APPENDIX C

Preliminary Geotechnical Report

McPHAIL ASSOCIATES, LLC

FOUNDATION ENGINEERING REPORT

BABSON COLLEGE
NEW RESIDENCE HALL

WELLESLEY MASSACHUSETTS

for

Babson College

December 10, 2012

Project No. 5477

McPHAIL ASSOCIATES, LLC

December 10, 2012

Babson College
Facilities Management and Planning
231 Forest Street
Sullivan Building; Room 111
Babson Park, MA 02457-0310

Attention: Ms. Kerrie Dunn, Buyer, Purchasing

Reference: Proposed New Residence Hall, Babson College; Wellesley, Massachusetts
Foundation Engineering Report

Gentlemen:

This report documents the results of our subsurface exploration program and foundation design study for the proposed new residence hall to be located on the campus of Babson College in Wellesley, Massachusetts. Refer to the Project Location Plan (Figure 1) for the general site location.

This report was prepared in accordance with the authorization of Ms. Kerris Dunn of Babson College. These services are subject to the limitations contained in Appendix A.

Purpose and Scope

The purposes of the subsurface exploration program and foundation design study are to assess the subsurface soil and groundwater conditions at the site as they relate to foundation design and construction, and based on this information to provide safe and economic foundation design recommendations for the proposed structure.

Foundation design includes foundation support of the proposed building and its lowest level slab, treatment of the lowest level slab in consideration of groundwater, and seismic design considerations in accordance with the provisions of the Eighth Edition of the Massachusetts State Building Code (Code). Foundation construction considerations relating to geotechnical aspects of the proposed construction are also presented herein.

Existing Site Conditions

The proposed residence hall is planned to be located within an existing landscaped area. The landscaped area is lightly wooded, contains paved walkways and is bounded by Babson College Drive to the southwest, Luksic Hall to the northwest, Park Manor South to the southeast and a campus roadway that provides access to Forest Street to the northeast. Existing site grades generally slope downward from the southwest towards the northeast, varying from about Elevation +188 to Elevation +173.

Proposed Site Development

It is understood that the proposed residence hall will consist of a 3-story structure with an approximate T-shaped footprint occupying an area of about 21,000 square feet. It is understood that one level of below grade space is planned as part of the construction. The lowest level slab of the proposed residence hall will be located at Elevation +173.

GEOTECHNICAL AND GEOENVIRONMENTAL ENGINEERS
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Cambridge, Massachusetts 02140
617 / 868-1420

Subsurface Exploration Program

On November 29 and 30, 2012, a subsurface exploration program consisting of six borings (B-1 through B-6) was completed at the project site by McPhail Associates, LLC (McPhail). The borings were performed by GeoLogic Earth Exploration, Inc. of Norfolk, Massachusetts under contract to McPhail. The borings were drilled to depths of 8.5 to 21 feet below existing grade, and were terminated in a glacial till deposit. Standard 2-inch O.D. split-spoon samples and standard penetration tests were obtained at minimum 5-foot intervals of depth in accordance with the standard procedures described in ASTM D1586. Boring logs prepared by McPhail are contained in Appendix B following the text of this report. Approximate plan locations of the borings are indicated on the enclosed Subsurface Exploration Plan (Figure 2).

Initially, to reduce the possibility of encountering unmarked utilities, each boring location was surveyed using a Ground Penetrating Radar (GPR) technique. After completion of the GPR survey and relocation of the boring location if deemed appropriate based on the survey results, an approximate 8-inch diameter hole was advanced to an approximate depth of 4 feet below the existing ground surface utilizing high-pressure, truck-mounted vacuum equipment.

The borings were monitored by a McPhail field representative who performed field layout, prepared field logs, obtained and visually classified soil samples, monitored groundwater conditions in the open boreholes, and determined the required exploration depths based upon the actual subsurface conditions encountered.

The borings were laid out in the field at locations chosen by and included on an existing conditions plan prepared by Sasaki Associates and dated November 8, 2012. The existing ground surface elevation at each boring location was determined by a level survey performed by our field staff utilizing vertical control information on the above mentioned existing conditions plan.

In-Situ Permeability Testing Procedures

On November 30, 2012 and December 5, 2012, a.total of three (3) constant head, in-situ permeability tests were performed at the site at locations selected by Sasaki Associates, the project architect. The permeability tests were conducted at locations P-1, P-2, and P-3. The tests were performed at the base of the pre-vacuumed holes at depths of about 4 to 4.5 feet below the existing ground surface. Each permeability test was performed within the glacial till deposit. The calculated permeability values ranged from 4.6×10^{-5} centimeters per second (cm/sec) to 2.0×10^{-6} cm/sec. These in-situ permeabilities are considered to be representative of the silt content and very dense nature of the relatively impervious glacial till deposit. The results of the individual in-situ permeability tests are presented in Appendix C and are summarized in Table 1.

The permeability tests were conducted within open-end casing and were performed in general accordance with the U.S. Bureau of Reclamation, Designation E-18 (USBR Method E-18). The general procedures are described below.

The borehole was advanced inside a 4-inch I.D. steel casing. Once the desired test depth was reached, the soil was carefully cleaned out to the bottom of the casing using wet rotary drilling techniques. Clean water was then introduced into the borehole to a pre-determined level. The flow rate of the water was

subsequently adjusted until a relatively constant head could be maintained in the casing at a relatively constant flow rate (steady state).

