SOR CONSULTING ENGINEERS, INC.
Geotechnical Engineering - Materials Testing - Forensic Studies

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SUBSURFACE INVESTIGATION REPORT
PROPOSED RAMAPO COLLEGE STUDENT CENTER PHASE 2
MAHWAH, NEW JERSEY

FOR

CAMBRIDGE CONSTRUCTION MANAGEMENT
CLINTON, NEW JERSEY

Prepared by: **Sor Consulting Engineers, Inc.**
98 Sand Park Road
Cedar Grove, New Jersey 07009

Report No.: 15-C-153
Job No.: 15-C-55
November 17, 2015

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November 17, 2015
Job No. 15-C-55
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Cambridge Construction Management
97 Grayrock Road
Clinton, New Jersey 08809

Attention: Gregory Romero, Jr.
E-Mail: gromerojr@cambridgecm.com

Re: Subsurface Investigation Report
Proposed Ramapo College Student Center Phase 2
Mahwah, New Jersey

INTRODUCTION

This report presents the results of a subsurface investigation performed for a proposed building addition to be constructed at the Ramapo College campus in Mahwah, New Jersey. The college is located at 505 Ramapo Valley Road. A new one-story slab-on-grade addition covering a plan area of approximately 2000 square feet will abut the northeast corner of the existing Student Center building.

PURPOSE AND SCOPE OF WORK

The purpose of this study was to:

- explore the subsurface conditions within the proposed building addition area;
- estimate the geotechnical engineering properties of the encountered subsurface materials;
- evaluate the foundation requirements for the building addition considering the anticipated structural loads and encountered subsurface conditions;
- recommend an appropriate type of foundation for support of the proposed structure and present geotechnical related foundation design and installation

criteria, including shallow and/or deep foundation design parameters and seismic site class;

- present recommendations relative to the support of slabs to be constructed on-grade, including modulus of subgrade reaction (Kv);
- estimate the post-construction performance of the recommended floor and foundation systems; and
- discuss appropriate earthwork operations or considerations consistent with the proposed construction and encountered subsurface conditions.

To accomplish this, a subsurface exploration program consisting of four soil borings was conducted on the site. The borings were performed on November 10, 2015 by Environmental Technical Drilling, Inc. using narrow gauge rubber track mounted drilling equipment and extended to depths ranging from 7 to 14.3 feet below the existing ground surface. Soil samples suitable for identification and laboratory testing purposes were extracted from the borings in accordance with the procedures of the Standard Penetration Test. Upon completion, the explorations were backfilled with soil cuttings so as not to leave any open holes.

The explorations were performed under the direct technical supervision of a licensed geotechnical engineer from Sor Consulting Engineers, Inc. Our representative located the borings at the site, prepared logs of the explorations as the work proceeded and supervised the soil sampling operations so as to obtain the appropriate subsurface information. The locations of the explorations are shown relative to the existing and proposed site features on the Boring Location Plan contained in Appendix I of this report. Detailed descriptions of the encountered subsurface conditions are presented on the individual boring logs contained in Appendix II. The soils were visually classified in accordance with the Burmeister Soil Classification System also included in Appendix II.

All soil samples were brought to our office where they were examined in our soil mechanics laboratory. Selected samples were subjected to moisture content and mechanical grain size distribution tests to aid in their engineering classification and estimation of engineering soil properties. The laboratory test results are presented in Appendix III.

The results of the field and laboratory testing programs have provided the basis for our engineering analysis and geotechnical recommendations. The following discussions of our findings and recommendations are subject to the limitations contained in Appendix IV of this report.

SITE CONDITIONS

Surface Features: Brick pavers cover the majority of the ground surface in the proposed building addition area. Numerous cut outs for trees and shrubs as well as storm drain inlets and utility conduits are present throughout the brick paver area. The brick paver surface is generally level with isolated uneven and raised areas, especially along edges. The paver surface is at the approximate same elevation as the existing building ground floor level.

Subsurface Conditions: The generalized subsurface conditions encountered in the proposed building addition area are illustrated on subsurface profile section A-A included in Appendix I of this report. The subsurface conditions encountered in the borings performed for this study consisted of the following strata in order of increasing depth.

1) Surface Materials: The surface was covered with brick pavers which were removed to perform Borings 1, 2 and 4. The ground surface at Boring 3 was covered with 6 inches of topsoil.
2) Fill Material: Fill consisting of brown to grayish brown to gray silty gravelly sand with minor amounts of roots and organics was present below the surface cover. The fill extended to depths ranging from 3 feet beneath the existing ground surface at Boring 1 to 9.5 feet at Boring 4. Borings 2 and 3 were terminated within the fill on an obstruction at a depth of approximately 7 feet below the ground surface. Standard Penetration Test (N) values obtained from the borings indicate that the fill is in a very loose/very soft to medium compact condition.
3) Clayey Silt: Mottled gray to olive clayey silt with minor amounts of sand was encountered beneath the fill in Boring 1 and extended to a depth of 5.5 feet

beneath the ground surface. N values obtained from the boring indicate that the natural clayey silt is in a soft to firm condition.

4) Silty Gravelly Sand: Brown to yellowish brown silty gravelly sand was encountered beneath the fill or clayey silt and extended to the maximum depth explored. N values obtained from the borings indicate that the silty gravelly sand stratum is in a medium dense to dense condition and generally became increasingly dense with increasing depth. Refusal to further penetration of the drilling and sampling equipment on rock fragments was encountered at depths varying from 13.7 to 14.3 feet below the existing ground surface.

Groundwater was measured at depths ranging from 4 to 6 feet below existing grade in the borings performed for this study. It should be anticipated that water levels may fluctuate from those observed at the time of this study as a result of seasonal variations in rainfall and temperature, water trapped in zones or pockets in the existing fill or adjacent to existing structures and other factors.

CONCLUSIONS AND RECOMMENDATIONS

General: Based on our evaluation of the subsurface conditions encountered in the borings performed for this study, the existing fill was found to vary significantly in relative density from medium dense to very soft/very loose and is therefore not capable of supporting the proposed foundations or the floor slab without the potential for excessive post-construction uniform and differential settlements. Consequently, the fill should either be removed and replaced with controlled fill for structure support or bypassed with a deep foundation/floor slab support system. Detailed discussions of these and other geotechnical related issues considered relevant to the proposed construction are presented in the following sections of this report.

Site Preparation for Fill Removal and Replacement: Site preparation should initially consist of removing the existing pavers, storm drains and subsurface utilities from within the proposed building addition area and extending at least 5 feet beyond the plan building limits. All existing topsoil, trees, shrubs and vegetation should also be removed from the proposed building area. As previously mentioned, the in-place fill

materials will not provide reliable support for the building foundation and floor slab without the risk of unacceptable post-construction settlements. Consequently, the existing fill as well as any soft clayey silt encountered beneath the fill should be removed to expose the competent bearing natural granular soils. The explorations performed for this study indicate that excavations to remove the unsuitable soils would range from approximately 5.5 to 9.5 feet. It should be anticipated, however, that the depth to the bottom of the in-place fill and soft unsuitable soils could vary between the exploration locations.

