REPORT

23-0793 S

July 26, 2023

Explorations and Geotechnical Engineering Services

Proposed Public Works Building Additions
680 Peverly Hill Road
Portsmouth, New Hampshire

Prepared For:
Altus Engineering
Attention: Cory Belden, P.E.
133 Court Street
Portsmouth, NH 03801

Prepared By:
S. W. Cole Engineering, Inc.
10 Centre Road
Somersworth, NH 03878
T: 603-692-0008

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July 26, 2023

Altus Engineering
Attention: Cory Belden, P.E.
133 Court Street
Portsmouth, NH 03801

Subject: Explorations and Geotechnical Engineering Services
Proposed Public Works Building Additions
680 Peverly Hill Road
Portsmouth, New Hampshire

Dear Corey:

In accordance with our Proposal, dated May 30, 2023, we have performed subsurface explorations for the subject project. This report summarizes our findings and geotechnical recommendations, and its contents are subject to the limitations set forth in Appendix A.

1.0 INTRODUCTION

1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information at the site in order to develop geotechnical recommendations relative to foundations and earthwork associated with the proposed building addition construction. Our scope of services included four test boring explorations, soils laboratory testing, a geotechnical analysis of the subsurface findings and preparation of this report.

1.2 Site and Proposed Construction

We understand the site is located at the existing Department of Public Works on the southwest side of Peverly Hill Road about 400 feet northwest of West Road. We understand the site consists of an approximate 2.3-acre parcel which is occupied by four existing structures. The proposed development site generally consists of open paved areas with a site retaining wall located toward the southwest corner of the main

building which includes adjacent office and garage space. The existing Garage and Office consist of a single-story high-bay structure and two-story structure, respectively. Existing grades slope gently downward across the site from northeast to southwest. An existing site retaining wall at the southwest side of the Office varies in height from approximately 2 to 6 feet. Based on an available site plan, the existing finish floor elevations of the Office and Garage buildings vary from approximate elevation 57.6 feet to 57.1 feet, respectively.

Proposed construction includes a Garage addition on the northeast side of the existing Garage and an Office addition on the southwest side of the existing Office building. We understand the Garage addition will consist of a single-story, high-bay structure with an on-grade slab slightly lower than the existing Garage slab. We understand no below-grade basement space is planned.

We understand the Office addition will consist of a two-story structure with an on-grade slab coincident with the existing ground level slab. We understand no below-grade basement space is planned. The proposed finish grades are anticipated to be within two feet of the existing grades.

Proposed and existing site features are shown on the “Exploration Location Plan” attached in Appendix B.

2.0 EXPLORATION AND TESTING

2.1 Explorations

Four test borings (B-1 through B-4) were made at the site on May 16, 2023 by Seaboard Drilling, LLC under subcontract to S. W. Cole Engineering, Inc. (S.W.COLE). The exploration locations were selected and established in the field by S.W.COLE using measurements from existing site features. The approximate exploration locations are shown on the “Exploration Location Plan” attached in Appendix B. Logs of the explorations and a key to the notes and symbols used on the logs are attached in Appendix C. The elevations shown on the logs were estimated based on existing finish floor elevations shown on the “Exploration Location Plan” and are approximate.

2.2 Field Testing

The test borings were drilled using hollow stem auger techniques. The soils were sampled at 2-to-5-foot intervals using a split spoon sampler and Standard Penetration Testing (SPT) methods. SPT blow counts results are shown on the logs.

2.3 Laboratory Testing

Soil samples obtained from the explorations were returned to our laboratory for further classification and testing. One gradation and moisture content test were performed on a select soil sample. The moisture content test result is noted on the log and the result of the gradation test is attached in Appendix D.

3.0 SUBSURFACE CONDITIONS

3.1 Soil and Bedrock

Proposed Garage Addition: Test borings B-1 and B-2 were made in the area of the proposed Garage addition and encountered a soils profile generally consisting uncontrolled fills overlying native glacial outwash and till deposits, overlying bedrock with depth. The fills contained various debris such as cinders, cobbles, boulders, asphalt, and organics/topsoil. The depth of fill encountered in test boring B-1 was approximately 5.5 feet. Refusals were met within the existing fill material at test boring B-2 in three attempts at depths varying from approximately 2 to 5 feet below the existing ground surface. The refusals are considered most likely attributable to boulders or bedrock. The native soils below the fill consist of medium dense outwash soil to 10 feet overlying very dense glacial till deposits to the boring termination depth at 16.0 feet.

Proposed Office Addition: Test borings B-3 and B-4 were made in the area of the proposed Office addition and encountered a soils profile generally consisting of uncontrolled fills overlying native glacial till. The fills contained various debris such as cinders, brick, asphalt, cobbles, boulders, and frequent wood. The depth of fill encountered in test boring B-3 was approximately 17 feet. Refusals were met within the existing fill material at test boring B-4 in three attempts at depths varying from approximately 4.5 to 6.3 feet below the existing ground surface. The refusals are considered most likely attributable to boulders within the fill. The native soils below the fill consist of medium dense to very dense glacial till deposits to the boring termination depth at 16.0 feet.

