GNCB
Consulting Engineers, P.C.
Structural Engineering
Geotechnical Engineering
Historic Preservation

September 24, 2020

Juster Pope Frazier Architects
82 North Street
Northampton, Massachusetts 01060

Attention: Mr. Kevin Chrobak (kevinchrobak@gmail.com)

Re: Geotechnical Engineering Investigation
Proposed Public Safety Building
16 Main Street
Williamsburg, Massachusetts

Principals
Charles C. Brown, P.E.
James F. Norden, P.E.
Amy Jagaczewski, P.E.

Principal Emeritus
Kenneth Gibble, P.E.

Geotechnical Associate
David L. Freed, P.E.

Structural Associate
Richard A. Centola, P.E.

Dear Kevin,

This report summarizes the results of subsurface explorations and foundation design recommendations completed for a proposed Public Safety building in Williamsburg, Massachusetts. Our geotechnical engineering phase services have been completed in accordance with our April 15, 2020 proposal, as authorized. GNCB also serves as the project structural engineer.

Briefly, the results of six test pits and six test borings, as located on Drawing 1, indicate subsurface soil conditions consist of a thin, typically 2.5 ft. thick or less, surface man-placed fill and topsoil underlain by successive layers of naturally-deposited soil consisting of an alluvium sand and outwash sand and gravel. We recommend removal of all man-placed fill and organic soils from the building limits and replacing them with compacted structural fill. Accordingly, the new building can be supported on reinforced concrete spread footings bearing on the suitable natural inorganic soils or on compacted structural fill; the ground floor slab may be an earth supported slab. In view of the proximity of groundwater to the finish slab, we also recommend a perimeter and underslab drainage system that is connected to a suitable gravity outlet. Our comments follow:

SITE LOCATION AND PROPOSED CONSTRUCTION

Site Conditions: The approximately 2.7-acre project site, which includes an existing building, is located southeast of the intersection of Main and South Streets in Williamsburg, Massachusetts. The rectangular shaped parcel

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includes a partially occupied, former school building, structure within the west portion and by open grass area within the east portion. The school playground equipment, located within the east grass portion, has been removed as evident by patches of disturbed surface areas. Wooded areas border the south and west sides of the site.

Within the east grass portion of the site, where a new structure may be located, ground surface grade rises slightly from east to west ranging from about El. 519 to El. 522. (Note: Elevations are in feet and refer to NAVD 88 Datum). A schematic design drawing you shared with us shows existing grading, as well as the location of the existing building. This plan was used as a base plan for the attached Drawing 1, "Subsurface Exploration Plan".

Proposed Construction: Development of the site as a Public Safety complex is uncertain at this time, as to whether renovation and expansion of the existing abandoned structure will be part of the complex and/or whether a new structure will be built within the east portion. Your schematic plan for the new building will be an approximately rectangular shaped one-story wood framed structure with no basement; with ground floor level at about El. 521. The building footprint is about 7,600 sq. ft. GNCB structural engineers estimate that the column dead plus live load will be about 50 kips or less, and exterior wall loads less than about 2 kips per linear foot.

SUBSURFACE INVESTIGATIONS AND CONDITIONS

Subsurface Investigations: We are not aware of any previous test borings being drilled at the site. In order to determine subsurface soil conditions at the site, GNCB recommended and monitored on a full-time basis a program of six test pits (TP-1 to TP-6) and six test borings (B-1 to B-6). Berkshire Design Group located these explorations in the field prior to the start of work, at the approximate locations shown on Drawing 1. GNCB determined ground surface elevations at the explorations by interpolated the contour elevations shown on the referenced base plan.

Table I, prepared by GNCB, summarizes the subsurface conditions observed at each subsurface exploration; detailed soil descriptions are contained in the following report section. Logs of the test pits (prepared by GNCB) and test borings (prepared by the Contractor and reviewed by GNCB), are attached as Appendix A and Appendix B, respectively.

> Design Phase Test Pits: The Town of Williamsburg Highway Department, as arranged by Juster Pope Frazier, excavated the test pits on September 8, 2020 using a Yanmar rubber-tired backhoe. The test pits, excavated to depths from 4.0 ft. to 7.2 ft., all terminated within naturally deposited soils. Berkshire Design Group observed the excavation of additional test pits for their site design studies.

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Design Phase Test Borings: Seaboard Drilling, Inc, of Chicopee, Massachusetts, under contract to GNCB, drilled the test borings on September 14, 2020 using a standard truck mounted drill rig to advance 4-1/4 in. inside diameter hollow stem augers (HSAs). Near continuous soil samples (ASTM D 1586) were obtained. Test borings ranged in depth from 4.0 ft. to 9.4 ft. All test borings terminated at refusal on cobbles and boulders within the dense sand and gravel soil which underlies the site; the presence of which prevented a maximum penetration into the deposit of 6.4 ft. at B-3.

Subsurface Soil Conditions: Test borings revealed that subsurface conditions consist of a surface man-placed fill and topsoil, underlain by naturally-deposited layers of sand, and outwash sand and gravel. These soil conditions are described below, progressing downward from ground surface:

Thickness (ft.)	General Description
0.0 to 3.5	Medium dense to loose brown, gray to brown silty fine SAND to medium to fine SAND, little silt (MAN-PLACED FILL)
Up to 0.9	Dark brown loamy fine SAND and SILT, trace roots. (TOPSOIL)
0.0 to 2.2	Medium dense gray or brown silty fine SAND to SILT, trace roots (ALLUVIUM DEPOSIT)
Up to 6.4 (at B-3)	Dense to very dense gray or brown gravelly coarse to fine SAND, little to trace silt with numerous cobbles and boulders (OUTWASH DEPOSIT)

At most subsurface exploration locations, the man-placed fill appears to blanket the surface of the site and is probably a result of site grading associated with previous site development. At most locations, the man-placed fill was underlain by a thin layer of original topsoil, however, at TP-4 through TP-6, the topsoil is at the surface and represents a fill material.

Below the man-placed fill and/or topsoil, a thin deposit, typically less than 2 ft. thick, blankets the site. This deposit is an alluvium material that is associated with the stream that borders the south property line. The major soil deposit at the site is a very dense sand and gravel OUTWASH DEPOSIT. This layer contains very dense material with numerous cobbles and boulders; the test pit excavations revealed boulders on the order of 2 ft. in diameter.

