Subsurface Investigation Report

116 York Street, Ottawa, ON, K1N 1K9

Abstract

This report presents the findings of a subsurface investigation completed at the 116 York Street parcel, in the City of Ottawa, ON, K1N 1K9, and issue recommendations for a proposed High Rise Building development with 3 levels of underground parking. It provides information of the subsurface conditions at 4 boreholes from information compiled from field sampling and testing and a subsequent laboratory testing program of soils. Sound limestone bedrock was found at depths ranging between 4.5 and 5.0 m in the 4 boreholes overlain by glacial till with boulders. The borehole locations are shown in figure 1 in page 6. The information reviewed also includes a site reconnaissance, readily available geologic information from the Geological Survey of Canada (GSC) and local climate data from Environment Canada.

Yuri Mendez M. Eng., P. Eng.

Report number: 36 BOHL-R0[1]
July 03, 2018

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[1]For the account of Bayview Ottawa Holdings Limited (BOHL) as per proposal dated May 30, 2018 and subject to the user agreement in page 12

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Contents

1 Report Organization

The body of this report and its appendices constitute the entire report. To facilitate expedite and efficient use of its contents, the most relevant aspects in connection with the findings of this investigation are described in the body under section headings. The discussion presented under sections in the body may refer to further information and/or background and/or details which may be required contextually for each topic in the appendices. The reader is responsible of reviewing the information in the appendices as applicable for each case. Other references may be presented as footnotes.

2 Sampling and Testing

The field and laboratory program set out in our proposal dated May 30, 2018, is guided by the following standards:

- ASTM D 420-98 Standard Guide to Site Characterization for Engineering Design and Construction Purposes,
- ASTM D5434 - 12 Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock,
- ASTM D1586 - 11 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils,
- ASTM D2113 - 14 Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration,
- Method C of ASTM D7012-14 Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures.

The program also included an elevation survey referenced to an elevation of 100 m assigned arbitrarily to the top of the water valve (TBM) shown in the Test Hole Locations Plan in fig. 1 in page 6. The program included in addition a laboratory review of samples recovered from the field and one sample submitted to a local laboratory to investigate soluble ions concentration, PH and resistivity.

The test hole locations are shown in the test-hole location plan in figure 1 in page 6. The laboratory testing, soil sampling and field testing at each location are shown in the soil profile testing and sampling logs (BH) in the appendices.

Note that all references to elevations in this report are with respect to the TBM.

3 Physical Settings, Strata and Topography

The site is presently a relatively flat asphalt covered parking lot within a city block in downtown Ottawa. It consists on the 116 York Street parcel in the

