, wet, Lean CLAY (CL), medium stiff (layer continued from previous page)	[Blue Hatched]															
	25	Tan, wet, Silty fine to medium SAND (SM), very loose	[Brown]	12	SS	24	0-0-0-0 (0)											
41.5		Tan-Gray, wet, Clayey fine to medium SAND (SC), loose	[Brown Hatched]	13	SS	24	3-2-3-5 (5)											
46.5		Red-Tan, wet, Silty fine to coarse SAND (SM), trace marine shell fragments, medium dense -Yorktown Formation	[Red-Tan]	14	SS	24	13-13-7-9 (20)											
	50	Changes to Tan at 58 to 60 ft. below grade	[Brown]	15	SS	19	6-8-9-9 (17)											
	55		[Brown]	16	SS	24	8-6-6-6 (12)											
60.0	60	Boring terminated at 60 feet below existing grade.																

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



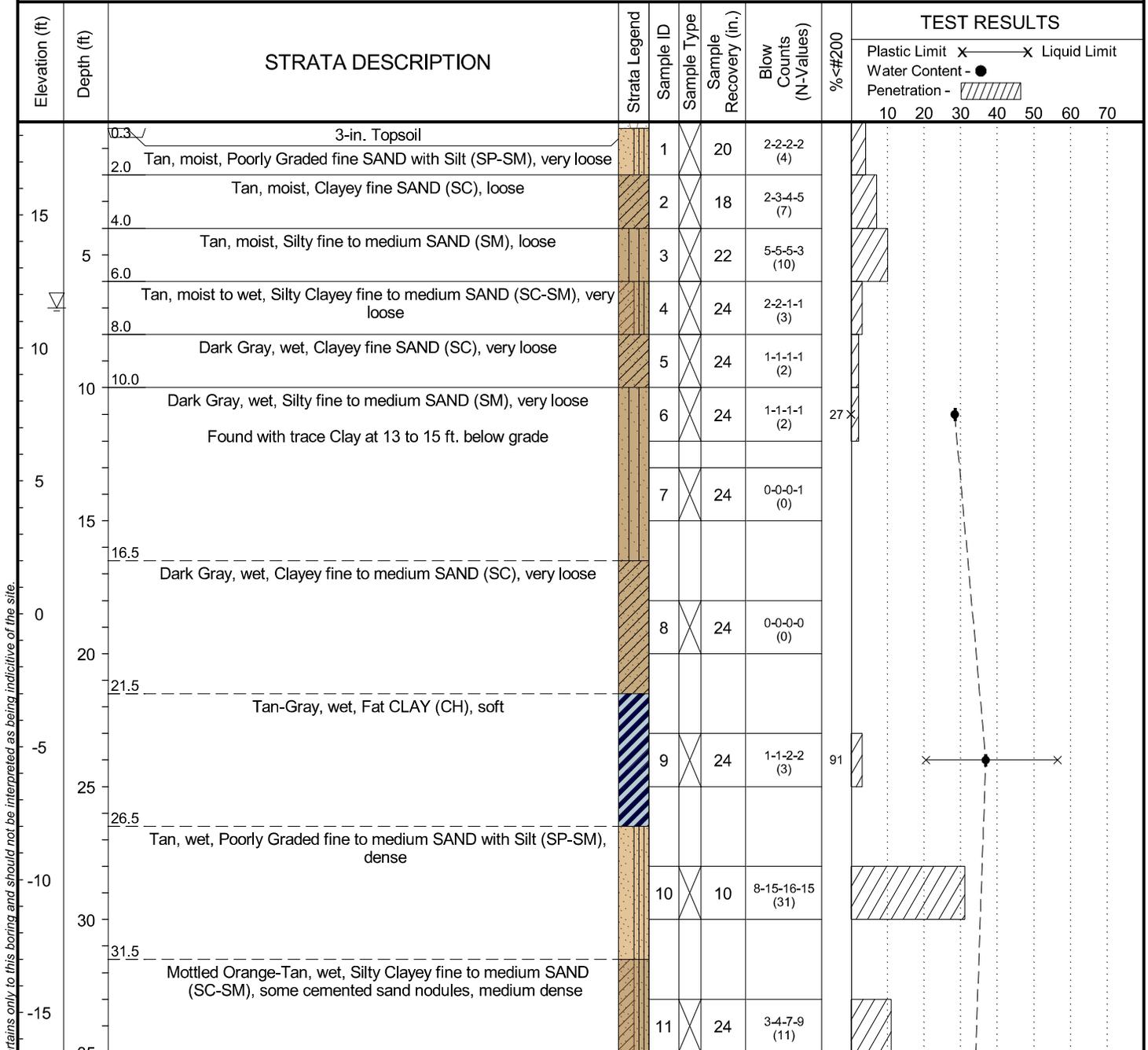
RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID D-4

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4310333 NORTH: 36.892375
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ∇ : 7 AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 18.5
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.