Groundwater Levels: Groundwater levels were observed at the completion of the test pits and test borings as well as observations of soil mottling within the test pits by Berkshire Design Group. With respect to these observations,

soil mottling likely represents the highest level that groundwater had experienced in the past. Furthermore, the difficult and intense HSA drilling at the test borings within the natural sand and gravel may result in temporary evaporation of water, such as the dry condition observed at the completion of B-1 and B-4. Based on our best interpretation of all the groundwater readings (refer to Table I and the respective exploration logs), we believe that groundwater at the proposed building site flows down from southwest to northeast, ranging from about El. 518 to El. 516. However, these water levels were made over a relatively short period of time and sufficient time may not have permitted the levels to stabilize.

In any event, water levels vary with precipitation, season, and other factors. As a result, water levels encountered during and after construction may differ from those observed in the observation well and test boring.

RECOMMENDATIONS FOR FOUNDATION DESIGN AND CONSTRUCTION

Building Foundations and Ground Floor Slab: In our opinion, the existing man-placed fill and topsoil are not suitable materials to support the new building frame or ground floor slab; both the naturally-deposited inorganic soils (i.e. alluvium and outwash sand and gravel) are suitable bearing materials. We recommend that all the man-placed fill and topsoil, or any other deleterious material, be removed from the proposed building area and be replaced with an off-site compacted structural fill.

Accordingly, we recommend that the new building be supported on reinforced concrete spread footing foundations bearing on the suitable natural deposited soils with an earth supported ground floor slab bearing directly on the suitable natural inorganic soils. The building footings may also be supported on a compacted structural fill that is placed on the suitable natural soils after removing the man-placed fill.

Foundation Design Criteria: The recommended general foundation design criteria follows:

1. Design in accordance with the applicable provisions of the current edition of the Commonwealth of Massachusetts Building Code.

2. Locate bottoms of footings at least 4.0 ft. below exterior ground surface exposed to freezing, for frost protection.

3. Proportion footings for a net allowable soil bearing pressure equal to 1.4 times the least lateral footing dimension as measured in feet, up to a maximum of 4.0 kip per square foot (ksf).

4. Where unsuitable (man-placed fill or organic soils) exist at normal design

bearing grade at footings, remove the unsuitable soil below the footing and replace it with compacted structural fill. Refer to Drawing 2 for proper lateral limits of compacted structural fill below footings.

5. As stated above, remove the surface man-placed fill and/or topsoil within the new building limits and replace them with compacted structural fill. Prior to placing the compacted structural fill, recompact the existing natural soils with at least 8 passes of a heavy vibratory roller that weighs at least 10 tons. Replace any visibly unstable soil with compacted structural fill. Provide a minimum 9 in. of compacted structural fill below the building ground floor slab.

6. We expect that total footing settlement will be about ¾ in. with a differential settlement of ½ in. in 25 ft. feet. Footing settlement is expected to occur as the load is applied.

Based on the subsurface explorations, design bearing grade for the perimeter building footings are expected to be below, or are within a foot, of the top of suitable outwash sand and gravel. However, any shallow interior footings, if needed in the design, will likely be founded on compacted structural fill, since the top of alluvium was found to range from 2 to 4 ft. below the top of finish building slab.

Foundation Drainage: In view of the groundwater levels within 3 ft. of the top of building slab, we recommend that the new building include both a perimeter and underslab drainage system.

The perimeter drainage system should consist of a perforated 6 in. diameter pipe, with invert grade at about El. 247, surrounded by a minimum 6 in. thick layer of ¾ in. crushed stone, which is further surrounded by filter fabric. In addition, a vertical drainage layer, consisting of either a minimum 3 ft. wide zone of compacted structural fill or a geocomposite drainage board such as Mirafi 6000, is required adjacent to the foundation wall. Where a foundation drain is provided at the perimeter of the building, provided a 6 in. thick impervious layer at ground surface over the drainage zone to minimize surface water flow into the foundation drain.

The underslab drain can consist of a 4 in. diameter perforated pipe installed in the center of a 12 in. thick layer of ¾ in. crushed stone, at an invert grade about El. 520. The underslab pipes should be spaced about 30 ft. apart and be interconnected. The stone needs to be underlain by a drainage filter fabric, such as Mirafi 140N.

The perimeter and underslab drainage pipes can be placed at a flat to near flat grade; they should discharge by gravity flow to a suitable gravity outlet.

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Lateral Earth Pressures: The current building design does not include any foundation walls; we can provide recommendations for lateral earth pressures, if needed.

Seismic Design: Table 20.3-1 (Manual ASCE 7-10) referenced in the Code provides recommendations for seismic site soil class. Based on our interpretation of the test boring logs, we recommend that the building be designed based on a Site Soil Class D. In addition, we recommend that seismic design include spectral acceleration design values for the Town of Williamsburg, of S_s=0.165 and S_1=0.056.

The natural inorganic granular soils or compacted structural fill to be placed are not susceptible to liquefaction

Compacted Structural and Common Fill: Fill for use as compacted structural fill as needed below the building footings and/or ground floor slab to replace unsuitable bearing soils, should consist of sandy gravel or gravelly sand, free of organic material, snow, ice or other unsuitable materials, and should be well graded within the following limits:

Sieve Size	Percent Finer By Weight
4 in.	100
No. 4	20 - 80
No. 40	5 - 50
No. 200	0 – 10

Compacted structural fill should be placed in horizontal layers having a maximum loose lift thickness of 10 in. (open areas) or 6 in. (confined areas). Each layer should be compacted to a dry density at least 95 percent of the maximum dry density as determined in accordance with ASTM Test Designation D1557. Appendix C contains Suggested Technical Specifications for Compacted Structural Fill Within Buildings.

CONSTRUCTION CONSIDERATIONS

We have the following comments regarding foundation construction:

1. Soil excavation for building footings is anticipated to be within the existing man-placed fill, topsoil, and possibly top of the natural inorganic granular. Normal backhoe or dozer equipment should be adequate.

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2. We do not expect that groundwater will be a site issue for excavations below about El. 518, except for excavations within the west portion of the site where groundwater is highest. Any water that accumulates within excavations should be removed by pumping from open sumps to permit the work to proceed in the dry.