The coefficient of permeability (k) of the soil was then calculated as:

$$k = \frac{q}{5.5rh}$$

where: q = constant rate of flow into the borehole;
r = inside radius of casing;
h = head of water used to maintain steady state.
(Note: Any consistent units may be used.)

Laboratory Testing

At the completion of the field work, soil samples were returned to our laboratory for more detailed classification, analysis and testing. The laboratory testing consisted of sieve analyses to determine the gradations and confirm the visual classifications of the glacial till deposit. Laboratory test procedures were in general accordance with applicable ASTM Standards. Results of the sieve analyses for the glacial till deposit appear in Figure 3.

Subsurface Conditions

A detailed description of the subsurface conditions encountered in the borings is documented on the logs contained in Appendix B. Based on the borings performed at the site, the following is a description of the generalized subsurface conditions across the site encountered from ground surface downward.

The surface treatment across the site consisted of a 2 to 4-foot layer of topsoil and subsoil consisting of loose, brown silty sand with roots and some gravel. Underlying the topsoil and subsoil material was a glacial till deposit typically consisting of a very dense, light brown to grayish brown, silty sand and gravel. The glacial till deposit was observed to contain numerous cobbles and boulders. The surface of the glacial till deposit was encountered at depths ranging from 2 to 4 feet below existing grade, or from about Elevation +172.8 to Elevation +182.6. The glacial till deposit was observed to extend to at least the bottom of the explorations at depths ranging from 8.5 to 21 feet below the existing ground surface. Borings B-1 and B-6 encountered auger refusal at depths of 17 feet and 8.5 feet, respectively, on what is believed to be boulders. Grain size distributions of typical samples of the glacial till deposit are presented on the enclosed Figure 3.

Groundwater was observed in the open boreholes at depths ranging from 8 to 18 feet below ground surface, or from about Elevation +166.8 to Elevation +168.9. It is anticipated that future groundwater levels across the site may vary from those reported herein due to factors such as normal seasonal changes, runoff during or following periods of heavy precipitation, and alterations to existing drainage patterns.

Foundation Design Recommendations

Based on the scope of the proposed construction and the subsurface conditions encountered at the site, it is recommended that the proposed structure be founded on conventional footing foundations bearing directly on the undisturbed, natural glacial till deposit. Footings should be proportioned utilizing an allowable design bearing pressure of four (4) tons per square foot. The minimum footing width for perimeter footings and isolated footings should be 24 inches and 30 inches, respectively. All foundations should be designed in accordance with the Code.

Perimeter foundations and interior foundations below unheated areas should be provided with a minimum 4-foot thickness of soil cover as frost protection. Interior foundations below heated areas should be located such that the top of foundation concrete is a minimum of six inches below the underside of the lowest level slab. All foundations should be located such that they are below a theoretical line drawn upward and outward at 2 to 1 (horizontal to vertical) from the bottom exterior edge of all adjacent footings, structures and utilities.

It is recommended that the lowest level slab be designed as a conventional soil-supported slab-on-grade. The slab-on-grade should be underlain by a polyethylene vapor barrier spread across the surface of a minimum 9-inch thickness of compacted 3/4-inch crushed stone placed over a filter fabric that is spread across the subgrade consisting of the undisturbed glacial till deposit.

In consideration of the lowest level slab being generally below the proposed exterior finished grade, it is recommended that perimeter and underslab drainage be provided wherever the proposed lowest level floor slab is more than 18 inches below the finished grade. Although groundwater was typically encountered 4 to 6 feet below the proposed lowest level slab during the subsurface exploration programs, the perimeter and underslab drains are intended to minimize groundwater intrusion into the below grade space due to conditions when groundwater may become temporarily elevated or "perched" on the glacial till deposit. The underslab and perimeter drainage systems are not intended to lower the existing groundwater level.

The perimeter drainage system should consist of a 4-inch diameter perforated PVC pipe having the highest invert a minimum of 12 inches below the underside of the lowest level slab. Where possible, the pipe should be pitched down at a minimum 0.5 percent slope in the direction of flow and be surrounded by a minimum 6-inch thickness of 3/4-inch crushed stone surrounded by a thickness of filter fabric such as Mirafi 140N, or equivalent.

All below-grade walls should receive a troweled-on bitumastic damproofing. A prefabricated drainage product, such as Miradrain 6000, should be installed directly against the below-grade perimeter foundation walls and be tied into the perimeter drainage system. Backfill against the perimeter foundation walls may consist of ordinary fill. Additionally, the exterior site grades should be sloped away from the perimeter of the proposed building to minimize surface water infiltration.

The underslab drainage system should consist of a series of 4-inch diameter perforated PVC pipes located within the crushed stone drainage layer and should be surrounded by a minimum 6-inch thickness of 3/4-inch crushed stone. The drain pipes should have an invert at least 12 inches below the bottom of the lowest level slab, and where possible, should be pitched down at a minimum 0.5 percent slope.

The perimeter and underslab drain lines should be gravity drained to a storm drain line that is not subject to surcharge or terminated within a sump pit that discharges into the storm drain system. If required, the

sump pit should be equipped with duplex pumps, each of which should be capable of pumping a minimum of 30 gallons per minute against a 20-foot head.

All localized depressions in the lowest level slabs, such as elevator pits, should be provided with properly tied continuous waterstops in all construction joints and metallic waterproofing should be applied to properly prepared interior surfaces to protect against groundwater intrusion.