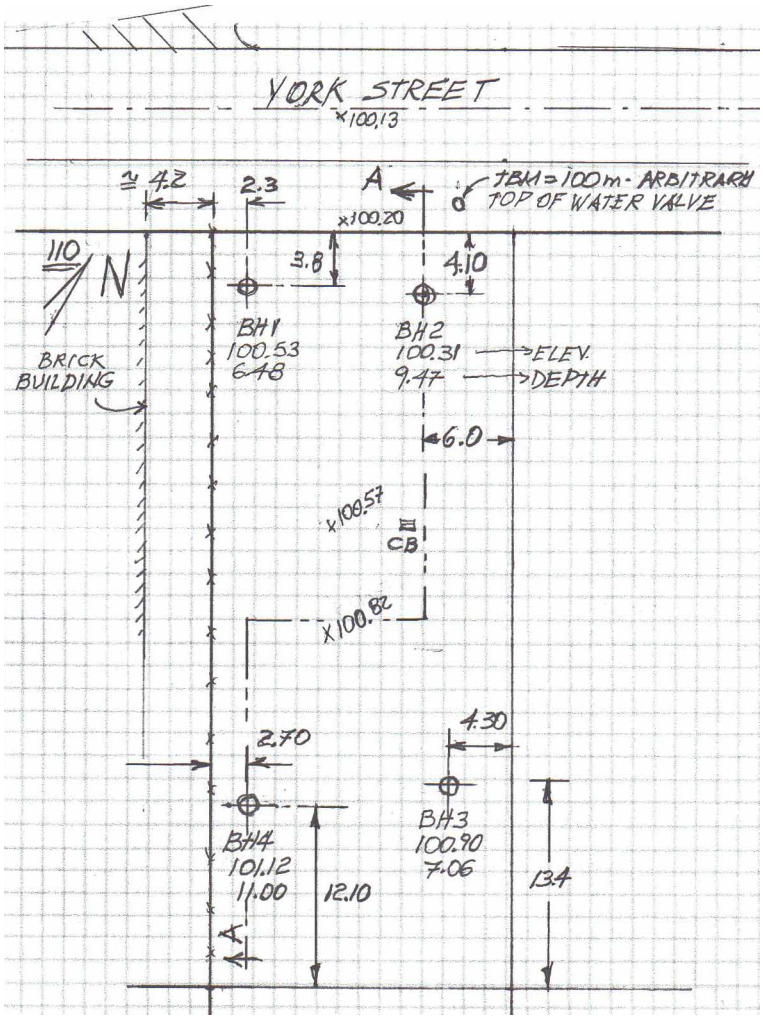

Figure 1: Test hole Locations Plan

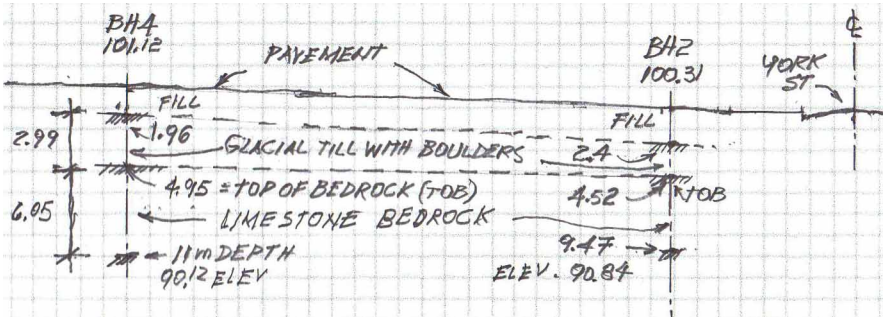

Figure 2: Schematic cross section A-A

City of Ottawa, ON. Figure 1 in page 6 shows a plan view of the site displaying the approximate test hole locations, elevations and depth. Figure 2 in page 7 presents a schematic site cross section including some borehole data.

The geology data base by Belanger J. R. 1998 suggests 3 to 5 m of overburden soils underlain by interbeded limestone and shale bedrock at this site.

3.1 Surface and Subsurface Materials

The site surface is asphalt covered. The arrangement of strata found in our investigation is shown in the borehole logs in appendix A. The schematic cross section shown in Fig. 2 in page 7 presents rough details regarding the geometry, depth and strata found during this investigation at the borehole locations.

It can be seen in fig. 2 in page 7 that the site is underlain by limestone bedrock at depths ranging between 4.5 and 5.0 m. The native soil materials above the bedrock consist of a layer of approximately 1.5 to 3.0 m of glacial till with boulders as found in the boreholes. The near surface materials consist of silt-sand-gravel-cobbles-clay fill underlying the pavement structure of approximately 0.2 to 0.25 of base granulars covered with 3.8 to 5.0 cms of asphalt.

3.1.1 Limestone Bedrock

As noted in the borehole logs the unconfined compressive strength and density of the bedrock at the proposed founding depths were found to be 107 to 142 MPa and approximately 2,740 kg/m^3 respectively at BH2 and 4. Rock Quality Designation (RQD) shown in the boreholes, rock core recovery and rock core review confirm bedrock that is massive and intact with minimal shallow fractures or discontinuities. RQDs within 1.5 m of the top of the bedrock in BH1 suggest some near surface fractures. Severe seepage through those fractures is not expected from what has been assessed from the rock-cores extracted and bedrock that is massive without fractures is not conducive of seepage for the bedrock found in the borehole.

3.1.2 Glacial Till

Glacial till encountered in the borehole consist of a mix of clayey and silty sand with gravel, cobbles and a significant amount of boulders. Issues during drilling and sampling such as difficulty in advancing augers and sampler refusals which were significantly present during drilling confirm the presence of boulders. In addition a 0.46 m rock-core was extracted at BH2. It can be seen in the borehole descriptions that a 34 degree friction and an 18.5 kN/m^3 have been assessed as applicable based on the testing program and other assessments.

3.2 Groundwater and Moisture

The water level was measured on June 30, 2018 in monitoring wells installed in BH2 and BH3 at 2.9 and 3.9 m depth respectively and shown in the borehole logs. Ground water measurements in stand pipe installations often require numerous assessments in combination with borehole data.

Field observations of soils as extracted in the field in the sampler and coloration suggest that the permanent water may be at approximately 4.2 m depth. The water level measurements obtain on June 30, 2018 are thus assessed as influenced by possible variations which may occur throughout the year. Because of what is being assessed under 3.1.1 this water table is thus perched on a portion of the permeable strata above bedrock that is massive.

4 Recommendations

The following set of the recommendations result from sampling and testing outlined in section 2 and from geotechnical engineering evaluation and assessments.

It is understood that the proposed development will consist of a High Rise Building with 3 levels of underground parking.

4.1 Foundations General

This investigation findings indicate that the three levels of underground parking of the proposed High Rise Building will be advanced through bedrock. The proposed OBC part 4 building can thus be founded on spread footings placed on the bedrock encountered at the proposed founding depth.

4.2 Bearing Capacity of Strip and/or Pad Footings

Given the assessments of bedrock cores set forth under section 3.1.1, RQDs and UCS shown in the borehole logs, the service limit (SLS) bearing capacity below represent a fraction of 0.14 of the allowable bearing capacity suggested by Peck et al. (1974) which can be used for design of the proposed spread footings placed on the bedrock encountered at the proposed founding depth. An average load factor of 1.5 is assumed for the bearing capacity for factored loads (ULS).

- 4 MPa at service limit (SLS).
- 6 MPa for factored loads (ULS).

4.3 Settlements

For the bearing capacities provided above settlement of foundations on bedrock will be negligible.

4.4 Basement Waterproofing

For the subsurface conditions encountered hydrostatic pressure will build up along the perimeter of the underground parking of the building. Waterproofing is thus required.