3. Prior to placing steel and forming footings, recompact soil footing bearing surfaces with vibratory plate compactors.

LIMITATIONS OF RECOMMENDATIONS

This report has been prepared for specific application to the Public Safety Building project in Williamsburg, Massachusetts, in accordance with generally accepted geotechnical engineering practice. No other warranty, express or implied, is made. In the event that any changes in the nature, design, or location of the construction is planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed, and conclusions of this report modified or verified in writing.

The analysis and recommendations in this report are based in part upon data obtained from the referenced subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

We appreciate the opportunity to work with you on this aspect of the project. If you have any questions, or need additional information, please call.

Sincerely yours,

David L. Freed, P.E.
Geotechnical Associate

Enclosures:

Table I – Summary of Subsurface Explorations
Drawing 1 – Subsurface Exploration Plan
Drawing 2 – Limits of Compacted Structural Fill Below Footings
Appendix A – Design Phase Test Pit Logs (TP-1 to TP-6)
Appendix B – Design Phase Test Boring logs (B-1 to B-6)
Appendix C – Suggested Specifications for Compacted Structural Fill

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Table I – Summary of Subsurface Explorations

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TABLE I
SUMMARY OF SUBSURFACE EXPLORATIONS

PUBLIC SAFETY BUILDING
16 MAIN STREET, WILLIAMSBURG, MASSACHUSETTS

EXPLORATION NO.	TOTAL DEPTH (FT.)	ELEV. GROUND SURFACE (FT.)	ELEV. WATER (FT.)	THICKNESS SOIL (FT.)					ELEV. TOP (FT.)	
				TOPSOIL	FILL	ORIGINAL TOPSOIL	ALLUVIUM	OUTWASH DEPOSIT	ALLUVIUM	OUTWASH DEPOSIT
TEST PITS										
TP-1	4.0	519.5	515.7	-	0.9	0.5	1.8	0.8+	518.1	516.3
TP-2	4.5	520.0	515.5	-	1.7	0.7	1.6	0.5+	517.6	516.0
TP-3	4.0	520.0	517.8	-	1.2	0.0	1.0	1.8+	518.8	517.8
TP-4	4.0	521.0	517.5	0.9	0.0	0.0	1.6	1.5+	520.1	518.5
TP-5	6.2	521.0	515.0	0.5	0.5	0.0	2.0	3.2+	520.0	518.0
TP-6	7.2	519.5	515.6	0.5	1.0	0.0	2.0	3.7+	518.0	516.0
TEST BORINGS										
B-1(R)	7.5	519.5	Below 512.0 *	-	0.0	0.8	1.7	5.0+	518.7	517.0
B-2(R)	5.5	520.0	516.5	-	3.5	0.0	0.0	2.0+	-	516.5
B-3(R)	9.4	520.5	516.5	-	0.8	0.0	2.2	6.4+	519.7	517.5
B-4(R)	4.0	521.0	Below 517.0 *	-	0.0	0.7	1.3	2.0+	520.3	519.0
B-5(R)	6.0	521.0	518.0	-	0.0	0.8	1.7	3.5+	521.2	519.5
B-6(R)	4.8	522.0	518.0	-	0.0	0.8	2.2	1.8+	521.2	519.0

(R) Hollow stem auger refusal on cobbles or boulders within outwash soil.
* Water not observed at completion of test boring; intense/hard drilling may have temporarily masked water readings

NOTES

1. Refer to Drawing 1 for locations of explorations.
2. Elevations are in feet and refer to NAVD 88 Datum.

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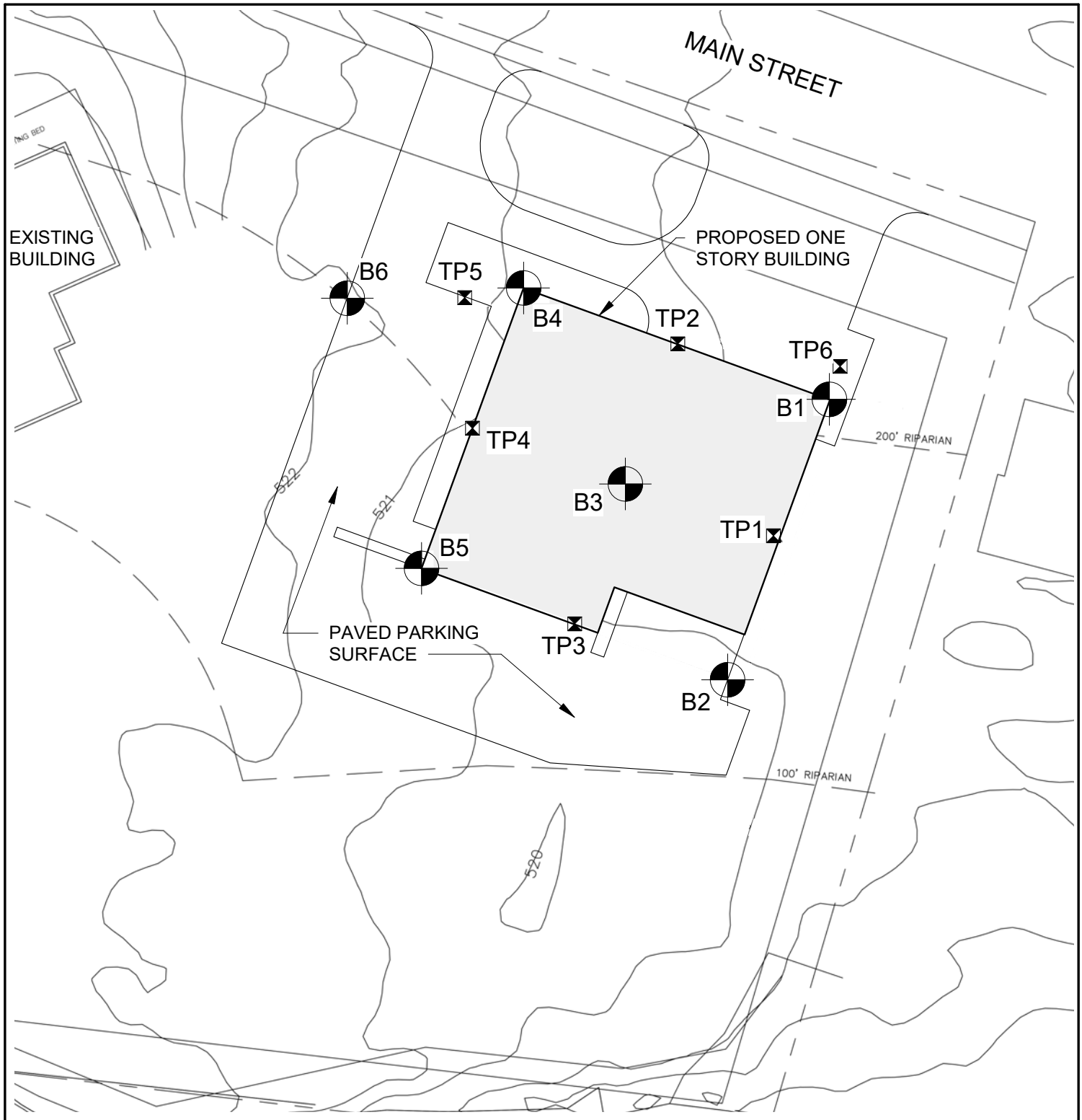
Drawings
Drawing 1 – Subsurface Exploration Plan
Drawing 2 – Limits of Compacted Structural Fill Below Footings