This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



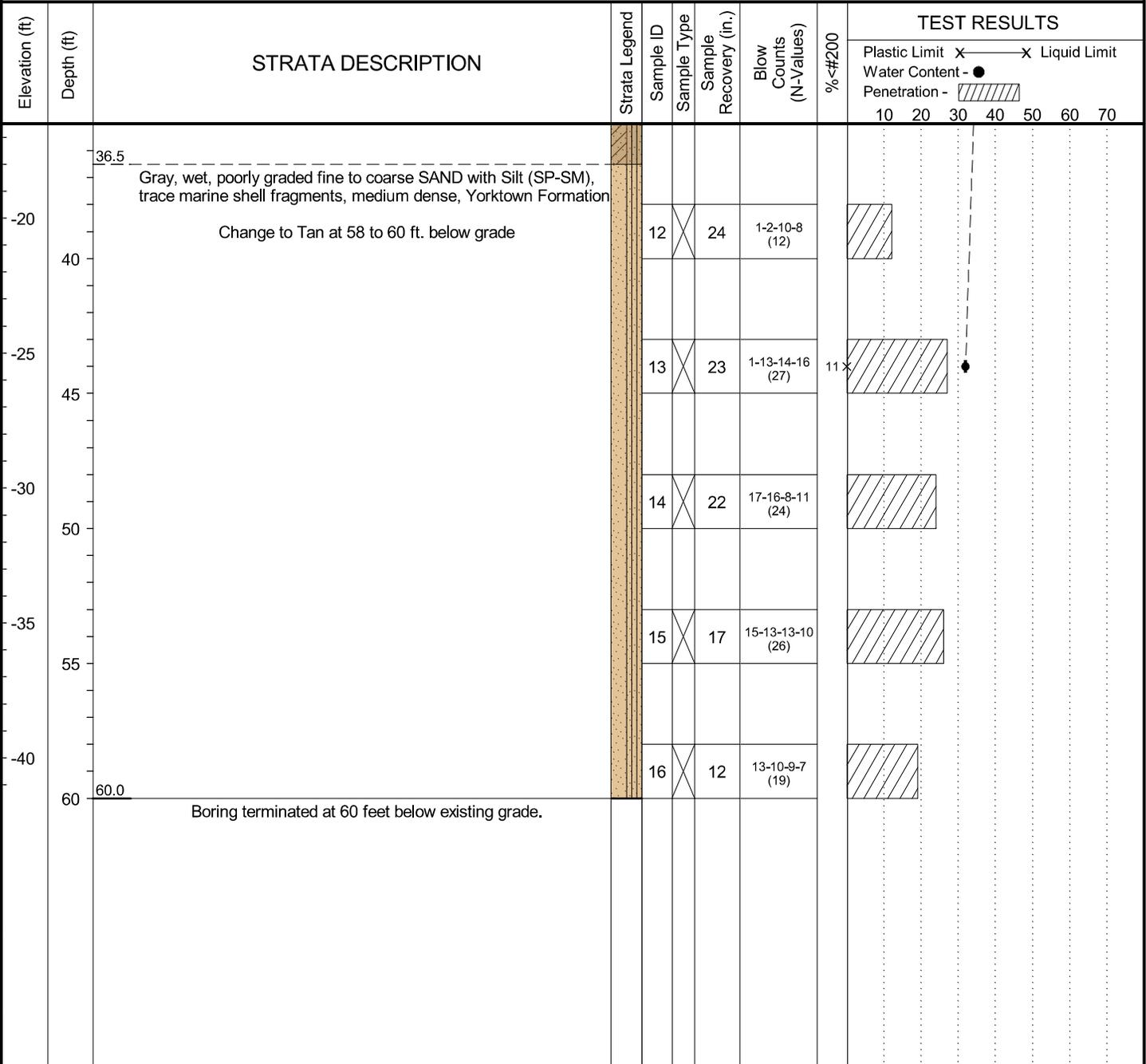
RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID D-4

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4310333 NORTH: 36.892375
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 7 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) Ⓞ: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 18.5
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.