4.5 Site Class for Seismic Design

At this site, the geotechnical testing completed are indicative of a Vs(30) exceeding 360 m/s. As such, site class C is assigned under the provisions in section 4.1.8.4 of the Ontario Building Code 2012 (OBC 2012) for seismic design.

Note that site class A or B could be applied for seismic design at this site upon confirmation with a seismic test. The seismic test is recommended.

4.6 Excavations, Open Cuts, Trenches and Safety

Note that the findings of this investigation suggest that the excavation to reach the founding depth will be through soils within 4.5 to 5.0 m of the surface and that at this site the proposed building footprint will occupy the entire property so that the engineered shoring requirement set out in item 3 below applies to this site for the excavation through soils. The excavation will be through bedrock from about 4.5 to about 11.0 m so that the requirement set out in item 2 below applies to that portion of the excavation upon confirmation during construction. The contextual background from which the requirements in item 2 and 3 occur is presented below.

Information regarding physical and mechanical properties of subsurface materials which will be required for shoring design are provided in this report.

Typically, the main concern when excavating soils or rock is the stability of the sides of excavations. The stability of the sides is achieved by either cutting the sides to safe slopes or by providing shoring. It is also an issue of safety because of imminent hazards to the safety of workers and to property. As such, excavations are governed by the provisions in the Occupational Health and Safety Act of Ontario (O. Reg. 213/91). The application of O. Reg. 213/91 requires a classification of soils in one or several of four types (type I to type IV). At this site for all excavations to the depth of the top of the bedrock, soils can be considered type II under O. Reg. 213/91 and type 1 for excavations

through the bedrock. As such, the following key aspects of O. Reg. 213/91 are applicable to this site:

1. For excavations up to depth of the top of the bedrock (soil types II):
    - Safe open cut is 1 vertical to 1 horizontal.
    - Within 1.2 m of the bottom of open cut areas or trenches, the soil can be cut vertical.
2. For excavations through the bedrock (soil types I):
    - Safe open cut is vertical.
3. Where the safe open cut in item 1 is not provided, either the shoring systems described in O. Reg. 213/91 or engineered shoring systems need be used.

Note also that since excavation and safety are usually in control of the contractor, *shoring design and construction is done by the contractor*.

4.7 Construction and Excavation Along Adjacent Structures and Property Boundaries

Significant concerns regarding safety and property damage result from excavations along adjacent structures and as such subject to O. Reg. 213/91. Along with the provisions of O. Reg. 213/91 note that excavation depths below the founding depth of adjacent structures will not take place, unless:

- Lateral support is provided to soils by cutting the slope to 1 horizontal to 1 vertical or
- lateral support is provided by shoring.

It is also recommended that the edge of the 1 horizontal to 1 vertical slope providing lateral support be offset 0.3 m away from the edge of the foundation.

4.8 Water Inflow Within Excavations and Water Takings

Water inflow within excavations in soils is influenced by the depth of excavations relative to the water table and flow behavior of water in soils as controlled by the permeability of soils. Because of the assessments under sections 3.1 and 3.2 and information seen in the borehole logs, water inflow is expected to be low and controllable by pumping from open sumps.

4.8.1 Water Takings and Permits

Water takings from the environment, including groundwater in excavations, are regulated under Ontario Water Resources Act, R.S.O. 1990, c. O.40. (OWRA). The OWRA is enforced by the Ministry of Environment (MOE). Under the OWRA. a Permit to Take Water (PTTW) is required for pumping from excavations exceeding 400 cubic meters per day. Along with the consideration of ground water from excavations, PTTW applications require in addition the consideration of precipitation. The excavations at this site are subject to OWRA and this section is intended to provide criteria indicative of whether a PTTW may be required or not.

Given the size (area) of the proposed excavations, precipitation data in Ottawa and the soil conditions assessed under sections 3.1 and 3.2 pumping from excavations is not expected to exceed the threshold of 400 cubic meters per day so that *the requirement of a PTTW may not apply to the proposed development.*

Metered outlets must be maintained and recorded as proof for confirmation in case that OWRA requires it. Note that PTTWs are issued after months of the first filing of documents.

4.9 Underground Corrosion

For the resistivity, PH and soluble ions concentrations found at this site and shown in the Paracel Laboratories certificate of analysis in appendix B.1, the soils are moderately corrosive. Resistivity, PH and soluble ions testing was completed in a representative sample at a 4.1 m depth in BH3. After Romanoff (1957)[2], the following corrosion rates can be used:

1. For carbon steel:
    - 25 μm/year for the first 2 years,
    - 18 μm/year, thereafter.
2. For galvanized metal:
    - 6 μm/year for the first 2 years,
    - 4.25 μm/year until depletion of zinc,
    - 18 μm/year for carbon steel.

4.10 Potential of Sulphate Attack to Concrete

For the sulphate content less than 0.1% in soil encountered at this site, there are no restrictions to the cement type which can be used for underground structures. This refers to restrictions associated with sulphate attack only.

[2]Romanoff's work for the U. S. National Bureau of Standards is authoritative in underground corrosion

4.11 Special Issues or Concerns

Our investigation did not reveal special concerns for the proposed development, such as slope stability, liquefaction, organic materials, etc.