NOTES

1. BASE PLAN IS AN ELECTRONIC COPY OF "TEST PITS + BORINGS" BY JUSTER POPE FRAZIER LLC, NORTHAMPTON, MA. DATED SEPTEMBER 1, 2020.
2. ELEVATIONS ARE IN FEET AND REFER TO NAVD 88 DATUM.

0 40' 80'

GRAPHIC SCALE: 1" = 40'

PROJECT NORTH

LEGEND

B-1	LOCATION OF TEST BORING DRILLED ON SEPTEMBER 14, 2020 BY SEABOARD DRILLING OF CHICOPEE, MA.
TP9	LOCATION OF TEST PIT EXCAVATED ON SEPTEMBER 8, 2020 BY TOWN OF WILLIAMSBURG, MA.
522	ELEVATION CONTOURS SHOWN ON BASE PLAN.

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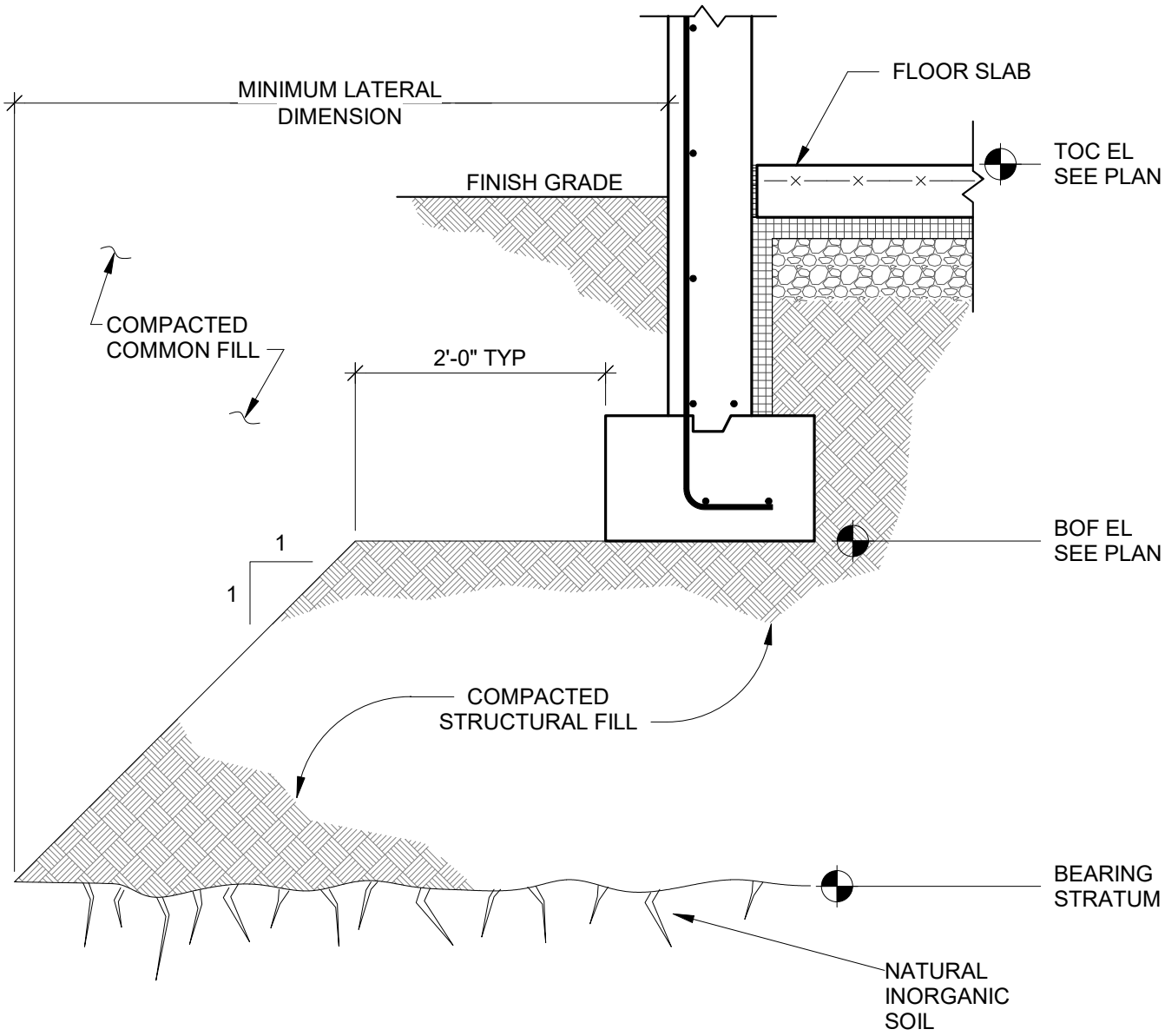
PUBLIC SAFETY BUILDING
WILLIAMSBURG, MA

