REPORT

17-0034

February 10, 2017

Geotechnical Engineering Services

Proposed 502 Deering Center
Mixed Use Building
502 Stevens Avenue
Portland, Maine

Prepared For:
Lachman Architects & Planners
Attention: Denis Lachman
58 Fore Street, Building 300
Portland, Maine 04101

Prepared By:
S. W. Cole Engineering, Inc.
286 Portland Road
Gray, Maine 04039
T: 207-657-2866

S.W.COLE ENGINEERING, INC.

- *Geotechnical Engineering*
- *Construction Materials Testing and Special Inspections*
- *GeoEnvironmental Services*
- *Test Boring Explorations*

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Attention: Denis Lachman
58 Fore Street, Building 300
Portland, ME 04101

Subject: Geotechnical Engineering Services
Proposed 502 Deering Center Mixed Use Building
502 Stevens Avenue
Portland, Maine

Dear Denis,

In accordance with our Agreement, dated January 3, 2017, we have observed test pit explorations and made a bearing capacity assessment of the subsurface findings for the subject project. The contents of this report are subject to the limitations set forth in Attachment A.

1.0 INTRODUCTION

1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information in order to develop geotechnical recommendations for foundations and earthwork associated with the proposed building construction. Our scope of services included observation of test pit explorations, an assessment of allowable soil bearing capacity, and preparation of this report.

1.2 Proposed Construction

The site is located at 502 Stevens Avenue in the Deering Center area of Portland. The site is relatively flat and level and is currently occupied by a single story residential building with partial basement. We understand development plans call for demolition of

the existing building and site improvements for construction of a three-story mixed commercial and residential building with associated paved areas. We understand the first floor elevation will be within one foot of Steven Avenue and the building may have a full basement under the front portion. Proposed and existing site features are shown on the "Exploration Location Plan" attached as Sheet 1.

2.0 EXPLORATIONS

Four test pit explorations (TP-1 through TP-4) were made on the site on January 17, 2017. The explorations were made by Boulanger's Earthworks & Property Maintenance working under subcontract to others. A plan showing the approximate exploration locations is attached as Sheet 1. Logs of the test pits are attached as Sheets 2 and 3. A key to the notes and symbols used on the logs is attached as Sheet 4. It should be noted a planned fifth test pit along Stevens Avenue was not excavated due to conflicts with buried utilities.

3.0 SUBSURFACE CONDITIONS

3.1 Soil and Bedrock

Test pits TP-1 through TP-4 encountered a soil profile consisting of about 6 inches of topsoil fill overlying about 1 foot of relic topsoil overlying a native deposit of sand with some silt and occasional cobbles overlying refusal surfaces (bedrock) at depths of 5 to 8 feet.

3.2 Groundwater

Groundwater was encountered at depths of 5 to 7 feet in the test pit explorations and is likely perched on top of shallow bedrock.

3.3 Frost and Seismic

The 100-year Air Freezing Index for the Portland, Maine area is about 1,407-Fahrenheit degree-days, which corresponds to a frost penetration depth on the order of 4.5 feet. Based on the subsurface findings, we interpret the site soils to correspond to Seismic Soil Site Class C according to 2009 IBC.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Based on the subsurface findings and our understanding of the proposed construction, spread footing foundations and on-grade floor slabs bearing on properly prepared subgrades appear feasible from a geotechnical standpoint. The principle geotechnical considerations are:

- The topsoil fill and relic topsoil encountered to depths of up to 1.5 feet below the ground surface must be removed and replaced with compacted granular borrow beneath the proposed building footprint. Likewise, existing foundations, utilities and uncontrolled fills must be removed within the building footprint and backfilled with compacted Granular Borrow.

- As discussed, bedrock was encountered at depths of 5 to 8 feet. If a basement is constructed, we anticipate bedrock removal by blasting or hoe-ramming would be needed. Additionally, groundwater was perched on top of the bedrock and would inundate a basement excavation; as such a basement would need to be waterproofed and a pumped sump with battery back-up would be needed to mitigate groundwater. We understand blasting and waterproofing are not desired and thus do not discuss a basement further in this report.

- The native sand may be reused as compacted Granular Borrow. Imported Underdrain Sand and Structural Fill will be needed for building construction

4.2 Site and Subgrade Preparation

The building site should be stripped of prior structures, foundations, topsoil, uncontrolled fill, relic topsoil and utilities to expose native undisturbed non-organic soils and then backfilled with compacted Granular Borrow up to the bottom of slab base material.