4.12 Bedrock Excavation

Refer to the borehole logs and to section 3.1.1 for geotechnical information that may assist evaluation of construction methods for bedrock removal. Additional assessments follow below.

4.12.1 Line Drilling and Blasting

Given the scope and the scale of excavation operations that can be envisioned from the findings of this investigation and the nature of the proposed development with three levels of underground parking, line drilling and blasting will be the method of choice to advance excavations through approximately 4.5 to 6.0 m of limestone bedrock to the proposed founding depth.

4.12.2 Bedrock Preparation

Footings will place on a clean sound bedrock surface. Final cleaning of bedrock surfaces for footings placement with compressed air is recommended.

4.13 Additional Geotechnical Services

The geotechnical services outlined in appendix C may be required during design and construction.

User Agreement

Acknowledgment of Duties

In this 36 BOHL-R0 report, Yuri Mendez Engineering (YME) has pursued to fulfill every aspect of the obligations of professional engineers. As a part of those duties, from field work, operations, testing, analyses, application of knowledge and report, YME has ensured that it meats a high standard of Geotechnical engineering practice and care in the province of Ontario. Obligations under R.R.O. 1990, Reg. 941: Professional Engineers Act, R.S.O. 1990, c. P.28, further referred to as Reg. 941 which are of immediate interest to this service are:

"77. 7. A practitioner shall,

i. act towards other practitioners with courtesy and good faith,

ii. not accept an engagement to review the work of another practitioner for the same employer except with the knowledge of the other practitioner or except where the connection of the other practitioner with the work has been terminated,

iii. not maliciously injure the reputation or business of another practitioner,

8. A practitioner shall maintain the honour and integrity of the practitioners profession and without fear or favour expose before the proper tribunals unprofessional, dishonest or unethical conduct by any other practitioner."

Communications

36 BOHL-R0 is to be used solely in connection with the High Rise Building by Bayview Ottawa Holdings Limited (BOHL) and thus subject of communications amongst other professionals (OP), government bodies and authorities, and BOHL for that purpose. YME demands great care in precluding damage to the integrity of this professional work which may arise from careless communications from engineers of Canada. OP and BOHL acknowledge understanding that where any such communication occur in connection with this report, they are bound by this agreement as an extension to the standard of care embodied in R.R.O. 1990, Reg. 941 and thus accept that any correspondence from OP or the public seen to add any bad connotations to the breadth, depth, typesetting, typography, formal semantics and scope of this report or otherwise diminish the breadth of services and knowledge delivered in this report which in any way raise concerns or insecurities to the qualities and/or the *reasonable completeness* delivered to BOHL in this report will be forwarded to YME.

Reasonable Completeness

OP and Bayview Ottawa Holdings Limited acknowledge understanding that said care and said standard has been applied equality to the reasonable completeness of this report relative to the information available from the field program and acknowledge understanding that is neither feasible nor possible to convey geotechnical information in this report that would cover for every possible consideration by OP and/or BOHL and that upon issuance it will be subject to reviews which may trigger the need to add information which at the discretion of YME will be added when considered within the practice obligations under Reg. 941. The geotechnical information here provided is thus envisioned as to cover for the scope and breadth of design figures and assessments generally foreseeable as needed by other designers at the time of issuance and which could be amended as needed within the context of services provided by other designers. YME agrees to issue revised versions of this 36 BOHL-R0 report by adding R# to each revision where # is the number of the revision. OP covenant to conduct all communications in connection with these reviews following great care to preclude the suggestion of a breach to the reasonable completeness acknowledged herein. Written communications which may trigger reviews under this agreement will be acknowledged as requests for "review under the 36 BOHL-R0 report user agreement". This reasonable completeness is also relative to the scope of services generally accepted in geotechnical engineering work in Ontario

Errors

Where errors are found during reviews under the 36 BOHL-R0 report user agreement, OP covenant great care in communications to preclude the suggestion of a breach to the duties acknowledge herein which could induce damages to YME. Communications triggered by errors or any such communication which would render the person doing the request in a position of technical authority above the author implies an unauthorized review and constitute a serious breach of the code of ethics under Reg. 941 and damages to YME and so subject to disciplinary measures and/or liability for damages to YME. BOHL is thus acquainted that correction of errors will be made and acknowledged by YME as they may arise in any professional work but in no way OP will purport or render such corrections as omissions departing away from the correction of errors set forth in this agreement. Where communications in connection with the correction of errors process set forth in this agreement raise concerns or insecurities to the qualities and/or the reasonable completeness delivered to BOHL in this report occur, BOHL covenants to inform YME. BOHL is acquainted that such corrections are part of the natural processes associated with the applied sciences nature of this report and so typified explicitly in this agreement to protect YME from inappropriate manipulation of those processes by OP and others.

Disclaimer

BOHL and OP understand that soils and groundwater information in this report has been collected in boreholes guided by standards and practice guidelines generally accepted for engineering characterization of ground conditions in Ontario and in no case borehole data and their interpretation warrant understanding of conditions away from the borehole locations. BOHL accepts that as development will have spread away from the boreholes other designers will need the best opinion from the geotechnical consultant based on the findings of the investigation so that any statements which could be implicitly or explicitly depart from the conditions at borehole may be given to fulfill this need in good faith as best available opinion with the information available at the time without any warranties.