This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



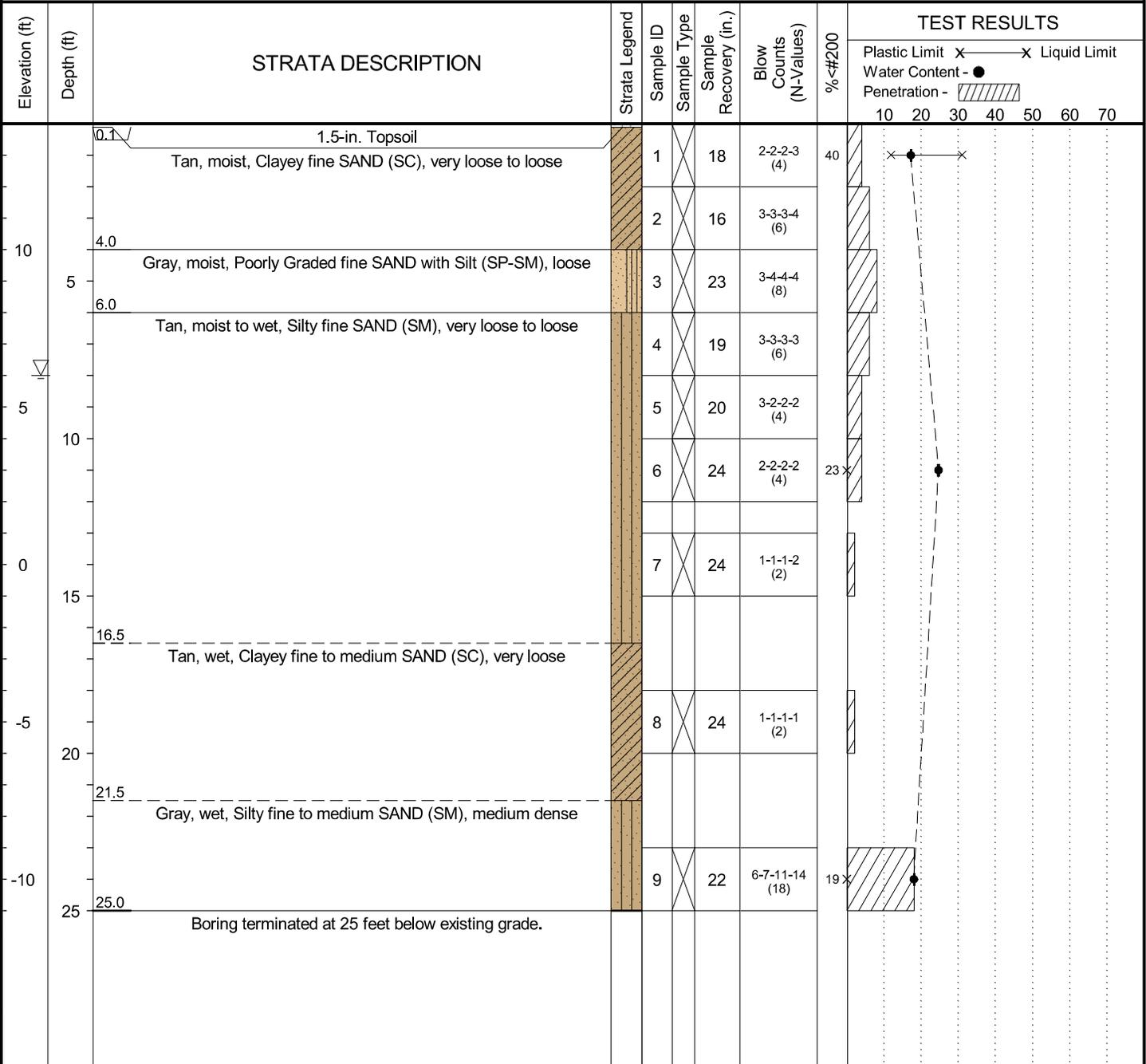
RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID B-1

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4270583 NORTH: 36.8964972
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 8 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 14
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.



This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703	Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452	Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765	Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915
--	--	--	--

BORING ID B-2

PROJECT NAME: The Point at Harbour View-Feasibility Study

CLIENT: Gee's Group

PROJECT LOCATION: Suffolk, VA

BORING COORDINATES: EAST: -76.4276722 NORTH: 36.896175

DRILLING METHOD(S): Rotary wash "mud"

GROUNDWATER*: INITIAL (ft) ▽: 8 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) Ⓞ: _____