Based on the subsurface findings and our understanding of the proposed construction, we anticipate that footings will be founded on native sandy soils. We recommend that excavation to subgrade be completed with a smooth-edged bucket and that footing subgrades be recompacted with a vibratory plate compactor prior to installing formwork. We recommend that footing subgrades be protected with 3-inches of Crushed Stone.

The crushed stone pad will provide a working mat for foundation construction and a media for temporary and long-term dewatering.

Groundwater seepage may be encountered during excavation work, particularly during periods of precipitation. Sump and pump dewatering techniques should be adequate to control groundwater within foundation excavations. Excavations must be properly sloped or shored according to OSHA Regulations.

4.3 Spread Footings

Based on the subsurface findings and our understanding of the proposed construction, the proposed building may be supported on spread footing foundations. For footings bearing on properly prepared subgrades, we offer the following geotechnical parameters for design consideration:

Geotechnical Parameters for Spread Footings and Foundation Walls	
Design Frost Depth	4.5 feet
Net Allowable Soil Bearing Pressure	2.0 ksf
Base Friction Factor	0.35
At-Rest Lateral Earth Pressure	0.65 pcf (equivalent fluid)
Seismic Soil Site Class (IBC 2009)	C

We anticipate post-construction settlement may approach 1-inch total and ½ inch differential.

4.4 Foundation Drainage

We recommend that perimeter underdrains be provided around the outside edge of perimeter footings at footing subgrade. We recommend a 4-inch diameter slotted foundation drain pipe enveloped in Underdrain Sand. The underdrain pipe must have a positive gravity outlet.

4.5 Floor Slabs

On-grade floor slabs in heated areas may be designed using a subgrade reaction modulus of 120 pci provided the slab is underlain by at least 12-inches of compacted Structural Fill (on-grade) placed over properly prepared subgrades. The structural

engineer or concrete consultant must design steel reinforcing and joint spacing appropriate to slab thickness and function.

We recommend a sub-slab vapor retarder 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.

4.6 Entrance Slabs

Entrance slabs to the building must be designed to reduce the effects of differential frost action between adjacent pavement and doorways. We recommend that clean, non-frost susceptible sand and gravel meeting the requirements of Structural Fill be provided to a depth of at least 4.5 feet below the top of entrance thresholds. This thickness of Structural Fill should extend the full width of the entrance thresholds and at least 4.5 feet outward; thereafter transitioning up to the bottom of the adjacent pavement subbase gravel at a 3H:1V or flatter slope.

4.7 Backfill and Compaction

Based on the subsurface findings, the native sands may be reused as compacted Granular Borrow. The existing topsoil and relic topsoil may be blended for reuse as loam in landscape areas. We recommend the following materials for building areas:

Granular Borrow: Fill to raise grades in building areas and backfill for utility trenches should be sand or silty sand meeting the requirements of 2014 MaineDOT Standard Specification 703.19 Granular Borrow.

Structural Fill: Backfill for foundations and base material below on-grade floor slabs should be a 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
#40	0 to 30
#200	0 to 5

Underdrain Sand: Clean, free-draining underdrain sand used around perimeter footing drains should meet the requirements for MaineDOT Standard Specification 703.22 Type B "Underdrain Aggregate".

Placement and Compaction: Fill and backfill 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 generally not exceed 12 inches. We recommend that fill and backfill in building and paved areas be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557.

4.8 Design Review and Construction Testing

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

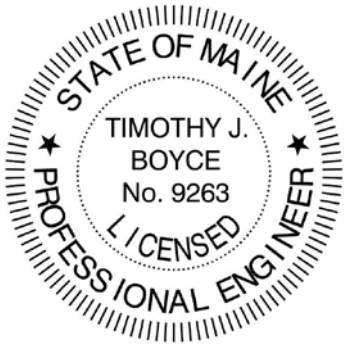
A soils and concrete testing program should also be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE should be engaged to observe subgrade soils for footings and is available to provide field and laboratory testing services for soil, concrete, steel and asphalt construction materials.

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 construction phase of this project.