3.2 Groundwater

The soils encountered at test borings B-1, B-2 and B-4 were dry to moist. Saturated soils were encountered at test boring B-3 below a depth of approximately 12 feet below the existing ground surface. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate, particularly in response to periods of snowmelt and precipitation, and changes in site use.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Based on the subsurface findings, the proposed construction appears feasible from a geotechnical standpoint. The principal geotechnical considerations include:

Proposed Garage Addition:

- The explorations encountered existing pavement and uncontrolled fills within the proposed Garage addition. Accordingly, we recommend the pavement and uncontrolled fills be completely removed from beneath the proposed building additions including entrance slabs and backfilled with compacted Granular Borrow. The excavated uncontrolled fills are indicated to contain oversized boulders and are not considered suitable for reuse as Granular Borrow or Structural Fill,

- It is our opinion that spread footing foundations and slab-on-grade floors bearing on properly prepared subgrades appear suitable for the proposed Garage addition. Footings should bear on a minimum 6-inches of compacted Crushed Stone wrapped in a geotextile fabric overlying newly placed Granular Borrow or undisturbed native glacial till or bedrock.

- Particular care should be taken to reduce the excavation for the proposed foundations immediately adjacent to the existing foundations to avoid undermining of the existing footings. Excavation should not extend below a 1H to 1V influence line extending from the bottom edge of existing footings. If excavation is to encroach beyond the influence line, underpinning of the existing buildings will be necessary. We suggest setting the slab elevation for the portion of the new building abutting the existing to the same slab elevation, extending north to for a

distance and constructing and interior retaining wall to accommodate the proposed lower slab elevation of the new building addition.

- The on-grade floor slab should be underlain by a vapor barrier and a minimum 12 inches of compacted Structural Fill.

- Entrance slabs should bear on Structural Fill extending to full frost depth overlying properly prepared subgrades.

- The design frost depth for Portsmouth, New Hampshire is 4 feet. All perimeter footings should have a minimum soil cover of 4 feet for frost protection.

- We recommend that foundation drains be installed along the outside edge of the new perimeter footings. The perimeter drains should be installed with a positive gravity outlet protected from freezing, clogging and backflow. Surface grades should be sloped away from the building for positive surface water drainage.

Proposed Office Addition:

- Test boring B-3 encountered uncontrolled fills extending to a depth of approximately 17 feet below the existing ground surface. Given the depth of uncontrolled fills and proposed construction, we recommend the proposed structural loads be supported on a pile foundation.

- Alternatively, the structure could be supported on spread footings following over-excavation of existing fills and replacement with compacted Granular Borrow. However, this approach would require a substantial temporary excavation support system to protect the existing foundations and could introduce additional risk for potential settlement of the existing Office building. Additionally, the excavated fill would require soil characterization for disposal. Given the amount of debris and large particles in the fill, the installation of a temporary excavation support system would require pre-excavation to remove oversized obstructions.

- We anticipate the foundation will consist of a system of pile caps which are interconnected with below-grade tie beams. Considering the depth of existing fill and presence of organic material (i.e., wood), we would recommend the ground

level slab be structurally framed with its load distributed to the pile caps and grade beams.

- Based on the anticipated loads for a two-story structure, helical screw piles or end-bearing driven piles are considered to be suitable and economical pile types, however subsurface obstructions can hinder the installation and the ability to achieve a target depth. Accordingly, pre-excavation to remove obstructions at pile locations is anticipated to be required. Although typically more expensive, micropiles can potentially be advanced though obstructions more effectively than helical screw piles or driven piles. Foundation piles should be advanced through the existing uncontrolled fills and derive their capacity within the underlying native glacial till deposit and/or bedrock.

- The design of foundation piles should be a delegated design prepared by an engineer registered in the State of New Hampshire and employed by the contractor. The foundation pile design should be reviewed by the owner's geotechnical engineer prior to installation.

- All pile caps and tie beams exposed to freezing temperatures should have at least 4.0 feet of soil cover to provide frost protection.

4.2 Site and Subgrade Preparation

We recommend site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. As much vegetation as possible should remain outside the construction areas to lessen the potential for erosion and site disturbance. Existing pavements, topsoil, uncontrolled fills and utilities should be completely removed from areas of proposed construction.

All organics and uncontrolled fills beneath the proposed Garage addition, must be removed to the undisturbed native glacial outwash or till deposits, or bedrock, and backfilled with compacted Granular Borrow. Within the Garage addition footprint, the extent of removal of existing fill should extend laterally 1 foot for every 1 foot of excavation depth (1H:1V bearing splay). Over excavations to remove uncontrolled fills must not undermine the existing buildings.

We recommend that footings be excavated using a smooth-edged bucket to reduce potential for soil disturbance.

4.3 Excavation and Dewatering

Excavation work will generally encounter existing fills with varying amounts of topsoil, brick, asphalt, and cinders, as well as native sand, silt and gravel. Within the proposed Garage, refusal surfaces are considered attributable to boulders or bedrock. Frequent boulders were noted in the existing fills within both proposed additions.

Care must be exercised during construction to limit disturbance of bearing soils. Earthwork and grading activities should occur during drier, non-freezing weather of Spring, Summer, and Fall. Final cuts to subgrade should be performed with a smooth-edged bucket to help reduce strength loss from soil disturbance. Subgrades that become disturbed should be over-excavated and replaced with compacted Granular Borrow or Crushed Stone.

Vibrations from construction should be controlled below threshold limits of 0.5 in/sec for structures, water supply wells and infrastructure within 500 feet of the project site. More restrictive vibration limits may be warranted in specific cases with sensitive equipment, historic structures or artifacts on-site or within close proximity.

Groundwater was not encountered at the anticipated footing elevations within the proposed Garage addition. Groundwater was encountered at approximately 12 feet below the lower existing grade within the proposed Office addition. The contractor should, however, be prepared to dewater the excavations from accumulated surface run-off in the excavations.

Excavations must be properly shored or sloped in accordance with OSHA Regulations to prevent sloughing and caving of the sidewalls during construction. Temporary excavation support systems, if implemented, should be sufficient to prevent any detrimental settlement of existing structures. The design and planning of excavations, excavation support systems, and temporary dewatering is the responsibility of the contractor.