Groundwater was encountered at depths of approximately 4 to 6 feet below the existing ground surface. Inasmuch as the excavation for the unsuitable soils is anticipated to extend to depths of approximately 5.5 to 9.5 feet, a portion of the excavation will occur below the groundwater level. We anticipate that significant groundwater inflows could occur during excavation, especially in the more granular materials. We therefore believe that an open excavation may be impractical and that a temporary sheeting system may be required to safely accomplish the excavation, minimize the potential for disturbance of adjacent structural elements and temporarily control groundwater inflows. The system should be designed to withstand lateral pressures equivalent to those imposed by a fluid having a unit weight of 40 pounds per cubic foot (earth pressure) above the maximum anticipated water level and 80 pounds per cubic foot (earth and water pressure) below this level. Surcharge allowances reflecting construction equipment and materials positioned adjacent to the excavation should also be added to this pressure. We also recommend that the sheeting system penetrate a minimum of 3 to 5 feet below the construction subgrade level or a sufficient distance into the medium dense to dense sand stratum to prevent heaving of the excavation bottom.

In order to achieve stable working conditions and to preclude loosening and disturbance of the subgrade soils, dewatering must be sufficient to keep the water level at least 2 feet below the bottom of the excavation. We believe that dewatering could be accomplished by pumping from multiple sumps within or adjacent to the excavation. Actual dewatering measures and design parameters should be based on field

conditions at the time of construction as well as the contractor's means and methods of water control.

We recommend that subgrade protection measures be instituted immediately after excavation and approval of the subgrade by the geotechnical engineer. We recommend that a geotextile stabilization fabric (Mirafi 600X or equivalent) be placed over the completed subgrade and an 18 to 24-inch thick clean ¾-inch crushed stone drainage and stabilization layer be placed over the fabric. The geotextile fabric and crushed stone blanket should stabilize the wet subgrade, allow for the placement of subsequent layers of controlled compacted fill and provide a porous layer from which to control any groundwater or seepage that may enter the excavation. We recommend that surface grades be maintained during construction to prevent the inundation of the subgrade soils from surface water runoff.

All excavations should be in accordance with OSHA requirements. For this site, the soils are considered to be Type C which limits excavation sides to 1 vertical to 1.5 horizontal. Steeper slopes should be adequately protected with sheeting, shoring and bracing.

After placement of the fabric and stone stabilization layer, the remainder of the excavation should be filled with controlled compacted fill for foundation and floor slab support. All mass fill placed within the building addition area should be spread in layers on the order of 10 to 12 inches in loose thickness. Backfill placed in confined areas, such as foundation and utility trench excavations or adjacent to the existing building wall should be spread in layers on the order of 6 to 8 inches in loose thickness. Each layer of fill and backfill should be compacted to at least 95 percent of maximum dry density as determined by the Modified Proctor Moisture-Density test procedure (ASTM D-1557).

Controlled fill and/or backfill imported to the site should be at a moisture content suitable for proper compaction and should consist of a relatively well-graded granular material containing less than 15 percent by weight passing a U.S. Standard No. 200 sieve and having a maximum particle sizes of 2 inches. Imported fill materials should be certified as environmentally clean fill and should meet the NJDEP clean fill requirements. The on-site soils may be reused as controlled fill or backfill provided they are predominantly granular soils free of organics or otherwise deleterious materials, are

less than 2 inches in nominal maximum size and are at a moisture content that will permit compaction to the required densities. The on-site fill soils are high in silt content and vary in moisture content. In addition, the deeper fill material is below the observed groundwater levels and therefore saturated. These materials are difficult to dry and will require significant moisture conditioning and aeration in order to be used as controlled fill.

Shallow Foundation Design Criteria: The proposed building addition may be supported on conventional spread foundations. New foundations established on the competent bearing natural granular soils or controlled compacted fill placed and compacted in accordance with subsequent sections of this report may be proportioned to impose a maximum allowable net bearing pressure of up to 4000 pounds per square foot. However, wall foundations should be at least 24 inches in width and column foundations should be at least 2 feet by 2 feet in plan dimension. The bottoms of all exterior foundations should be established at least 3.5 feet below the adjacent exterior grades to provide protection from frost penetration. New foundations placed adjacent to existing foundations should be at the same level and may be stepped away at 2 horizontal to 1 vertical. Interior foundations in permanently heated portions of the building addition may be established at convenient depths beneath the floor slab.

We estimate that foundations designed and installed in accordance with our recommendations would experience total settlements of less than ½ of 1 inch. We expect that settlements would occur rapidly, practically upon application of load, and that post-construction differential settlements would be less than ¼ of 1 inch.

Slab-On-Grade Design Criteria: We recommend that immediately prior to slab construction, the exposed subgrade soils be moisture conditioned as necessary and recompacted and proofrolled to a dense and unyielding condition using a vibratory steel drum compactor. Any localized areas that cannot be recompacted to a dense and unyielding condition should be removed to expose suitable subsoils and the excavations backfilled with controlled compacted backfill. Following the recompaction and proofrolling operations, slabs may be designed using a vertical modulus of subgrade reaction (Kv) of 250 pounds per cubic inch. We recommend that slabs be underlain by

a minimum 6-inch thick layer of clean ¾-inch size crushed stone to provide a capillary break as well as porous drainage layer beneath the slab.

Deep Foundation and Slab Support System: This solution would entail supporting the entire building foundation and floor slab on a pile foundation system that extends through the unsuitable bearing fill and clayey silt layers to derive its support from the natural medium dense to dense silty gravelly sand. Consideration was given to various deep foundation systems including driven piles such as timber and pipe piles. However, due to the close proximity of adjacent structures and the potential for damage to these structures during pile driving operations, drilled in piles would be a more appropriate option for foundation and floor slab support at this site. We believe that mini-pipe or helical-auger piles designed for an axial capacity of up to 10 tons would be appropriate for this structure. We estimate that pile lengths would be approximately 13 to 14 feet beneath the existing ground surface. Pipe piles having a nominal outside diameter of 6 inches and helical piles having a helix diameter of 12 inches and extending at least 3 to 5 feet into the natural silty gravelly sand would have a lateral capacity of approximately 1 ton per pile and an uplift capacity of 3 tons per pile. We estimate that post-construction settlements of the building addition foundations and slab supported on piles would be negligible.