Appendices

A Borehole Logs

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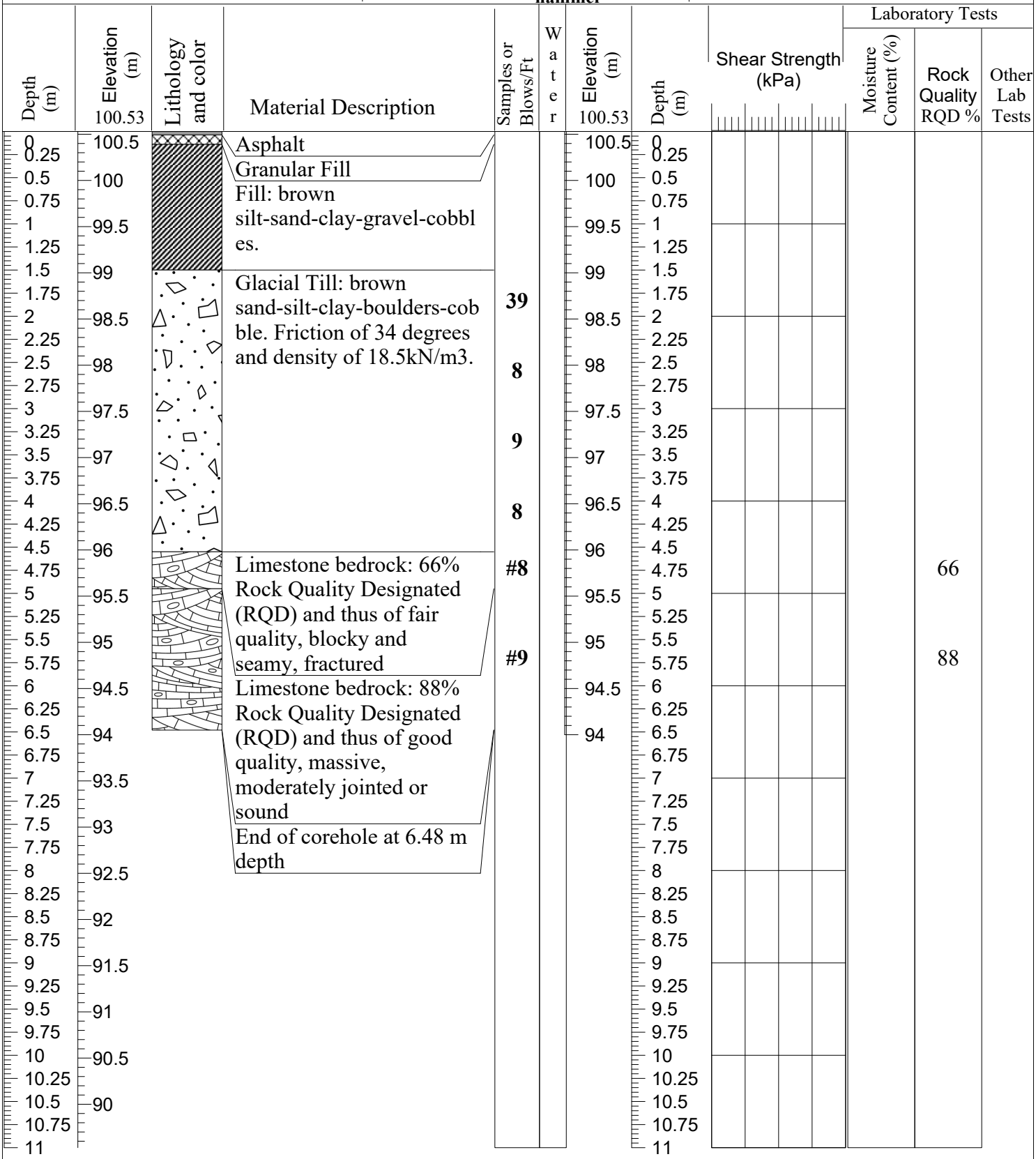
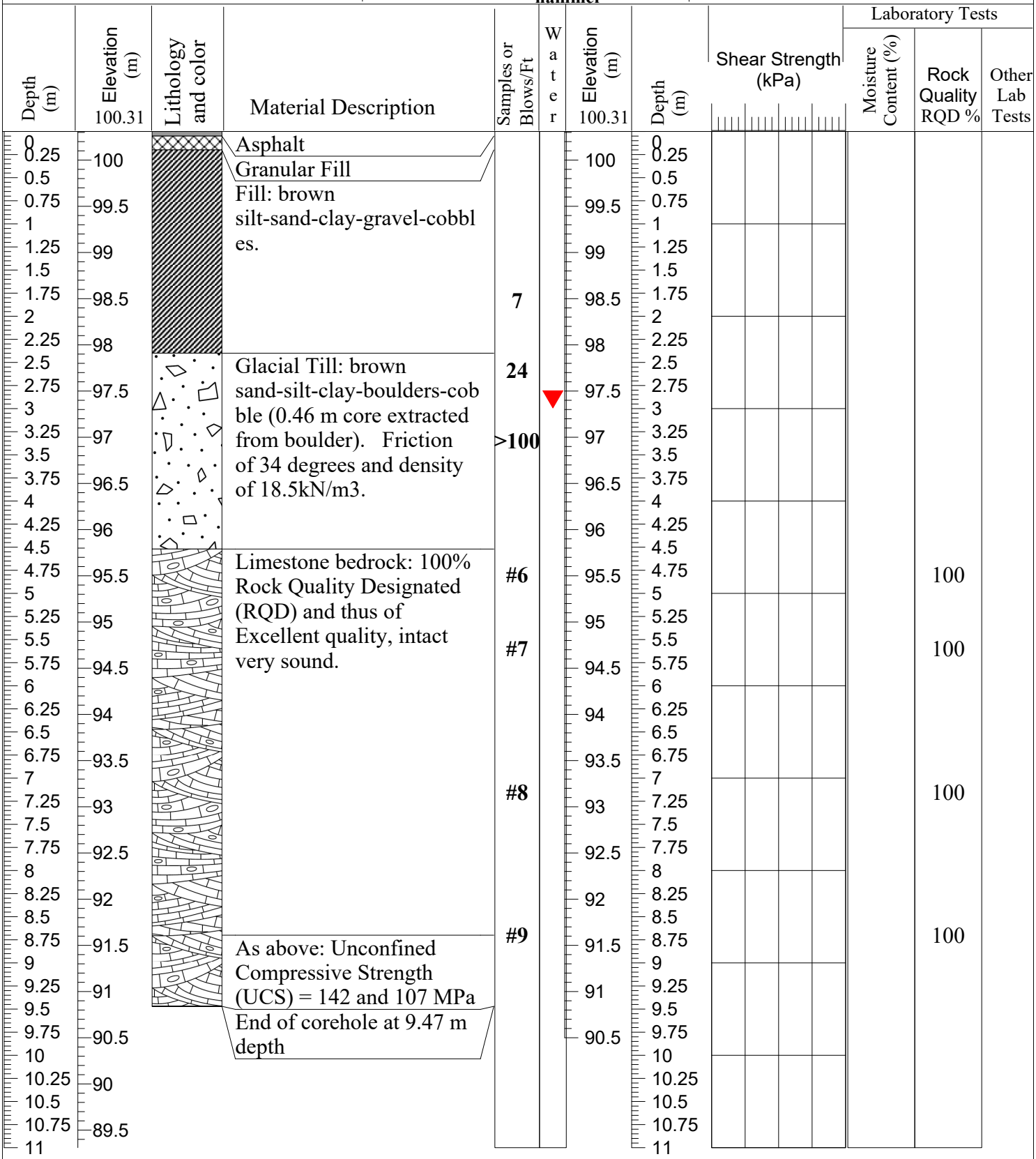
Project:	**High Rise Building**	Yuri Mendez Engineering
Location: **116 York St.**	Client: **Byview Ottawa Holdings Ltd.**	**Test Hole No.: BH1 of 4**
Job No.: **36-BOHL**	Test Hole Type: **8" hollow stem augers**	Date: **June 23 and 24, 2018**
Standard SPT and 50mm rock cores	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**