4.4 Foundations

Proposed Garage Addition:

We recommend the proposed Garage addition be supported on spread footings founded on at least 6 inches compacted Crushed Stone overlying compacted Granular Borrow or, undisturbed native glacial till. For foundations bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design consideration:

Geotechnical Parameters for Spread Footing Foundation - Garage	
Design Frost Depth (100-year AFI)	4.0 feet
Net Allowable Soil Bearing Pressure	4.0 ksf
Base Friction Factor	0.45
Total Unit Weight of Backfill (Structural Fill)	125 pcf
Active Lateral Earth Pressure Coefficient	0.3
Passive Earth Pressure Coefficient	3.0
At-Rest Lateral Earth Pressure Coefficient	0.5
Seismic Soil Site Class (IBC 2018)	D
Estimated Total Settlement	1-inch or less
Differential Settlement	½-inch or less over building width

Proposed Office Addition:

Considering the depth of uncontrolled fills, observed groundwater conditions, proximity to the existing Office building and no proposed below-grade space, we recommend the proposed Office addition be supported on a pile foundation. We anticipate the proposed foundation will consist of pile caps interconnected with below-grade tie beams or grade beams.

Typically, economical pile types include helical screw piles and driven steel H-piles, however both have challenges of passing obstructions. Accordingly, pre-excavation to remove obstructions at pile locations is anticipated to be required. Although typically more expensive, micropiles would also be suitable and have the ability to drill through obstructions more effectively than helical screw piles or driven piles. Piles must be installed through the fill layer and develop their resistance within the native glacial till deposit, and/or bedrock.

The design of the foundation piles should be a delegated design prepared by an engineer registered in the State of New Hampshire and employed by the contractor.

The pile design should be reviewed by the owner's geotechnical engineer prior to installation. The pile designer will require foundation plans, structural loading, and subsurface conditions from the test borings.

For pile-supported foundations, we recommend the following performance criteria for pile foundations:

Geotechnical Performance Criteria for Pile Foundation - Office	
Design Frost Depth (100-year AFI)	4.0 feet
Allowable Axial, Uplift, and Lateral Load	tailored to number of piles and proposed loads
Minimum Pile Spacing	30 inches or 3 pile diameters whichever is greater
Minimum Number of Piles Per Pile Cap	2
Seismic Soil Site Class (IBC 2018)	D
Total Slab and Foundation Settlement	1/2-inch or less

Lateral loads may be resisted from earth pressures acting on the sides of the grade beams, tie beams and pile caps provided they are backfilled with compacted Structural Fill using a total unit weight of granular backfill (γt) of 125 pcf, an angle of internal friction of 30 degrees with an at-rest lateral earth pressure coefficient (Ko) of 0.5. Depending upon the amount of deflection, lateral earth resistance may mobilize an ultimate passive lateral earth pressure coefficient (Kp) of 3.0. S.W.COLE can assist with lateral capacities, as deemed necessary by the structural engineer.

S.W.COLE should be engaged to review the contractor's pile design submittal and observe pile installation activities.

4.5 Foundation Drainage

We recommend a perimeter drain system be installed on the outside edge of proposed footings for the proposed Garage addition. Based on the selected foundation and excavation plan for the proposed Office addition, recommendations for foundation drainage for this structure can be provided under a separate cover.

The underdrain pipe should consist of 4-inch diameter, perforated SDR-35 foundation drain pipe bedded in Crushed Stone and wrapped in non-woven geotextile fabric. The underdrain pipe must have a positive gravity outlet protected from freezing, clogging and

backflow. Surface grades should be sloped away from the building for positive surface water drainage. General underdrain details for the proposed Garage addition are illustrated on the “Foundation Detail Sketch” attached in Appendix B.

4.6 Slab-On-Grade

On-grade floor slabs for the Garage addition which are in heated areas, may be designed using a subgrade reaction modulus of 100 pci (pounds per cubic inch) provided the slab is underlain by at least 12 inches of compacted Structural Fill. The structural engineer or concrete consultant must design steel reinforcing and joint spacing appropriate to slab thickness, function, and prevention of slab curling and cracking.

We recommend a sub-slab vapor retarder for the slab particularly in areas of the building where the concrete slab will be covered with an impermeable surface treatment or floor covering that may be sensitive to moisture vapors. The vapor retarder must have a permeance that is less than the floor cover or surface treatment that is applied to the slab. The vapor retarder must have sufficient durability to withstand direct contact with the sub-slab base material and construction activity. The vapor retarder material should be placed according to the manufacturer’s recommended method, including the taping, and lapping of all joints and wall connections. The architect and/or flooring consultant should select the vapor retarder products compatible with flooring and adhesive materials.

The floor slab should be appropriately cured using moisture retention methods after casting. Typical floor slab curing methods should be used for at least 7 days. The architect or flooring consultant should assign curing methods consistent with current applicable American Concrete Institute (ACI) procedures with consideration of curing method compatibility to proposed surface treatments, flooring, and adhesive materials.

4.7 Entrance Slabs and Sidewalks

Entrance slabs and sidewalks adjacent to the building must be designed to reduce the effects of differential frost action between adjacent pavement, doorways, and entrances. We recommend that non-frost susceptible Structural Fill be provided to a full frost depth of at least 4.0 feet below the top of entrance slabs. This thickness of Structural Fill should extend the full footprint of the entrance slab, thereafter, transitioning up to the

bottom of the adjacent sidewalk or pavement gravels at a 3H:1V or flatter slope. General details of this frost transition zone are shown on the "Foundation Detail Sketch" included in Appendix B.