Seismic Design Considerations: Structures must be designed in conformance with the applicable seismic design criteria of the New Jersey Edition of the 2009 International Building Code. In accordance with Section 1613 of the Code, the subsurface information obtained from the borings and the known geologic conditions in this area, the site is considered to have a soil profile identified as site class "C". Based on our analysis of the subsurface conditions at this site, the field and laboratory test results, and the known geology of this area, the on-site soils are not subject to liquefaction in a seismic event and the underlying bedrock is not susceptible to solutioning or the formation of sinkholes.

RECOMMENDED SERVICES

It is recommended that Sor Consulting Engineers be provided the opportunity for a general review of the final design and specifications to assure that the foundation and

earthwork recommendations are properly interpreted and implemented in the construction documents.

We also recommend that earthwork and foundation construction operations be observed by a geotechnical engineer from our firm. This is to ensure compliance with the recommendations contained herein and to address any changes in the subsurface conditions that were not disclosed by the borings.

Sor Consulting Engineers is pleased to be of assistance with this study. Should there be any questions concerning the information or recommendations provided herein, please do not hesitate to contact us. The following appendices are attached and complete this report:

Appendix I: Boring Location Plan
Subsurface Profile Section A-A
Appendix II: Boring Logs 1 through 4
Burmeister Soil Classification System
Appendix III: Laboratory Soil Test Results
Appendix IV: Limitations

Respectfully submitted,

SOR CONSULTING ENGINEERS, INC.

Atilla Sencar, P.E.
Senior Engineer

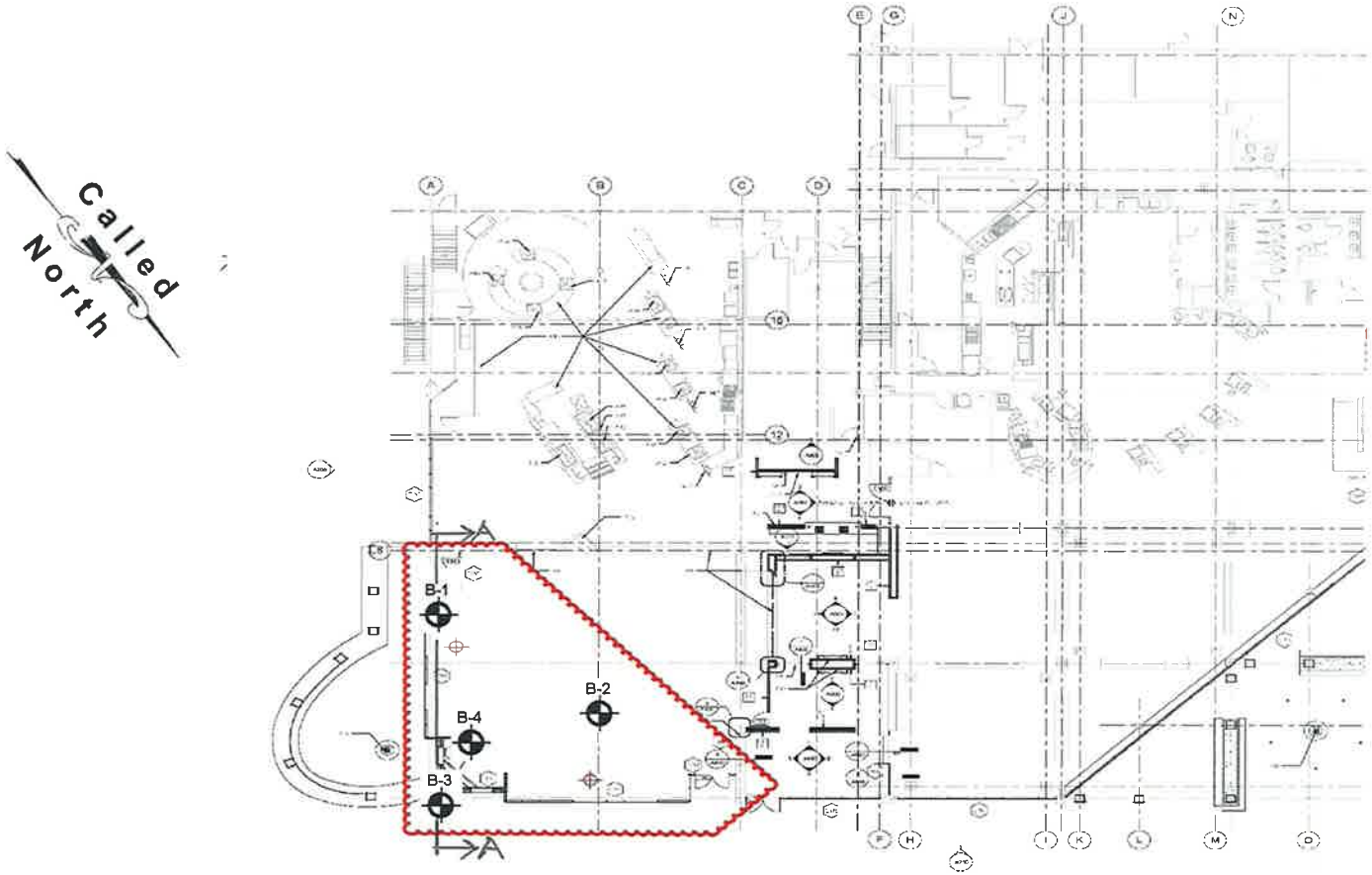
Kenneth J. Rowbotham, P.E.
Senior Engineer

AS/gs

APPENDIX I

BORING LOCATION PLAN

SUBSURFACE PROFILE SECTION A-A



LEGEND

B-1 ⊕ Number and approximate location of geotechnical boring performed by SCE for this study.

NOTES

1. This drawing is part of Sor Consulting Engineers, Inc. Report No. 15-C-153 and should be read together with the report for complete evaluation.
2. General Layout was obtained from a plan provided by the Client.

BORING LOCATION PLAN
CAMBRIDGE CONSTRUCTION MANAGEMENT
PROPOSED RAMAPO COLLEGE STUDENT CENTER PHASE 2
MAHWAH, NEW JERSEY

SOR CONSULTING ENGINEERS, INC.
Geotechnical Engineering – Materials Testing – Forensic Studies
98 Sand Park Road, Cedar Grove, New Jersey 07009

Prepared By : A.S.	Approved By : K.J.R.	DRAWING NO.
Date : 11/16/2015	Date : 11/16/2015	15-C-55-1
Scale : NTS	Report No. : 15-C-153	Sheet No. 1 of 1