Sincerely,

S. W. COLE ENGINEERING, INC.



Timothy J. Boyce, P. E.
Senior Geotechnical Engineer

TJB:rec

Attachment A
Limitations

This report has been prepared for the exclusive use of Lachman Architects & Planners for specific application to the proposed 502 Deering Center Mixed Use Building at 502 Stevens Avenue in Portland, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct the work in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

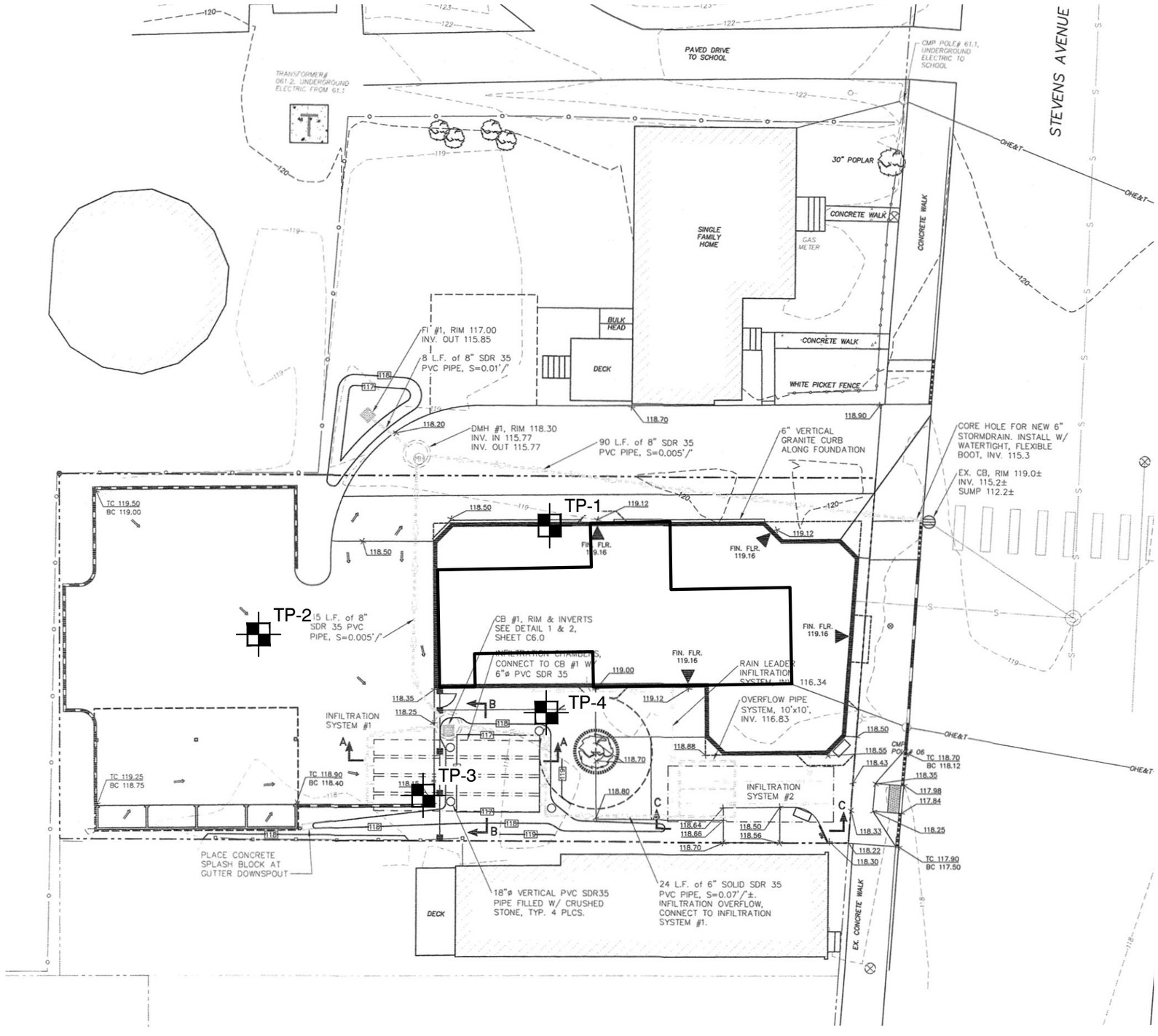
The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

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 work 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.



LEGEND:

APPROXIMATE TEST PIT LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=10' SCALE PLAN OF THE SITE ENTITLED "GRADING AND STORMWATER MANAGEMENT PLAN," PREPARED BY PINKHAM & GREER CIVIL ENGINEERS, DATED 12/22/2016.
2. THE TEST PITS 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 20 40 Feet

S.W.COLE ENGINEERING, INC.