4.8 Fill, Backfill and Compaction

We recommend the following fill and backfill materials: recycled products must also be tested in accordance with applicable environmental regulations and approved by a qualified environmental consultant.

Granular Borrow: Fill to raise grades in building areas should be sand or silty sand meeting the following gradation:

Granular Borrow	
Sieve Size	**Percent Finer by Weight**
Portion Passing 3-inch Sieve	
No. 40	0 to 70
No. 200	0 to 20

Structural Fill: Backfill for foundations and material below exterior entrances slabs should be clean, non-frost susceptible sand and gravel meeting the gradation requirements for Structural Fill as given below:

Structural Fill	
Sieve Size	**Percent Finer by Weight**
4 inch	100
3 inch	90 to 100
¼ inch	25 to 90
No. 40	0 to 30
No. 200	0 to 6

In our opinion, 2016 NHDOT Standard Specification 209.2.1.2 Granular Backfill (gravel) meets the requirements of Structural Fill.

Crushed Stone: Crushed stone used beneath foundations, beneath basement slabs, and for underdrain aggregate should be washed, hard, durable rock meeting the requirements of 2016 NHDOT Standard Specification 703-1 Standard Stone Size #57.

Reuse of Site Soils: The on-site soils are considered to be unsuitable for reuse in building areas.

Placement and Compaction: Fill should be placed in horizontal lifts and compacted such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thicknesses for grading, fill and backfill activities should not exceed 12 inches. We recommend that fill and backfill in building areas be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Crushed Stone should be compacted with 3 to 5 passes of a vibratory plate compactor having a static weight of at least 500 pounds.

4.9 Weather Considerations

Construction activity should be limited during wet and freezing weather and the site soils may require drying or thawing before construction activities may continue. The contractor should anticipate the need for water to temper fills in order to facilitate compaction during dry weather. If construction takes place during cold weather, subgrades, foundations, and floor slabs must be protected during freezing conditions. Concrete and fill must not be placed on frozen soil; and once placed, the concrete and soil beneath the structure must be protected from freezing.

4.10 Paved Areas

We anticipate new paved areas will consist of small areas abutting the proposed building additions. We anticipate pavement will be subjected to a combination of passenger vehicles and heavier public works equipment. Considering the site soils, and proposed usage, we offer the following pavement section for consideration.

FLEXIBLE (HMA) PAVEMENT SECTION – 2016 NHDOT Standard Specs	
Pavement Layer	**Material Thickness**
NHDOT ½ inch Superpave Wearing Course	1 ½ inches
NHDOT ¾ inch Superpave Binder Course	2 ½ inches
NHDOT Crushed Stone (fine) (304.4) Base Course	6 inches
NHDOT Gravel (304.2) Subbase Course or Crushed Stone (coarse) (304.5) Subbase Course	12 inches

The base and subbase materials should be compacted to at least 95 percent of their maximum dry density as determined by ASTM D-1557. Hot mix asphalt pavement

should be compacted to 92 to 97 percent of its theoretical maximum density as determined by ASTM D-2041. A tack coat should be used between successive lifts of bituminous pavement.

4.11 Design Review and Construction Testing

S.W.COLE should be retained to review the construction documents prior to bidding to determine that our earthwork and foundation recommendations have been properly interpreted and implemented.

A construction materials testing and quality assurance program should be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE is available to observe earthwork activities, the preparation of foundation bearing surfaces and pavement subgrades, as well as to provide testing and IBC Special Inspection services for soils, concrete, steel, spray-applied fireproofing, structural masonry, and asphalt construction materials.

4.12 Recommendations for Additional Study

Based on the age of the existing Office building, we anticipate that the existing footings adjacent to the proposed addition bear at approximately 4 feet below existing grade. Determining the actual bearing elevation, foundation geometry and bearing soils would be beneficial in selecting a foundation type and excavation plan for the proposed Office addition.

Also, within the proposed Office addition, test boring B-4 encountered refusals at three attempts in the existing fill. These refusals are considered most likely attributable to frequent boulders in the fill. As a result, the depth of fill material could not be determined at this location.

Accordingly, we recommend additional test pits along the existing Office building at the proposed addition to determine the actual bearing elevation, foundation geometry and bearing soils at this portion of the building. We also recommend additional test borings in the proposed Office addition coupled with the use of an excavator to attempt to excavate through and remove obstructions to facilitate boring activity.

5.0 CLOSURE

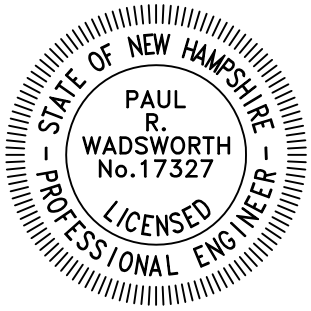
It has been a pleasure to be of assistance to you with this phase of your project. We look forward to working with you during the design and construction phases of the project.