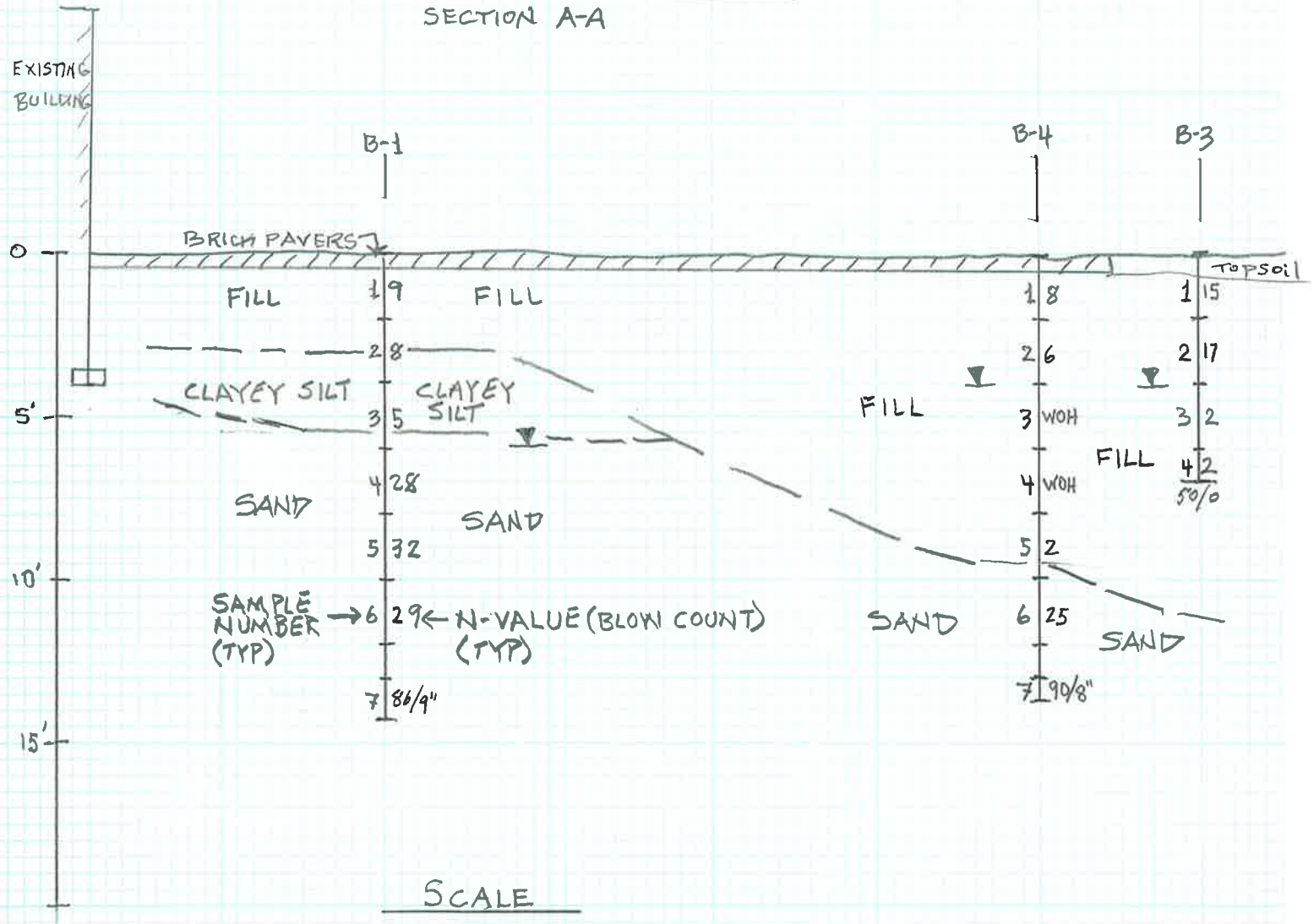
SOR CONSULTING ENGINEERS, INC.
SOR TESTING LABORATORIES, INC.
Geotechnical Engineering – Materials Testing – Forensic Studies

98 Sand Park Road, Cedar Grove, NJ 07009
(973) 239-6001 Fax (973) 239-8380

CLIENT. Cambridge Construction Management PROJECT. Ramapo College Student Center Phase 2
SUBJECT . Subsurface Profile PROJECT NUMBER. . . 15-C-55
BY . AS . DATE 11/13/15 . . CHECKED BY . EJS . . . . DATE 11/17/15 . . . . SHEET NUMBER . . . 1 . . . . . OF . . 1 . . . .

SUBSURFACE PROFILE

SECTION A-A



SCALE

VERTICAL: 1" = 5'

HORIZONTAL: 1" = 5'

APPENDIX II

BORING LOGS 1 THROUGH 4

BURMEISTER SOIL CLASSIFICATION SYSTEM

SOR CONSULTING ENGINEERS, INC.	TEST BORING LOG	BORING 1

CLIENT	Cambridge Construction Management	GSE	N/A
PROJECT	Proposed Ramapo College Student Center Phase 2	DATUM	Ground Surface
LOCATION	Mahwah, New Jersey	DATE START	11/10/2015

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATE FINISH	11/10/2015
DATE	TIME	DEPTH	CASING	TYPE	FJ	SS				
11/10/15		6'-0"		DIA.	3"	2" OD			JOB NO.	15-C-55
				WT.		140 lbs			REPORT NO.	15-C-153
				FALL		30"			SHEET NO.	1 of 1

depth, ft.	casing blows	sample type/no.	depth	sampler blows per 6"	N value	DESCRIPTION	REMARKS
1		S-1	0-2'	3 4 5 7	9	Brick Surface Grayish brown coarse to fine Sand, some Silt, some medium to fine Gravel, trace roots, organics (Fill)	Moist
2							
3		S-2	2'-4'	10 5 3 3	8	Same 3'-0"	
4						Mottled gray to olive Clayey SILT, some medium to fine Sand	
5		S-3	4'-6'	1 1 4 13	5	5'-6"	
6							
7		S-4	6'-8'	15 14 14 20	28	Brown to yellowish brown coarse to fine Sand, little Silt, and medium to fine Gravel	Wet
8							
9		S-5	8'-10'	18 14 18 14	32	Brown coarse to fine SAND, little Silt, little medium to fine Gravel	
10							
11		S-6	10'-12'	16 14 15 14	29	Same	
12							
13							
14		S-7	13'-14.3'	28 36 50/3"	86/9"	Same with rock fragments	
15						Test Boring Completed at 14'-3"	
16						(Spoon Sampler and Casing Refusal)	
17							
18							
19							
20							
21							
22							
23							
24							
25							

S - SPLIT SPOON SAMPLER
U - UNDISTURBED SAMPLE
C - CORE DRILLED

DRILLING CONTRACTOR: Environmental Technical Drilling, Inc.
DRILLING EQUIPMENT: Geoprobe 7822DT
SCE REPRESENTATIVE: Atilla Sencar

SOR CONSULTING ENGINEERS, INC.	TEST BORING LOG	BORING 2

CLIENT	Cambridge Construction Management	GSE	N/A
PROJECT	Proposed Ramapo College Student Center Phase 2	DATUM	Ground Surface
LOCATION	Mahwah, New Jersey	DATE START	11/10/2015