Below-grade foundation walls receiving lateral support at the top and bottom (i.e. restrained walls) should be designed for a lateral earth pressure corresponding to an equivalent fluid density of 60 pounds per cubic foot. To these values must be added the pressures attributable to earthquake forces per Section 1610.2 of the Code.

Lateral forces can be transmitted from the structure to the soil by passive pressure on the footings utilizing an equivalent fluid density of 120 pounds per cubic-foot providing that these structural elements are designed to resist these pressures. Lateral forces can also be considered to be transmitted from the structure to the soil by friction on the base of the footings using a frictional coefficient of 0.50 to which a factor of safety of 1.5 should be applied.

Seismic Design Considerations

For the purposes of determining parameters for structural seismic design, this site is considered to be a Site Class C as defined in Section 1613.5.2 of the Code. Further, the bearing strata on the proposed site is not considered to be subject to liquefaction during an earthquake based on the criterion of Section 1806.4 of the Code.

Foundation Construction Considerations

The primary construction considerations include preparation of the foundation bearing surfaces, relocation of existing utilities, construction dewatering, subgrade protection, reuse of on-site soils, and off-site disposal of excess excavated soil.

The final excavation of the footing subgrade should be accomplished using an excavator that is equipped with smooth-edged bucket to avoid disturbance of the bearing surface. Further, it is recommended that as soon as the bearing surface is exposed, it be immediately covered with a minimum 3-inch thickness of compacted 3/4-inch crushed stone to prevent disturbance of the subgrade during subsequent forming operations.

Where existing utilities and structures are located within the footprint of the proposed building, they should be relocated prior to construction. The resulting abandoned utility/structure and associated backfill should be removed and replaced with compacted gravel fill.

Due to the moderate silt content of the existing glacial till deposit, proper control of groundwater and surface water will be necessary to maintain a firm subgrade to support construction traffic. Based on the soil and groundwater conditions encountered in the subsurface explorations, it is anticipated that groundwater and surface water can be controlled using conventional sumping. Pumped groundwater should be recharged on site where possible. Otherwise, the appropriate dewatering discharge permits should be obtained prior to discharging water into nearby storm drains. Even with proper control of both

surface water and groundwater, it is probable that during periods of wet weather off-site gravel fill and/or crushed stone may be required to maintain trafficability for construction equipment.

Due to the moderate silt content of the glacial till, this soil is not anticipated to be suitable for reuse as structural fill. However, the glacial till deposit is anticipated to be suitable for reuse as ordinary fill, provided that it is maintained in a relatively dry condition and can be properly compacted. The explorations indicate the presence of cobbles and boulders in the glacial till deposit. Thus, prior to reusing the glacial till as ordinary fill, it will be necessary to cull out all material in excess of 6 inches in largest dimension.

As indicated above, the glacial till deposit contains a moderate silt content. Hence, it is emphasized that these excavated soils can become unsuitable for reuse as fill if they become too wet. It is recommended that stockpiles of excavated material intended for reuse be protected against increases in moisture content by securely covering the stockpiles prior to and during precipitation events. Therefore, the placement and compaction of the on-site soil should be completed during relatively dry and non-freezing conditions.

Current Department of Environmental Protection (DEP) policies and regulations for off-site disposal of excess excavated soil require environmental characterization of the excess excavated soil prior to its off-site disposal. In general, one full suite of chemical analyses per 500 cubic yards of topsoil material and one full suite of chemical testing per 1,000 cubic yards of glacial till material is typically required by the receiving facilities. Therefore, based on the actual volume of topsoil and glacial till that is required to be removed from the site, some chemical testing of soil samples may be required for the off-site disposal of excess excavated soil. McPhail Associates, LLC can provide these services should they be required for this project.

Final Comments

It is recommended that McPhail Associates, LLC be retained to provide design assistance to the design team during the final design phase of this project. The purpose of this involvement would be to review the structural foundation drawings and foundation notes for conformance with the recommendations presented herein and to prepare the earthwork specification section for inclusion into the Contract Documents for construction.

It is also recommended that McPhail Associates, LLC be retained during the construction period to observe final preparation of the foundation bearing surfaces and to monitor placement and compaction of fill materials in accordance with the provisions of the Code and the provisions of the Contract Documents. Our involvement during the construction phase of the work should minimize costly delays due to unanticipated field problems since our field engineer would be under the direct supervision of our project manger who was responsible for the subsurface exploration program and foundation design recommendations documented herein.

McPHAIL ASSOCIATES, LLC

We trust that the above is sufficient for your present requirements. Should you have any questions concerning the recommendations presented herein, please do not hesitate to contact us.

Very truly yours,

McPHAIL ASSOCIATES, LLC

Benjamin E. Downing

Chris M. Erikson, P.E.