S = Sample for lab review and moisture content

▼ Measured water level. June 30, 2018, 10:00 am

Project:	**High Rise Building**	Yuri Mendez Engineering
Location: **116 York St.**	Client: **Byview Ottawa Holdings Ltd.**	**Test Hole No.: BH2 of 4**
Job No.: **36-BOHL**	Test Hole Type: **8" hollow stem augers**	Date: **June 23 and 24, 2018**
Standard SPT and 50mm rock cores	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**



S = Sample for lab review and moisture content

▼ Measured water level. June 30, 2018, 10:00 am

Project: **High Rise Building**		Yuri Mendez Engineering
Location: **116 York St.**	Client: **Byview Ottawa Holdings Ltd.**	Test Hole No.: **BH3 of 4**
Job No.: **36-BOHL**	Test Hole Type: **8" hollow stem augers**	Date: **June 23 and 24, 2018**
Standard SPT and 50mm rock cores	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**

Depth (m)	Elevation (m) 100.9	Lithology and color	Material Description	Samples or Blows/Ft	Water	Elevation (m) 100.9	Depth (m)	Shear Strength (kPa)	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Rock Quality RQD %	Laboratory Tests: Other Lab Tests
0	100.9		Asphalt			100.6	0				
0.25			Granular Fill				0.25				
0.5	100.5		Fill: brown silt-sand-clay-gravel-cobbles.			100.1	0.5				
0.75							0.75				
1	100					99.6	1				
1.25							1.25				
1.5	99.5					99.1	1.5				
1.75							1.75				
2	99			3		98.6	2				
2.25							2.25				
2.5	98.5		Glacial Till: brown sand-silt-clay-boulders-cobble. gray at 4.8 m depth. Friction of 34 degrees and density of 18.5kN/m3.	16		98.1	2.5				
2.75							2.75				
3	98					97.6	3				
3.25				21			3.25				
3.5	97.5					97.1	3.5				
3.75							3.75				
4	97			19		96.6	4				
4.25							4.25				
4.5	96.5					96.1	4.5				
4.75							4.75				
5	96					95.6	5				
5.25							5.25				
5.5	95.5		Limestone bedrock: 94% Rock Quality Designated (RQD) and thus of Excellent quality, intact very sound.	#8		95.1	5.5			94	
5.75							5.75				
6	95					94.6	6				
6.25							6.25				
6.5	94.5					94.1	6.5				
6.75			Limestone bedrock: 100% Rock Quality Designated (RQD) and thus of Excellent quality, intact very sound.	#9			6.75			100	
7	94					93.6	7				
7.25							7.25				
7.5	93.5						7.5				
7.75							7.75				
8	93		End of corehole at 7.06 m depth				8				
8.25							8.25				
8.5	92.5						8.5				
8.75							8.75				
9	92						9				
9.25							9.25				
9.5	91.5						9.5				
9.75							9.75				
10	91						10				
10.25							10.25				
10.5	90.5						10.5				
10.75							10.75				
11	90						11				