The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G

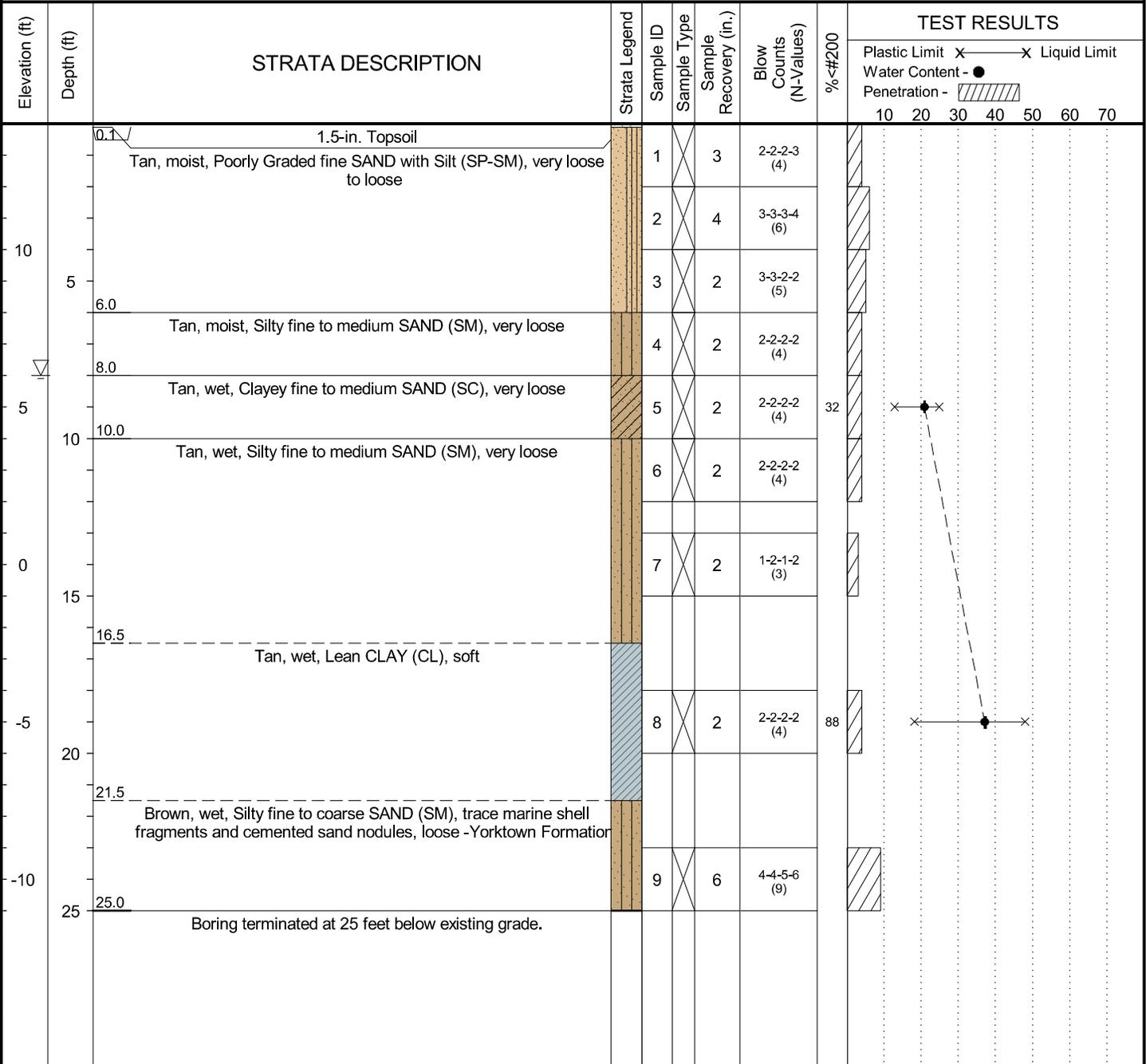
SURFACE ELEVATION (MSL) (ft): 14

LOGGED BY: E.Setnicky

DATE STARTED: 2/14/2017

DATE COMPLETED: 2/14/2017

DRILLER: GET Solutions, Inc.



This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
SS - Split Spoon

Notes:



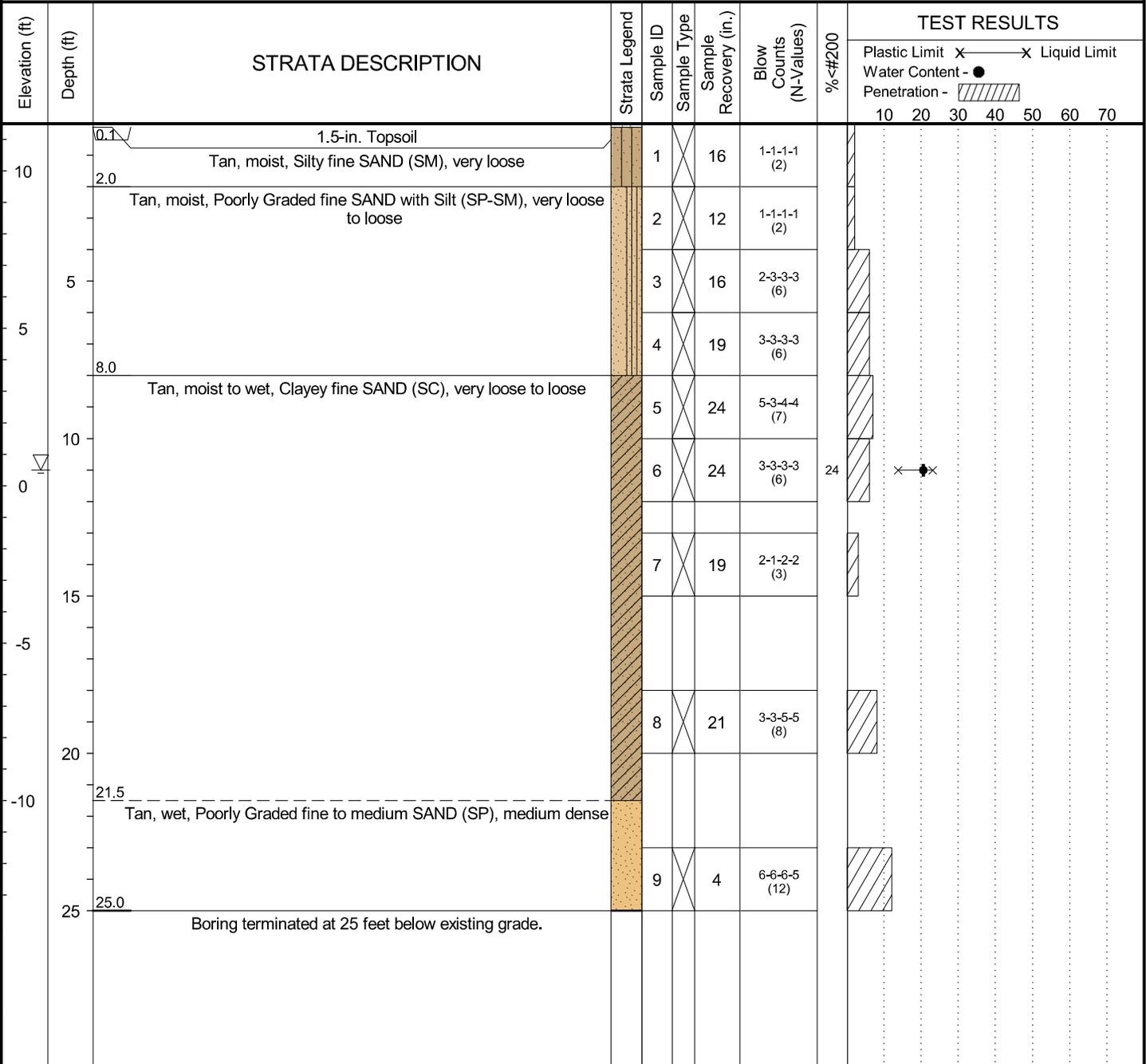
RECORD OF SUBSURFACE EXPLORATION

Virginia Beach: 204 Grayson Road, Virginia Beach, VA 23642, 757-518-1703
 Williamsburg: 1592-E Penniman Road, Williamsburg, VA 23185, 757-564-6452
 Elizabeth City: 106 Capital Trace Unit E, Elizabeth City, NC 27909, 252-335-9765
 Jacksonville: 415-A Western Blvd, Jacksonville, NC 28546, 910-478-9915

BORING ID B-4

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4283194 NORTH: 36.8939583
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 11 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ◊: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 11.5
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.