SUB SURFACE EXPLORATION PLAN

SCALE: As indicated SEPTEMBER 2020



TYPICAL EXTERIOR WALL

1 LIMITS OF COMPACTED STRUCTURAL FILL BELOW FOOTINGS

3/4" = 1'-0"

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PUBLIC SAFETY BUILDING
WILLIAMSBURG, MA

LIMITS OF COMPACTED STRUCTURAL FILL BELOW FOOTINGS

SCALE: 3/4" = 1'-0" SEPTEMBER 2020

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Appendix A
Design Phase Test Pit Logs (TP-1 to TP-6)

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TEST PIT REPORT

Project: Public Safety Building, Williamsburg, MA
Client: Juster Pope Frazier Architects
Contractor: Town of Williamsburg Highway Department
Equipment: Yanmar Rubber Track Backhoe with ¼ cubic yard bucket

Project No. 20152.00
Test Pit No: TP-1
Elevation: 519.5
Date: 08 Sept. 2020
Field Rep.: G. Jacobsen

Scale in Feet	Strata Change	Sample Number	Sample Depth Range	Description of Materials	Remarks
	0.9			Yellow brown silty SAND with loamy topsoil layer (FILL)	
	1.4			Dark brown loamy fine SAND (TOPSOIL)	
- 2 -				Mottled gray to brown silty fine SAND	
	3.2			(ALLUVIUM)	
				Gray gravelly coarse to fine SAND with numerous cobbles and boulders to 2 ft. dia.	
- 4 -				Bottom of Exploration at 4.0 ft.	
- 6 -					
- 8 -					
- 10 -					

GROUNDWATER

DATE	TIME*	DEPTH/FT.
8 SEP 20	0.5	3.8

NOT ENCOUNTERED ☐ * HRS. AFTER COMPL.

9 x 3 x 4 = 108 Cu. Ft.
(L) (W) (D)

NOTE: Length (L) and Width (W) measurements made at ground surface; Volume reflects a reduced width with depth.

BOULDERS

8" TO 18" DIAM: NO. ____= Vol. _____Cu. Ft.
OVER 18" DIAM: No. _____= Vol. _____Cu. Ft.

SUMMARY

DEPTH 4.0 ft.
JAR SAMPLES 0
BAG SAMPLES 0
GROUNDWATER 3.8 ft.

TEST PIT NO. TP-1

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Project: Public Safety Building, Williamsburg, MA
Client: Juster Pope Frazier Architects
Contractor: Town of Williamsburg Highway Department
Equipment: Yanmar Rubber Track Backhoe with ¼ cubic yard bucket

Project No. 20152.00
Test Pit No: TP-2
Elevation: 520.0
Date: 08 Sept. 2020
Field Rep.: G. Jacobsen

Scale in Feet	Strata Change	Sample Number	Sample Depth Range	Description of Materials	Remarks
	0.8			White PEASTONE (FILL)	
	---	---	---	---	
	1.7			Brown loamy fine SAND (FILL)	
- 2 -				Brown loamy fine SAND	
	2.4			(TOPSOIL)	
				Mottled brown silty fine SAND	
- 4 -	4.0			(ALLUVIUM)	
				Brown gravelly coarse to fine SAND (OUTWASH)	
				Bottom of Exploration at 4.5 ft.	
- 6 -					
- 8 -					
- 10 -					

GROUNDWATER		
DATE	TIME*	DEPTH/FT.
8 SEP 20	0.0	4.5
NOT ENCOUNTERED	* HRS. AFTER COMPL.	

9 (L) x 3 (W) x 4.5 (D) = 122 Cu. Ft.

NOTE: Length (L) and Width (W) measurements made at ground surface; Volume reflects a reduced width with depth.

BOULDERS
8" TO 18" DIAM: NO. ____= Vol. _____Cu. Ft.
OVER 18" DIAM: No. _____= Vol. _____Cu. Ft.

SUMMARY

DEPTH	4.5 ft.
JAR SAMPLES	0
BAG SAMPLES	0
GROUNDWATER	4.5 ft.

TEST PIT NO. TP-2

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TEST PIT REPORT

Project: Public Safety Building, Williamsburg, MA
Client: Juster Pope Frazier Architects
Contractor: Town of Williamsburg Highway Department
Equipment: Yanmar Rubber Track Backhoe with ¼ cubic yard bucket

Project No. 20152.00
Test Pit No: TP-3
Elevation: 520.0
Date: 08 Sept. 2020
Field Rep.: G. Jacobsen

Scale in Feet	Strata Change	Sample Number	Sample Depth Range	Description of Materials	Remarks
	1.2			Dark brown WOOD CHIPS with layers of white peastone on filter fabric (FILL)	
- 2 -	2.2			Gray silty fine SAND (ALLUVIUM)	
- 4 -	4.0			Gray gravelly coarse to fine SAND with numerous cobbles and several boulders to 1.5 ft. dia. (OUTWASH)	
- 6 -				Bottom of Exploration at 4.0 ft.	
- 8 -					
- 10 -					

GROUNDWATER

DATE	TIME*	DEPTH/FT.
8 SEP 20	0.25	2.2
	0.5	1.7

NOT ENCOUNTERED | * HRS. AFTER COMPL.

9 (L) x 3 (W) x 4 (D) = 108 Cu. Ft.

NOTE: Length (L) and Width (W) measurements made at ground surface; Volume reflects a reduced width with depth.

BOULDERS

8" TO 18" DIAM: NO. ____= Vol. _____Cu. Ft.
OVER 18" DIAM: No. _____= Vol. _____Cu. Ft.

SUMMARY

DEPTH 4.0 ft.
JAR SAMPLES 0
BAG SAMPLES 0
GROUNDWATER 2.2 ft.

TEST PIT NO. TP-3

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TEST PIT REPORT

Project: Public Safety Building, Williamsburg, MA
Client: Juster Pope Frazier Architects
Contractor: Town of Williamsburg Highway Department
Equipment: Yanmar Rubber Track Backhoe with ¼ cubic yard bucket

Project No. 20152.00
Test Pit No: TP-4
Elevation: 521.0
Date: 08 Sept. 2020
Field Rep.: G. Jacobsen

Scale in Feet	Strata Change	Sample Number	Sample Depth Range	Description of Materials	Remarks
	0.9			Dark brown loamy fine SAND (TOPSOIL)	
- 2 -	2.5			Gray to red brown silty fine SAND (ALLUVIUM)	
- 4 -				Brown gravelly coarse to fine SAND with numerous cobbles and several boulders (OUTWASH)	
				Bottom of Exploration at 4.0 ft.	
- 6 -					
- 8 -					
- 10 -					

GROUNDWATER		
DATE	TIME*	DEPTH/FT.
8 SEP 20	0.0	3.5
NOT ENCOUNTERED	* HRS. AFTER COMPL.	