Sincerely,

S. W. Cole Engineering, Inc.

Digitally signed by Paul Wadsworth
DN: dc=lan, dc=SWCole, ou=SWCole Users, ou=Somersworth, cn=Paul Wadsworth
Date: 2023.07.26 13:10:58 -04'00'

Paul R. Wadsworth, P.E.
Senior Geotechnical Engineer



PRW:cbm

APPENDIX A

Limitations

This report has been prepared for the exclusive use of Altus Engineering for specific application to the proposed Public Works Building Additions at 680 Peverly Hill Road in Portsmouth, New Hampshire. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

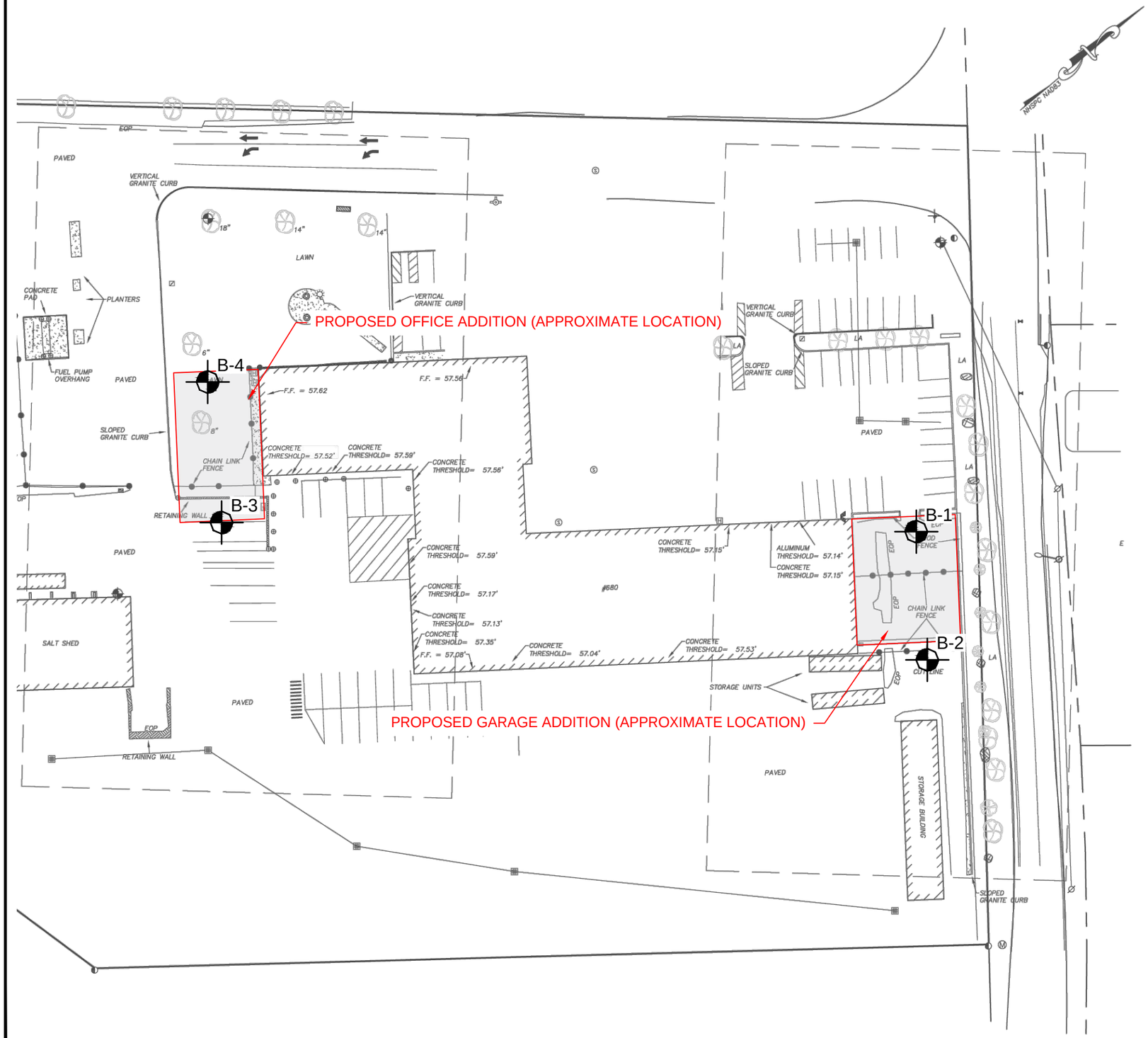
Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

S.W.COLE's scope of services has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.

APPENDIX B

Figures



LEGEND:

APPROXIMATE BORING LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=30' SCALE PLAN OF THE SITE ENTITLED "EXISTING CONDITIONS SITE PLAN," PREPARED BY ALTUS ENGINEERING, INC., DATED 5/30/2023 AND PROVIDED AS A PORTABLE DOCUMENT FORMAT (PDF) FILE.
2. THE BORINGS WERE LOCATED IN THE FIELD BY MEASUREMENTS FROM EXISTING SITE FEATURES.
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
4. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.