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATE FINISH	11/10/2015
DATE	TIME	DEPTH	CASING	TYPE	FJ	SS				
11/10/15		4'-0"		DIA.	3"	2" OD			JOB NO.	15-C-55
				WT.		140 lbs			REPORT NO.	15-C-153
				FALL		30"			SHEET NO.	1 of 1

depth, ft.	casing blows	sample type/no.	depth	sampler blows per 6"	N value	DESCRIPTION	REMARKS
				2		Brick Surface	
1		S-1	0-2'	1	5	Brown to gray coarse to fine Sand, some Silt, some coarse to	Moist
				4		fine Gravel, trace roots, organics (Fill)	
2				6			
				5			
3		S-2	2'-4'	3	7	Same (Fill)	
				4			
4				2			
				4			
5		S-3	4'-6'	2	5	Gray coarse to fine GRAVEL mixed with soil (Fill)	Wet
				3			
6				2			
				3			
7		S-4	6'-7.1'	17			
				50/1"	67/7"	Same with rubberized material at tip (Fill)	
8						Test Boring Completed at 7'-1"	
9						(Spoon Sampler and Casing Refusal)	
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

S - SPLIT SPOON SAMPLER

U - UNDISTURBED SAMPLE

C - CORE DRILLED

DRILLING CONTRACTOR: Environment Technical Drilling, Inc.

DRILLING EQUIPMENT: Geoprobe 7822DT

SCE REPRESENTATIVE: Atilla Sencar

SOR CONSULTING ENGINEERS, INC.	TEST BORING LOG	BORING 3

CLIENT	Cambridge Construction Management	GSE	N/A
PROJECT	Proposed Ramapo College Student Center Phase 2	DATUM	Ground Surface
LOCATION	Mahwah, New Jersey	DATE START	11/10/2015

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATE FINISH	11/10/2015
DATE	TIME	DEPTH	CASING	TYPE	FJ	SS				
11/10/15		4'-0"		DIA.	3"	2" OD			JOB NO.	15-C-55
				WT.		140 lbs			REPORT NO.	15-C-153
				FALL		30"			SHEET NO.	1 of 1

depth, ft.	casing blows	sample type/no.	depth	sampler blows per 6"	N value	DESCRIPTION	REMARKS
				1		Topsoil 6"	Moist
1		S-1	0-2'	4	15	Grayish brown coarse to fine Sand, some Silt, some coarse to fine Gravel, trace roots, wood (Fill)	
				11			
2				10			
				6			
3		S-2	2'-4'	7	17	Same (Fill)	
				10			
4				8			
				1			
5		S-3	4'-6'	1	2	Gray coarse to fine Sand, some Clayey Silt, some coarse to fine Gravel (Fill)	Wet
				1			
6				1			
				1			
7		S-4	6'-7'	1	1	Same (Fill)	
				50/0			
8						Test Boring Completed at 7'-0"	
9						(Spoon Sampler and Casing Refusal)	
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

S - SPLIT SPOON SAMPLER
U - UNDISTURBED SAMPLE
C - CORE DRILLED

DRILLING CONTRACTOR: Environmental Technical Drilling, Inc.
DRILLING EQUIPMENT: Geoprobe 7822DT
SCE REPRESENTATIVE: Atilla Sencar

SOR CONSULTING ENGINEERS, INC.	TEST BORING LOG	BORING 4

CLIENT	Cambridge Construction Management	GSE	N/A
PROJECT	Proposed Ramapo College Student Center Phase 2	DATUM	Ground Surface
LOCATION	Mahwah, New Jersey	DATE START	11/10/2015

GROUND WATER					CAS.	SAMP.	CORE	TUBE		
DATE	TIME	DEPTH	CASING	TYPE	FJ	SS				
11/10/15		4'-0"		DIA.	3"	2" OD			JOB NO.	15-C-55
				WT.		140 lbs			REPORT NO.	15-C-153
				FALL		30"			SHEET NO.	1 of 1

depth, ft.	casing blows	sample type/no.	depth	sampler blows per 6"	N value	DESCRIPTION	REMARKS
1		S-1	0-2'	2 3 5 6	8	Brick Surface Grayish brown coarse to fine Sand, some Silt, some coarse to fine Gravel, trace roots, wood (Fill)	Moist
3		S-2	2'-4'	3 3 3 3	6	Same (Fill)	
5		S-3	4'-6'	WOH ↓ ↓ ↓	WOH	Gray coarse to fine Sand, and Clayey Silt, some coarse to fine Gravel (Fill)	Wet
7		S-4	6'-8'	WOH ↓ ↓ ↓	WOH	Same (Fill)	
9		S-5	8'-10'	1 1 1 5	2	Same (Fill) 9'-6"	
11		S-6	10'-12'	8 10 15 20	25	Brown coarse to fine Sand, some Silt, some medium to fine Gravel	
13							
14		S-7	13'-13.7'	40 50/2"	90/8"	Same with rock fragments	
15						Test Boring Completed at 13'-7" (Spoon Sampler and Casing Refusal)	
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

S - SPLIT SPOON SAMPLER
U - UNDISTURBED SAMPLE
C - CORE DRILLED

DRILLING CONTRACTOR: Environmental Technical Drilling, Inc.
DRILLING EQUIPMENT: Geoprobe 7822DT
SCE REPRESENTATIVE: Atilla Sencar

VISUAL IDENTIFICATION OF SAMPLES

The samples were identified in accordance with the American Society for Engineering Education System of Definition described by Professor Donald M. Burmeister in ASTM Special Technical Publication 479, 5th Edition, 1970.

I. Definition of Soil Components and Fractions

MATERIAL	SYMBOL	FRACTION	SIEVE SIZE	DEFINITION
Boulders	Bldr	--	9" +	Material retained on 9" sieve.
Cobbles	Cbl	--	3" to 9"	Material passing the 9" sieve and retained on the 3" sieve.
Gravel	G	Coarse (c) Medium (m) Fine (f)	1" to 3" 3/8" to 1" No. 10 to 3/8"	Material passing the 3" sieve and retained on the No. 10 sieve.
Sand	S	Coarse (c) Medium (m) Fine (f)	No.30 to No. 10 No.60 to No. 30 No.200 to No. 60	Material passing the No. 10 sieve and retained on the No. 200 sieve.
Silt	$	--	Passing No. 200 (0.074 mm)	Material passing the No. 200 sieve that is non-plastic in character and exhibits little or no strength when air dried.

Organic Silt (O$)

Material passing the No. 200 sieve which exhibits plastic properties within a certain range of moisture content, and exhibits fine granular and organic characteristics.