Enclosures

F:\WP5\REPORTS\5477_FER.wpd

BED/cme

FIGURE 1

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617/868-1423 (Fax)

N

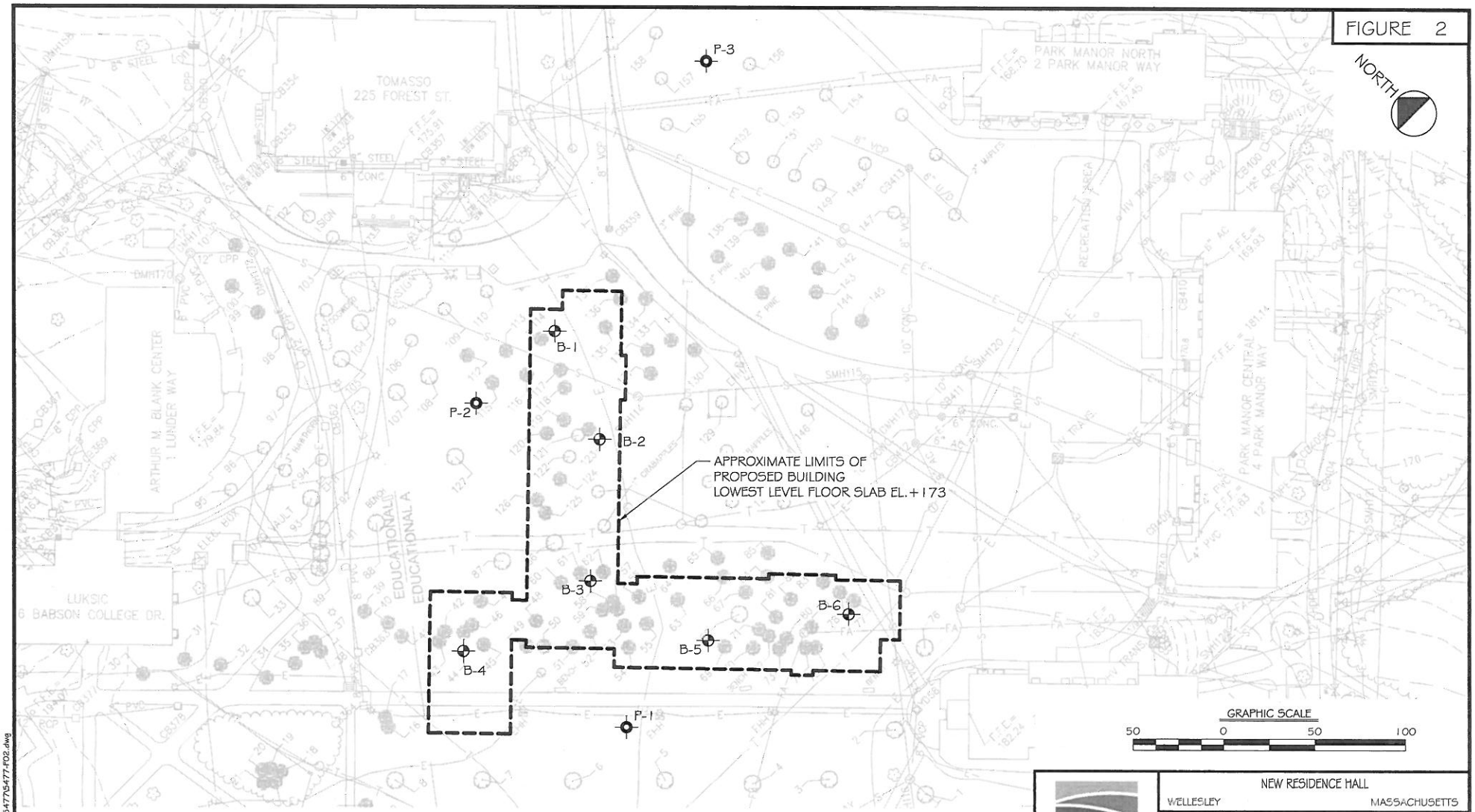
SCALE 1:25,000

PROJECT LOCATION PLAN

NEW RESIDENCE HALL

WELLESLEY MASSACHUSETTS

FIGURE 2



LEGEND

- ⊕ — APPROXIMATE LOCATION OF BORINGS PERFORMED BY GEO-LOGIC EARTH EXPLORATION, INC. ON NOVEMBER 29 AND 30, 2012 FOR McPHAIL ASSOCIATES, LLC
- ⊕ — APPROXIMATE LOCATION OF INFILTRATION TEST PERFORMED BY McPHAIL ASSOCIATES, LLC ON NOVEMBER 30, 2012 AND DECEMBER 5, 2012

REFERENCE: THIS PLAN WAS PREPARED FROM A 50-SCALE DRAWING PROVIDED BY SASAKI ASSOCIATES, INC.

McPHAIL ASSOCIATES, LLC
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NEW RESIDENCE HALL
WELLESLEY MASSACHUSETTS
SUBSURFACE EXPLORATION PLAN
FOR
BABSON COLLEGE
BY
McPHAIL ASSOCIATES, LLC