S = Sample for lab review and moisture content

▼ Measured water level. June 30, 2018, 10:00 am

Project: **High Rise Building**		Yuri Mendez Engineering
Location: **116 York St.**	Client: **Byview Ottawa Holdings Ltd.**	Test Hole No.: **BH4 of 4**
Job No.: **36-BOHL**	Test Hole Type: **8" hollow stem augers**	Date: **June 23 and 24, 2018**
Standard SPT and 50mm rock cores	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**

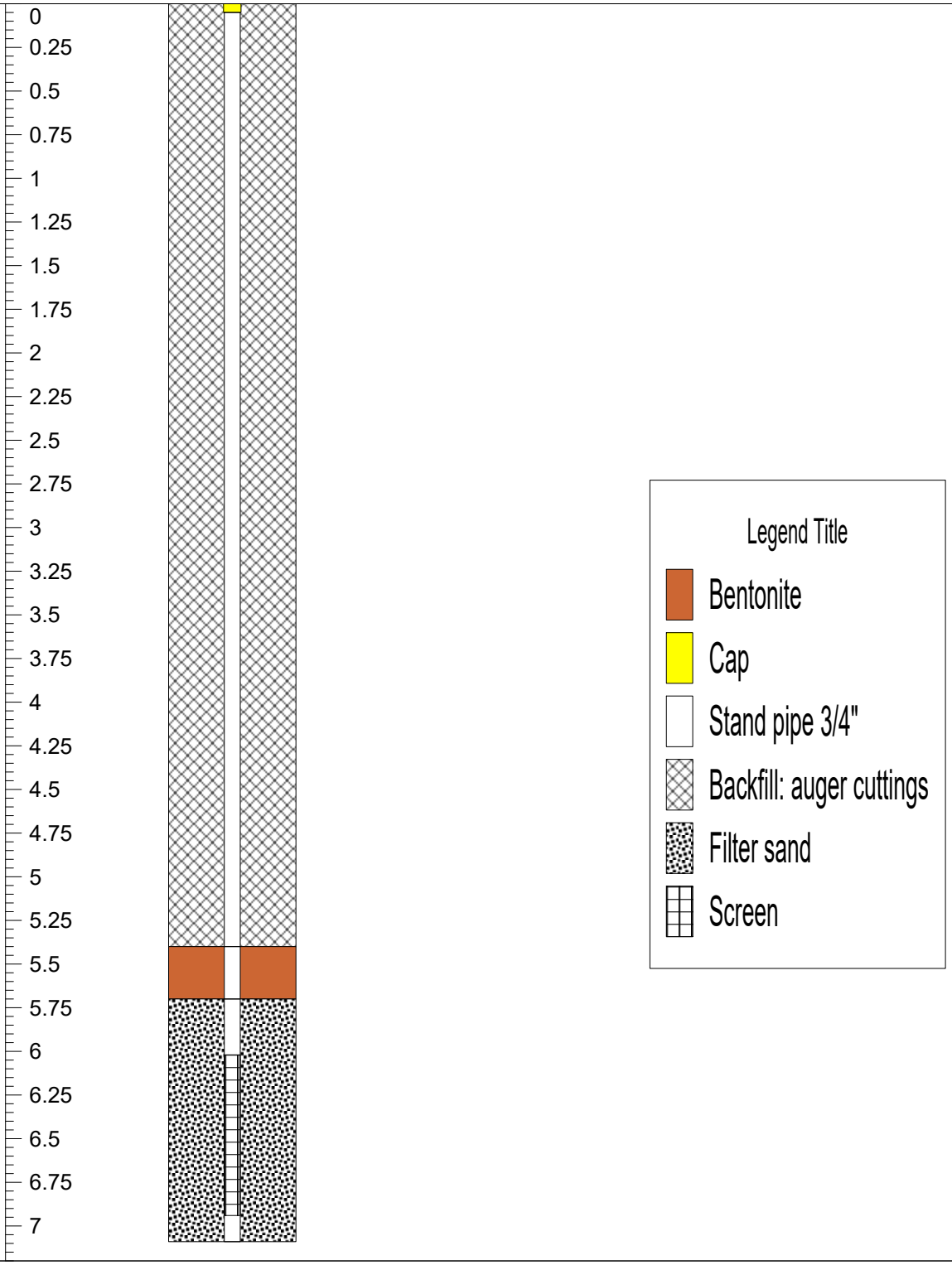
Depth (m)	Elevation (m) 101.12	Lithology and color	Material Description	Samples or Blows/Ft	Water	Elevation (m) 101.12	Depth (m)	Shear Strength (kPa)	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Rock Quality RQD %	Laboratory Tests: Other Lab Tests
0	101		Asphalt			101	0				
0.25			Granular Fill				0.25				
0.5	100.5		Fill: brown silt-sand-clay-gravel-cobbles.			100.5	0.5				
0.75							0.75				
1	100					100	1				
1.25							1.25				
1.5	99.5					99.5	1.5				
1.75				**26**			1.75				
2	99		Glacial Till: brown sand-silt-clay-boulders-cobble. gray at 4.9 m depth. Friction of 34 degrees and density of 18.5kN/m3.			99	2				
2.25							2.25				
2.5	98.5			**19**		98.5	2.5				
2.75							2.75				
3	98					98	3				
3.25							3.25				
3.5	97.5			**41**		97.5	3.5				
3.75							3.75				
4	97			**6**		97	4				
4.25							4.25				
4.5	96.5					96.5	4.5				
4.75							4.75				
5	96		Limestone bedrock: 94% Rock Quality Designated (RQD) and thus of Excellent quality, intact very sound.			96	5				
5.25							5.25				
5.5	95.5			**#8**		95.5	5.5			94	
5.75							5.75				
6	95					95	6				
6.25							6.25				
6.5	94.5		Limestone bedrock: 100% Rock Quality Designated (RQD) and thus of Excellent quality, intact very sound.			94.5	6.5				
6.75							6.75				
7	94			**#9**		94	7			100	
7.25							7.25				
7.5	93.5					93.5	7.5				
7.75							7.75				
8	93					93	8				
8.25							8.25				
8.5	92.5			**#10**		92.5	8.5			100	
8.75							8.75				
9	92					92	9				
9.25							9.25				
9.5	91.5		As above: Unconfined Compressive Strength (UCS) = 132 and 108 MPa			91.5	9.5				
9.75							9.75				
10	91			**#11**		91	10			100	
10.25							10.25				
10.5	90.5					90.5	10.5				
10.75							10.75				
11			End of corehole at 11 m				11				