This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID B-5

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4297417 NORTH: 36.8941389
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 7 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 18.5
 LOGGED BY: E.Setnicky
 DATE STARTED: 1/16/2017
 DATE COMPLETED: 1/16/2017
 DRILLER: GET Solutions, Inc.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	% <#200	TEST RESULTS										
									Plastic Limit	Water Content	Penetration	Liquid Limit							
	0.1	1-in. Topsoil																	
	2.0	Tan, moist, Sandy Lean CLAY (CL), soft		1	SS	23	2-2-2-2 (4)												
15		Tan, moist to wet, Poorly Graded fine SAND with Silt (SP-SM), loose		2	SS	22	2-4-2-4 (6)												
5				3	SS	18	2-4-3-4 (7)												
	8.0	Orange-Tan, wet, Silty fine to medium SAND (SM), very loose		4	SS	24	4-4-4-3 (8)												
10				5	SS	24	1-1-1-1 (2)												
	10.0	Dark Gray, wet, Silty fine to medium SAND (SM), very loose		6	SS	24	1-1-1-1 (2)												
	12.5	Dark Gray, wet, Clayey fine to medium SAND (SC), very loose		7	SS	24	0-0-0-4 (0)												
5																			
	16.5	Dark Gray, wet, Silty fine to medium SAND (SM), very loose		8	SS	24	1-1-1-1 (2)												
15																			
	21.5	Orange-Gray, wet, Clayey fine SAND (SC), loose		9	SS	24	1-3-6-8 (9)												
	25.0	Boring terminated at 25 feet below existing grade.																	

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID B-6

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4300028 NORTH: 36.8932333
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 6.5 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 19
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	% <#200	TEST RESULTS										
									Plastic Limit	Water Content	Penetration	Liquid Limit							
	0.3	3-in. Topsoil																	
	2.0	Brown, moist, Lean CLAY (CL) with some Sand, stiff		1	SS	21	2-6-3-5 (9)												
	4.0	Tan, moist, Clayey fine SAND (SC), medium dense		2	SS	23	4-5-7-5 (12)												
	6.0	Tan, moist, Poorly Graded fine SAND with Silt (SP-SM), loose		3	SS	24	5-5-4-3 (9)												
	8.0	Orange-Tan, moist to wet, Silty fine SAND (SM), very loose to loose		4	SS	24	2-3-2-2 (5)												
	10.0			5	SS	24	1-1-1-1 (2)												
	12.5	Dark Gray, wet, Clayey fine to medium SAND (SC), very loose		6	SS	24	1-1-1-1 (2)												
	15.0			7	SS	24	0-0-0-0 (0)												
	16.5	Dark Gray, wet, Silty Clayey fine SAND (SC-SM), very loose		8	SS	24	0-0-0-0 (0)												
	21.5	Tan, wet, Poorly Graded fine SAND with Silt (SP-SM), medium dense		9	SS	24	5-13-14-17 (27)												
	25.0	Boring terminated at 25 feet below existing grade.																	

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID B-7

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4292889 NORTH: 36.891125
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 8.5 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 17
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	% <#200	TEST RESULTS					
									Plastic Limit	Water Content	Penetration	Liquid Limit		
	0.2	2.5-in. Topsoil												
15		Tan, moist, Clayey fine SAND (SC), very loose to loose		1	SS	15	1-2-2-2 (4)	42						
	4.0	Tan, moist, Poorly Graded fine SAND with Silt (SP-SM), loose		2	SS	22	3-2-3-2 (5)							
5				3	SS	24	3-3-3-3 (6)							
10				4	SS	24	2-2-2-2 (4)							
	8.0	Tan, moist to wet, Silty fine to medium SAND (SM) with trace Clay, loose		5	SS	24	2-3-2-2 (5)							
10				6	SS	24	2-3-2-3 (5)							
5														
	12.5	Tan, wet, Poorly Graded fine to medium SAND with Silt (SP-SM), very loose		7	SS	20	2-1-1-2 (2)							
15														
0	16.5	Mottled Orange-Tan, Clayey fine SAND (SC), very loose		8	SS	24	2-1-1-1 (2)							
20														
-5	21.5	Tan-Orange, wet, Silty fine to medium SAND (SM), medium dense												
25	25.0	Boring terminated at 25 feet below existing grade.		9	SS	19	8-8-12-21 (20)							