LACHMAN ARCHITECTS & PLANNERS

EXPLORATION LOCATION PLAN

PROPOSED MIXED USE BUILDING
STEVENS AVENUE
PORTLAND, MAINE

Job No.:	17-0034	Scale:	1" =20'
Date :	02/10/2017	Sheet:	1

TEST PIT LOGS

S.W.COLE ENGINEERING, INC.

CLIENT: Lachman Architects & Planners
PROJECT: Proposed 502 Deering Mixed Use Building
PROJECT LOCATION: 502 Stevens Avenue, Portland, Maine

PROJECT NO. 17-0034
LOGGED BY: Tim Boyce
CONTRACTOR: Boulanger's Earthwork
EQUIPMENT:

TEST PIT TP- 1

DATE: 1/17/17 **LOCATION:** See Exploration Location Plan **SURFACE ELEVATION:** _____ **COMPLETION DEPTH:** 5.8
WATER LEVEL DEPTHS (ft): ▽ 5.60

Depth (feet)	Graphic Log	Stratum Description	H_20 Depth	Sample No.	Type	Sample Depth (ft)	Field / Lab Test Data
		Brown sandy LOAM (FILL)					
		0.5 Dark brown sandy LOAM (RELIC TOPSOIL)					
		1.5 Oxide-stained SAND some silt					
		2.5 Tan SAND some silt with cobbles					
5			▽ 5.6				
		5.8 Refusal @ 5.8' (bedrock)					

TEST PIT TP- 2

DATE: 1/17/17 **LOCATION:** See Exploration Location Plan **SURFACE ELEVATION:** _____ **COMPLETION DEPTH:** 5.0
WATER LEVEL DEPTHS (ft): No free water observed

Depth (feet)	Graphic Log	Stratum Description	H_20 Depth	Sample No.	Type	Sample Depth (ft)	Field / Lab Test Data
		Brown sandy LOAM (FILL)					
		0.5 Dark brown sandy LOAM (RELIC TOPSOIL)					
		1.5 Oxide-stained SAND some silt					
		2.5 Tan SAND some silt with cobbles					
5							
		5.0 Refusal @ 5.0' (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.

KEY TO NOTES AND SYMBOLS:
Water Level
▽ At time of Digging
▼ At Completion of Digging
▼ After Digging

q_p = Pocket Penetrometer Strength, kips/sq.ft.

S.W.COLE ENGINEERING, INC.

TEST PIT LOGS

CLIENT: Lachman Architects & Planners
PROJECT: Proposed 502 Deering Mixed Use Building
PROJECT LOCATION: 502 Stevens Avenue, Portland, Maine

PROJECT NO. 17-0034
LOGGED BY: Tim Boyce
CONTRACTOR: Boulanger's Earthwork
EQUIPMENT:

TEST PIT TP- 3

DATE: 1/17/17 **LOCATION:** See Exploration Location Plan **SURFACE ELEVATION:** _____ **COMPLETION DEPTH:** 7.2
WATER LEVEL DEPTHS (ft):

Depth (feet)	Graphic Log	Stratum Description	H_20 Depth	Sample No.	Type	Sample Depth (ft)	Field / Lab Test Data
		Brown sandy LOAM (FILL)					
		0.5 Dark brown sandy LOAM (RELIC TOPSOIL)					
		1.5 Oxide-stained SAND some silt					
		2.5 Tan SAND some silt with cobbles					
5							
		7.2 Refusal @ 7.2' (bedrock)					

TEST PIT TP- 4

DATE: 1/17/17 **LOCATION:** See Exploration Location Plan **SURFACE ELEVATION:** _____ **COMPLETION DEPTH:** 8.0
WATER LEVEL DEPTHS (ft): ▽ 6.00

Depth (feet)	Graphic Log	Stratum Description	H_20 Depth	Sample No.	Type	Sample Depth (ft)	Field / Lab Test Data
		Brown sandy LOAM (FILL)					
		0.5 Dark brown sandy LOAM (RELIC TOPSOIL)					
		1.5 Oxide-stained SAND some silt					
		2.5 Tan SAND some silt with cobbles					
5			▽ 6				
		8.0 Refusal @ 7' to 8' (sloping 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.

KEY TO NOTES AND SYMBOLS:
Water Level
▽ At time of Digging
▼ At Completion of Digging
▼ After Digging

q_p = Pocket Penetrometer Strength, kips/sq.ft.

KEY TO NOTES & SYMBOLS
Test Boring and Test Pit Explorations

All 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.