		PLASTICITY	PLASTICITY INDEX	CLAY-SOIL
Clayey SILT	Cy$	Slight (sl)	1 to 5	Material passing the No. 200 sieve which can be made to exhibit plasticity and clay qualities within a certain range of moisture content, and which exhibits considerable strength when air-dried.
SILT & CLAY	$&C	Low (l)	5 to 10	
CLAY & SILT	C&$	Medium (m)	10 to 20	
Silty CLAY	$yC	High (h)	20 t 40	
CLAY	C	Very High (vh)	40 plus	

II. Definition of Component Proportions

COMPONENT	WRITTEN	PROPORTIONS	SYMBOL	PERCENTAGE RANGE BY WEIGHT*
Principal	CAPITALS	--		50 or more
Minor	Lower Case	and some little trace	a.	35 to 50
			s.	20 to 35
			l.	10 to 20
			t.	1 to 10

*Minus sign (-) lower limit, plus sign (+) upper limit, no sign middle range.

III. Glossary of Modifying Abbreviations

CATEGORY	SYMBOL	TERM	SYMBOL	TERM	SYMBOL	TERM
A. Borings	U/D	Undisturbed	B	Exploratory	A	Auger
B. Samples	C D O.E.	Casing Denison Open End	L S	Lost Spoon	U W	Undisturbed Wash
C. Colors	bk bl br gr	black blue brown gray	gn or rd tn	green orange red tan	wh yw dk lt	white yellow dark light
D. Organic Soils	dec dec'g lig	decayed decaying lignite	o rts ts	organic roots topsoil	veg pt	Vegetation peat
E. Rocks	LS Gns	Limestone Gneiss	rk SS	rock Sandstone	Shst Sh	Schist Shale
F. Fill and Misc. Material	bldr(s) brk(s) cndr(s)	boulder(s) brick(s) cinder(s)	cbl (s) wd dbr	cobble (s) wood debris	gls misc rbl	glass miscellaneous rubble
G. Misc. Terms	do el, El fgmt (s) frqt lrg mtld no rec pen	ditto elevation fragment(s) frequent large mottled no recovery penetration	pp P.I. P pc(s) rec or R	pocket penetrometer Plasticity Index pushed pressed piece(s) recovered	ref sm W.L. W.H. W.R.	refusal small water level weight of hammer weight of rods
H. Stratified Soils	alt thk thn w prt seam lyr stra vvd c pkt Ins occ freq	alternating thick thin with parting seam layer stratum varved Clay pocket lens occasional frequent	-) to 1/16" thickness - 1/16 to 1/2" thickness - 1/2 to 12" thickness - greater than 12" thickness - alternating seams or layers of sand, silt and clay - small, erratic deposit, usually less than 1 foot - lenticular deposit - one or less per foot of thickness - more than one per foot of thickness			

IV. Other Descriptive Criteria

A. Relative density of coarse-grained soils and non-plastic silts.

N-VALUE	DESCRIPTIVE TERM	RELATIVE DENSITY (%)
0-4	Very Loose	0-15
4-10	Loose	15-45
10-30	Medium Dense	45-70
30-50	Dense	70-85
50+	Very Dense	85-100

B. Consistency of fine-grained soils with some plasticity.

N-VALUE	DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH (tsf)
0-2	Very Soft	Less than 0.25
2-4	Soft	0.25-0.50
4-8	Medium	0.50-1.00
8-16	Stiff	1.00-2.00
16-32	Very Stiff	2.00-4.00
32+	Hard	4.00+

APPENDIX III

LABORATORY SOIL TEST RESULTS

SOR TESTING LABORATORIES, INC.