0 60 120 Feet

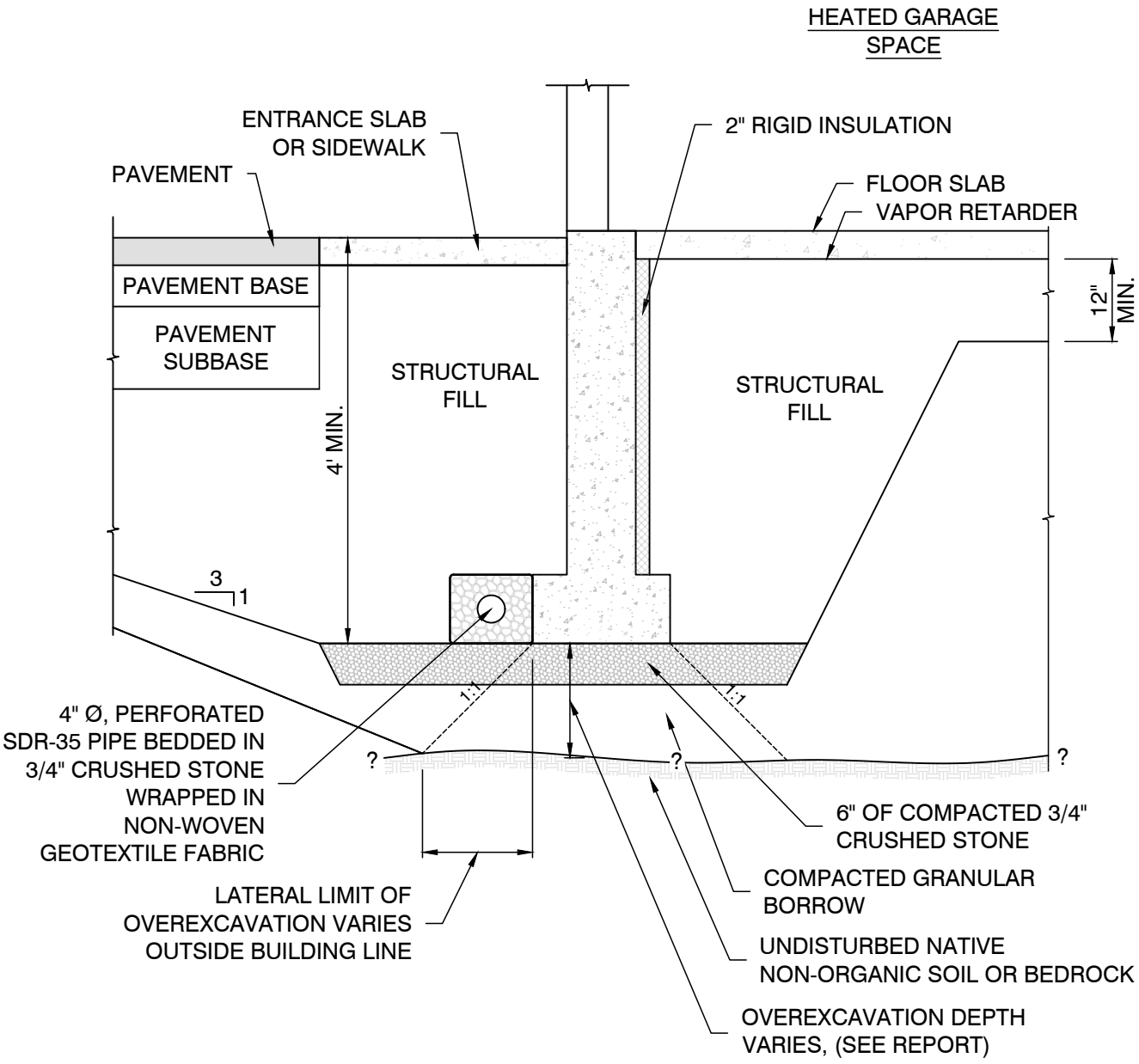
S.W.COLE ENGINEERING, INC.

ALTUS ENGINEERING

EXPLORATION LOCATION PLAN

PROPOSED PUBLIC WORKS BUILDING ADDITIONS
680 PEVERLY HILL RD.
PORTSMOUTH, NEW HAMPSHIRE

Job No.:	23-0793	Scale:	1" = 60'
Date :	07/17/2023	Sheet:	1



NOTE:

1. UNDERDRAIN INSTALLATION AND MATERIAL GRADATION RECOMMENDATIONS ARE CONTAINED WITHIN THIS REPORT.
2. DETAIL IS PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY, NOT FOR CONSTRUCTION.

S.W.COLE ENGINEERING, INC.

ALTUS ENGINEERING

FOUNDATION DETAIL SKETCH

PROPOSED PUBLIC WORKS BUILDING ADDITIONS
680 PEVERLY HILL RD.
PORTSMOUTH, NEW HAMPSHIRE

Job No.:	23-0793	Scale:	Not to Scale
Date :	07/17/2023	Sheet:	2

APPENDIX C

Exploration Logs and Key

BORING LOG

S.W.COLE

CLIENT: Altus Engineering
PROJECT: Proposed Additions - Portsmouth DPW
LOCATION: 680 Peverly Hill Road, Portsmouth, NH

BORING NO.: B-1
SHEET: 1 of 1
PROJECT NO. 23-0793
DATE START: 5/16/2023
DATE FINISH: 5/16/2023

Drilling Information

LOCATION: See Exploration Location Plan
ELEVATION (FT): 55' Estimated
TOTAL DEPTH (FT): 16.0
LOGGED BY: P. Wadsworth
DRILLING CO.:
DRILLER: Dale
DRILLING METHOD: Hollow Stem Auger
RIG TYPE: Truck Mounted Mobile
AUGER ID/OD: 2 1/4 in / 5 5/8 in
SAMPLER: Standard Split-Spoon
HAMMER TYPE: Automatic / Safety
HAMMER WEIGHT (lbs): 140 / 300
CASING ID/OD: N/A /N/A
CORE BARREL:
HAMMER CORRECTION FACTOR:
HAMMER DROP (inch): 30 / 16
WATER LEVEL DEPTHS (ft): 6/15/2023 12:00 am No free water observed
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			1D		0.5-2.5	24/12	30-34-17-13			0.1 1.5 Inches Asphalt Pavement Very dense gray gravelly silty SAND, frequnet cobbles, with asphalt pieces (Fill)		
			2D		2.5-4.5	24/10	17-41-14-14	ID 22957 S w =8.1 % ASTM C136 & D2216		2.5 Very dense gray gravelly silty SAND, frequent cobbles and boulders with asphalt pieces (Fill)		Boulder at 4 Ft.
50	5		3D		5-7	24/16	35-8-5-6			5.5 Mediusm dense brown fine SAND, trace silt (Glacial Outwasht)		
45	10		4D		10-10.2	2/0	55/2"			10.0 Very dense gray SAND and GRAVEL, some silt, frequent cobbles and boulders (Glacial Till)		
40	15		5D		15-16	12/0	19-17-50/0"					