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



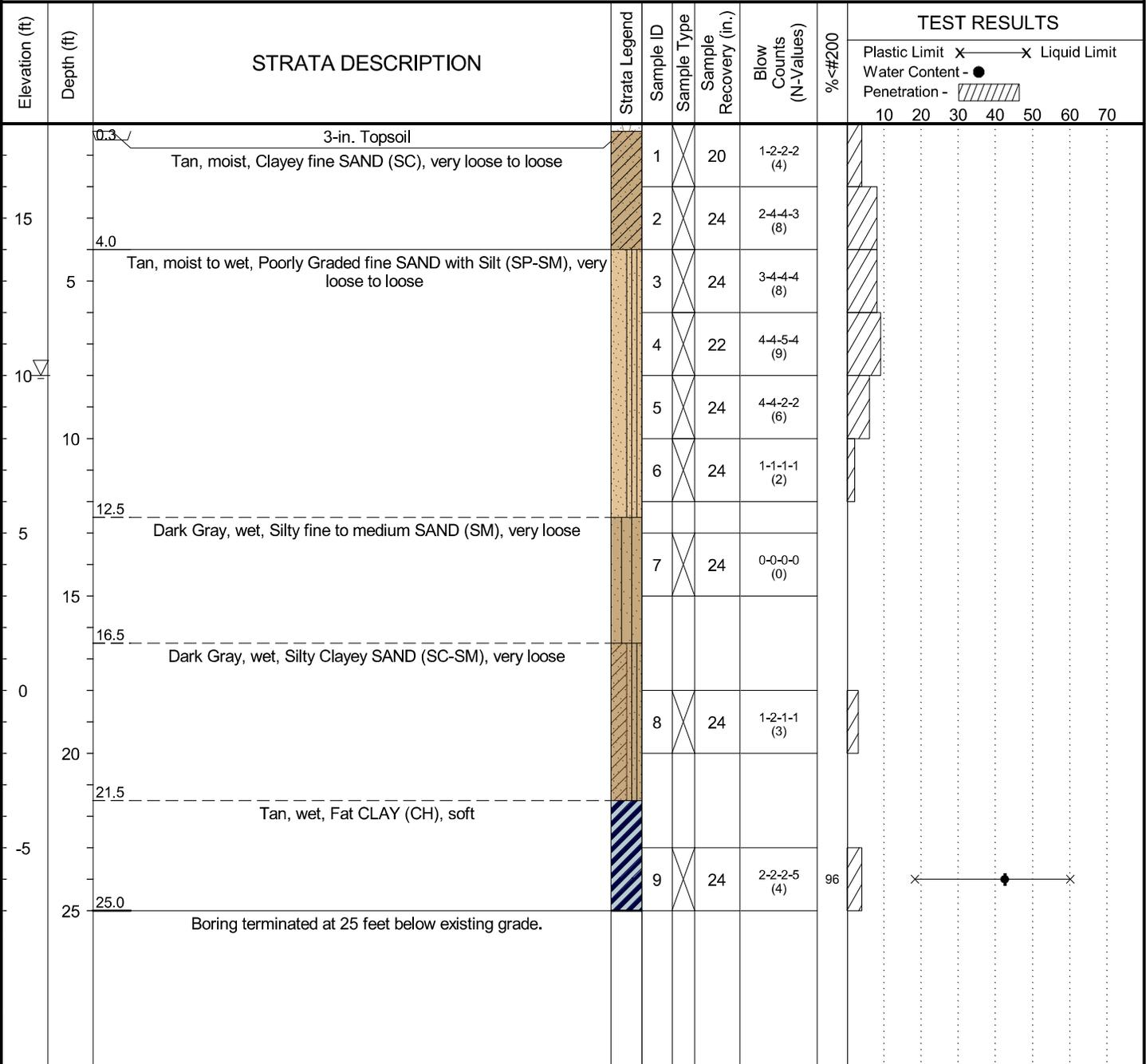
RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID B-8

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4317194 NORTH: 36.8943861
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 8 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 18
 LOGGED BY: E.Setnicky
 DATE STARTED: 1/16/2017
 DATE COMPLETED: 1/16/2017
 DRILLER: GET Solutions, Inc.



This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID CBR-1

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4287056 NORTH: 36.8946417
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 8 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 11.5
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	% <#200	TEST RESULTS					
									Plastic Limit X	Liquid Limit X	Water Content - ●	Penetration - ▨		
	0.3	4-in. Topsoil												
10		Tan-Brown, moist, Clayey fine to medium SAND (SC), very loose to loose		1	SS	20	1-1-2-1 (3)	27						
	4.0	Tan, moist to wet, Poorly Graded fine to medium SAND with Silt (SP-SM), very loose		2	SS	21	2-3-3-3 (6)							
5		Change to Tan-Gray at 8 to 10 ft. below grade		3	SS	24	2-2-2-2 (4)	10						
5				4	SS	24	2-1-1-1 (2)							
10	10.0	Boring terminated at 10 feet below existing grade.		5	SS	24	1-2-2-3 (4)							

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID CBR-2

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4289667 NORTH: 36.8932194
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 8 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 16
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	% <#200	TEST RESULTS	
									Plastic Limit X	Liquid Limit X
	0.1	1.5-in. Topsoil								
15		Tan-Brown, moist, Clayey fine SAND (SC), loose		1		22	1-2-3-2 (5)	47		
	2.0	Tan, moist to wet, Poorly Graded fine to medium SAND with Silt (SP-SM), very loose to medium dense		2		20	1-2-2-2 (4)			
	5			3		24	2-2-2-3 (4)			
	10			4		24	3-4-7-5 (11)	12		
	10.0	Boring terminated at 10 feet below existing grade.		5		24	1-2-2-1 (4)			