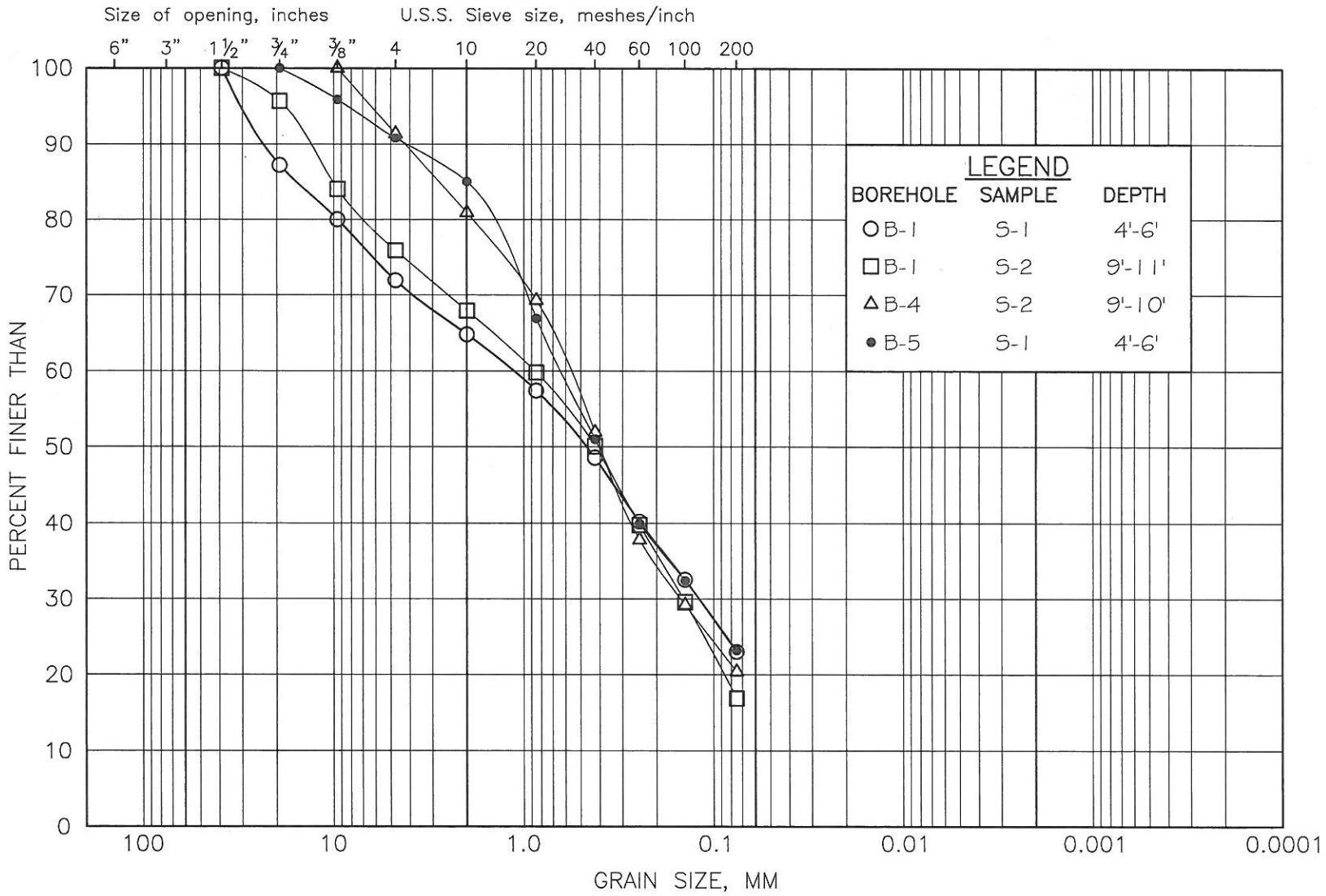
Date: DECEMBER 2012	Dwn: F.G.P.	Chkd: B.E.D.	Scale: 1" = 50'
Project No: 5477			

FILE NAME: H:\Acad\JOBS\5477\5477-F02.dwg

FILE NAME: H:\Acad\JOBS\5477\5477-F03_Sieve.dwg

PROJECT No. 5477

M.I.T. GRAIN SIZE SCALE



COBBLE SIZE	GRAVEL SIZE			SAND SIZE			FINE GRAINED	
	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE

McPHAIL ASSOCIATES, LLC

GRAIN SIZE DISTRIBUTION
GLACIAL TILL

FIGURE 3

McPHAIL ASSOCIATES, LLC

TABLE 1

Babson College New Residence Hall
Wellesley, MA
Project No. 5477

Constant Head Borehole Permeability Test Summary

Borehole	Test Depth (ft)	Soil Strata	Head (ft)	Flow Rate, q (cm^3/s)	Permeability, k (cm/s)	(ft/day)
P-1	4	Glacial Till	4.5	$1.92x10^{-1}$	$2.51x10^{-5}$	$7.10x10^{-2}$
P-2	4.5	Glacial Till	5.5	$4.31x10^{-1}$	$4.60x10^{-5}$	$1.31x10^{-1}$
P-3	4.5	Glacial Till	5	$8.33x10^{-3}$	$1.96x10^{-6}$	$5.54x10^{-3}$

McPHAIL ASSOCIATES, LLC

APPENDIX A

Limitations

McPHAIL ASSOCIATES, LLC

Limitations

This report has been prepared on behalf of and for the exclusive use of Babson College for specific application to the proposed 3-story residence hall to be located in Wellesley, Massachusetts in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

In the event that any changes in nature, design or location of the proposed structure are planned, the information contained in this report should not be considered valid unless the changes are reviewed and the information presented in this report is modified or verified in writing.

The analyses and recommendations presented in this report are based upon the data obtained from the subsurface explorations performed at the approximate locations indicated on the enclosed Figure 2. If variations in the nature and extent of subsurface conditions between the widely spaced explorations become evident during the course of construction, it will be necessary for a re-evaluation of the recommendations of this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations.

McPHAIL ASSOCIATES, LLC

APPENDIX B

Boring Logs Prepared by McPhail Associates, LLC

Project:	Babson College New Residence Hall	**Job #:**	5477
Location:	Babson College	**Date Started:**	11-29-12
City/State:	Wellesley, MA	**Date Finished:**	11-29-12

Boring No.