S = Sample for lab review and moisture content

▼ Measured water level. June 30, 2018, 10:00 am

Yuri Mendez Engineering

Well Construction



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Appendix

B Resistivity, PH and Soluble Salts Test

Certificate of Analysis
Client: Yuri Mendez
Client PO:

Report Date: 28-Jun-2018
Order Date: 25-Jun-2018
Project Description: 116 York

	Client ID:	BH3-SS6	-	-	-
	Sample Date:	06/24/2018 09:00	-	-	-
	Sample ID:	1826064-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	90.4	-	-	-
General Inorganics					
pH	0.05 pH Units	7.95	-	-	-
Resistivity	0.10 Ohm.m	49.5	-	-	-
Anions					
Chloride	5 ug/g dry	282	-	-	-
Sulphate	5 ug/g dry	151	-	-	-

Appendix

C Recommended Geotechnical Services During Design and Construction

It is recommended that geotechnical services be retained in order to insure that the recommendations in this report are implemented in the final design and construction.

C.1 Design Phase Supplemental Geotechnical Services for the Proposed Development

Geotechnical services are expected to consist in additional design and plan reviews once draft plans defining details concerning grading, services, pavements and foundation dimensions, elevations, depth and loads become available. The design services may be requested in advance by other designers and depend on design decisions and/or plans differing from the assumptions in this report. The geotechnical designer is to produce at this stage technical letters and/or drawings supporting analyses and final design decisions.

C.2 Construction Phase Supplemental Geotechnical Consultant Services for the Proposed Development

The geotechnical consultant services for construction will consist on inspections and testing for quality control. The inspections may be visual examination only or in conjunction with testing. Inspection and quality control testing programs are tailored to include but not limited to:

- Confirmation of findings of the geotechnical investigation.
- Monitor the performance of temporary geotechnical structures in time.
- Satisfy the consultant that the physical and mechanical properties of existing and newly placed geotechnical materials meet the requirements in this report.
- Inspect temporary soil cut for signs of distress.
- Satisfy the consultant that manufacturer specifications involving systems and materials interacting with ground conditions and ground water are being met
- Satisfy the consultant that performance measures and tolerances of geotechnical structures are being met (piles, anchors, etc.)

Supplemental geotechnical services in this stage may include shop drawings review for contractor designed geotechnical structures (typically shoring, temporary soil cut and anchors)

C.3 Contractor Designed Temporary Geotechnical Structures

Since excavations are recognized as a hazardous construction operation and contractors have control of the construction operations and safety, temporary slope cut stability and temporary shoring design are typically done by the contractor. The anchoring systems to shoring, dewatering systems and other applications are also done by the contractor except specified otherwise. In particularly sensitive ground water conditions dewatering systems may need to be designed by the geotechnical consultant.

Temporary soil cut and shoring must be designed to meet O. Reg. 213/91. The general design requirement is that the risks to workers and the public be kept to acceptable levels and that adjacent properties and existing structures are not damaged.

The consultant role is to conduct reviews of shop drawings defining details of temporary geotechnical structure designed by the contractor. It is expected that this investigation report be sufficient to supply the data required for temporary slope cut and shoring design.