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



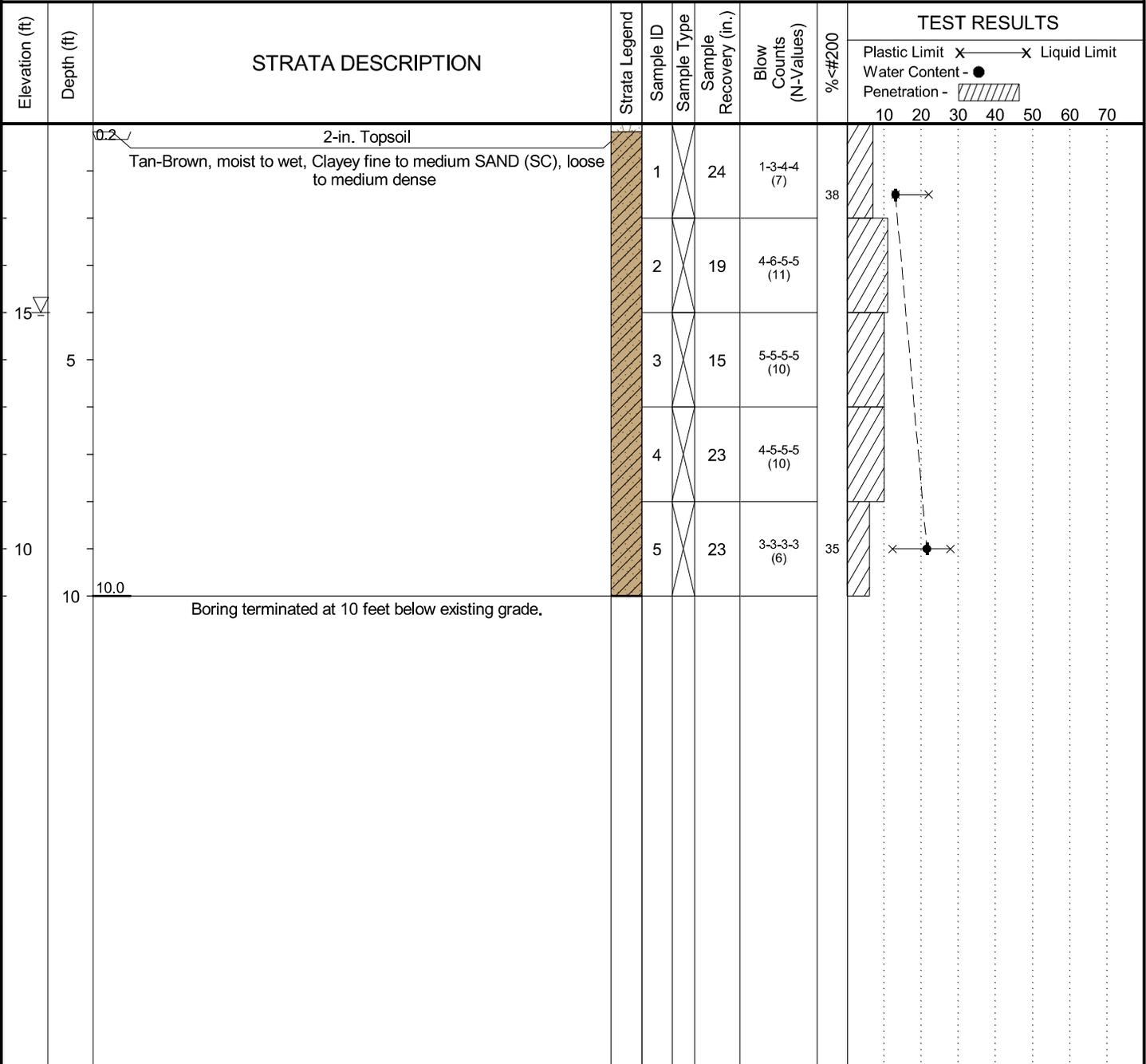
RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID CBR-3

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4286139 NORTH: 36.8917417
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 4 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 19
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.



This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



RECORD OF SUBSURFACE EXPLORATION

BORING ID CBR-4

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4303361 NORTH: 36.8925278
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 6 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 19
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	% <#200	TEST RESULTS					
									Plastic Limit	Water Content	Penetration	Liquid Limit		
	0.1	1.5-in. Topsoil												
		Brown, moist, Clayey fine SAND (SC), very loose to loose		1		19	1-2-2-2 (4)							
		Change to Tan-Gray at 2 to 4 ft. below grade												
	4.0	Tan-Gray, moist, Poorly Graded fine to medium SAND with Silt (SP-SM), medium dense		2		23	3-4-6-5 (10)							
15	5			3		23	6-6-7-6 (13)							
	6.0	Mottled Orange-Tan, wet, Silty fine SAND (SM), loose		4		24	2-3-2-2 (5)							
	8.0	Dark Gray, wet, Silty Clayey fine SAND (SC-SM), very loose		5		24	1-1-1-1 (2)							
	10.0	Boring terminated at 10 feet below existing grade.												