B-1

Contractor: Geo-Logic
Driller/Helper: Charlie
Logged By/Reviewed By: RJC/BED
Surface Elevation (ft): 174.8

Casing Type/Depth (ft): 3 3/4" HSA
Casing Hammer (lbs)/Drop (in): N/A
Sampler Size/Type: 1 3/8" SS
Sampler Hammer (lbs)/Drop (in): 140 lb/30 in

Groundwater Observations

Date	Depth	Elev.	Notes
11-29-12	8	166.8	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	Sample No.	Sample Pen./Rec. (in)	Sample Depth (ft)	Sample Blows/6" / Min/ft	Sample Description and Boring Notes
1	174			(TOPSOIL and SUBSOIL)	-		/	0.0		Vacuum truck from 0-4 ft. Surface of Glacial Till deposit observed in open vac hole.
2	173		2.0 / 172.8							
3	172									
4	171									
5	170				227	S-1	24/18	4.0-6.0	33 120 107 91	Very dense, light brown, gravelly/silty SAND (Glacial Till)
6	169									
7	168				-		/	6.0		Difficlut drilling from 6-9 ft, numerous cobbles and boulders
8	167									
9	166									
10	165			(GLACIAL TILL)	101	S-2	24/8	9.0-11.0	140 50 51 53	Very dense, light brown silty SAND and GRAVEL (Glacial Till)
11	164									
12	163									
13	162									
14	161									
15	160				120/6"	S-3	12/6	14.0-15.0	50 120	Very dense, grayish brown SILT, SAND, and GRAVEL.
16	159				-		/	15.0		Difficult drilling, likely cobbles and boulders. Auger refusal at 17 ft.
17	158		17.0 / 157.8	Auger Refusal - Bottom of Exploration						
18	157									
19	156									
20	155									
21	154									
22	153									
	152									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL	
"TRACE"	0-10%	SOIL CONTAINING THREE
"SOME"	10-20%	COMPONENTS EACH OF WHICH
"ADJECTIVE" (eg SANDY, SILTY)	20-35%	COMPRISE AT LEAST 25% OF
"AND"	35-50%	THE TOTAL ARE CLASSIFIED AS
		"A WELL-GRADED MIXTURE OF"

Notes:

Weather: Sunny Temperature: 38

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FAX: 617-868-1423

Project:	Babson College New Residence Hall	**Job #:**	5477
Location:	Babson College	**Date Started:**	11-29-12
City/State:	Wellesley, MA	**Date Finished:**	11-29-12

Boring No.

B-2

Contractor: Geo-Logic
Driller/Helper: Charlie
Logged By/Reviewed By: RJC/BED
Surface Elevation (ft): 176.9

Casing Type/Depth (ft): 3 3/4" HSA
Casing Hammer (lbs)/Drop (in): N/A
Sampler Size/Type: 1 3/8" SS
Sampler Hammer (lbs)/Drop (in): 140 lb/30 in

Groundwater Observations

Date	Depth	Elev.	Notes
11-29-12	8	168.9	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	Sample No.	Sample Pen./Rec. (in)	Sample Depth (ft)	Sample Blows/6" / Min/ft	Sample Description and Boring Notes
1	176			(TOPSOIL and SUBSOIL)	-		/	0.0		Vacuum truck from 0-4 ft. Surface of Glacial Till deposit observed in open vac hole.
2	175		2.5 / 174.4							
3	174			(GLACIAL TILL)						
4	173				129/6"	S-1	12/6	4.0-5.0	86 129	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
5	172				-		/	5.0		Difficult drilling, likely numerous cobbles and boulders
6	171									
7	170									
8	169									
9	168				106	S-2	24/18	9.0-11.0	68 56 50 59	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
10	167									
11	166				-		/	11.0		Difficult driling, likely cobbles and boulders
12	165									
13	164									
14	163				135/6"	S-3	12/1	14.0-15.0	72 135	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
15	162				-		/	15.0		Difficult drilling, likely cobbles and boulders
16	161									
17	160									
18	159									
19	158				120/6"	S-4	12/2	19.0-20.0	37 120	Very dense, grayish brown SILT, SAND, and GRAVEL (Glacial Till)
20	157		20.0 / 156.9							
21	156			Bottom of Exploration						
22	155									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:

Weather: Sunny Temperature: 40

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Project:	Babson College New Residence Hall	**Job #:**	5477
Location:	Babson College	**Date Started:**	11-29-12
City/State:	Wellesley, MA	**Date Finished:**	11-29-12

Boring No. B-3

Contractor: Geo-Logic
Driller/Helper: Charlie
Logged By/Reviewed By: RJC/BED
Surface Elevation (ft): 182.9
Casing Type/Depth (ft): 3 3/4" HSA
Casing Hammer (lbs)/Drop (in): N/A
Sampler Size/Type: 1 3/8" SS
Sampler Hammer (lbs)/Drop (in): 140 lb/30 in