9 x 3 x 4 = 108 Cu. Ft.
(L) (W) (D)

NOTE: Length (L) and Width (W) measurements made at ground surface; Volume reflects a reduced width with depth.

BOULDERS
8" TO 18" DIAM: NO. ____= Vol. _____Cu. Ft.
OVER 18" DIAM: No. _____= Vol. _____Cu. Ft.

SUMMARY

DEPTH	4.0 ft.
JAR SAMPLES	0
BAG SAMPLES	0
GROUNDWATER	3.5 ft.

TEST PIT NO. TP-4

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TEST PIT REPORT

Project: Public Safety Building, Williamsburg, MA
Client: Juster Pope Frazier Architects
Contractor: Town of Williamsburg Highway Department
Equipment: Yanmar Rubber Track Backhoe with ¼ cubic yard bucket

Project No. 20152.00
Test Pit No: TP-5
Elevation: 521.0
Date: 08 Sept. 2020
Field Rep.: G. Jacobsen

Scale in Feet	Strata Change	Sample Number	Sample Depth Range	Description of Materials	Remarks
	0.5			Dark brown loamy fine SAND (TOPSOIL)	
	1.0			Brown silty medium to fine SAND (FILL)	
- 2 -				Brown silty fine SAND	
	3.0			(ALLUVIUM)	
- 4 -				Brown gravelly coarse to fine SAND with numerous cobbles and boulders	
- 6 -				(OUTWASH)	
				Bottom of Exploration at 6.2 ft.	
- 8 -					
- 10 -					

GROUNDWATER		
DATE	TIME*	DEPTH/FT.
8 SEP 20	0.0	6.0
NOT ENCOUNTERED	* HRS. AFTER COMPL.	

12 x 4 x 6.2 = 298 Cu. Ft.
(L) (W) (D)

NOTE: Length (L) and Width (W) measurements made at ground surface; Volume reflects a reduced width with depth.

BOULDERS
8" TO 18" DIAM: NO. ____= Vol. _____Cu. Ft.
OVER 18" DIAM: No. _____= Vol. _____Cu. Ft.

SUMMARY

DEPTH	6.2 ft.
JAR SAMPLES	0
BAG SAMPLES	0
GROUNDWATER	6.0 ft.

TEST PIT NO. TP-5

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TEST PIT REPORT

Project: Public Safety Building, Williamsburg, MA
Client: Juster Pope Frazier Architects
Contractor: Town of Williamsburg Highway Department
Equipment: Yanmar Rubber Track Backhoe with ¼ cubic yard bucket

Project No. 20152.00
Test Pit No: TP-6
Elevation: 519.5
Date: 08 Sept. 2020
Field Rep.: G. Jacobsen

Scale in Feet	Strata Change	Sample Number	Sample Depth Range	Description of Materials	Remarks
	0.5			Dark brown loamy fine SAND (TOPSOIL)	
	1.5			Brown silty medium to fine SAND (FILL)	
- 2 -				Brown silty fine SAND (ALLUVIUM)	
- 4 -				Brown gravelly coarse to fine SAND with few cobbles	
- 6 -				(OUTWASH)	
- 8 -				Bottom of Exploration at 7.2 ft.	
- 10 -					

GROUNDWATER		
DATE	TIME*	DEPTH/FT.
NOT ENCOUNTERED	X	* HRS. AFTER COMPL.

12 (L) x 4 (W) x 7.2 (D) = 346 Cu. Ft.

NOTE: Length (L) and Width (W) measurements made at ground surface; Volume reflects a reduced width with depth.

BOULDERS
8" TO 18" DIAM: NO. ____= Vol. _____Cu. Ft.
OVER 18" DIAM: No. _____= Vol. _____Cu. Ft.

SUMMARY

DEPTH	7.2 ft.
JAR SAMPLES	0
BAG SAMPLES	0
GROUNDWATER	N.E.

TEST PIT NO. TP-6

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Appendix B
Design Phase Test Boring logs (B-1 to B-6)

Client: GNCB				**SEABOARD**	**Test Boring/ B-1**
Location: 16 Main Street Williamsburg Ma				**DRILLING, INC.**	**Monitor Well ID:**
Project: Public Safety Project				**649 Meadow St., Chicopee, MA 01013**	
Contractor: Seaboard Drilling, Inc.				**DRILLING/SOIL LOG**	**Sheet No. 1 of 1**
	Casing		**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 9/14/2020
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 9/14/2020
O.D. Inch	**8-1/2"**			**Rig Type: Diedrich D 50**	**Driller: Doug Feeley**
I.D. Inch	**4-1/4"**				GS EL. 519.5

Depth (ft.) Range	Blows	Sample No.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	1-1-2-2	S-1	16"	0.0'-0.8': Dark Brown fine SAND and Silt (Topsoil)
2-4'	5-22-18-25	S-2	14"	0.8'-2.5': Yellow brown fine sandy SILT (ALLUVIUM)
				2.5'-4.0': Brown coarse to fine sandy GRAVEL, trace Silt (OUTWASH)
				Augered very hard 5'-7.5' with numerous cobbles
5-7'	2--22-36-41	S-3	16"	4.0'-7.5': Brown gravelly coarse to fine SAND (OUTWASH)
				Auger refusal @7.5'
				Water not observed at completion of test boring; intense/hard drilling may have temporarily masked water readings.