98 Sand Park Road - Cedar Grove, NJ 07009
Tel.: (973) 239-6001 Fax: (973) 239-8380 http://www.sorlabs.com

PARTICLE SIZE DISTRIBUTION TEST REPORT

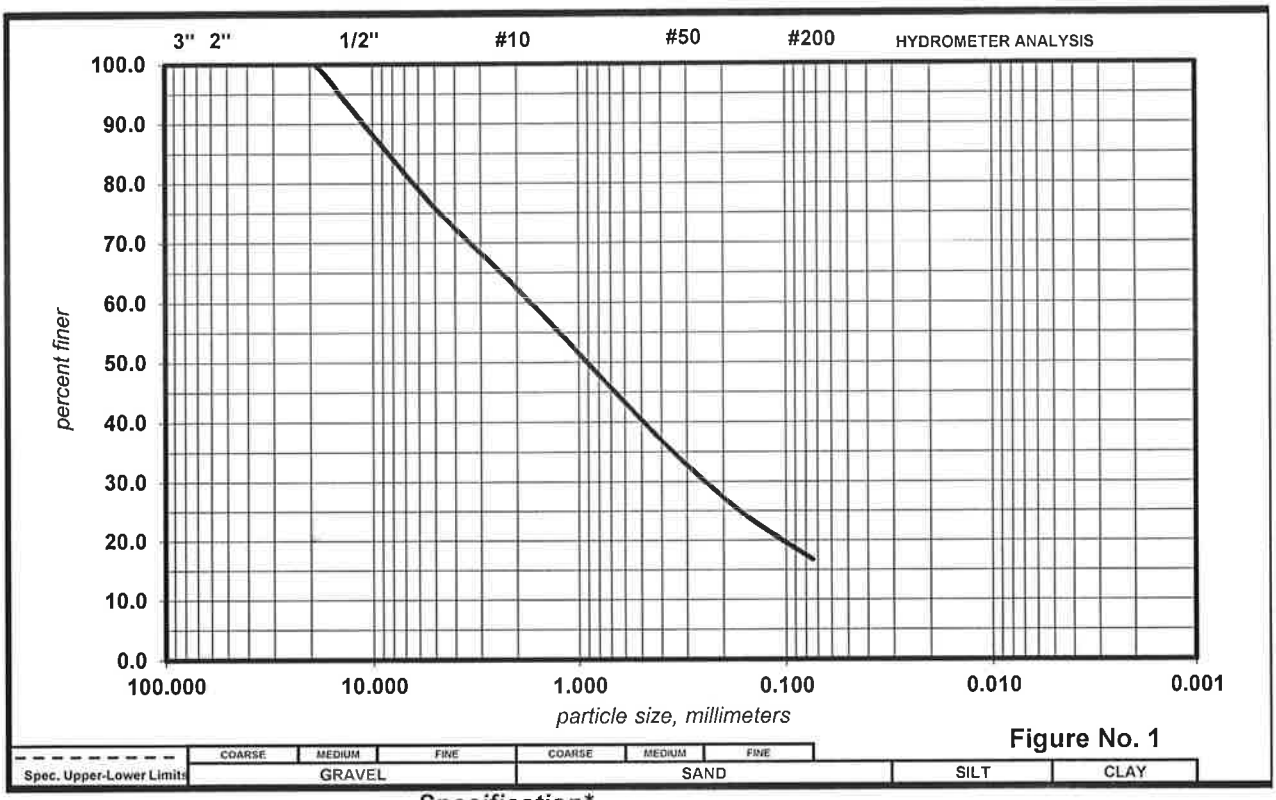


Figure No. 1

*Specification**

Sieve Size	% Finer	Min.(%)	Max.(%)
3" (75 mm)			
2 1/2" (63 mm)			
2" (50 mm)			
1 1/2" (38.1 mm)			
1" (25 mm)			
3/4" (19 mm)	100.0		
5/8" (16 mm)			
1/2" (12.5 mm)	92.5		
3/8" (9.5 mm)	87.4		
5/16" (8 mm)			
1/4" (6.3 mm)			
#4 (4.75 mm)	75.1		
#6 (3.35 mm)			
#8 (2.36 mm)			
#10 (2 mm)	62.3		
#14 (1.4 mm)			
#16 (1.18 mm)			
#20 (850 µm)			
#30 (600 µm)	43.0		
#40 (425 µm)	37.6		
#50 (300 µm)			
#60 (250 µm)	30.2		
#100 (150 µm)	23.7		
#200 (75 µm)	16.7		

* -

Sample Identification

Sample No.: B-1, S-4
Lab No.: A15-199-01
Source/Location: 6'-8'
Description:
D.Yel.Brown cf Sand, little Silt, and mf Gravel

sample description in accordance with Burmister System

LL :	PL :	PI :

As received Moisture Content: 10.0 %

Classification:
USCS: [SM]
AASHTO:

Remarks:
Sample received in lab on November 12, 2015

Client: Cambridge Construction Management
Project: Ramapo College Student Center Phase 2
Location: Mahwah, New Jersey
Date: 13-Nov-15
Job No.: 15-C-55 **Report No.:** 15-C-153

SOR TESTING LABORATORIES, INC.

98 Sand Park Road - Cedar Grove, NJ 07009
Tel.: (973) 239-6001 Fax: (973) 239-8380 http://www.sorlabs.com

PARTICLE SIZE DISTRIBUTION TEST REPORT

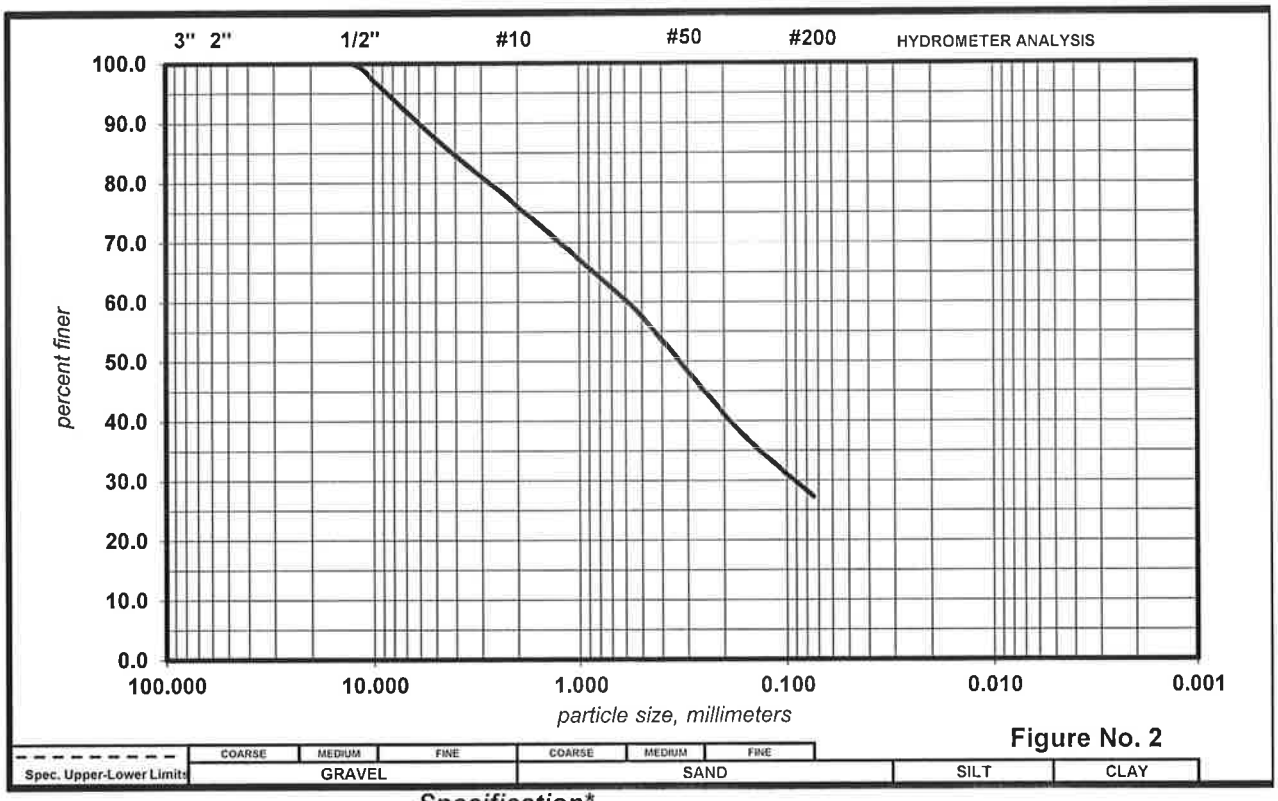


Figure No. 2

*Specification**

Sieve Size	% Finer	Min.(%)	Max.(%)
3" (75 mm)			
2 1/2" (63 mm)			
2" (50 mm)			
1 1/2" (38.1 mm)			
1" (25 mm)			
3/4" (19 mm)			
5/8" (16 mm)			
1/2" (12.5 mm)	100.0		
3/8" (9.5 mm)	96.5		
5/16" (8 mm)			
1/4" (6.3 mm)			
#4 (4.75 mm)	86.8		
#6 (3.35 mm)			
#8 (2.36 mm)			
#10 (2 mm)	76.0		
#14 (1.4 mm)			
#16 (1.18 mm)			
#20 (850 µm)			
#30 (600 µm)	60.1		
#40 (425 µm)	54.4		
#50 (300 µm)			
#60 (250 µm)	44.9		
#100 (150 µm)	36.3		
#200 (75 µm)	27.3		

* -

Sample Identification

Sample No.: B-3, S-3
Lab No.: A15-199-02
Source/Location: 4'-6'
Description:
D.Ol.Gray cf Sand, some Silt, some mf Gravel

sample description in accordance with Burmister System

LL :	PL :	PI :

As received Moisture Content: 17.4 %

Classification:
USCS: [SM]
AASHTO:

Remarks:
Sample received in lab on November 12, 2015

Client: Cambridge Construction Management
Project: Ramapo College Student Center Phase 2
Location: Mahwah, New Jersey
Date: 13-Nov-15
Job No.: 15-C-55 **Report No.:** 15-C-153

SOR TESTING LABORATORIES, INC.