Groundwater Observations

Date	Depth	Elev.	Notes
11-29-12	16	166.9	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	Sample No.	Sample Pen./Rec. (in)	Sample Depth (ft)	Sample Blows/6" / Min/ft	Sample Description and Boring Notes
1	182			(TOPSOIL and SUBSOIL)	-		/	0.0		Vacuum truck from 0-4 ft. Surface of Glacial Till deposit observed in open vac hole.
2	181									
3	180		3.0 / 179.9							
4	179			(GLACIAL TILL)	-	S-1	6/3	4.0-4.5	140	Very dense, light brown SAND and GRAVEL, some silt (Glacial Till)
5	178				-		/	4.5		Difficult drilling, numerous cobbles and boulders
6	177									
7	176									
8	175									
9	174									
10	173				113	S-2	24/20	9.0-11.0	40 60 53 75	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
11	172									
12	171									
13	170									
14	169				118/6"	S-3	12/12	14.0-15.0	95 118	Very dense, light brown sitly SAND and GRAVEL (Glacial Till)
15	168									
16	167									
17	166									
18	165									
19	164				140/6"	S-4	12/10	19.0-20.0	72 140	Very dense, light brown silty SAND and GRAVEL (Glacial Till)
20	163		20.0 / 162.9							
21	162			Bottom of Exploration						
22	161									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:

Weather: Sunny Temperature: 38

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project:	Babson College New Residence Hall	**Job #:**	5477
Location:	Babson College	**Date Started:**	11-30-12
City/State:	Wellesley, MA	**Date Finished:**	11-30-12

Boring No.

B-4

Contractor: Geo-Logic
Driller/Helper: Charlie
Logged By/Reviewed By: RJC/BED
Surface Elevation (ft): 185.6

Casing Type/Depth (ft): 3 3/4" HSA
Casing Hammer (lbs)/Drop (in): N/A
Sampler Size/Type: 1 3/8" SS
Sampler Hammer (lbs)/Drop (in): 140 lb/30 in

Groundwater Observations

Date	Depth	Elev.	Notes
11-30-12	18	167.6	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	Sample No.	Sample Pen. /Rec. (in)	Sample Depth (ft)	Sample Blows/6" / Min/ft	Sample Description and Boring Notes
1	185				-		/	0.0		Vacuum truck from 0-4 ft. Surface of Glacial Till Deposit observed in open vac hole.
2	184			(TOPSOIL and SUBSOIL)						
3	183		3.0 / 182.6							
4	182									
					115/6"	S-1	12/2	4.0-5.0	84 115	Very dense, brownish gray SAND (Glacial Till)
5	181				-		/	5.0		Numerous cobbles and boulders
6	180									
7	179									
8	178									
9	177									
					135/6"	S-2	12/10	9.0-10.0	49 135	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
10	176									
11	175									
12	174			(GLACIAL TILL)						
13	173									
14	172									
					140/6"	S-3	12/10	14.0-15.0	97 140	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
15	171									
16	170									
17	169									
18	168									
19	167									
					145/6"	S-4	12/0	19.0-20.0	68 145	No recovery.
20	166		20.0 / 165.6							
21	165			Bottom of Exploration						
22	164									
	163									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL	
"TRACE"	0-10%	SOIL CONTAINING THREE
"SOME"	10-20%	COMPONENTS EACH OF WHICH
"ADJECTIVE" (eg SANDY, SILTY)	20-35%	COMPRISE AT LEAST 25% OF
"AND"	35-50%	THE TOTAL ARE CLASSIFIED AS
		"A WELL-GRADED MIXTURE OF"

Notes:

Weather: Cloudy Temperature: 33

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Project:	Babson College New Residence Hall	**Job #:**	5477
Location:	Babson College	**Date Started:**	11-30-12
City/State:	Wellesley, MA	**Date Finished:**	11-30-12

Boring No.

B-5

Contractor: Geo-Logic
Driller/Helper: Charlie
Logged By/Reviewed By: RJC/BED
Surface Elevation (ft): 182.4

Casing Type/Depth (ft): 3 3/4" HSA
Casing Hammer (lbs)/Drop (in): N/A
Sampler Size/Type: 1 3/8" SS
Sampler Hammer (lbs)/Drop (in): 140 lb/30 in

Groundwater Observations

Date	Depth	Elev.	Notes
11-30-12	14	168.4	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	Sample No.	Sample Pen. /Rec. (in)	Sample Depth (ft)	Sample Blows/6" / Min/ft	Sample Description and Boring Notes
1	182			(TOPSOIL and SUBSOIL)	-		/	0.0		Vacuum truck from 0-4 ft. Surface of Glacial Till deposit observed in open vac hole.
2	181		2.0 / 180.4							
3	180									
4	179									
5	178				68	S-1	24/18	4.0-6.0	24 33 35 46	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
6	177									
7	176									
8	175									
9	174									
10	173				169	S-2	18/10	9.0-10.5	31 69 100	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
11	172				-		/	10.5		Difficult drilling, likely cobbles and boulders.
12	171			(GLACIAL TILL)						
13	170									
14	169									
15	168				105/6"	S-3	12/9	14.0-15.0	63 105	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
16	167									
17	166									
18	165									
19	164									
20	163				165	S-4	24/20	19.0-21.0	77 91 74 50	Very dense, brown silty, gravelly SAND (Glacial Till)
21	162		21.0 / 161.4							
22	161			Bottom of Exploration						
	160									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL	
"TRACE"	0-10%	SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"
"SOME"	10-20%	
"ADJECTIVE" (eg SANDY, SILTY)	20-35%	
"AND"	35-50%	

Notes:

Weather: Cloudy Temperature: 32

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
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FAX: 617-868-1423

Project:	Babson College New Residence Hall	**Job #:**	5477
Location:	Babson College	**Date Started:**	11-30-12
City/State:	Wellesley, MA	**Date Finished:**	11-30-12

Boring No.