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density (# Hammer Blows)		Cohesive Consistence (# Hammer Blows)				PROPORTIONS	
0-4	Very Loose	0-2	Very Soft	3-4	Soft	Trace	0 to 10%
5-9	Loose	5-8	Medium-Stiff	9-15	Stiff	Little	10 to 20%
10-29	Medium-Dense	16-30	Very Stiff	31+	Hard	Some	20 to 35%
30-49	Dense					and	30 to 50%
50+	Very Dense						

Client: GNCB				**SEABOARD**	**Test Boring/ B-2**
Location: 16 Main Street Williamsburg Ma				**DRILLING, INC.**	**Monitor Well ID:**
Project: Public Safety Project				**649 Meadow St., Chicopee, MA 01013**	
Contractor: Seaboard Drilling, Inc.				**DRILLING/SOIL LOG**	**Sheet No. 1 of 1**
	Casing		**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 9/14/2020
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 9/14/2020
O.D. Inch	**8-1/2"**			**Rig Type: Diedrich D 50**	**Driller: Doug Feeley**
I.D. Inch	**4-1/4"**				GS EL. 520.0

Depth (ft.) Range	Blows	Sample No.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	2-4-9-12	S-1	19"	0.0'-3.5': Dark Brown to Brown fine to coarse SAND and Gravel, little Silt (FILL)
2-4'	11-12-11-20	S-2	16"	(color change to gray,brown and white at 3')
				3.5'-5.5': Gray to brown gravelly coarse to fine SAND, with cobble fragments (OUTWASH)
4-4.9'	24-50/4"	S-3	6"	Augered very hard from 4' to 5.5'
				Auger refusal @5.5'
				Water at 3.5' after 0.5 HRS.

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density (# Hammer Blows)		Cohesive Consistence (# Hammer Blows)				PROPORTIONS	
0-4	Very Loose	0-2	Very Soft	3-4	Soft	Trace	0 to 10%
5-9	Loose	5-8	Medium-Stiff	9-15	Stiff	Little	10 to 20%
10-29	Medium-Dense	16-30	Very Stiff	31+	Hard	Some	20 to 35%
30-49	Dense					and	30 to 50%
50+	Very Dense						

Client: GNCB				**SEABOARD**	**Test Boring/ B-3**
Location: 16 Main Street Williamsburg Ma				**DRILLING, INC.**	**Monitor Well ID:**
Project: Public Safety Project				**649 Meadow St., Chicopee, MA 01013**	
Contractor: Seaboard Drilling, Inc.				**DRILLING/SOIL LOG**	**Sheet No. 1 of 1**
	Casing		**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 9/14/2020
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 9/14/2020
O.D. Inch	**8-1/2"**			**Rig Type: Diedrich D 50**	**Driller: Doug Feeley**
I.D. Inch	**4-1/4"**				GS EL. 520.5

Depth (ft.) Range	Blows	Sample No.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	2-1-1-1	S-1	18"	0.0'-0.8': Dark brown fine SAND and SILT (TOPSOIL)
2-4'	2-5-10-18	S-2	14"	0.8'-3.0': Gray to dark brown silty fine SAND, tr. Roots (ALLUVIUM)
4-6'	14-28-33-40	S-3	12"	3.0'-9.4': Brown to gray browngravelly coarse to fine SAND, little to trace silt (OUTWASH)
				Augered very hard from 4' to 8' (note: broke shear pins)
8-9.4'	16-34-50/5"	S-4	12"	Brown coarse to fine SAND , little gravel
				Split Spoon Refusal @ 9.4'
				Water at 4.0 at 0.5 HRS.

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density (# Hammer Blows)		Cohesive Consistence (# Hammer Blows)				PROPORTIONS	
0-4	Very Loose	0-2	Very Soft	3-4	Soft	Trace	0 to 10%
5-9	Loose	5-8	Medium-Stiff	9-15	Stiff	Little	10 to 20%
10-29	Medium-Dense	16-30	Very Stiff	31+	Hard	Some	20 to 35%
30-49	Dense					and	30 to 50%
50+	Very Dense						

Client: GNCB				**SEABOARD**	**Test Boring/ B-4**
Location: 16 Main Street Williamsburg Ma				**DRILLING, INC.**	**Monitor Well ID:**
Project: Public Safety Project				**649 Meadow St., Chicopee, MA 01013**	
Contractor: Seaboard Drilling, Inc.				**DRILLING/SOIL LOG**	**Sheet No. 1 of 1**
	Casing		**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 9/14/2020
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 9/14/2020
O.D. Inch	**8-1/2"**			**Rig Type: Diedrich D 50**	**Driller: Doug Feeley**
I.D. Inch	**4-1/4"**				GS EL. 521.0

Depth (ft.) Range	Blows	Sample No.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	2-2-3-3	S-1	14"	0.0'-0.7': Dark Brown loamy SILT (TOPSOIL)
				0.7'-2.0': Yellow brown fine sandy SILT (ALLUVIUM)
2-3.9'	8-37-38-50/5"	S-2	14"	2.0'-4.0': Gray to brown gravelly coase to fine SAND w/ cobbles (OUTWASH)
				Auger Refusal @4'
				Water not observed at completion of test boring; intense/hard drilling may have temporarily masked water readings

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density (# Hammer Blows)		Cohesive Consistence (# Hammer Blows)				PROPORTIONS	
0-4	Very Loose	0-2	Very Soft	3-4	Soft	Trace	0 to 10%
5-9	Loose	5-8	Medium-Stiff	9-15	Stiff	Little	10 to 20%
10-29	Medium-Dense	16-30	Very Stiff	31+	Hard	Some	20 to 35%
30-49	Dense					and	30 to 50%
50+	Very Dense						

Client: GNCB				**SEABOARD**	**Test Boring/ B-5**
Location: 16 Main Street Williamsburg Ma				**DRILLING, INC.**	**Monitor Well ID:**
Project: Public Safety Project				**649 Meadow St., Chicopee, MA 01013**	
Contractor: Seaboard Drilling, Inc.				**DRILLING/SOIL LOG**	**Sheet No. 1 of 1**
	Casing		**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 9/14/2020
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 9/14/2020
O.D. Inch	**8-1/2"**			**Rig Type: Diedrich D 50**	**Driller: Doug Feeley**
I.D. Inch	**4-1/4"**				GS EL. 521.0

Depth (ft.) Range	Blows	Sample No.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	3-2-1-2	S-1	4"	0.0'-0.8': Dark Brown loamy medium to fine SAND, little silt (TOPSOIL)
2-4'	8-14-27-35	S-2	12"	0.8'-2.5': Gray silty fine SAND (ALLUVIUM)
				2.5'-6.0': Gray to brown gravelly coarse to fine SAND, little silt (OUTWASH)
				Augered very hard from 3' to 4'
4-6'	28-19-15-27	S-3	14"	S-3: same as S-2
				Auger & Split Spoon Refusal @ 6'
				Water at 3' at 0.5 HRS.