Split Spoon Refusal at 16.0 feet
Probable Boulder or Bedrock

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-1

BORING LOG

BORING NO.:	**B-2**
SHEET:	1 of 1
PROJECT NO.	23-0793
DATE START:	5/16/2023
DATE FINISH:	5/16/2023

CLIENT: Altus Engineering
PROJECT: Proposed Additions - Portsmouth DPW
LOCATION: 680 Peverly Hill Road, Portsmouth, NH

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 55' Estimated **TOTAL DEPTH (FT):** 5.0 **LOGGED BY:** P. Wadsworth
DRILLING CO.: **DRILLER:** Dale **DRILLING METHOD:** Hollow Stem Auger
RIG TYPE: Truck Mounted Mobile **AUGER ID/OD:** 2 1/4 in / 5 5/8 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: N/A **HAMMER WEIGHT (lbs):** 140 / 300 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER CORRECTION FACTOR: **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 6/15/2023 12:00 am No free water observed
GENERAL NOTES: Two additional attempts encountered Refusals at 2 Ft. & 2.5 Ft.

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			1D	▽	0.5-1.9	17/12	7-17-50/5"			0.1 1.5 Inches Asphalt Pavement Very dense gray SAND and GRAVEL, some silt, frequent cobbles and boulders, trace ash, cinders, topsoil (Fill)		Two additional attempts encountered Refusals at 2 Ft. & 2.5 Ft.
50	5		2D		5-5	0/0	50/0"			Split Spoon & Auger Refusal at 5.0 feet Probable Boulder or Bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: **B-2**

BORING LOG

BORING NO.: B-3
SHEET: 1 of 1
PROJECT NO. 23-0793
DATE START: 5/16/2023
DATE FINISH: 5/16/2023

CLIENT: Altus Engineering
PROJECT: Proposed Additions - Portsmouth DPW
LOCATION: 680 Peverly Hill Road, Portsmouth, NH

Drilling Information

LOCATION: See Exploration Location Plan | **ELEVATION (FT):** 52' Estimated | **TOTAL DEPTH (FT):** 21.0 | **LOGGED BY:** P. Wadsworth
DRILLING CO.: | **DRILLER:** Dale | **DRILLING METHOD:** Hollow Stem Auger
RIG TYPE: Truck Mounted Mobile | **AUGER ID/OD:** 2 1/4 in / 5 5/8 in | **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: N/A | **HAMMER WEIGHT (lbs):** 140 / 300 | **CASING ID/OD:** N/A /N/A | **CORE BARREL:**
HAMMER CORRECTION FACTOR: | **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): ▽ 12 ft 6/15/2023 Free water observed at 12 Ft.
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0.3-2.3	24/22	15-22-21-15			0.1 1.5 Inches Asphalt Pavement Dense gray SAND and GRAVEL, some silt, frequent cobbles with brick, asphalt pieces (Fill)		
50			2D		2.3-4.3	24/13	18-14-12-13			2.3 Medium dense gray SAND and GRAVEL, some silt (Fill)		
	5		3D		5-7	24/18	7-6-7-6			5.0 Medium dense gray silty SAND, some gravel with asphalt pieces (Fill)		
45			4D		7-9	24/16	3-6-6-8					
	10		5D		10-12	24/10	3-3-3-3			10.0 Loose dark gray silty fine SAND, some gravel, trace asphalt, cinders (Fill)		
40			6D		12-12.9	11/9	14-50/5"			12.0 Frequent pieces of WOOD with some sand (Fill)	▽	
	15		7D		15-17	24/1	7-4-2/12"					
35			8D		17-19	24/12	7-18-10-10			17.0 Medium dense gray SAND and GRAVEL, some silt with occasional cobbles and boulders (Glacial Till)		
	20		9D		19-21	24/10	20-33-49-47			19.0 Very dense gray GRAVEL, some sand, some silt (Glacial Till)		

Bottom of Exploration at 21.0 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG

BORING NO.:	**B-4**
SHEET:	1 of 1
PROJECT NO.	23-0793
DATE START:	5/16/2023
DATE FINISH:	5/16/2023

CLIENT: Altus Engineering
PROJECT: Proposed Additions - Portsmouth DPW
LOCATION: 680 Peverly Hill Road, Portsmouth, NH

Drilling Information

LOCATION: See Exploration Location Plan | **ELEVATION (FT):** 56' Estimated | **TOTAL DEPTH (FT):** 6.3 | **LOGGED BY:** P. Wadsworth
DRILLING CO.: | **DRILLER:** Dale | **DRILLING METHOD:** Hollow Stem Auger
RIG TYPE: Truck Mounted Mobile | **AUGER ID/OD:** 2 1/4 in / 5 5/8 in | **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: N/A | **HAMMER WEIGHT (lbs):** 140 / 300 | **CASING ID/OD:** N/A /N/A | **CORE BARREL:**
HAMMER CORRECTION FACTOR: | **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 6/15/2023 12:00 am No free water observed
GENERAL NOTES: Two additional attempts encountered Refusals at 4.5 Ft. and 5 Ft.