B-6

Contractor: Geo-Logic
Driller/Helper: Charlie
Logged By/Reviewed By: RJC/BED
Surface Elevation (ft): 179.5

Casing Type/Depth (ft): 3 3/4" HSA
Casing Hammer (lbs)/Drop (in): N/A
Sampler Size/Type: 1 3/8" SS
Sampler Hammer (lbs)/Drop (in): 140 lb/30 in

Groundwater Observations

Date	Depth	Elev.	Notes

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	Sample No.	Sample Pen./Rec. (in)	Sample Depth (ft)	Sample Blows/6" / Min/ft	Sample Description and Boring Notes
0	179				-		/	0.0		Vacuum truck from 0-4 ft. Surface of Glacial Till deposit observed in open vac hole.
1	178									
2	177			(TOPSOIL and SUBSOIL)						
3	176									
4			4.0 / 175.5							
5	175				240	S-1	18/16	4.0-5.5	67 100 140	Very dense, grayish brown silty SAND and GRAVEL (Glacial Till)
6	174				-		/	5.5		Difficult drilling, numerous cobbles and boulders. Auger refusal on possible boulder at 8.5 ft
7	173			(GLACIAL TILL)						
8	172									
9	171		8.5 / 171.0							
10	170			Auger Refusal - Bottom of Exploration						
11	169									
12	168									
13	167									
14	166									
15	165									
16	164									
17	163									
18	162									
19	161									
20	160									
21	159									
22	158									
	157									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:

Weather: Cloudy Temperature: 30

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McPHAIL ASSOCIATES, LLC

APPENDIX C

Permeability Test Results

CONSTANT HEAD
BOREHOLE PERMEABILITY TEST
Field Data

Borehole:	P-1	Project:	Babson College New Residence Hall
Test Depth:	4 feet	Project No.	5477.2.00
Casing Radius:	4 inch	Driller:	GeoLogic
Head (h):	4.5 feet	Engineer:	Rob Collins
Soil Strata:	Glacial Till	Date:	11/30/2012

Water Volume Increment (cm^3)	Elapsed Time (h:m:s)	Time Increment (h:m:s)	Time Increment (s)	Flow Rate, q (cm^3/s)	Permeability, k (cm/s)
20	0:01:00	0:01:00	60	3.33E-01	4.35E-05
20	0:02:00	0:01:00	60	3.33E-01	4.35E-05
25	0:04:00	0:02:00	120	2.08E-01	2.72E-05
25	0:06:00	0:02:00	120	2.08E-01	2.72E-05
20	0:08:00	0:02:00	120	1.67E-01	2.17E-05
20	0:10:00	0:02:00	120	1.67E-01	2.17E-05
20	0:13:00	0:03:00	180	1.11E-01	1.45E-05
150	**0:13:00**	**0:13:00**	**780**	**1.92E-01**	**2.51E-05**

CONSTANT HEAD
BOREHOLE PERMEABILITY TEST
Field Data

Borehole:	P-2	Project:	Babson College New Residence Hall
Test Depth:	4.5 feet	Project No.	5477.2.00
Casing Radius:	4 inch	Driller:	GeoLogic
Head (h):	5.5 feet	Engineer:	Rob Collins
Soil Strata:	Glacial Till	Date:	11/30/2012

Water Volume Increment (cm^3)	Elapsed Time (h:m:s)	Time Increment (h:m:s)	Time Increment (s)	Flow Rate, q (cm^3/s)	Permeability, k (cm/s)
75	0:02:00	0:02:00	120	6.25E-01	6.67E-05
60	0:04:00	0:02:00	120	5.00E-01	5.34E-05
40	0:06:00	0:02:00	120	3.33E-01	3.56E-05
50	0:08:00	0:02:00	120	4.17E-01	4.45E-05
50	0:10:00	0:02:00	120	4.17E-01	4.45E-05
45	0:12:00	0:02:00	120	3.75E-01	4.00E-05
45	0:14:00	0:02:00	120	3.75E-01	4.00E-05
50	0:16:00	0:02:00	120	4.17E-01	4.45E-05
50	0:18:00	0:02:00	120	4.17E-01	4.45E-05
465	**0:18:00**	**0:18:00**	**1080**	**4.31E-01**	**4.60E-05**

CONSTANT HEAD
BOREHOLE PERMEABILITY TEST
Field Data

Borehole:	P-2	Project:	Babson College New Residence Hall
Test Depth:	4.5 feet	Project No.	5477.2.00
Casing Radius:	2 inch	Driller:	
Head (h):	5 feet	Engineer:	Tom Cormican
Soil Strata:	Glacial Till	Date:	12/5/2012

Water Volume Increment (cm^3)	Elapsed Time (h:m:s)	Time Increment (h:m:s)	Time Increment (s)	Flow Rate, q (cm^3/s)	Permeability, k (cm/s)
5	0:02:00	0:02:00	120	4.17E-02	9.79E-06
4	0:10:00	0:08:00	480	8.33E-03	1.96E-06
3	0:20:00	0:10:00	600	5.00E-03	1.17E-06
3	0:30:00	0:10:00	600	5.00E-03	1.17E-06
15	**0:30:00**	**0:30:00**	**1800**	**8.33E-03**	**1.96E-06**