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density (# Hammer Blows)		Cohesive Consistence (# Hammer Blows)				PROPORTIONS	
0-4	Very Loose	0-2	Very Soft	3-4	Soft	Trace	0 to 10%
5-9	Loose	5-8	Medium-Stiff	9-15	Stiff	Little	10 to 20%
10-29	Medium-Dense	16-30	Very Stiff	31+	Hard	Some	20 to 35%
30-49	Dense					and	30 to 50%
50+	Very Dense						

Client: GNCB				**SEABOARD**	**Test Boring/ B-6**
Location: 16 Main Street Williamsburg Ma				**DRILLING, INC.**	**Monitor Well ID:**
Project: Public Safety Project				**649 Meadow St., Chicopee, MA 01013**	
Contractor: Seaboard Drilling, Inc.				**DRILLING/SOIL LOG**	**Sheet No. 1 of 1**
	Casing		**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 9/14/2020
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 9/14/2020
O.D. Inch	**8-1/2"**			**Rig Type: Diedrich D 50**	**Driller: Doug Feeley**
I.D. Inch	**4-1/4"**				GS EL. 522.0

Depth (ft.) Range	Blows	Sample No.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	2-2-2-2	S-1	20"	0.0'-0.8': Dark brown loamy SILT (TOPSOIL)
2-4'	10-9-40-22	S-2	14"	0.8'-3.0': Yellow brown fine sandy SILT with coarse gravel at 3'-4' (ALLUVIUM)
				3.0'-4.8': Brown/Gray gravelly coarse to fine SAND, little silt (OUTWASH)
				augered very hard 3' to 4.5'
4-4.8'	38-50/4"	S-3	8"	Brown/White coarse to fine SAND and GRAVEL, trace Silt
				Split Spoon Refusal @ 4.8'
				Water not observed at completion of test boring; intense/hard drilling may have temporarily masked water readings.

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density (# Hammer Blows)		Cohesive Consistence (# Hammer Blows)				PROPORTIONS	
0-4	Very Loose	0-2	Very Soft	3-4	Soft	Trace	0 to 10%
5-9	Loose	5-8	Medium-Stiff	9-15	Stiff	Little	10 to 20%
10-29	Medium-Dense	16-30	Very Stiff	31+	Hard	Some	20 to 35%
30-49	Dense					and	30 to 50%
50+	Very Dense						

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Appendix C
Suggested Specifications for Compacted Structural Fill

SECTION 312100 - COMPACTED STRUCTURAL FILL WITHIN BUILDINGS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

The work covered by this specification consists of furnishing all plant, labor, equipment and materials and performing all operations in connection with excavation, preparation of subgrade, and providing, placing and compacting Structural Fill within the building.

1.2 QUALITY ASSURANCE

Monitoring of earthwork operations will be provided by the Owner.

The Contractor shall not place a layer of fill until the Owner has observed the underlying materials.

PART 2 – PRODUCTS

2.1 STRUCTURAL FILL

Structural fill shall be suitable gravel, sandy gravel, or gravelly sand, free of organic material, loam, trash, snow, ice, frozen soil and other objectionable material and shall be well-graded within the following limits:

Sieve Size	Percent Finer by Weight
4 inches	100
No. 4	20 – 80
No. 40	5 – 50
No. 200	0 – 10

Excavated material is generally not suitable for use as Structural Fill. The inorganic sand and gravel materials typically below a depth of 3 ft. may be a suitable compacted structural fill, however material sizes greater than 4 in. will need to be removed. As excavation proceeds, stockpile potential structural fill materials for laboratory testing to confirm they satisfy the above gradation criteria.

All material is subject to approval by the Owner’s representative.

PART 3 – EXECUTION

3.1 SUBGRADE PREPARATION

Remove all topsoil, man-placed fill, and other unsuitable materials from the area of new building footing and slab foundations and to lateral limits extended beyond the footings a

distance equal to the depth of fill required below the footing plus two feet. Upon completion of the excavation, the soil subgrade shall be compacted by at least eight (8) coverages with the treads of a crawler type tractor weighing at least 30,000 pounds, with the rear wheels of a fully loaded ten-wheel dump truck, or by a suitable 10-ton vibratory roller as approved by the Owner. Where, in the opinion of the Owner, compaction of the subgrade is not desirable, the above compaction requirements will be waived.

3.2 PLACEMENT OF COMPACTED STRUCTURAL FILL

Structural Fill shall be placed in layers not to exceed ten (10) inches in thickness as measured before compaction. Each layer shall be compacted by a minimum of four coverages with the equipment described below to at least 95 percent of maximum dry density as determined by ASTM Test D1557. Incidental compaction due to traffic by construction equipment will not be credited toward the required minimum four coverages.

Compaction equipment in open areas shall consist of vibratory rollers, fully loaded ten-wheel dump trucks, or other compaction equipment approved by the Owner. Compaction equipment in confined areas (in trenches and adjacent to walls, piers and footings) shall consist of hand-guided vibratory equipment or mechanical tampers as approved by the Owner. Layer thickness prior to compaction in confined areas, shall not exceed six (6) inches, measured prior to compaction.

All Structural Fill shall be placed and compacted “in-the-dry”. The Contractor shall dewater excavated areas as required to perform the work and in such a manner as to preserve the undisturbed state of the existing soil subgrade.

The Contractor shall not place a layer of Compacted Structural Fill on snow, ice or soil that was permitted to freeze prior to compaction. Removal of these unsatisfactory materials will be required as directed by the Owner.

In freezing weather, a layer of Structural Fill shall not be left in an uncompacted state at the close of a day’s operations. Prior to terminating operations for the day, the final layer of fill, after compaction, shall be rolled with a smooth-wheeled roller to eliminate ridges of soil left by tractors, trucks and compaction equipment.

Compacted Structural Fill shall not be placed when ambient temperatures are below freezing.

END OF SECTION 312100