98 Sand Park Road - Cedar Grove, NJ 07009
Tel.: (973) 239-6001 Fax: (973) 239-8380 http://www.sorlabs.com

PARTICLE SIZE DISTRIBUTION TEST REPORT

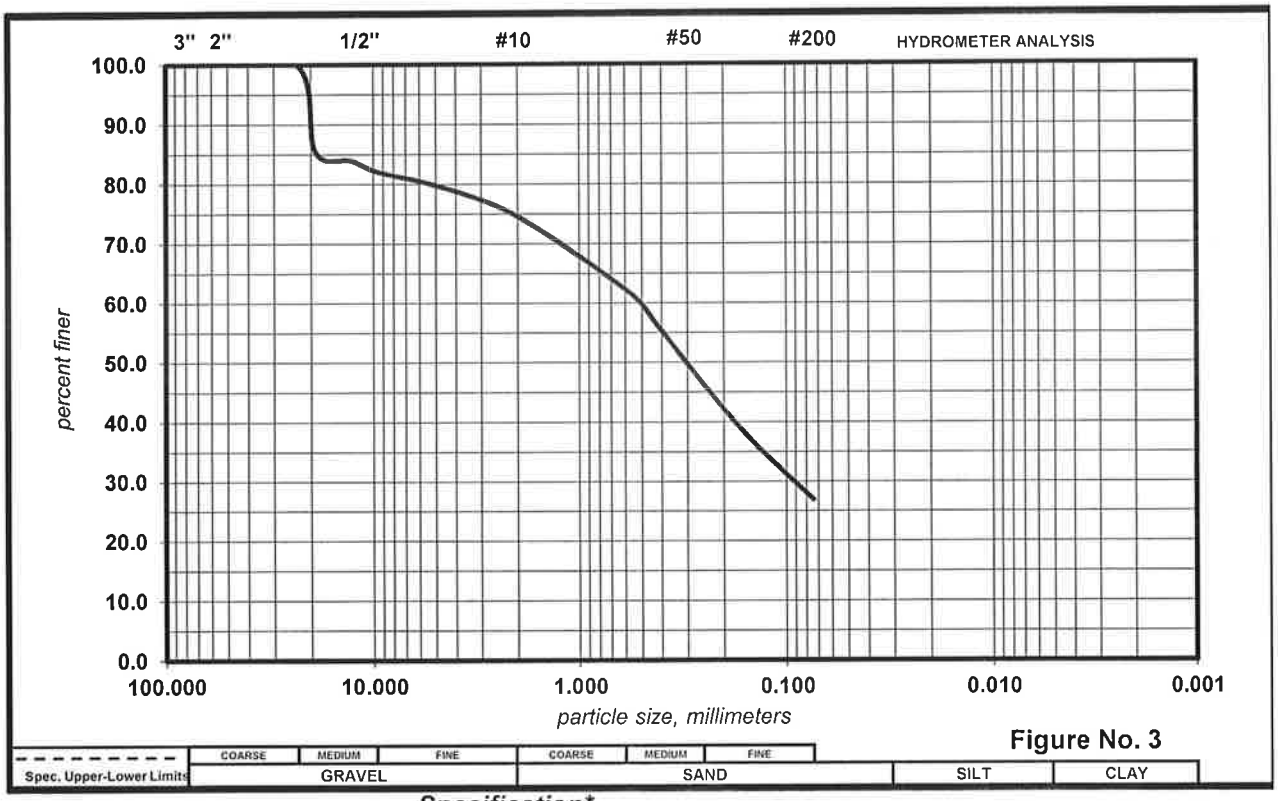


Figure No. 3

*Specification**

Sieve Size	% Finer	Min.(%)	Max.(%)
3" (75 mm)			
2 1/2" (63 mm)			
2" (50 mm)			
1 1/2" (38.1 mm)			
1" (25 mm)	100.0		
3/4" (19 mm)	85.5		
5/8" (16 mm)			
1/2" (12.5 mm)	84.0		
3/8" (9.5 mm)	82.1		
5/16" (8 mm)			
1/4" (6.3 mm)			
#4 (4.75 mm)	79.6		
#6 (3.35 mm)			
#8 (2.36 mm)			
#10 (2 mm)	74.6		
#14 (1.4 mm)			
#16 (1.18 mm)			
#20 (850 µm)			
#30 (600 µm)	62.1		
#40 (425 µm)	56.2		
#50 (300 µm)			
#60 (250 µm)	46.2		
#100 (150 µm)	37.0		
#200 (75 µm)	27.0		

* -

Sample Identification

Sample No.: B-4, S-6
Lab No.: A15-199-03
Source/Location: 10'-12'
Description:
Ol.Brown cf Sand, some Silt, some mf Gravel

sample description in accordance with Burmister System

LL :	PL :	PI :

As received Moisture Content: 9.2 %

Classification:
USCS: [SM]
AASHTO:

Remarks:
Sample received in lab on November 12, 2015

Client: Cambridge Construction Management
Project: Ramapo College Student Center Phase 2
Location: Mahwah, New Jersey
Date: 13-Nov-15
Job No.: 15-C-55 **Report No.:** 15-C-153

APPENDIX IV

LIMITATIONS

LIMITATIONS

The conclusions and recommendations contained in this geotechnical report no. 15-C-153 are based upon the applicable standards of our profession at the time this report was prepared.

The analyses and recommendations submitted in this report are based in part upon the data obtained from four widely-spaced test borings performed for this study. The stratification lines shown on the individual logs of the subsurface explorations represent the approximate boundaries between soil types. However, the transition between soil types may be gradual.

In our opinion, the number of explorations performed for this study are adequate for a general understanding of the site subsurface conditions. However, the nature and extent of variations between the explorations may not become evident until construction. If, during construction, variations become evident, it will be necessary to re-evaluate the recommendations of this report.

In the event that any changes in the nature, design or location of the proposed building addition are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

This report may be referred to or included in the project specifications for general information purposes only, but should not be solely used as the technical specifications for the work.

This geotechnical engineering report was prepared for the project by Sor Consulting Engineers, Inc. for design purposes only, and may not be sufficient to prepare an accurate bid. Contractors utilizing the information in the report should do so with the express understanding that its scope is limited to design considerations. Prospective bidders should obtain the owner's permission to perform whatever additional explorations or data gathering they deem necessary to prepare their bid accurately.

This report has been prepared in accordance with generally accepted geotechnical engineering practices for the exclusive use of Cambridge Construction Management and/or their authorized representatives for specific application to the design of the proposed Ramapo College Student Center Phase 2 building addition project to be constructed on the Ramapo College campus located at 505 Ramapo Valley Road in Mahwah, New Jersey. No other warranty, expressed or implied, is made.