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach 204 Grayson Road Virginia Beach, VA 23642 757-518-1703
 Williamsburg 1592-E Penniman Road Williamsburg, VA 23185 757-564-6452
 Elizabeth City 106 Capital Trace Unit E Elizabeth City, NC 27909 252-335-9765
 Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915

BORING ID CBR-5

PROJECT NAME: The Point at Harbour View-Feasibility Study
 CLIENT: Gee's Group
 PROJECT LOCATION: Suffolk, VA
 BORING COORDINATES: EAST: -76.4306778 NORTH: 36.8944167
 DRILLING METHOD(S): Rotary wash "mud"
 GROUNDWATER*: INITIAL (ft) ▽: 6.5 AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⊖: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB17-124G
 SURFACE ELEVATION (MSL) (ft): 18
 LOGGED BY: E.Setnicky
 DATE STARTED: 2/14/2017
 DATE COMPLETED: 2/14/2017
 DRILLER: GET Solutions, Inc.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	% <#200	TEST RESULTS					
									Plastic Limit	Water Content	Penetration	Liquid Limit		
	0.2	2-in. Topsoil												
	2.0	Tan, moist, Clayey fine SAND (SC), loose		1	SS	20	1-2-3-1 (5)	24						
15		Tan, moist, Poorly Graded fine SAND with Silt (SP-SM), loose		2	SS	23	3-4-4-5 (8)							
	4.0	Mottled Orange-Tan, moist to wet, Silty fine SAND (SM), loose		3	SS	23	3-4-5-5 (9)							
				4	SS	24	2-3-3-2 (6)							
				5	SS	24	2-3-3-3 (6)							
	10.0	Boring terminated at 10 feet below existing grade.												

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Sample Type(s):
 SS - Split Spoon

Notes:

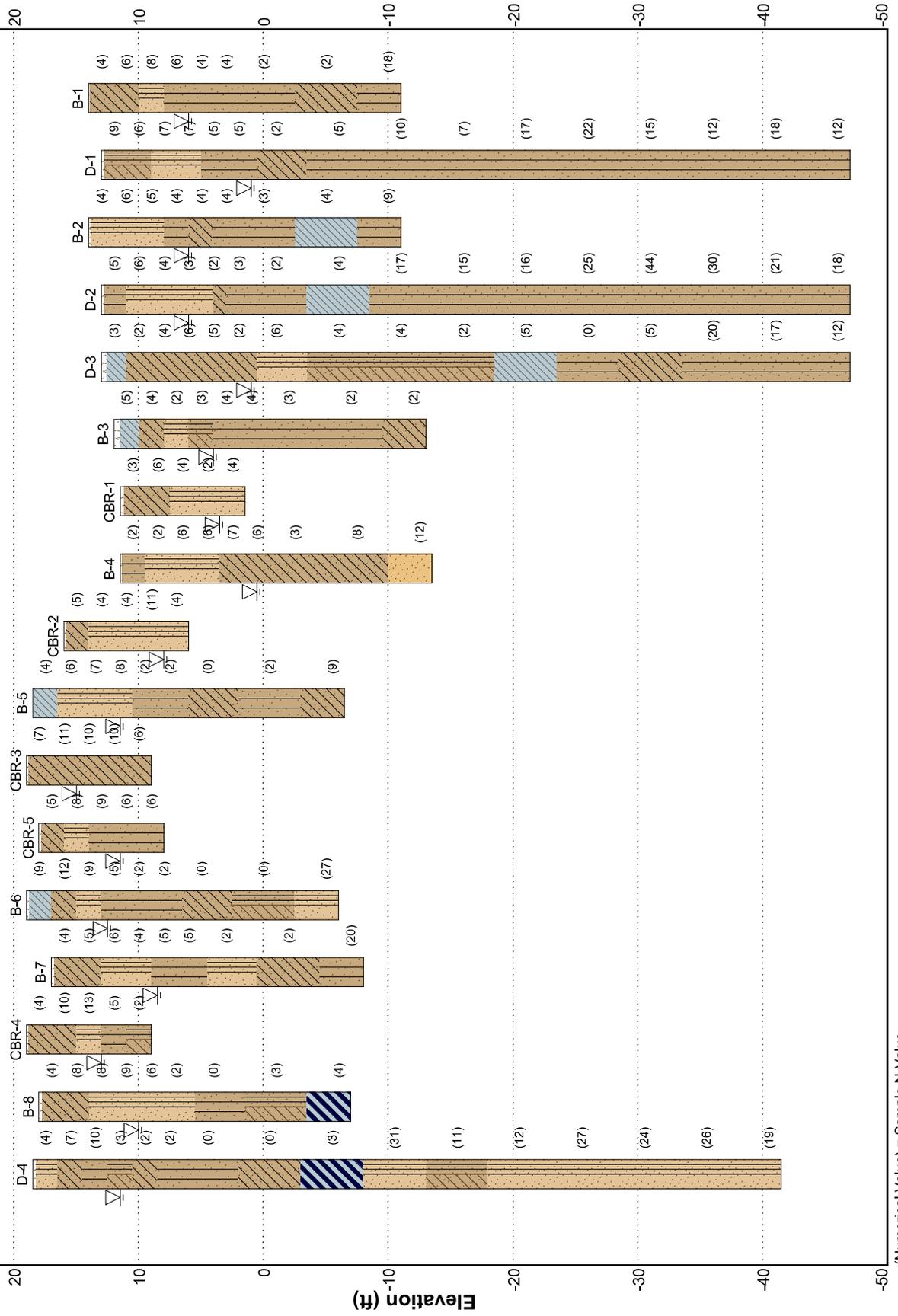
APPENDIX VI

GENERALIZED SOIL PROFILES

GENERALIZED SOIL PROFILE

PROJECT NAME: The Point at Harbour View-Feasibility Study
 PROJECT LOCATION: Suffolk, VA

PROJECT NUMBER: VB17-124G
 CLIENT: Gee's Group



(Numerical Value) = Sample N-Value