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
55			1D		0-2	24/20	4-14-34-20			6 Inches of Topsoil (0.5) Dense dark broun silty SAND and GRAVEL, frequent cobbles and boulders with brick, asphalt pieces (Fill) (2.0) Very dense gray sandy GRAVEL, frequent cobbles and boulders, trace brick chips (Fill)		
	5		2D		5-6.3	16/12	14-17-50/4"					Two additional attempts encountered Refusals at 4.5 Ft. and 5 Ft.
50												

Split Spoon Refusal at 6.3 feet
Probable Boulder or Bedrock

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: **B-4**

KEY TO NOTES & SYMBOLS

Test Boring and Test Pit Explorations

Stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Key to Symbols Used:

w	-	water content, percent (dry weight basis)
q_u	-	unconfined compressive strength, kips/sq. ft. - laboratory test
S_v	-	field vane shear strength, kips/sq. ft.
L_v	-	lab vane shear strength, kips/sq. ft.
q_p	-	unconfined compressive strength, kips/sq. ft. – pocket penetrometer test
O	-	organic content, percent (dry weight basis)
W_L	-	liquid limit - Atterberg test
W_P	-	plastic limit - Atterberg test
WOH	-	advance by weight of hammer
WOM	-	advance by weight of man
WOR	-	advance by weight of rods
HYD	-	advance by force of hydraulic piston on drill
RQD	-	Rock Quality Designator - an index of the quality of a rock mass.
γ_T	-	total soil weight
γ_B	-	buoyant soil weight

Description of Proportions:

Trace:	0 to 5%
Some:	5 to 12%
"Y"	12 to 35%
And	35+%
With	Undifferentiated

Description of Stratified Soils

Parting:	0 to 1/16" thickness
Seam:	1/16" to 1/2" thickness
Layer:	½" to 12" thickness
Varved:	Alternating seams or layers
Occasional:	one or less per foot of thickness
Frequent:	more than one per foot of thickness

REFUSAL: **Test Boring Explorations** - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

REFUSAL: **Test Pit Explorations** - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

APPENDIX D

Laboratory Test Results

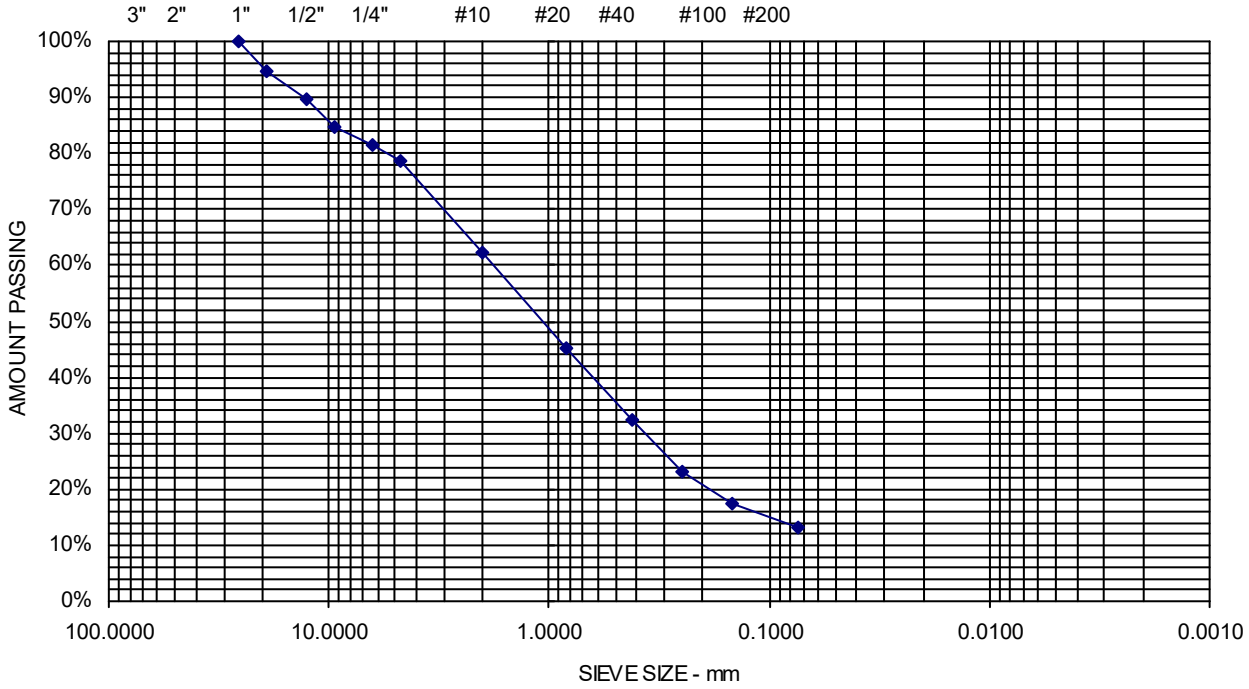
S.W.COLE ENGINEERING, INC.

Report of Gradation

ASTM C-117 & C-136

Project Name	PORTSMOUTH NH - PROPOSED PUBLIC WORKS BUILDING ADDITIONS - GEOTECHNICAL ENGINEERING SERVICES	Project Number	23-0793
Client	ALTUS ENGINEERING, INC.	Lab ID	22957S
Exploration	**B-1 2D 2.5' - 4.5'**	Date Received	7/13/2023
Material Source	**ON-SITE**	Date Completed	7/14/2023
		Tested By	BRADLEY GERSCHWILER

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
25.0 mm	**1"**	**100**	
19.0 mm	**3/4"**	**95**	
12.5 mm	**1/2"**	**90**	
9.5 mm	**3/8"**	**85**	
6.3 mm	**1/4"**	**82**	
4.75 mm	**No. 4**	**79**	21.3% Gravel
2.00 mm	**No. 10**	**62**	
850 um	**No. 20**	**45**	
425 um	**No. 40**	**32**	65.6% Sand
250 um	**No. 60**	**23**	
150 um	**No. 100**	**17**	
75 um	**No. 200**	**13.1**	13.1% Fines



Comments: Moisture Content = 8.1%

Sheet